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Publication date:
2009

Document Version
Accepted author manuscript, peer reviewed version

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DPhil Thesis

June 2009

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University of Sussex

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Summary

Over the last three decades, outsourcing has had a big influence on the international division of labour. It is clear that it has been a major reason for the enormous build-up of production capabilities in the developing world, in particular in the export platforms of Asia. However, we do not know whether the outsourcing of production and services from OECD to developing countries has triggered the transition from production to innovation capability or not. In particular, it is not clear whether and how outsourcing contributes to the formation of advanced innovative capability. This is the question addressed in this thesis. It examines this question by focusing on the global software-outsourcing industry and the supply platform in Bangalore (India), one of the most prominent cases of latecomer development in the global economy.

In order to examine this question, the thesis suggests new categories for assessing innovativeness in this complex sector. It shows that there is considerable scope for innovation as an incremental extension of routine outsourcing. A segment of Bangalore software suppliers has entered a new phase of building innovative capability. This capability is not restricted to process and organisational capability but extends to problem-framing innovative capability. This challenges the widely held opinion that only lower-order activities are outsourced and that relationships are unlikely to evolve beyond certain threshold levels because they do not provide proximity to tacit knowledge and domain expertise. This finding goes against the view that Bangalore's software industry has not progressed beyond producing to customers' specifications. More generally, it challenges the view that advanced innovation capabilities are beyond suppliers in global value chains.

While the documentation of advanced innovation capability is an important contribution in itself, the main contribution lies in showing *how* capability development occurs in global value chains. 'Supplier learning' is often assumed, but it remains a 'black box' in most of the literature on outsourcing. The thesis shows how outsourced activities focused on labour-intensive 'production activities' can (over time) provide a stepping-stone for acquiring high-order innovative capabilities. It examines the factors that explain this transition on the supply side and the demand side.

On the supply side, the study focuses on learning events as the main unit of analysis and examines how outsourcing influences the formation of new innovative capability. The thesis emphasises that while outsourcing creates new spaces, the exploitation of these spaces is

not automatic; it shows how projects undertaken by suppliers have mobilised resources – ideas, investment and knowledge – to capture new opportunities in global chains. This creation of capability at the project level is important, but new capability is only fully realised via firm-level competence leveraging across different buyers and business lines. The main determinants of the acquisition of new capabilities are global linkages and firm internal strategies and initiatives. Local linkages play only a minor role. This poses important questions for the debate on local clusters and innovation systems.

On the demand side, the thesis compares three software buyer segments and shows that practices differ between these groups of buyers. It also shows that buyers' outsourcing strategies change over time and that the 'space' for innovation by suppliers has increased. Critical to this analysis is the distribution between 'integrated' and 'standalone' innovation activities. They key finding is that the greatest advances in acquiring innovation capability are made in the integrated activities where knowledge use and knowledge creation are tightly connected. Other studies have come to more pessimistic findings because they have tended to concentrate on standalone innovation activities.

The two-pronged approach using supply and demand side informants enables the triangulation of findings. It also makes it possible to examine how demand-side and supply-side dynamics interact. The thesis shows how 'innovation-push' by specialising buyers and 'innovation-pull' by increasingly capable suppliers reinforce each other. Most studies tend to focus on only one side; but the key is to see them in conjunction. The thesis suggests that their co-evolution changes not only the scale of outsourcing but also its contents. It indicates that a qualitative shift in the global division of labour is underway.

Author's Declaration

I hereby declare that this thesis has not been, and will not be, submitted in whole or in part to another university for the award of any other degree.

Rasmus Lema

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Acknowledgements

This thesis benefited from an 'international PhD grant' from the Social Science Research Council, Danish Agency for Science, Technology and Innovation. The project had a joint institutional affiliation at the Institute of Development Studies (IDS), United Kingdom, and the Department of Society and Globalisation, Roskilde University, Denmark. I am particularly indebted to Hubert Schmitz, my supervisor at IDS, for timely challenges and tireless support. His effort and commitment is unmatched. I am also grateful to Laurids Lauridsen, my co-supervisor at Roskilde, particularly for useful suggestions in the run-up phase. Kapil Shukla provided research assistance during fieldwork and Monica Allen helped to edit the thesis.

Fieldwork for this research would not have been possible without the cooperation of many individuals and organisations. I am grateful to contacts and friends at the Indian Institute of Management Bangalore – particularly Gita Sen, Murali Patibandla, Rajan Govil and Rishi Krishnan – who helped to arrange my stay as a Visiting Scholar and who gave me invaluable leads and contacts. I am indebted to the software firms and institutions in Bangalore that granted access to interviews and observation. The same is true of informants in 'buyer firms' in various parts of the world. The appendix contains a list of interviewees, but because of confidentiality clauses, many informants remain anonymous.

During various stages of the research, I received comments from people in many parts of the world. I benefited greatly from comments and suggestions from members of the Globalisation Team at IDS, particularly John Humphrey, Lizbeth Navas-Alemán and Mai Fujita. I have also had the opportunity to present my work-in-progress at workshops and seminars. A large number of individuals provided helpful feedback and thought-provoking questions, including Franco Malerba, Ian Scoones, Ming Dong, Paulo Figueiredo, Rajah Rasiah, Raphael Kaplinsky, Roberto Rabellotti, Stephen Flowers, Suma Athreye and Timothy Sturgeon. Furthermore, Anthony D'Costa and Martin Bell deserve special acknowledgments for their valuable comments on previous drafts. I thank Martin in particular for the meticulous comments – received when I first *thought* the thesis was complete. His intervention helped to reduce vulnerabilities and sharpen the analysis.

Throughout the entire course of this research, I benefited from participation in the research project 'The Changing Knowledge Divide in the Global Economy' that is funded by the Volkswagen Foundation. This project provided stimulus as well as structure. Discussions with colleagues in this project – Philipp Oswald, Ruy Quadros, Simone Strambach and Hubert Schmitz – inspired the direction as well as key ideas in this thesis.

My three years as a doctoral candidate were enjoyable and immensely enriching, not just intellectually but also personally. Most of all, I am forever grateful to my family – Linus, Olivia and Stine – for being courageous and sharing with me the challenges and joys of adapting to new cultures and languages. Thanks also to all of our new friends and colleagues in India and the UK who took good care of us along the way.

Rasmus Lema, Brighton, May 2009

Key concepts

This glossary presents the key concepts. The explanations provided here are brief; the main text elaborates on these definitions.

Business model
A business model is the way a firm generates value and captures a share of this value.

Business model, open
Firms with open business models use the organisational decomposition of innovation activities to generate and capture value.

Capability leveraging
Capability leveraging refers to the exploitation of an existing stock of capabilities and its use in a new domain.

Innovation
An innovation is the introduction of a new or significantly improved product (including 'service product') or process.

Innovative activities
Innovation activities create knowledge and transform it into specifications and systems. These activities are carried out in order to produce an innovation.

Innovation activities, decomposition of
The decomposition of innovation activities is the reconfiguration within and between firms (or other organisations) of innovative functions that have hitherto been performed in-house.

Innovation activities, integrated
Integrated innovation activities are bundled with production activities.

Innovation activities, standalone
Standalone innovation activities are 'de-linked' (in organisational terms) from downstream production activities.

Learning (firm level)
The various processes that permit firms to accumulate new types and levels of capability

Outsourcing
This refers to the externalisation of production and/or innovation activities to independent firms (in low-cost economies).

Opportunity space
This refers to suppliers' opportunities to engage in innovative activities. In the outsourcing context, these often refer to spaces for innovation created by the demand of the client.

Problem framing
The term problem framing refers to the subset of innovation activities that define products/systems and their architectures.

Production activities
These are the knowledge-using (as opposed to knowledge-creating) activities concerned with the manufacturing/construction/provision of goods and services.

Software industry, primary
The primary software industry consists of firms that develop and sell software as their main business.

Software industry, secondary
The secondary software industry comprises software-producing organisations (e.g. IT departments) residing within firms whose main business is not software.

Software-outsourcing industry
The software-outsourcing industry comprises buyers and suppliers of outsourced software services as well as the related institutional environment.

Supply platform
A supply platform is an agglomeration of export-oriented firms in a low-cost economy.

Value-chain co-evolution
Mutually reinforced change in buyer and supplier organisations.

Acronyms

3PL	Third-Party Logistics
ADL	Application Development and Maintenance
AM	Application Management
ASD	Agile Software Development
B/OSS	Billing and Operations Support Solution
B2B	Business to Business
BOT	Build-Operate-Transfer
BPI	Business Process Improvements
BPM	Business Process Modelling
BPSS	Business Process Software Services
CAD	Custom Application Development
CAE	Computer-Aided Engineering
CEO	Chief Executive Officer
CIO	Chief Information Officer
CRM	Customer Relationship Management
DMS	Dealer Management System
DSP	Digital Signal Processing
EMS	Electronics Manufacturing Services
ERP	Enterprise Resource Planning
ESO	Engineering Services Outsourcing
ETF	Electronics and Telecom Firms
ETL	Extract Transform and Load
GCC	Global Command Centre
GSM	Global System for Mobile Communications
HBU	Horizontal Business Unit
HR	Human Resource
IBU	Integrated Business Unit
ICT	Information and Communication Technology
IEEE	Institute of Electrical and Electronic Engineers
IMS	Infrastructure Management Services

IP	Intellectual Property
ISO	Information System Outsourcing
ISV	Independent Software Vendors
IT	Information Technology
ITD	IT Department
ITS	Independent Testing Services
KIBS	Knowledge-Intensive Business Services
KM	Knowledge Management
LAN	Local Area Network
MAC	Media Access Control
MFI	Microfinance Institutions
MIP	Made in India Products
MIS	Management Information System
MNC	Multinational Corporation
NASA	National Aeronautics and Space Administration
NASSCOM	National Association of Software and Services Companies
NGO	Non-Governmental Organisation
NIC	Network Information Centre
NMS	Network Management System
NPD	New Product Development
ODC	Offshore Development Centres
ODIP	Organisational Decomposition of the Innovation Process
ODM	Own Design Manufacturing
ODPP	Organisational Decomposition of the Production Process
OECD	Organisation for Economic Cooperation and Development
OEM	Original Equipment Manufacturer
OPD	Offshore Product Development
OS	Operating System
OSS	Operations Supports Solution
PC	Personal Computer
PDSS	Product Development Software Services
PES	Product Engineering Solutions
PMO	Project Management Office

R&D	Research and Development
SaaS	Software as a Service
SAD	Software Architecture Document
SETLAB	Software Engineering and Technology Lab
SME	Small and Medium Enterprise
SOA	Service-Oriented Architecture
UML	Unified Modelling Language
USB	Universal Serial Bus
UTI	Unified Testing Initiative
UWB	Ultra Wideband
VoIP	Voice over Internet Protocol
XP	Extreme Programming
Y2K	Year 2000

1 Introduction

The global economy is currently witnessing two remarkable phenomena that were largely unforeseen a decade ago. The first is a fundamental change in the outsourcing strategies of a large number of leading firms in Organisation for Economic Cooperation and Development (OECD) countries: these firms used to function with internally focused systems of value generation, but many have since migrated to models that are substantially more open. Firms are now outsourcing activities that they used to undertake in-house, sometimes also innovative activities, to low-cost countries (Carpay, Hang and Yu 2007; Engardio and Einhorn 2005; Ernst 2008; Tate, Ellram, Bals and Hartmann 2009).

The second phenomenon is the rapid transformation and upgrading of supply platforms in low-cost economies such as China and India. There are indications that these hubs no longer just specialise in labour-intensive production of goods and services. In China and India, for example, the transition from production capability to innovation capabilities has begun and, in certain sectors, the emergence of low-cost innovation is visible (Altenburg, Schmitz and Stamm 2008; Zeng and Williamson 2007).

The present thesis aims to explore the link between outsourcing in developed countries and the transition from production to innovation in global supply platforms in developing countries. In examining this link, the thesis concentrates on evidence from firms in the supply platform in Bangalore and buyers in the global software industry. It provides empirical insights into whether and how outsourcing has influenced the global distribution of innovative activities in the software-outsourcing industry.

1.1 Purpose and scope of the study

The overall question addressed in this study is *whether and how outsourcing influences the formation of advanced innovation capability in developing country supply bases.* Recent literature has suggested that outsourcing changes the international division of labour. It is clear that outsourcing has been a major reason for the enormous build-up of production capabilities in the developing world, in particular in the export platforms of Asia. Moreover, there is increasing suspicion that this acquisition of productive capability from outsourcing is now followed by the shift to innovation capabilities. There is

limited evidence, however, of *how* this occurs and *whether* it extends to 'advanced' innovative capability. It is unclear how deep innovative capability goes and even how this should defined. Specifying how this can be assessed is in itself a main task of the thesis.

In essence, the study is about the relationship between:

(i) Offshore outsourcing by firms in OECD countries, and
(ii) The formation of (advanced) innovative capability by firms in developing countries.

The thesis feeds into the debate about the process of change in the global distribution of labour, particularly in innovative activity, but it examines this relationship in the context of the software services industry in Bangalore, India. If the division of labour is changing substantially we would expect this to be identifiable in an advanced export platform such as Bangalore. In examining the relationship between outsourcing and the emergence of innovative capability on the supply side, the thesis has a 'core focus' and an 'extended focus'.

The core focus (Chapters 2 to 7) is the influence of outsourcing on the formation of innovation in supplier firms. The main aim of the thesis is to explore the *how* element of the question and the observed phenomena. This entails that the thesis (i) examines the process of firm-level acquisition of new capability in supplier firms in an outsourcing industry, and (ii) seeks to specify the role of outsourcing (i.e. 'buyers') in that process. Capability formation is evidently a cumulative process that can be retraced indefinitely, at least in principle. However, the key word is 'new' capability, that is, capability developed within the observation period (2001–2006). The observation period of 2001 to 2006 was chosen because previous studies have indicated that there was very little innovation capability in the Indian software industry before the turn of the century (Altenburg *et al.* 2008; Lema 2009b). The study is particularly focused on the observation of 'peak capabilities' and on the projects in which they were formed. It is thus concerned with the most sophisticated capabilities demonstrated by software suppliers and the study uses the term 'peak capability' to refer to this.

As mentioned, it remains an open question whether the outsourcing practices of firms in developed countries lead to the build-up of innovation capabilities in the developing world. The underlying hypothesis driving this research is that outsourcing has a major influence on the location and build-up of innovative capability in the world. In order to explore this hypothesis, this study puts centre stage a factor that has received little in-depth attention in the literature: the *space for innovation* and then how such spaces emerge, what their boundaries are and what firms do to 'fill them'.

Some argue that the spaces for the build-up of innovative capabilities in emerging economies are increasing because of new outsourcing practices including the 'globalisation of innovation and R&D' in this context (UNCTAD 2005). The study is motivated by suggestions that outsourcing to low-cost countries has been changing over time towards higher end and innovative activities (Jensen 2009; Maskell, Pedersen, Petersen and Dick-Nielsen 2007; Tate *et al.* 2009). Particularly interesting is the recent work on the organisational decomposition of the innovation process (ODIP). Schmitz and Strambach (2009) ask whether and how ODIP may contribute to global dispersal or continuing concentration of innovation activities in developed countries.[1]

In examining changes in the global distribution of innovation activities, this thesis is not just concerned with 'pure' innovation activities such as R&D activities. It pays particular attention to outsourced activities that have innovation activities built into the provision of standard services (integrated innovation activities).[2] This broader scope is adopted because supply platforms typically emerge as hot spots for labour-intensive manufacturing and routine service provision and the offshore outsourcing of innovation to new economic regions is unlikely to start with 'standalone innovation'.

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[1] Schmitz and Strambach (2008) emphasise that this decomposition has an intra-firm as well as an inter-firm dimension. However, this thesis is particularly concerned with the inter-organisational dimensions. In other words, the study is concerned with offshore *outsourcing* to low-cost countries, not offshoring through FDI.

[2] This distinction is elaborated in later chapters. Like Ariffin's, this study is concerned with 'the internationalisation of innovative capability, not R&D and patenting capabilities or on production capability alone' (Ariffin 2000: ii).

The extended focus (Chapter 8) is competence leveraging, co-evolution and buyer business models. While the examination of the relationship between outsourcing and supplier capabilities may seem straightforward at first, considerable complexity arises if one seeks to understand the *process* and avoid determinism. The initial research interest was purely top-down centred, focusing on how outsourcing by buyers in the OECD countries influences the formation of new capabilities in the developing world. However, during the course of this research it became apparent that there might be dynamics running in the opposite direction: enhanced capability deepening in global supply platforms may have an influence on lead firm sourcing strategies.

The research was therefore extended to include these 'supply-side dynamics' – an area in which the existing literature has very little to say. It examines the changes which occur in the supply base due to the leveraging of competences between business lines and firms and then explores how the heightened competences affect outsourcing decisions in the USA and Europe. The thesis addresses this issue by adopting a co-evolutionary framework, by adopting a longer time perspective (1980s to 2000s) and by analysing the influence of changing demand-side business models over this time-span.

1.2 The structure of the thesis

The thesis contains nine chapters (including this short introductory chapter). This section outlines the structure of the thesis chapter by chapter.

Theoretical framework: outsourcing and supplier capability (Chapter 2). This chapter sets out the theoretical framework and combines this with a review of the literature of global value chains and supply-side learning. It introduces the idea that the relationship between learning and new capability is mediated by the 'opportunity space' in which suppliers can build new capability in outsourcing industries. It also makes an analytical distinction between 'learning' and the resulting attainment/demonstration of 'new capability' by suppliers. This is followed by a brief review of the literature on the Indian software industry, concerned particularly with modes of learning in Indian software firms and their acquired levels/types of capability. On this basis, the chapter concludes by posing the broad research question and the corresponding research hypotheses explored in the empirical parts of the thesis.

Operationalisation (Chapter 3). The aim of this chapter is to operationalise the key concepts and provide an analytical basis for the empirical analysis of capability formation and software-outsourcing relationships. It starts by explaining the software development process and by identifying steps that constitute the loci of (different forms of) production and innovation activities. Building on this analysis, the chapter then explains how the key concepts are operationalised, in particular: (i) types of innovative capability in supplier firms, (ii) inputs and sources in the learning process related to the attainment of new capability, and (iii) buyer outsourcing practices.

Methodology (Chapter 4). A key feature of the research is the focus on inter-firm relationships comprising suppliers and buyers. The methodology chapter starts by describing features of the overall population from which the supply-side sample was drawn. It explains the procedures involved in the sampling of firms, in identifying 'innovation events' within those firms, and in the selection of demand-side partners. It proceeds by explaining and discussing (i) how observations were classified, and (ii) the basis on which this thesis draws conclusion. The concluding summary is a central reference point in the thesis as it presents the detailed research questions that drive the later chapters.

New supply-side capabilities (Chapter 5). This chapter examines the types of peak capability supplier firms have acquired and demonstrated since 2001. It examines 'events' of new capability development in different supplier business lines and it classifies observed activities according to their underlying types of capability. This is embedded in analyses of trajectories in firms and business lines since this is required to understand the purpose of innovative activities. It shows descriptively how firms have moved into new spaces and acquired new capabilities.

Inputs into the innovation process in supplier firms (Chapter 6). The next step in the empirical analysis is to examine *how* sampled firms used internal and external sources/linkages to build new capabilities. External sources are further disaggregated into 'local' and 'global'. Much of this analysis builds on the observation of frequencies of different types of linkage and their combination. However, this is supported by qualitative assessments of their roles and this allows for the identification of a dominant 'learning model'. Two examples are presented for a deeper understanding of how this

type of learning ‘works’. The conclusion specifies the role of outsourcing buyers in the observed events.

Outsourcing and bounded opportunity spaces (Chapter 7). This chapter initiates the presentation of demand-side findings. It contrasts three buyer segments and presents a number of case studies in each segment. The purpose is to examine the outsourcing practices and how they influenced the attainment (or not) of new qualities of capability in the supply base. It investigates the boundaries or ‘upper limits’ of outsourcing and discusses the dynamics which create and limit opportunities for suppliers. It shows that ‘new spaces’ of considerable significance have emerged in the global software-outsourcing industry, but that these vary by buyer segment.

Causation by interaction (Chapter 8). The penultimate chapter extends the focus beyond the core contribution of this thesis, thereby seeking to make sense of the findings in a broader perspective. It discusses whether new qualities of capability in the supply base create a ‘pull’ that reinforces the deepening of outsourced activities. The pull arises from direct and indirect feedback mechanisms from outsourcing that change the environment in which buyer firms compete. The chapter explores whether successive phases of outsourcing are driven by self-enforcing dynamism arising in the interface between practices on the demand side and capabilities on the supply side. In order to do this, the chapter elaborates the identified learning model and explains how the latest development phase relies on cross-domain leveraging of competences. The chapter also explores the role of business models on the demand side and their changes as an underlying factor, which has enabled and enhanced the observed changes. Unlike previous chapters, this chapter cannot examine systematically the proposition of interacting forces from above and below. Rather, it seeks to provide plausible anecdotal evidence combined with further theoretical framing in terms of co-evolutionary development.

Conclusion (Chapter 9). The final chapter provides a summary of the main findings, drawing conclusions on how outsourcing influences new qualities of capabilities in the sampled firms in the software supply platform in Bangalore. In the course of doing so, it brings out the main contributions to the literature. It discusses the role of outsourcing in the emerging transition from labour-cost-based to innovation-based competitive

advantage in global supply platforms more widely. The chapter concludes by drawing attention to shortcomings and limitations of this thesis and their implications for the interpretation of the overall findings.

2 Theoretical framework: outsourcing and supplier capability

The proposition driving this thesis is that outsourcing has a major influence on the location and build-up of innovation capabilities in the world. This proposition is not novel in itself but there are relatively few insights with regard to how this process 'works'. Later chapters seek to examine the process empirically. This chapter presents the conceptual framework for the research and combines this with a review of the relevant literature. This will then help to specify more precisely the questions and concrete research hypotheses examined in this thesis.

The study seeks to contribute mainly to the literature on global value chains and supplier learning. This literature addresses explicitly the connection between outsourcing and supplier capabilities. It is however insufficient on its own for the purposes of this thesis and other sets of literature are therefore drawn upon. Bringing together three sets of literature is key to this endeavour:

- The part of the value-chain literature that focuses on the connections between global lead firms and local capabilities in low-cost countries (e.g. Ernst and Kim 2002; Gereffi, Humphrey and Sturgeon 2005; Schmitz 2007b).

- The literature that focuses on learning and accumulation of innovation capabilities in so-called latecomer countries (e.g. Ariffin and Figueiredo 2006; Bell 2006; 2007).

- The various elements of the innovation literature which focuses on relevant issues such as (i) the nature of innovation in services firms, (ii) local innovation systems, and (iii) global reorganisation of innovative activities and (iv) systems integration (including Brusoni 2005; Cooke 2005; Lundvall, Intarakummnerd and Vang 2006; Miles 2008; Schmitz and Strambach 2009).

This chapter does not proceed by discussing these bodies of literature one by one but draws on them where they are relevant for providing concepts and sharpening questions. The aim of the chapter is to set out a framework for the analysis of how outsourcing may influence capability formation in supplier firms.

The chapter is structured under four main headings:

- *Outsourcing – opportunities and constraints*: discusses how outsourcing may influence the process of capability formation in supplier firms and what the limits are. It does this mainly by elaborating the concept of opportunity space and by discussing how buyer firms can open up new spaces and define the boundaries of these spaces.

- *Formation of new capability*: reviews the conceptualisation of capability attainment, discussing how this may differ in services firms and how capability formation may depend on 'available' opportunity spaces.

- *India's software industry – the received wisdom*: sets out what existing literature on the Indian software industry tells us about the key issues addressed in this thesis.

- *Overall research framework, question and proposition*: summarises the overall guiding framework of this study, specifies the research questions examined in this thesis and develops research hypotheses to explore the empirical parts.

2.1 Outsourcing – opportunities and constraints

There is a relatively clear view on the main research question running through the general literature on outsourcing and value chains. The view is that the accumulation of production capabilities extends at best to minor innovation capabilities but not to major or advanced innovation capabilities. This section starts by unfolding this argument.

2.1.1 New opportunities arise but these are limited

Value-chain research has shown that low-cost suppliers often upgrade the quality and scope of their services in response to the requests of lead firms in the USA or the European Union (Gereffi 1999; Humphrey and Schmitz 2002). In certain cases, 'buyers may welcome increasing supply competences as part of a broader strategy of focusing on their own core competences' (2004: 33). New sourcing strategies may drive up the nature of the 'requests' passed on to the supply base and may play an important role in

the deepening of supplier capabilities. From the supplier perspective, these requests may represent new business opportunities through which they can develop 'new capability'. However, the literature also suggests that the development of supplier capability may often be confined to capability that strengthens suppliers' existing position in value chains. Buyers (also referred to as 'lead firms') are thus seen as having a major influence on opportunities and constraints through the adoption of different sourcing strategies and relationships with suppliers.

Until recently the value-chain literature maintained that only certain stages of the chain tend to be outsourced to emerging market economies, mainly manufacturing and standardised services. Lead firms have different strategies for the control of the value chain, but one common characteristic is that innovation activities tend to remain in so-called advanced economies (Mudambi 2008).[3] However, there is literature that recognises that some innovation activities are offshored. Outsourcing includes not just routine activities but also knowledge-intensive activities, including some R&D activities (Ernst 2008; Hansen, Schaumburg-Müller and Pottenger 2008). It is suggested that 'transformations in strategy and organisation have provoked fundamental changes in innovation management and enhanced the mobility of innovation' (Ernst 2006). However, the literature on global outsourcing value chains still argues that dispersed innovation activities are of a second order. Innovation outsourcing follows the practice of multinational corporations (MNCs), which tend to distribute their innovation activities hierarchically, 'with advanced technology being confined to advanced industrialised countries while more routine low-end innovation is decentralised in a few developing countries' (Chen 2008: 622). This suggests that there are strategic and non-strategic innovation activities. Such strategic capabilities are most likely to be 'advanced' relative to the existing endowment in supplier firms.

Schmitz (2007b) argues that strategic innovation activities are 'problem framing'. He draws on the modularity literature, which shows that firms in most industries seek to

[3] Authors such as Gereffi (1999) and Hobday (1995) have been more optimistic, but they have focused on evolutionary paths along which suppliers move to transcend their role as suppliers by attaining own-brand manufacturing capability, allowing them to sell directly to end markets. It is not clear whether outsourcing vendors in software tend to seek such an end goal.

avoid the effective loss of system integration capabilities (Brusoni 2005; Brusoni, Prencipe and Pavitt 2001; Pavitt 2005). This system integration activity is a critical step in the innovation processes, even where the systems integrator (buyer) itself is a sub-system supplier in intermediate markets. The failure to retain the system-integrating step in the innovation process could result in a situation where the buying firm no longer possesses the capabilities to incorporate new knowledge and components effectively into its systems (Chesbrough 2003c: 191). For this reason, lead firms are much more readily prepared to outsource 'problem-solving' innovation such as the design and engineering activities associated with the development of a system component. The situation that arises is that buyer firms keep problem-framing activities in-house (or close to home) and only disperse problem-solving activities to lower-cost suppliers in new economic regions (Schmitz and Strambach 2009).[4] Thus, new spaces arise for the supply base, but these are limited to problem-solving activities.

2.1.2 The notion of space

The limited prospects for developing higher-order innovative capability arise because the interests of the outsourcing lead firm determine opportunities further down the chain:

> The central proposition of the value chain approach … is that the lead firms of value chains have a major influence on the spaces in which other firms in the chain can innovate.
>
> (Schmitz 2007b: 155)

However, the notion of space is not clearly conceptualised in the value-chain literature. Rather, the literature tends to *assume* that increasing (or unchanged) supplier capability is the result of more (or unchanged) space.[5] Yet the existing literature has provided no operational definition of 'space', nor has it examined or conceptualised *how* firms develop capability in such spaces.

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[4] The literature uses different terminology to capture the problem-framing/problem-solving distinction. Henderson and Clark (1990) use the terms architectural and modular innovation. Others use the terms system and component innovation (Van Den Ende and Jaspers 2004).

[5] For instance, Navas-Alemán (2006) seemed to suggest – on the basis of this assumption – that the local market provided more space than the global market in the Brazilian shoe industry.

In essence, outsourcing means that a buyer invites a supplier to undertake a certain subset of activities. 'Space' is understood in this study simply as an *opportunity for innovation* arising directly or indirectly from outsourcing or buyer linkages more generally. Through such opportunities, firms can realise their learning efforts and it is within such spaces that they can *demonstrate* the acquisition of observable new capability.[6]

The notion of space prompts the key assumption that firms in the supply base can only take advantage of the new spaces when they have pre-existing capabilities that allow them to capture new opportunities. In the outsourcing context, suppliers with stronger pre-existing capacities would be more likely to capture more demanding project opportunities than firms with lesser capabilities would be. This assumption is unlikely to be contested and its validity is *not* explored in this thesis. Instead, the focus is on *how* the process might work if and when suppliers (often referred to as 'vendors') develop *new* innovative capabilities.

It is commonly assumed that the spaces that accrue to suppliers are closely associated with the design parameters set by the customer. Tightly defined parameters leave only small spaces for creativity; parameters that are more open-ended will transfer a part of the innovation challenge to the supplier. When parameters are indicated loosely, the supplier becomes responsible for working out how to meet them. In this way, the design parameters are central determinants of the opportunities and barriers to supplier learning.

2.1.3 Modularity and systems integration

The literature on modularity addresses the issue of space from a systems integration perspective (Brusoni *et al.* 2001; Chesbrough 2003c; Davies, Brady and Hobday 2007; Henderson and Clark 1990). The following subsections set out briefly what this litera-

[6] Spaces may be mainly external and other organisations may have certain degrees of control over the activities undertaken. They may determine not only the size of the space but also the boundaries. This is not least the case when the space is an opportunity for innovation created by the demand of the client(s). However, as should become clearer, an opportunity space might also exist entirely within the firm (some process innovations) with very limited external influence.

ture says; they highlight different innovation categorisations and discuss their importance to the firm.

Henderson and Clark (1990) distinguished between two different kinds of knowledge involved in the development of new products and systems. The first is knowledge of the system components and the second is knowledge about the linkage between them, i.e. architectural knowledge. In many industries, component knowledge is provided by suppliers, whereas architectural knowledge is retained by lead firms that function as system integrators. While such structures are particularly pronounced in industries dealing in highly complex products, some scholars have suggested that regardless of industry, coordinating and integrating specialised knowledge is an important feature of innovation processes in general (Pavitt 2005). System integrators must have both architectural knowledge as well as some degree of component knowledge in order to cope with technological change and product-level interdependencies. They must 'know more than they make' (Brusoni *et al.* 2001).[7]

Modular production and innovation networks are dependent on what Baldwin and Clark (2003) call a pinch point in the flow of activities, i.e. a codified and standardized transfer (hand-off) of design parameters. However, there are indications that such pre-defined divisions of labour are not clear-cut, particularly if industries and inter-firm relationships are studied in a dynamic perspective. [8]

If a lead firm wants to place a transaction in a particular location it must undertake upfront work to define and measure the transacted 'objects'; this work will incur transaction costs (Baldwin 2008). Importantly, the establishment of a pinch-point may

[7] Lead firms need to retain knowledge and competences to integrate the various activities, even if the majority of them are outsourced. It is necessary to coordinate more and more specialised knowledge domains, and increasingly distributed learning. This requires the presence of in-house staff in the lead firm that possesses a 'higher level understanding'

[8] Research on the outsourcing of printed circuit board manufacturing confirms that the overall design parameter typically remains in the hands of the customer because the requirements depend upon the electronics product into which it is inserted. However, a part of the design challenge is transferred to competent suppliers who then gain some scope to draw on and further develop distinct in-house competences (Lee and Chen 2000). Ernst (2005b) has shown that there are limits to modularity in chip design because of cognitive complexity. Technology change is unpredictable and it changes faster than the ability to codify. Inter-firm collaboration requires coordination and networks become more integrated (relational) rather than arms length.

be associated with significant transaction costs which occur when the buyer undertakes product definition and specifies service-level agreement, process-approach, testing method etc. Transactions between firms (externalisation) are more likely to occur where these costs are low. By implication, the outsourcing of standardised product components is feasible and straightforward as firms can rely on general industry standards and on clear product and process specifications. However, the ability to codify becomes more difficult as you proceed with functions that have knowledge creating elements, such as design and engineering activities (D&E) or even research and development (R&D).

In such cases, inter-firm transactions cannot be fully specified *ex ante*, even if the effort to adopt modular design approaches reduces transaction costs. All else being equal, the potential transaction costs are likely to rise as the lead firm deepens the outsourcing strategy to include knowledge-intensive service. Offshore outsourcing of such activities can make sense if associated transaction costs are seen as investments that are offset by (longer term) factor-cost savings. The 'pinching' of the inter-firm link is likely to be pushed to the limit, but the parties may invest in a (temporary) transaction-free zone. Such zones are 'physical, virtual, or social spaces where, by convention, a designated set of transfers occurs freely' (Baldwin 2008: 181). Such zones are needed to facilitate complex, interdependent, and iterative transfers in the task network.

> Some complex and contingent transfers between a supplier and a customer may be needed to achieve the desired outcome. In such cases, a relational contract can support the creation of a limited transaction-free zone between two otherwise encapsulated enterprises.
>
> (Baldwin and Clark 2006: 39).

This observation seems particularly relevant in the case of software outsourcing where non-repeatability is the rule rather than the exception. As emphasised by Brooks (1995) in his seminal book, *The Mythical Man Month*, every software development project is unique, organically growing and very difficult to specify *ex ante*. This means that a division of labour in software development is difficult to establish because of the limited ability to 'pinch'.[9] The architecture of a software system, including the inter-

[9] This is why one software developer can achieve much more in two months than two software developers can achieve in a one-month collaborative project.

faces with other systems (hardware, software and human systems), may not be clear until the system has actually been developed and implemented. The implication of this is that some degree of 'system ignorance' (bounded rationality) on behalf of buyers of software services or software products needs to be acknowledged. Requirements and specification may not yet have been worked out at the time of engagement or they may even be impossible to work out *ex ante*. In such cases, contractors may 'know less than they buy' (Flowers 2007) and this could have implications for the space that accrues to suppliers.

2.1.4 The relevance of progressively 'advanced' innovation capability

The insights derived from the systems integration literature may advance further our understanding of the types of distributed (or non-distributed) innovation in value chains and their relevance to the firm or supply platform. The key point that emerges from the literature is that there is an 'order' of different types of innovation.

The literature suggests that problem framing innovation (relying on integrative competences) is a higher order form of knowledge creation than problem solving innovation (narrowly specialised capabilities) as it involves a higher degree of complexity and a need for an oversight across different knowledge domains.[10] Furthermore, it suggests that there is a continuum with differing *scopes* of knowledge creation along the task network. Initially, knowledge creation is wide open, with almost infinite options for how to proceed. Further along the continuum, these options decrease as the application of knowledge in the context of commercial use increases the need for specificity.[11]

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[10] A related terminology highlights that knowledge can be highly abstract, as in blue sky research in technical fields – creating 'bodies of understanding' or it can be context-specific, associated with specific product or process innovation – creating 'bodies of practice' (Nelson 2000; Pavitt 1998). Bodies of understanding include more 'pure' forms of knowledge creation as they are based on competences in specific domains that are reflected in the fields in which the firm undertakes systematic knowledge exploration. Bodies of practice are related to the design, development, production and use of a specific product or service. 'As such, it is an organizational task, so that 'a body of practice' consists largely of organizational knowledge that links 'a body of understanding' with commercially successful (or, more broadly, useful) artefacts ' (Pavitt 1998).

[11] This is different from other classification systems where the 'degree' or 'depth' of knowledge creation is considered in much more abstract terms. For instance, one such framework specifies different levels of innovative capability in terms of basic, intermediary and advanced (Bell 2007). However, these 'depths' of innovation capability can be achieved or performed within different functional domains. Such functional domains include common Schumpeterian distinction between product and process innovation. While much innovation literature continues to use this distinction recent applications separate out organisational and marketing innovation as sub-types of process innovation (OECD 2005).

This perspective suggests that several types of innovation need to be considered when seeking to understand innovation and product/systems development that is distributed in global value chains. We may distinguish between: (A) innovation related to high-level systemic development, (B) innovation related to low-level applied development and (C) production process innovation related to manufacturing or service provision activities.[12]

It is important to maintain such a distinction because the scope and degree of knowledge creation is related to the dynamic ability to uphold competiveness in progressively profitable parts of the value chain. In principle, firms may concentrate in any of the above types of innovation, thereby taking a functional deepening route to competitive advantage.[13] However, the existing literature suggests that different roles in the distributed task networks are associated with different degrees of value-creation and profitability (Dedrick, Kraemer and Linden 2009).

Higher entry barriers and unique, difficult-to-trade knowledge assets involved in problem framing and systems integration are associated with increased bargaining power which can be used as the distribution of profits is negotiated in the chain. Entry barriers in the form of required technical and relational investments are likely to be highest at the 'top' (high-level systemic development) and then gradually decreasing. Ultimately, unique and mobile knowledge bases can help to circumscribe the division of labour in the value chain and create opportunities for high levels of value appropriation (Jacobides, Knudsen and Augier 2006).[14]

The attainment of progressively advanced and knowledge-intensive capabilities is important, more generally, as these are likely to be more 'dynamic'. Operational capabilities enable firms to create rents in the present, but dynamic capabilities are

[12] These types are considered in later empirical chapters. However, a fourth type is added. This is (D) process and organisational innovation that may cut across the three first types of innovation, and which is directed towards other aspects of general business.

[13] Humphrey and Schmitz note that 'In some cases functional specialisation may well be superior to functional upgrading' (Humphrey and Schmitz 2004a: 376).

[14] In other words, the acquisition of higher levels of capability by suppliers may change the power balance with buyers, increasing the prospects of generating (higher) innovation rents (Kaplinsky 2005).

concerned with *change* as they enable firms to modify their resource base (Augier and Teece 2009; Teece, Pisano and Shuen 1997).[15] As suppliers – or collectives of firms in supply platforms – move from the provision of basic 'manufacturing' service to increasingly higher-order innovation capabilities they enter a learning curve that is likely to create a basis for the attainment of knowledge that will be critical to the future. Dynamic capabilities are particularly important in so-called latecomer firms that seek to accelerate their uptake and learning efforts to continually enhance their resource base and, over time, become 'advanced players' themselves (Mathews 2007; Mathews 2006).

2.1.5 Technical and non-technical elements of problem framing

The literature on systems integration has tended to emphasise engineering issues. Therefore, it has largely neglected what we refer to in this thesis as the non-technical elements of problem framing. Certain system integrators address intermediate markets while others sell to final consumers. In both cases, the management of such firms must be capable of recognizing and responding to changing market characteristics. Identifying new opportunities, crafting concepts and organising effectively to embrace them are fundamental to wealth creation in such firms (Teece *et al.* 1997). These are the non-technical elements of problem framing.

Research on user-driven innovation has shown that there is significant learning involved in the use of products and systems and that users and groups of users tend to have a better understanding of the qualitative ('exterior') features. This is why the knowledge provided by users is a key source of innovation; user-derived knowledge is often key in the development of new or better products, systems and services (von Hippel 1988). In many sectors, lead firms thus draw customers into the qualitative definition of problems. It is particularly prevalent in KIBS sectors where such customer interaction is fundamental (Strambach 2008), not only in traditional packaged IT sectors (e.g. Microsoft) but also in the customised IT consulting market (e.g. IBM or Accenture). This was recognised by Pavitt (1991) who categorised software firms as 'specialised suppliers',

[15] Similarly, Altenburg (2008) referred to 'dynamic scale economies'. Such economies are likely to create the basis for competitive advantages in the future, i.e. investments have forward linkages that open up completely new possibilities.

relying on the ability to match technology with specific customer requirements and benefitting systematically from user experience.

It is typically in and around forward linkages that non-technical elements of problem framing takes place, as the touch and feel and qualitative functionality of products and systems are defined to meet the needs of consumers and alliance partners. When decomposing problem framing at the level of products or systems (tradable artefacts), it is thus clear that the non-technical element is a problem of user needs and the subsequent technical step is largely an engineering problem. While these two steps are intrinsically tied together, certain elements of the engineering problem are sometimes outsourced. As mentioned, lead firms are likely to retain the overall architectural function but they may (re)locate certain elements of the product development process (PDP) in and around backward linkages.[16] It is not clear from the literature whether suppliers can progress into problem framing in the engineering sense and – where they can – whether this would then amount to achieving the highest order of innovation capability. These are issues addressed in this thesis.

2.1.6 Changes over time and their detection

Undoubtedly, access to 'production' capability at low cost is the driver of offshore outsourcing, at least initially. However, this experience may give rise to a deepening of the outsourcing relationship. Some authors emphasise that offshore outsourcing is a learning path, and they argue that:

> Over a period of time the outsourcing experience lessens the cognitive limitations of decision-makers as to the advantages that can be achieved through outsourcing in low-cost countries: the insourcer/vendor may not only offer cost advantages, but also quality improvement and innovation.
> (Maskell et al. 2007: 239)

[16] This gradual transition from non-technical elements (connection to use) to technical elements (connection to design and production) is evident in the software development process model discussed in section 3.1

Building on this line of thought it is easy to assume that buyer firms seldom start out with outsourcing R&D and then expand 'downwards' towards production.[17] Very rarely will a buyer firm start by outsourcing research, then add design and engineering activities, before completing the 'outsourcing portfolio' with manufacturing activities. The reverse 'bottom-up' gradual pathway is more likely. One would therefore expect that particular attention is given to the intermediate stages between pure production activities, which depends only on the *use* of existing/given knowledge, and R&D, which is only concerned with the creation of knowledge.

Surprisingly, however, the literature on innovation in global networks has concentrated mainly on R&D, and mainly on the 'R' within that process. The focus in this literature is predominantly on access to highly specialised knowledge at the forefront of emerging technologies (Christensen, Olesen and Kjær 2005; Cooke 2005; Santos, Doz and Williamson 2004). The literature builds on the implicit assumption that 'the knowledge boundaries' and the 'production boundaries' of firms are separated (see, for example, Brusoni 2005: 589). In short, the focus of existing literature on innovation outsourcing is clear: it concentrates on the farming out of readily observable innovation activities (e.g. R&D). In other words, it focuses on standalone innovation activities. However, the 'bottom-up' perspective suggests that the tightly connected type of innovative activity, while often overlooked, may be central to the outsourcing learning path. The key characteristic of this type of outsourcing is that it concentrates on the acquisition of a good or services but that some innovating by the supplier is required to provide this good or service.

In other words, the requirement to produce and innovate comes in a bundle. The incentives for this type of bundling may be rooted in 'linkage economies', 'whereby controlling multiple value chain activities enhances the efficiency and effectiveness of each one of them' (Mudambi 2008: 705). These economies arise because knowledge flows more freely within firms than between firms. For instance, design and engineering

[17] Today East Asia is host to clusters of so-called 'fabless' electronics firms that do not manufacture their own silicon wafers. Instead, they concentrate on the design and development of semiconductor chips. While these provide standalone innovation services today, their capabilities developed over time from their initial specialisation in semiconductor fabrication.

activities may become more efficient if they integrate with production activities undertaken by the same firm. However, the process of bundling and unbundling has many determinants. Transaction costs are important, but they are only one part of the equation, and relative factor costs are often more important. From a buyer perspective, the benefits from low-factor costs in the supply base (e.g. those related to design and engineering-type innovation activities) may simply outweigh the transaction costs associated with the integrated outsourcing of these more complex tasks.

This thesis gives equal attention to the 'hidden' innovation activities that are associated with the tightly connected type as well the more recognisable innovation activities associated with the loosely connected type of innovative activity. Some of the outsourcing literature suggests that the successful transfer of production activities to new low-cost localities is accompanied with the handover of a substantial body of seemingly unseen knowledge (Madsen, Riis and Waehrens 2008).

This subsection has set out and discussed the main propositions that arise from the general literature on outsourcing and global value chains. However, the review of this literature shows that it is almost exclusively concerned with the opportunities and constraints that accrue to suppliers in outsourcing relationships, whereas it has little to offer with regard to the process by which opportunities are translated into realities. It has devoted little attention to the actual *process* and almost nothing to the intra-firm dimension of this process. To advance research in this field requires conceptual tools from the literature that focus on the formation of innovation capabilities within firms or local systems. This is not straightforward. Even though a recent paper advocates the combination of the intra-firm-learning literature with the value-chains literature (Morrison, Pietrobelli and Rabellotti 2008), there is in fact no suggestion as to how this fusion can be operationalised.[18]

2.2 Formation of new capability

In order to bring the literatures together, we start by reviewing what the literature on learning and formation of innovation capabilities in latecomer countries tells us with

[18] Despite the subtitle of that paper, there is no 'framework' on which this thesis could draw.

regard to three central issues. These three issues are: (i) learning and the formation of innovative capability, (ii) the importance of local innovation systems, and (iii) learning in project-based firms.

2.2.1 Learning and the formation of innovative capability

The learning literature has made the simple but fundamental point that the formation of innovation capabilities depends on strategic intent and the willingness to make the necessary investments; it does not 'just occur' (Bell and Albu 1999; Morrison *et al.* 2008).[19] In particular, 'deeper' forms of innovative capability (advanced innovative capability) depend on various types of deliberate *initiative* and *effort* within the firms (Bell 1984). However, the literature also acknowledges that firms may combine *intra-active* and *inter-active* learning mechanisms, not least when firms are located in industrial clusters (Bell and Albu 1999).

This literature defines 'learning' as the various *processes* that permit firms to accumulate new types and levels of capability (Bell 1984; Figueiredo 2003). The formation of 'new capability' is the *outcome* of a process referred to as 'learning'. In terms of operationalisation, it is important to note that this 'new capability' refers to *demonstrated* capability, where these capabilities are classified based on *activities* performed by the firm.[20] Capabilities tend to be categorised by function (such as product-centred functions or functions related to process and production organisations) and by level of difficulty.

However, there is little explicit discussion in this literature about how outsourcing and supply relationships might influence the learning process in latecomer firms. On the contrary, the few studies that have examined firms in sub-contractor relationships seem to assume that the main influence runs in the opposite direction. Accumulation of capabilities is viewed as an *independent process* that *permits* the establishment of

[19] It is well established that capability formation is dependent on the 'absorptive capacity' (Cohen and Levinthal 1990; Ernst and Kim 2002). This capacity arises from the prior knowledge base, the intensity of learning efforts and the ability to blend internal and external resources for the build-up of new capabilities.

[20] In other words, innovative capabilities can only be identified *after* innovative activities have been undertaken.

different types of buyer/parent linkages, such as innovation-centred linkages (Ariffin 2000). Specifying the chain of causality is not easy. It is clear, however, that ideally one needs to examine and discuss causality in a multi-directional fashion (as will be done in Chapter 8). However, the immediate task of the thesis is to shed light on the processes by which new opportunity spaces are 'filled'.

2.2.2 The importance of local innovation systems

Much of the literature on learning argues that geographical proximity is particularly conducive to innovation (Gertler 2003; Malmberg and Maskell 2006). The basic tenet of the innovation systems literature is that innovation is a relational interactive process, which occurs between a range of different actors, including not least buyers and suppliers (users and producers), but also providers of knowledge-intensive business services, trade organisations and public support institutions. Tacit knowledge constitutes the most important basis for innovation-based learning and value creation and this type of knowledge is typically created in interaction between actors embedded in the same political and cultural setting (Lundvall, Johnson, Andersen and Dalum 2002). The central proposition is that innovative capability depends on the density and quality of relationships between such economic actors.

The recent debate on innovation in developing countries and the evolution beyond competiveness based on low-labour cost has thus focused on linkages in the regional or national innovation systems (see, for instance, Lundvall *et al.* 2006). With few exceptions (Bell and Albu 1999), the literature does not make explicit analytical distinctions between production and innovation spheres. However, it is clear that the systemic requirements for each of these are different. While local passive and intangible system dynamics may be sufficient for growth and production capability, it is commonly argued that they will be insufficient for innovation. Active and tangible transaction and knowledge linkages between firms and institutions (such as universities) are required for innovation. The common proposition is that a strong, highly networked local innovation system is required before knowledge-based competitive advantage can be achieved.

Much of this literature is based on the premise that the *cluster* is a key locus for the development of capabilities (Malmberg and Maskell 2006; Porter 1998). This is highly

relevant in the context of global supply platforms. The bulk of the global-scale extension of manufacturing and services witnessed in recent decades has been concentrated in an expanding, but essentially limited, number of specialised supply platforms. The literature refers to this phenomenon as 'concentrated dispersion' (Ernst 2002; Zaheer and Manrakhan 2001).

While production and some bounded D&E and R&D activities are outsourced to locations with low wages, these may be confined to activities where knowledge spillover and local synergy effects are not very important. For instance, McKendrick, Doner and Haggard (2000) have argued that IT industries tend to be organized into two different types of clusters, 'technology clusters' and 'operational clusters'. Lead firms that focus on product development and ongoing innovations dominate the first type of cluster, relying largely on tacit knowledge and face-to-face interaction. The second type of cluster, often based in low-cost locations, is focused on 'base processes' of generic manufacturing, assembly and logistics. These two types of clusters are interrelated as complementary locations in global production networks, but they are focused on different lines of activity for which firms and supporting institutions specialise. However, while such paired opposites of 'factor cost-based' vs. 'knowledge-based' (locational) advantages are commonplace, they lack discriminatory power (Altenburg 2006b). Rather, they are best seen as poles on a continuum, and the fluidity between the two means that a gradual transition from one to another is possible.

Importantly, there is an increasing amount of case material on cluster and local innovation systems, not just from OECD countries, but from many parts of the developing world. They have contributed in many different ways to understanding the rise of new capabilities in new locations. A summary assessment is hard to make but, some overall observations can be made: The strength of this material lies in the analysis of local linkages and how they contribute (or not) to growth and innovation. The search for collective efficiency and systemic gains has contributed to this prioritisation of local linkages. This strength has to be seen against two weaknesses in the literature. First, global linkages were either not given sufficient attention or not sufficiently integrated

into the analysis. [21] Second, the mesmerisation with local linkages led to a neglect of studying what goes on inside the firm.[22] However, this is crucial because sustaining and benefitting from linkages requires firm-internal investments in people, organisation and equipment. The capability literature on learning in latecomer firms reminds us that that it is important to examine how internal capabilities are built by drawing on internal sources and external knowledge sources (Figueiredo 2008).[23] The key point is that understanding where, how and why innovation capabilities emerge, requires bringing all three dimensions (firm-internal, local linkages and global linkages) together. This is what this thesis has tried to do.

2.2.3 Learning in project-based firms

Paying attention to firm-internal processes is important, but the existing literature that is explicitly concerned with the formation of innovation capabilities has focused on industrial sectors such as steel (Figueiredo 2003) and electronics subcomponents (Ariffin 2000). While this study draws on these studies, it examines capability formation in *services firms,* for which the literature offers much less guidance.

This study is concerned, in particular, with suppliers of *knowledge-intensive business services* (KIBS). The KIBS literature has emphasised that learning in such firms tends to be project based. In other words, most KIBS providers are so-called project-based organisations (Whitley 2006). Two typical features of such project-based organisations are worth noting (Hobday 2000: 875):

- The 'knowledge, capabilities, and resources of the firm are built up through the *execution of major projects*' (emphasis added).

[21] Exceptions include Cooke (2005). Furthermore, much of the global value chain literature has concentrated on the relationship between local clusters and global chains (Giuliani, Pietrobelli and Rabellotti 2005; Humphrey and Schmitz 2002; Lema 2006; 2009b; Sturgeon, Van Biesebroeck and Gereffi 2008). This is important because synergy effects may arise between proximate firms in the supply base: 'they cluster and new specialisations develop' (Schmitz and Strambach 2008). These new specialisations include knowledge-intensive activities and business services. Competence leveraging can then occur between firms within supply platforms that specialise in different sub-sectors (Kishimoto 2002).

[22] Since this literature has become mesmerised by *relations* between firms, it has often neglected to pay attention to processes within firms (Bell and Albu 1999).

[23] External sources include (i) pulling knowledge and people in from the outside, (ii) interacting with suppliers and users, and (iii) interacting with supporting organizations (Figueiredo 2008).

- Projects are 'the normal mechanism for creating, responding to and executing *new business opportunities*' (emphasis added).

This suggests that learning and project execution is hard to separate and that the formation of 'new capability' takes place – and is best observed – in and around particular projects, not least those that address (new) business opportunities. In outsourcing, such new opportunities are likely to be client driven. In general, the KIBS literature tends to emphasise learning in client-facing project teams (Miles 2004; 2008; Strambach 2008; Zhou, Tang and Xiong 2005). Crucially, for the sake of the bigger picture, learning in such firms is cumulative, linking learning in one project with the application of capabilities in later projects.[24]

This project focus is of direct relevance for this thesis in terms of both substance and method. The building of capabilities is a process to which many factors contribute. Tracing and specifying the influence of specific factors can be very difficult. Focusing on particular project carried out by a firm makes this easier. That is why this thesis examines capability formation by focusing on particular events. How this works will be explained later. Similarly, how the outsourcing and learning dimensions will be brought together will be discussed later. Before doing this, the next section will examine what the existing literature on the software industry in India/Bangalore reveals on the issues raised so far.

2.3 India's software industry – the received wisdom

The Indian software industry has received a lot of attention in the academic and business literature. For the purpose of this thesis, three issues seem most relevant: (i) the quality of capabilities in the Indian software supply base, (ii) the nature of capability formation, and (iii) opportunities and constraints in the nature of the software outsourcing business.

[24] This is touched upon in Chapter 6, but it is explained more fully in Chapter 8.

2.3.1 The quality of capabilities in the Indian software supply base

The dominant argument about the 'quality' of capabilities is that Indian firms have become strong in production/execution capabilities but remain weak in innovation capability (Arora, Forman and Yoon 2008; Dossani 2006). The popular business press is also sometimes an exponent of this view. A *Forbes* analyst provided the following assessment: 'India, for all its glory, is still the world's back office. India's tech industry is a "services" industry. The Indians don't do the thinking. The customers do. India executes' (Mitra 2008).

The emphasis on 'productive' capacity is particularly strong in the works of D'Costa (see, for example, 2006; 2009).[25] He argues that the rootedness of India's competitive advantage in low labour costs gave rise to 'extensive growth', the linear expansion of the work force, without a corresponding increase in the deepening of skills. Indian firms tended to focus on the lower value-added stages of the software-development cycle in which learning opportunities were limited (see also Tschang 2005).

However, some recent studies give a slightly different picture. Athreye (2005b) agrees that Indian firms focus on downstream execution tasks, but she highlights the formation of strong *process and organisational capabilities*. These capabilities did not change the division of labour between buyer and supplier, but they were necessary to exploit the opportunity that arose with offshore outsourcing (as distinct from on-site). The National Association of Software and Services Companies (NASSCOM) reached the same conclusion in a major study on innovation. It found that innovation was 'heavily skewed', focused predominantly on competitiveness 'sustaining' efforts of improving inputs (human resources) and business processes, while neglecting 'enhancing' and 'market-facing areas' such as research and development (R&D) services, intellectual

[25] As will be discussed in Chapter 3, a certain phase in the software-development life-cycle is in a sense a manufacturing process.

property (IP) creation and the development of 'Indian standards' for next-generation technologies (NASSCOM 2007b).[26]

With regard to future prospects, most analysts agree that India will continue doing some of the low-end work in the *immediate future*, but there is also increasing agreement that parts of the Indian software industry are likely to acquire stronger innovative capability in the *long haul* (see, for example, 2004: 276). There is very limited agreement, however, with regard to the circumstances in which the transformation of capabilities may occur.

2.3.2 Formation of new (innovative) capability

The existing literature provides very few insights with regard to how *intra-active learning* occurs in Indian software supply firms. The business and management literature is the only place in which the intra-firm dimension receives attention, and then it is only limited. The focus of this literature is on the structures and systems of firms, not least knowledge management systems, that enable them to transform and adapt to fast-changing environments (Garud, Kurnaraswamy and Sambamurthy 2006). Interestingly, some of this literature suggests that a push for innovation may come from employees who seek greater 'variety in the work' and 'empowerment'. Nirjar and Tylecote (2005: 40) forward this argument specifically with reference to small and medium enterprises (SMEs): 'Though SMEs have meagre resources for moving up [the value ladder], compared to large firms, they have a greater incentive to do so, and this organizational interest accords with the interests and motivations of their employees for career development.' Based on case studies of three Indian software SMEs they stress that human resource development and the effective formation of communities of practice within firms provide opportunities for moving up the value ladder.

[26] The most optimistic scholarly assessment to date – and the view which diverges the most from the conventional wisdom – is provided by Parthasarathy and Aoyama (2006). Based on interviews with 12 CEOs of Bangalore software firms, mainly those developing so-called embedded software, they conclude that the industry is moving 'from providing low-skill software services to providing high-skill R&D services'. These authors do not provide direct evidence of this move, but they convey the perception of managers in the segment of embedded-software firms.

Others suggest that this applies not only to small firms. In order to create a fulfilling work environment 'Indian software firms need to take more challenging tasks with better learning environments to build further competence in the sector' (Mehra and Dhawan 2003: 121). However, there are few insights with regard to the types of 'new challenging tasks' that are feasible for software suppliers, nor does the literature point out the mechanisms by which software suppliers may move into such new spaces.

Most of the literature on the Indian software industry seeks guidance implicitly or explicitly from some version of the innovation system (see for instance Balasubramanyam and Balasubramanyam 2000; Chaminade and Vang 2008a; Fromhold-Eisebith 1999; Kumar 2001; Kumar and Joseph 2005; NASSCOM 2006a; Parthasarathy and Aoyama 2006; Vijayabaskar and Krishnaswami 2003). This literature focuses mainly on inter-organisational relationships within the supply base and its supporting environment, thereby emphasising the importance of *inter-active learning*.

Not surprisingly, much of this empirical research has focused on Bangalore, the most visible of the Indian software clusters. The importance of Bangalore's institutional endowment is undisputed.[27] However, there is also widespread agreement that the local innovation system in Bangalore is generally weak (Krishnan 2007; Tschang 2005; Vang and Chaminade 2006; Vijayabaskar and Krishnaswami 2003). NASSCOM expresses this view clearly when stating that there is no innovation system at all and that 'all constituents are weak participants' (NASSCOM 2007b: 127).[28] While most analysts agree that systemic features are weak, there is some debate over the strength and importance of particular linkages, such as those between domestic firms and multina-

[27] The city received large investments in defence and other public sectors in the post-independence period. There is widespread agreement that the technology and training centres established in earlier periods (for different purposes) contributed to the formation of a critical mass of skilled labour. In addition, Bangalore hosts premier institutions such as the Indian Institute of Science, and it was the first Indian city to have a software technology park in 1991. This marked the beginning of the software industry's take-off phase and Bangalore's firm establishment on the world economic map. One of the best sources concerned with Bangalore institutional legacy is Heitzman (2004).

[28] Lema and Hesbjerg (2003) found that 'cluster dynamism' within the Bangalore region was limited during the 'take-off' period in the 1990s. They showed that software firms were able to grow and develop their production capabilities, despite the limited presence of active collaboration between firms. Instead, these firms relied on individual excellence and the more passive benefits of clustering, such as reputational effects and the externalities that arise with the inter-firm mobility of labour. However, they did not discuss the dynamics of firm-based capability building in detail, nor did they examine the relationships between intra-firm and extra-firm learning mechanisms.

tionals (for contrasting views see Athreye 2004; Patibandla and Petersen 2002) and between enterprises and research institutions (for contrasting views see Basant and Chandra 2007; D'Costa 2009).

The conclusions on the deficiencies of the innovation system (against a usually unspecified ideal model) have meant that the prospects of developing innovation capability have appeared dim in the literature. For instance, Vang and Chaminade see the level of cluster dynamism as insufficient for the development of innovation capabilities. They reach a similar conclusion about the role of the innovation system by distinguishing between two phases. They argue that the 'systemic propensity' of the region was not necessary in the first phase, where the main challenge was to attract foreign investment and accumulate basic competences. 'However, it becomes a crucial factor when the firms attempt to move up the value chain with activities that involve a higher degree of innovation' (Vang and Chaminade 2006: 26). Software suppliers in the cluster are therefore unlikely to break out of lock-in unless they can exploit the benefits of local interactive learning in the regional system (Chaminade and Vang 2008b; Vang and Chaminade 2006). As will become clearer later, this thesis agrees with them on the potential relevance of local interactive learning, but it also suggests that they failed to focus on the interactions that mattered most and failed to recognise the actual build-up of innovation capabilities that has occurred.

2.3.3 Opportunities and constraints in the nature of the outsourcing business

The literature that focuses on the global connections has also tended to be pessimistic about learning and innovation in Indian software suppliers. It has tended to emphasise the *core-competence strategies* in driving software outsourcing to India and the strained opportunities for capability formation associated with this type of outsourcing. Arora describes the division of labour in outsourced software services as follows:

> At the risk of oversimplification, software-related activities generally fall into one of three categories: design, coding, or maintenance. Design, which translates approximately into R&D and product development, has the highest value added of the three activities. Coding and maintenance may be thought of as analogous to production in other industries and consequently entail lower-end tasks. … [M]ost of the functions offshored (especially to India) involve production, while design has tended to remain local (Arora 2006: 400).

The literature widely agrees that firms in OECD countries that had adopted core-competence strategies drove the boom in software outsourcing to India during the 1990s. This helped customer firms to cut cost and focus on distinct capability fields (Arora, Arunachalam, Asundi and Fernandes 2001; D'Costa 2003; Kobitzsch, Rombach and Feldmann 2001; Pfannenstein and Tsai 2004). As stated by Arora *et al*.:

> Firms outsource because they do not want to invest in in-house capability in areas outside their core-competence (such as developing applications for old computing platforms) and to free their in-house IT staff from mundane maintenance tasks for more creative projects.
>
> (Arora et al. 2001: 1276)

Pfannenstein and Tsai (2004: 72) found that that lower labour costs were the primary driver of offshore information technology (IT) outsourcing, 'but companies also want to focus on their core businesses and create value for their shareholders'. Lema (2009b) argues that such core competence strategies contributed to the shift from on-site services to the offshore model. The offshore model fulfilled several core competence objectives, such as vertical specialisation (focus on selected value-chain tasks), asset variability and increased organisational flexibility.

However, much of the literature has tended to argue that this type of outsourcing limits the opportunities for capability formation in the Indian supply base. Outsourcing relationships do not provide proximity to tacit knowledge and domain expertise because customers are at a physical and social distance from India (Hoekstra 2006). Because lead firms keep core competences in-house, the formation of innovative capabilities is constrained. In the words of D'Costa (2003: 214), 'Export services that are outsourced to India are likely to remain non-critical adjuncts to central functions'. The core and strategically important innovative activities of OECD-based customers are typically perceived as 'non-globalised' and 'bound' to their home locations; they are thought to depend on localised and intricate linkages between firms and institutions in lead markets (see Wibe and Narula 2002: 243). The suspicion that these views might need to be revised gave rise to the research presented in this thesis. The next section specifies the questions that will be examined.

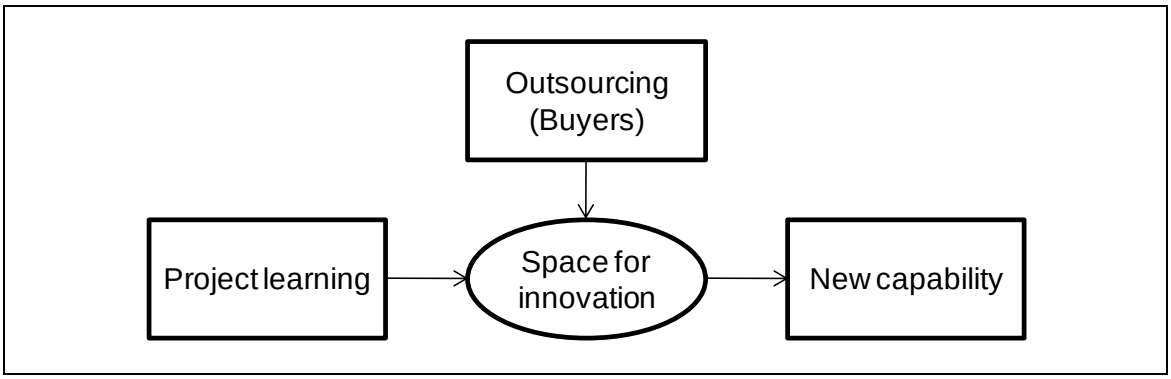
2.4 Overall research framework, question and proposition

This study seeks to examine the implications of outsourcing for the global division of labour, with particular reference to the formation of innovative capability in low-cost supply bases such as Bangalore. It remains unclear whether capabilities extend beyond process and organisational capability and whether advanced innovation capabilities have emerged, enabling India to deepen its traditional position in the global division of labour in the software industry. The existing literature suggests that innovative activity has spread to the Indian supply base to a very limited degree (or not at all). If there is evidence to the contrary the challenge is to show how (and ultimately why) this has occurred.[29]

2.4.1 Framework

The core part of the thesis is guided by Figure 2.1, which seeks to capture the key elements, discussed in this chapter. One empirical chapter is devoted to each of the boxes in the figure. The issue of space binds these chapters together, and it is incorporated into each of them.

Figure 2.1: Outsourcing on capability formation in supplier firms (core focus)



Source: Own figure bringing together the key elements in this chapter.

This figure indicates that the formation of new supplier capability is mediated by opportunity *space* associated with outsourcing. The challenges posed by buyers open up new spaces and suppliers engage in and create projects to address them. It is inside or through such spaces that these suppliers can develop new qualities of capability.

[29] If innovative capabilities *cannot* be observed one can examine the process of how outsourcing does not change the division of innovation labour, thereby digging deeper into the dynamics described in much of the existing literature.

2.4.2 Focus on project learning and peak capability

The literature that deals with learning and accumulation of innovation capabilities in so-called latecomer countries emphasises that shifts in capability types and levels (learning) occurs in a long and cumulative process, working through progressive stages in which new qualities of capability emerge (Ariffin and Bell 1996; Bell 2007). While this process needs be examined through time (Bell 2006), capturing the full process from its beginnings is difficult. In fact, for the purpose of this thesis it is not necessary, since we focus on *new* capabilities that emerge in the course of carrying out particular outsourced projects. The focus is thus on project learning, not on pre-existing learning. A central concern in this thesis is how such learning 'works' – not in a general sense but with regard to the formation of 'peak capability' during the process of breakthrough from production to innovation.

The notion of peak capability has not been defined elsewhere. The study uses this term to refer to the top of the iceberg in supplier firms' evolving capability endowment. This is to say, the capabilities at the top of the iceberg are 'most developed'. However, they are not necessarily 'advanced'. Whether they are advanced or not is a matter of empirical validation. It is clear that new capabilities are constantly developed on all fronts. Some of these can only be characterised as basic, even if these are necessary and important to remain competitive in general. However, these are unlikely to shed light on the key question addressed in this thesis. The study is particularly concerned with whether or not one can identify advanced innovative capability that signifies a changing division of labour. If such capabilities *cannot* be identified in a sample of leading firms in Bangalore, there are grounds to conclude that outsourcing has limited influence on the global division of innovative labour.

2.4.3 Defining innovation and advanced innovation

The study defines innovation in general as the creation of new knowledge and putting it to productive use (Altenburg *et al.* 2008: 237). In the corporate world this equates to the introduction of a new or significantly improved artefact, where the term 'artefact' is understood broadly to include products, services, systems, processes, organisational arrangements and delivery methods. Specific types of innovation will be defined later.

The key point for this study is that innovation is not confined to R&D and patented intellectual property. A good part of the innovation literature has focused too narrowly on knowledge that is 'detached' from the basis of production and from ongoing service provision. This bias features in some of the most influential empirical assessments of the innovative activities undertaken in the Indian software industry (Arora 2006; Arora *et al.* 2008; Dossani 2006). Coincidently many of these studies have a genesis as reports to US policy-makers concerned about the competitive threat from India and China. There is a danger that such assessments fail to capture the most important developments.

Moreover, even though the capability literature does not confine itself to such a narrow focus, it usually defines *advanced* innovation as innovation based on R&D. The term 'advanced innovation' thus comes with certain baggage that is inappropriate for this study. As will be elaborated further, R&D is an inappropriate focal point in the context of services industries, not least software. Rather, advanced innovation refers in this study to problem-framing innovation. Making this operational is in itself a major task of the thesis and addressed in Chapter 3.

2.4.4 Questions and propositions

As shown in this chapter, there is a clear view on the question of whether outsourcing gives rise to advanced innovative capability running through two bodies of literature: (i) the general literature on outsourcing and value chains, and (ii) the literature on the specific case of India/Bangalore. This view posits that peak capability in outsourcing vendors amounts at best to basic innovation capabilities but not to advanced innovation capabilities. In order to explore this, the broad research questions of the thesis are:

1. What types of peak capability have Indian suppliers acquired and demonstrated after the turn of the millennium?
2. How did firms build new capability and what were the main sources of inputs into the learning and innovation process?
3. How did the outsourcing practices of buyer firms influence the process of capability formation?

These research questions are shown in Table 2.1. This table also pulls together the corresponding hypotheses derived from the review of the literature. These hypotheses have been constructed based on a mix of the existing theoretical and empirical literature and the key references are provided in the table. The hypotheses are meant to function as focusing devises for an exploration, not as statements that can be statistically tested. While much of the thesis is exploratory, it is nevertheless essential to make these questions and hypothesis operational for empirical examination. This is what the next chapter intends to do.

Table 2.1: Questions and research hypotheses

Question	Hypothesis derived from literature
1. What types of peak capability have advanced Indian software suppliers acquired and demonstrated after the turn of the millennium?	The acquisition of innovative capability within Bangalore software suppliers does not occur at all (Arora 2006; D'Costa 2009) or is limited to process and organisational capability (Athreye 2005a; 2005b). In general, problem-framing capability does not spread to suppliers in the outsourcing business (because lead firms keep these in-house or close to home (Schmitz 2007b)).
2. How did such firms build new capability? What were the main sources of inputs into the learning and innovation process?	The acquisition of innovate capability in latecomer firms builds largely on internal effort (Bell 2006; 2007), but in many cases, and in Indian software firms in particular, linkages in the local/national innovation system would have to buttress the formation of innovative capability (Chaminade and Vang 2008a; 2008b; D'Costa 2009).
3. How did the outsourcing practices of buyer firms influence the types of capability acquired by these suppliers?	Global client linkages alone do not provide the basis for acquiring high-order capabilities in the software industry (D'Costa 2003; 2006). Outsourced activities are focused on labour-intensive production activities (Arora *et al.* 2008; Dossani 2006). In general, any outsourcing of innovative tasks is closely linked with production tasks, and this limits the scope for building further capability (Chen 2008; Mudambi 2008).

3 Operationalisation

The previous chapter sketched out a framework for examining outsourcing and the formation of capability in supplier firms. This chapter continues with the construction of a conceptual apparatus for empirical analysis. This is done for the issues captured in the headings of the sections that make up this chapter:

- *The software development process – production and innovation*: elaborates the key phases and tasks in the software development process, and provides insights into which of these (are likely to) constitute the key loci of innovation.

- *Types of innovative capability*: builds on the previous section to draw up a vocabulary and apparatus for the classification of different types of innovative capability.

- *Inputs and their sources*: develops a conceptual apparatus to classify sources/linkages and inputs into projects (events) associated with the development of new capability.

- *Outsourcing practices*: constructs a framework that will be used to distinguish different types of outsourcing. This section provides particular reference to the distinct between tight and loose connection between production and innovation activities.

- *Summary of key concept and distinctions*: presents an overview of the key conceptual distinctions used in this study and specifies the main chapters in which they are used.

3.1 The software development process – production and innovation

As stressed by Heeks (2006), the innovation patterns associated with software suppliers are poorly understood. In order to initiate the discussion of how one can classify 'innovative activities' in software, it is useful to discuss the various activities in software development and provide some guide with regard to which of these are likely to constitute the loci of innovation. The section discusses issue of software development

activities in some detail because subsequent classifications pertaining to types of capabilities and types of outsourcing draw heavily on this conceptual basis.

'Software' is a general term used to describe a collection of computer programs, procedures and documentation that perform some tasks on a computer system. Software development is an iterative process, with various phases involving technical as well as non-technical tasks. Feedback loops are unavoidable and several activities can occur simultaneously. Planning and estimation of software development therefore revolve around phases that combine various tasks. Table 3.1 describes the four key phases in a software development project, including typical activities during each phase. One advantage of this 'phase approach' is that it highlights the connection between different activities at different points in time. Table 3.2 shows how multiple activities occur in each phase.

The inception phase is central to the discussion of innovation in the software development process. It is necessary to place the software development process firmly in the context of its use – whether this software is for new product development (NPD) or business process improvements (BPI). This is important because software feeds into larger human or non-human systems:

> A software system is often a component of a much larger system. The software engineering activity is therefore part of a much larger systems design activity in which the requirement of the software is balanced against the requirements of other parts of the system being designed …. Dealing with such system requires the software engineer to participate in the development of requirements for the whole system. It requires that the software engineer attempt to understand the application area before starting to think of what abstract interfaces the software must meet.
>
> (Ghezzi, Jazayeri and Mandrioli 2003: 3)

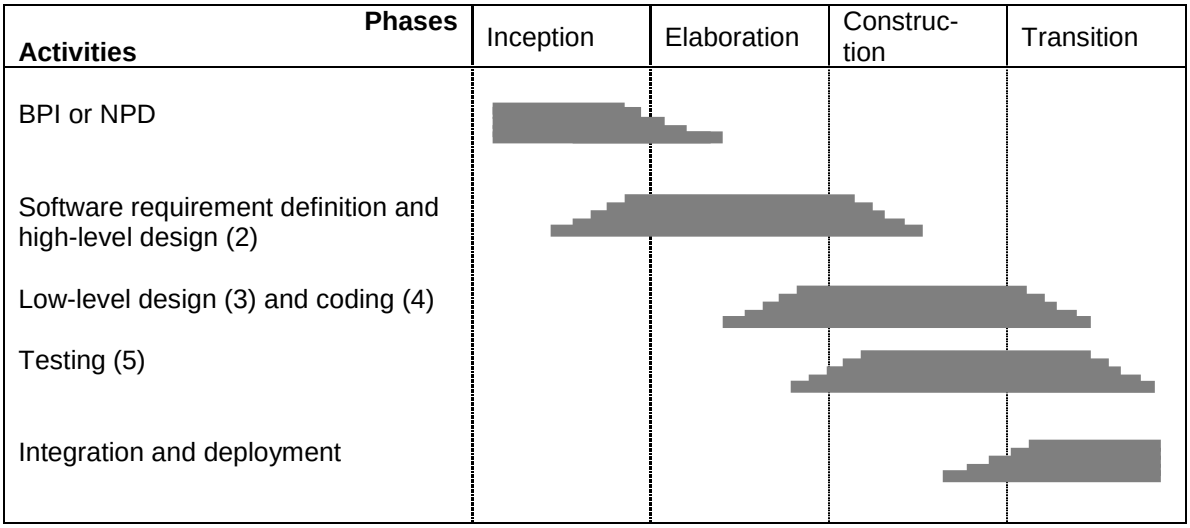
In other words, the software value chain connects with and is dependent on a larger value chain. Product development services feed into hardware systems (e.g. software in a phone), as opposed to business process software, which may underpin human systems and routines (e.g. a customer relationship management (CRM) system). Hence, the inception phase is dependent on radically different types of domain knowledge.

Table 3.1: Phases in the development of business software

Phases	Description
Inception	Inception is significant for new development efforts; business and requirement risks must be addressed before the project can proceed. For projects focused on enhancements to an existing system, the Inception phase is shorter, but is still focused on ensuring that the project is both worth doing and possible. During Inception, the business case for building the software is made. The Vision, a key intermediary artefact produced during Inception, is a high-level description of the system. It tells everyone what the system is, and may tell who will use it, why it will be used, what features must be present, and what constraints exist. Often the Vision contains the critical features the software must provide to the customer. This is often expressed in so-called use-cases that capture functional requirements. Use-cases allow description of sequences of events that, taken together, lead to a system doing something useful. An initial use-case model is typically drawn up with the use of diagrams that adhere to a modelling language such as the unified modelling language (UML).
Elaboration	The goal of the Elaboration phase is to baseline the architecture of the system to provide a stable basis for the bulk of the design and implementation effort in the Construction phase. The Vision is refined. Design activities focus on the notion of software architecture. The architecture evolves out of a consideration of the most significant requirements (those that have a great impact on the architecture of the system) and an assessment of risk. The stability of the architecture is evaluated through one or more architectural prototypes. Key intermediary artefacts during this stage are the software architecture document (SAD) and the iteration plan for the construction phase.
Construction	The goal of Construction is to complete the development of the system. The construction phase is, in some sense, a manufacturing process, where you emphasise managing resources and controlling operations to optimise costs, schedules and quality. In this sense, the management mindset undergoes a transition from the development of intellectual property during inception and elaboration, to the development of deployable products during construction and transition. The Construction phase is where you produce code. It is typically the most substantial step in the process, with the bulk of person-hours used in this stage. It is typically divided into iterations that correspond to one component. Each component is built to satisfy one or more use-case and other functionality for the iteration.
Transition	The focus of Transition is to ensure that software is available for its end-users. The Transition phase includes testing the product in preparation for release and making minor adjustments based on user feedback. At this point in the lifecycle, user feedback needs to focus mainly on fine-tuning the product, configuring, installing and usability issues.

Source: Pollice (2003: 3-11).

Table 3.2: Phase model of the software process model

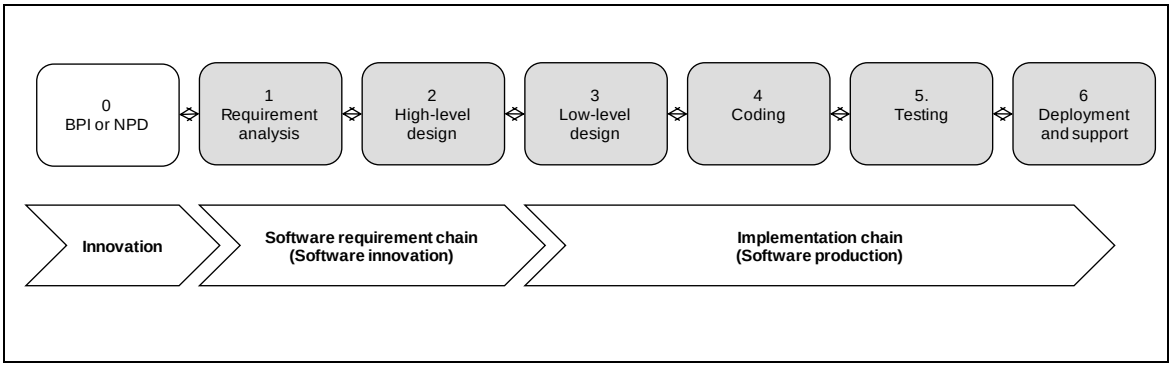


Sources: Adapted from Kruchten (2004), Tsui and Karam (2007) and Pollice (2003).

This domain knowledge influences the phase of software requirement definition and high-level design. This is the so-called software requirement chain. According to Arora, Forman and Yoon (2008) *software innovation* occurs in this 'requirement chain' which connects user needs to software functionality. This stage defines what a new or modified software system should do as well as its architecture. These authors contrast this with the 'implementation chain' in which a software artefact is actually constructed (coded in given programming language), tested and released. They refer to this as *software production*.[30] Figure 3.1 shows the requirement and implementation chains in the standard waterfall model of the software development life-cycle. These are the definitions of innovation and production activities in the software context. However, the next section adds further conceptual depth to the concept of innovation and the next chapter discusses the importance of analysing innovativeness in the context of business lines.

[30] It is sometimes said that the term 'production' is a misnomer in the services context. However, the term production is often used in the software industry itself to denote relatively non-innovative processes. These are mainly implementation activities comprising coding and testing. However, implementation activities are not entirely 'non-creative'. On the contrary it has been suggested that it involves as much technical brilliance and creativity as does requirement definition (Brooks 1995). It is important to acknowledge that creative activities occur in both steps of the value chain, but for the purposes of this study, it is feasible to focus on knowledge creation in the requirement stage.

Figure 3.1: Software activities in the waterfall model – production and innovation



Sources: Adapted from Royce (1970) and Arora, Forman and Yoon (2008).

In this way, one can think of software production and innovation as occurring in two different part of the development life-cycle, involving different types of software activities. However, it is important to keep in mind the *interface* between production and innovation activities in the software development process, which occurs in the elaboration and construction phase. The keyword here is *specification*. The specification is typically a written document (sometime referred to as 'the manual'), based on requirements and the definition of the systems as perceivable by the user.[31] These specifications provide instructions about how the software system development team should proceed with its implementation. However, the specified requirements can vary in nature and quality. They may be detailed or not, and they may include more or less instruction about architecture and technology. Specifications that allow for a breakpoint between innovation and production activities for outsourcing purposes require large upfront investment in detailed design specifications. Firms reduce these investments when they have supplier staff on-site to mediate communication flows. Furthermore, it can be reduced by modular 'object-oriented' or 'component-based' software architecture. This allows the outsourcing of low-level design to the external provider. Software design is a multi-layered process characterised by increasing specificity (or a decreasing scope of available choices about how to proceed). However, there is always some room for interpretation and it can have emergent features in which low-level design appears in the coding process.

[31] Requirements are both functional (what the system should do) and non-functional (system qualities such as scalability). They can, at least in theory, be constructed independently from technological choices such as programming language.

Different people with different roles and competences – analysts, architects, designers, programmers and testers – are responsible for corresponding activities. Grouping different people together gives some scope for dividing the work process into separate bundles with distinct contracts. As described by Lott (1997), one contract can involve requirements definition and high-level design, while a second can be dedicated to low-level design, coding and testing. There may be good reasons to bundle low-level design with implementation activities in a cross-functional team. There are advantages associated with doing this, such as the reduction of risk, the leveraging of external competences and cost savings. Nevertheless, there are no *given* breakpoints in the process. Buyers may define the work packages in different ways. In other words, the relationship between client and contractor is not predetermined (1997).

3.2 Types of innovative capability

The purpose of this section is to devise a conceptual framework that can be used to classify innovation activities (by suppliers) in and around the software development process. An analysis in later chapters uses this framework to classify learning events (projects) in terms of their innovative outcomes.

While there is agreement that there are different types and degrees of innovativeness involved in innovation processes, there is also agreement that innovation is difficult to measure. This section first discusses aspects of existing frameworks before specifying the framework used in this study.

3.2.1 Existing frameworks and methods of measurement

Many studies of innovation have adopted a narrow definition of innovation and it has been measured accordingly, that is, with the use of proxies such as patent statistics or R&D expenditures. But these indicators do not take account of the range of informal innovation activities taking place outside the R&D department and therefore fail to embrace process elements and the organisational setting in which the innovative capability develops and is embedded.

The learning literature is concerned with the analysis of innovative capability specifically in developing countries. This literature tends to view innovativeness not as a separate functional category of capabilities; rather it is a quality or depth of different

functional areas. This literature has developed a framework that embodies two dimensions. A horizontal dimension relates to different functional areas of innovation such as product-centred activities vs. process and production organisation. A vertical dimension relates to different degrees of change (or difficulty) and the type of knowledge creation. It usually distinguishes between three vertical levels:

- *Basic*: minor product adaptation to market needs and incremental improvements in quality; minor process adaptation.
- *Intermediate*: incremental new product design; reverse engineering; processes improvements; licensing new technology.
- *Advanced*: product innovation and related R&D; processes innovation and related R&D.

This framework was initially developed by Lall (1992), later modified by Bell and Pavitt (1995) and recently customised to assess the capabilities of latecomer firms in a variety of sectors, including steel (Figueiredo 2003) and electronics (Ariffin 2000). It has greatly improved our understanding of innovation in developing countries, not least by recognising the high rate of innovative activities and capabilities that cannot be measured by R&D expenditure and patents. However, the framework has a number of limitations, some of which relates to the difficulty in applying it to the software outsourcing industry. These limitations are:

- *Difficulty in distinguishing between the levels in actual empirical classification of observed phenomena*. It is difficult if not impossible to distinguish rigorously between a 'minor process adaptation' (basic) and a 'process improvement' (intermediate).
- *Confusion (or inconsistency) between input and output indicators*. While basic and intermediate are 'measured' based on innovation outcomes, the advanced level is identified by one type of its input (R&D). Therefore it is not clear, for instance, how one should define an 'incremental' (as opposed to radical) new product design if it draws on knowledge creation that can be characterised as R&D. As will be discussed, the identification of R&D is particularly tricky in software.

- *Inability to compare 'levels' across industries*. There may be relatively high differences in complexity and magnitude of change in similarly labelled types of change across industries. Incremental product design is different in the aircraft industry and the garment industry. Comparing across manufacturing and services industries is particularly difficult.
- *Problems of assessing the 'level' in firms engaging in multiple activities*. Firms and industries – particularly those that develop common-purpose components – may engage in different business lines and therefore researchers need to define multiple operational definitions, which can induce fatal levels of complexity.[32]
- *Inability to address issues of production fragmentation in vertically disintegrated industries*. The framework takes as a point of departure the production of 'rounded goods'. This limits the ability to assess the issue of labour division and innovativeness in which product definition and manufacturing is organisationally de-linked.

The study initially set out to use this framework, but because of these limitations, the fully fledged adoption of this approach is not feasible for the software-outsourcing industry. Some – but not all – of these limitation can be avoided or reduced.

Other classification schemes have focused mainly on functional categories or types. Four types of innovation are used in the Oslo Manual (OECD 2005):

- Innovation in products
- Innovation in process
- Innovation in organisational arrangement
- Innovation in marketing.

This study adopts a similarly broad view of innovation and it adopts some elements of this line of thinking. However, in order to reduce complexity, innovation in organisation

[32] This study examines six business lines and therefore it would need six different operational definitions specifying for each of the three levels.

and marketing are best viewed as subtypes of process innovation.[33] The resulting distinction between product and process innovations is commonplace. In the Oslo Manual (OECD 2005), the term 'product' covers both goods and services. For instance, 'product innovation' can be identified by the introduction of a new service or significant improvement to functional characteristics of an existing service (OECD 2005: 48). Process innovations include not only the implementation of a new or improved production or delivery method but also a new or improved organisational method in firms' business practice, workplace organisation or external relations. If one uses a broad general definition of innovation that is consistent with the general Oslo Manual view, the minimum requirement for an innovation is that a product or process is new (or significantly improved) to the firm.

However, this distinction between product and process is still less than straightforward, particular in some services settings in which 'the process is the product'. In industries such as software, a change in a customer-facing process is also a change in the service product. It is therefore crucial to distinguish between changes that are customer facing and those that are not. This is a key dimension to include in the discussion of product versus process innovation.

The global value chain literature has also taken its point of departure in the product/process distinction. However, it adds a third type: functional innovation. This refers to a change in the mix of activities undertaken within the firm. This is particularly relevant for the analysis of the division of labour in fragmented industries. However, because value-chain activities differ across industries it is difficult to create 'external validity' by allowing for aligned inter-industry comparisons of functional activities undertaken by buyers and suppliers respectively.

The literature on global chains has complicated the conceptual discussion because it uses the term 'upgrading' rather than 'innovation'. However, these concepts are clearly

[33] Organisational capability is a sub-category of process capability, but discussing organisational innovation explicit may be particularly justified when looking at developing countries, since organisational change is 'extremely significant in the innovation process' in such countries (Polcuch, Lugones and Peirano 2005).

interrelated. According to Kaplinsky and Morris 'upgrading' is a relational concept since it refers to innovations that give a competitive edge vis-à-vis current or potential rivals:

> If the rate of innovation is lower than that of competitors, this may result in declining value added and market shares; in the extreme case it may also involve immiserising growth. Thus innovation has to be placed in a relative context – how fast compared to competitors – and this is a process, which can be referred to as one of *upgrading*.
>
> (Kaplinsky and Morris 2001: 37).

Thus, the process referred to is one of describing innovation-based 'Schumpeterian competition' that may or may not be effective in securing innovation-rents, depending on whether it is fast and profound enough. Upgrading becomes successful Schumpeterian competition.[34] To lessen the confusion, this paper will follow the approach adopted by UNIDO (2002: 105-115) in their discussion of 'innovation and learning in global value chains' by referring primarily to innovation rather than upgrading.[35] The term upgrading is reserved to describe trajectories or paths.

3.2.2 A framework for classifying innovative activity in the software industry

Some authors claim that the software industry is distinctly innovative: 'Software production is almost by definition an innovation activity because it aims to produce new products or new ways of executing known tasks and functions' (Rousseva 2008). In one place the Oslo Manual seems to go even further when stating that 'Developing new or substantially improved software, either as a commercial product or for use as an in-house process (an innovation in its own right), involves research and experimental development and a range of post-R&D activities' (OECD 2005: 97). However, these perspectives seem to neglect the range of routine activities that tend to take up the substantial part of any large software projects. Defining the software as innovative *per se* is not helpful if one aims to understand the global division of labour in the industry. It is important to recognise that even if a software development project is innovative (by

[34] Similarly Giuliani *et al*. (2005) defines upgrading as innovating to increase value added.

[35] It may be argued that the overlaps and similarities between these two concepts by far exceed any differences; they are two sides of the same coin and the analytical value added by distinguishing between the two is limited.

whatever definition) there are different activities with different degrees or types of innovativeness involved in the software innovation process.

Consistent with the global value chain approach it is the examination of different types of 'activity' that is central to this study. While the study is concerned with 'capability' (of various types), it uses a proxy for capability. It seeks to classify types of innovative activity and it then makes the assumption that if firms undertake particular types of activity they must have the underlying capability for doing so. Hence, this study will operationalise concepts of innovative capability in terms of a 'revealed' capability measure, rather than actually try to assess and classify capabilities as such. It shares this focus on revealed capability measure with most previous work that uses a capability approach.

In order to classify activities the study (i) draws on the waterfall model of the software development lifecycle – as explained above in Section 3.1, and (ii) applies the concepts of problem framing and solving to the software development processes. It uses a fourfold distinction to classify innovation tasks:

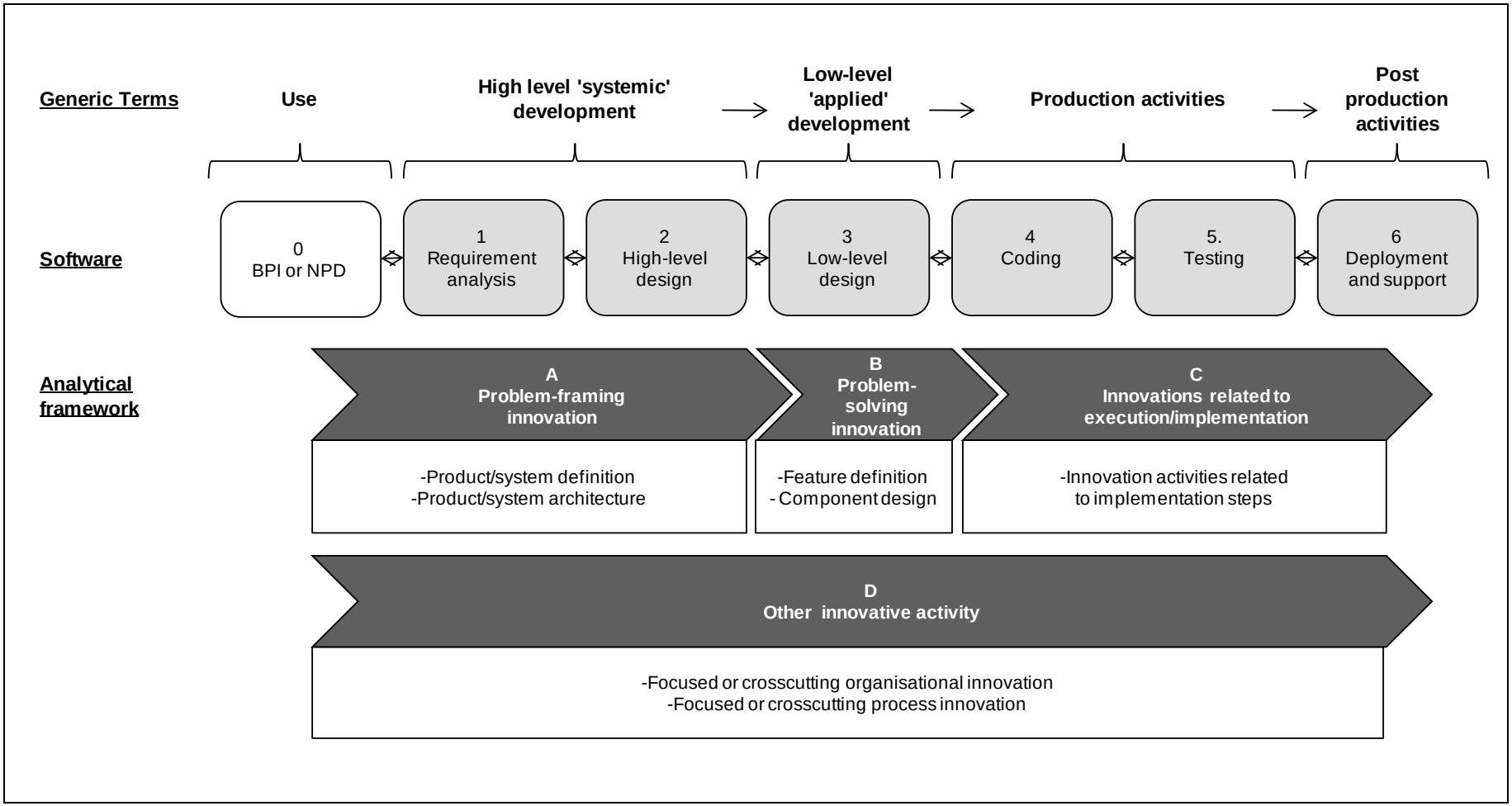
A. *Problem framing*: activity directed towards the definition of new systems/products, including their high-level architecture (requirement analysis and high-level design).
B. *Problem solving*: activity directed towards system components including those concerned with separable features or functionality. This category therefore includes the improvement of existing systems by providing new add-on functionality (low-level design).
C. *Improving execution*: activity directed towards the development or enhancement of processes pertaining to software programming. It improves the execution/implementation steps in the software development processes (coding and testing).
D. *Other innovative activity*: activity directed towards any other aspect of general business, including delivery, marketing or change/expansion of the business portfolio (cross-cutting or superseding innovative efforts).

These four types relate to different stages in the waterfall model. Problem framing bridges non-software innovation activities (relaleated to the immediate use, BPI or NPD) and software innovation activities (related to the defintion of the software system, requirements and high-level design). Problem solving is more limited in scope and bridges core innovation and software production, even though it has an independent element of knowledge addition within the confines of an overall architecture. As disucsssed, both of these steps in the chain are inherently concerned with the creation or modification of knowledge. Therefore they can easily be classified as innovative activities. Execution in itself is not an innovative activity. However, firms may undertake innovative activities to improve execution. In addition, firms may undertake innovative activity not directly related to the development of software (in a broad sense, the 'development processes'), but to other commercial and organisational aspects of business. The four types are shown in Figure 3.2.

The framework builds on the working hypothesis that the types of innovation are characterised by decreasing difficulty – that is, Type A is more difficult than Type B and so on. However, Type D is partly a residual category and its difficulty can only be examined empirically. It is also assumed that the difficulty is correlated with the degree to which the underlying capabilities are 'dynamic' (in the sense discussed in section 2.1.4). This correlation is not clear-cut, however, because in principle, highly sophisticated process innovations, e.g. in programming or testing (category C) could be more complex and knowledge-intensive than certain problem framing capacities. Innovation Type C would then be more difficult to emulate and provide the firm (or the supply platform) advantages in terms of competiveness and rents. However, the structuring/ranking of the innovation types used here was verified by interviews, although an exception also appeared since some process innovations of Type D were perceived as particularly demanding and associated with potential step-changes in competiveness.[36] The indicators of these types of activities are shown in Table 3.3.

[36] With the exception of a few cases it was not possible to trace directly the influence of particular events on revenues, productivity or market share. There are two reasons for this. First, this type of information tended to be viewed as sensitive and interviewees were unwilling to divulge these details. Secondly, it was difficult to isolate the effect of particular innovations from other changes.

Figure 3.2: Types of innovation



Source: Own figure.

Table 3.3: Indicators of innovation types

Shorthand category	Descriptive category	Typical association with activities in waterfall model	Indicators (outcomes)
Type A	Problem-framing innovative activity	High-level design and requirements	New system/product development Product or system co-development Systems and business consulting activity New method of requirement definition New organisational unit devoted to consulting, high-level design or requirements
Type B	Problem-solving innovative activity	Low-level design	New module or system components New licensable intellectual property component Re-writing existing software and adding new features or properties
Type C	Innovative activity related to implementation/execution	Coding and testing (programming)	Development of new software tools Development of re-usable software components New test methodology
Type D	Other innovative activity		New general project management methodology New organisational structures New business line added to business portfolio

Source: This chapter.

This conceptual approach provides a tighter grip for the classification of innovative activity in the software outsourcing industry, than do the frameworks mentioned above. Because it relates to relatively concrete steps in the software value chain it reduces the problems that arise when observed phenomena can be classified as both 'product' and 'process' and where it is difficult to judge whether a change is 'minor' or 'incremental'. Because it relates to features of systems (problem framing/solving) that have wider applicability, it is easier to make at least some kind of meaningful inter-industry comparison.

Yet there are operational limitations. Importantly, it may be difficult to identify 'the system'. This is particularly so in the case of embedded software. For instance, if software is used in a washing machine, is problem framing related to the washing machine (as a system) or to the software system within it? This and other problems related to the operational application of the framework are discussed in the next chapter.

To some extent, the indicators shown in the table are ex post constructs. This is because the classification scheme is partly an inductive construct – a way of structuring observed phenomena in view of the waterfall framework and the broader generic categories. This is discussed further in the next chapter.

3.3 Inputs and their sources

The previous section has sought to operationalise the discussion about innovation outcomes in software outsourcing. This section puts forward analytical tools for the analysis of the process through which such outcomes are achieved. As mentioned, the focal device is particular projects that relate to different learning 'events'. This section develops a framework to classify sources and linkages in the process. The conceptual apparatus developed here builds on existing frameworks but combines and adapts them in new ways.

3.3.1 Types of input

Like most other literature, this study examines 'knowledge' as a key resource in the innovation process. However, unlike many other studies, this study is not confined to this type of input. Rather, it uses a simple 'model' with three elements: ideas, investment and knowledge. These correspond roughly to three overlapping phases.

As will be discussed further in the next chapter, this draws in part on conceptualisation of phases in the software development process. Segelod and Jordan (2004) defined four phases: (i) ideas phase, (ii) decision phase, (iii) development phase, and (iv) commercialisation phase. This study does not examine commercialisation. However, the first three steps define phases that are associated with ideas, resource decisions (investments) and knowledge inputs respectively.

While this phase model was developed with the aim of analysing software development projects, the first three steps can be applied to any project, even if these are not concerned with software development as such. This requires, however, that the notion of 'development' should be interpreted broadly as carrying out a project.

- *Ideas*: Most innovation processes/projects are initiated with some type of reference to an end-goal, even if this goal may be clearer in hindsight. This focus on how and why a learning or innovation event was initiated is not common in the literature on learning in latecomer firms. However, the focus on ideas is common in management literature (Chesbrough 2007; Hansen and Birkinshaw 2007) and literature on software firms (Jordan and Segelod 2006; Segelod and Jordan 2004). The focus on ideas is important for examining the link between (identified) opportunity spaces and the initiation of projects, not least because some authors argue that lead firms increasingly seek to externalise some of their ideas to suppliers and partners (Chesbrough 2003a).

- *Investments*: The decision to take forward an idea is likely to be accompanied/followed by investments in preparatory activities. Firms may invest in hiring people, with particular skills or experience or in the development of such skills by existing employees. They may set up internal R&D projects or communities of practice or they may acquire entire firms or business units. Such investments are made to bridge the 'gap' between existing competences/resources and an end-goal. The capability literature has convincingly showed that learning requires investment (Bell 1984).

- *Knowledge*: The software industry is knowledge intensive with a few relatively modest needs for capital equipment. Investment decisions are therefore typically related to the some form of knowledge acquisition, where new knowledge (at least to the firm) is required to meet a goal. However, not all knowledge requires investment. Codified knowledge may be widely accessible whereas tacit knowledge requires at least some type of mechanism of development and sharing. Knowledge may become embodied in people, in technology and in organisational arrangements.

Table 3.4: Examples/indicators of ideas, investments and knowledge

Idea	• Idea for new product • Idea for new process • Idea for new project
Investments	• Investment in training internal staff • Investment in people (from outside) • Investment in ad hoc workshops • Investment in relationships • Investment by acquiring external firms or business units
Knowledge	• Knowledge embodied in routines and practices • Knowledge embodied in people • Knowledge embodied in manuals, documentation material or publicly available sources (e.g. online) • Knowledge embodied in software or capital equipment (including intangible equipment such as proprietary methodologies)

Source: This chapter.

3.3.2 Sources

It is commonplace to distinguish between internal and external sources (Lauridsen 2006; OECD 2005). However, for the purposes of this study it is useful to consider also the types of internal and external sources with respect to one central aspect, namely, their relation (or unrelatedness) to customers/clients. The framework therefore considers both dimensions, as shown in Table 3.5. This table provides examples of literature that has tended to emphasise the importance of the respective quadrants for knowledge acquisition or other inputs.

Table 3.5: Different sources of inputs: a matrix

	Client	Non-client (other)
Internal	Internal client-facing sources/units (Strambach 2008)	Other internal sources/units (Bell 1984)
External	External client-related sources (von Hippel 1988)	Other external sources (OECD 2005)

Note: The table provides references to texts that tend to emphasise sources in each quadrant. These examples are indicative, not exhaustive. Sources provided in the table.

A. *Internal client-facing sources/units*. The KIBS literature tends to emphasise learning in client-facing projects teams. Learning is cumulative, linking learning in one project with the application of capabilities in later projects (leveraging). Other literature has emphasised the role of the sales departments, such as their participation in trade fairs.

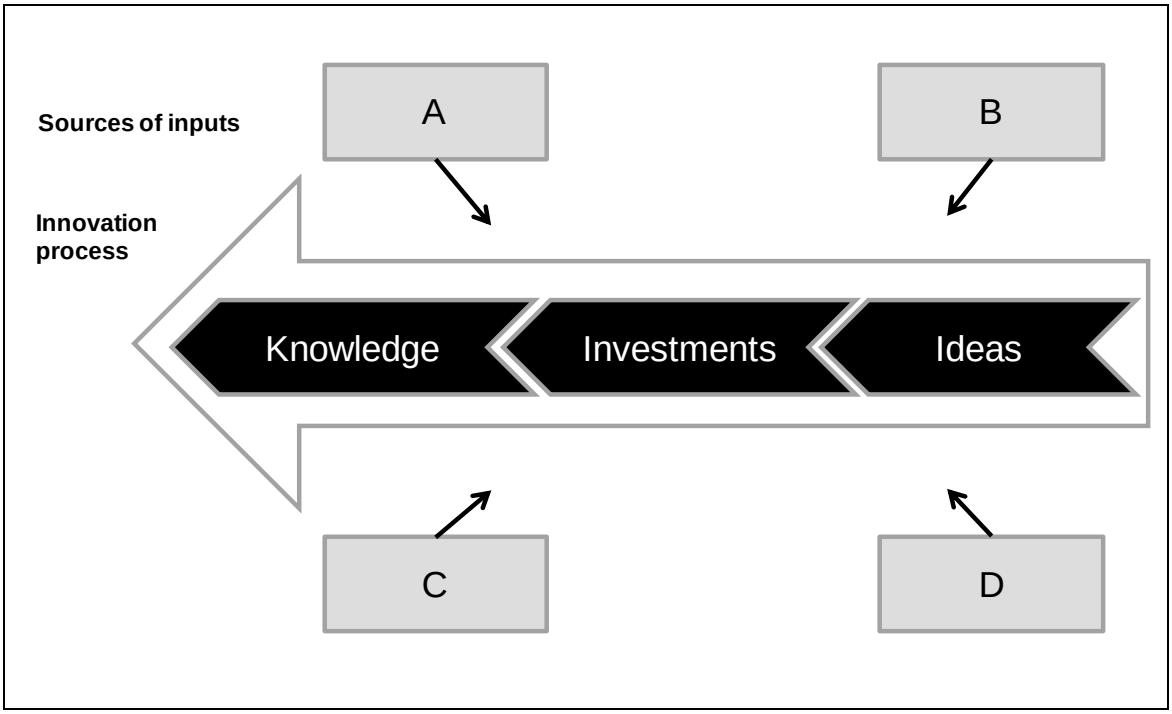
B. *Other internal sources/units*. R&D efforts in permanent dedicated departments are typical sources of knowledge in many industries. However, internal sources within the enterprise may also be of more of a non-R&D, temporary nature, for example, a workshop established to solve an immediate technological problem or capability gap. The capability literature has emphasised the role of engineering and quality departments and the role of activities such as training and 'change' activities. Newer literature has emphases the role of knowledge communities and knowledge management programmes aimed at sharing and utilising knowledge within the enterprise. Strategic unit or initiatives – senior management and innovation schemes – may also play a role.

C. *External client-related sources*. Because this thesis deals with an 'outsourcing industry', the role of the buyer (forward linkages) is presumed important (Segelod and Jordan 2004). This category also includes end-users and third-party collaborators that interact with buyers as well as suppliers. Firms may benefit 'passively' from the interaction with buyers as they acquire knowledge and experience in different buyer domains. Presumable this is important in the software industry as information requirements are typically high. On the other hand, firms can benefit 'actively' when buyers invest in supplier capability through different types of progressive support.

D. *Other external sources*. There is a multitude of ways in which firms may use external sources. They may be categorised as backward-link sources (such as providers of embodied technology, including software tool providers or providers of KIBS) or horizontal linkages (competitors or alliance partners) or R&D linkages may be formed with research institutes or universities. Finally, a range of other possible sources includes general open information sources such as knowledge from manuals, textbooks or web resources.

Building on this, Figure 3.3 seeks to summarise the analytical framework for the analysis of inputs into the innovation process. It contains two main elements. The first element is the innovation process and its phases; the second is the sources of inputs. The figure draws on the notion of three phases in the innovation process that require different types of inputs, i.e. (i) *ideas* in the idea phase, (ii) *investments* (or rather commitments to make investments) in the decision-making phase and (iii) *knowledge* in the development phase.

Figure 3.3: Framework for analysis of learning/innovation process



Source: This chapter. Note that there is not a perfect correspondence between neat temporal phases and types of inputs due to feedback loops.

In theory, these are distinct temporal phases, in that the creation of new knowledge (and channelling this knowledge into use) is dependent on some type of purposeful invest-

ments, which in turn requires an idea or vision. However in reality these phases are overlapping and there are feedback mechanisms involved. While acknowledging this, the framework makes it possible to examine the role of different types of sources – internal client facing sources (other internal sources, external client-related sources, and other external sources) in relation to the three different dimensions (i.e. ideas, investments and knowledge) in the innovation process. Table 3.6 summarises different types of sources in each category.

Table 3.6: Sources of inputs into events

A. Internal client-facing sources	• Prior or other projects • Project team • Sales • Other
B. Other internal sources	• Non-R&D knowledge creation and knowledge management unit • R&D unit and activities • Strategic units and initiatives • Other
C. External client-related sources	• Customers • End-users • Third party collaborators • Other
D. Other external sources	• Backward-link sources • Horizontal-link sources • R&D institutions • Other

Source: This chapter. Note that the exploratory nature of the study makes feasible the open-ended nature of the framework, including the inclusion of the 'other' category under each type.

Furthermore, it is necessary to subdivide external linkages further by geography in order to explore the potential dynamics of learning in global supply platforms. This study makes a simple distinction between *local linkages* and *global linkages*.

3.4 Outsourcing practices

This section puts forward the key concepts for distinguishing outsourcing practices in the software industry. Software shares a number of characteristics with other services, but it belongs to a subset of services in which 'unbundling' is a key feature (Miles 2004). For this reason the industry is particularly amenable to fragmentation and global dispersion (Arora *et al.* 2001). On a global scale it is organised like global-level networked manufacturing with high labour requirements (Dicken 2003; Lall, Albaladejo and Zhang 2004: n. 10).

3.4.1 Existing frameworks

The literature on global value chains has provided several different frameworks useful to the study of outsourcing from high- to low-wage economies, most recently the value-chain governance framework developed by Gereffi *et al.* (2005). While this framework relates to some of the central issues in this thesis, there are several reasons for *not* using it as the primary focusing device:

- *Supplier capability as dependent and independent variable*. In the value-chain framework of Gereffi *et al.* (2005), supplier capability is internal to the model – a variable that determines value-chain governance. However, this thesis is centrally concerned with *explaining* supplier capability and its upgrading.
- *Weak distinction (and intrinsic relationship) between complexity and codifiability*. Two other core independent variables in the framework – the complexity of activities and the ability to codify – are likely to be causally related. Furthermore, there is – to the best knowledge of this author – no workable method to measure complexity.
- *Predetermined levels of supplier capability*. The framework as such does not seem appropriate to the study of innovation capability because (pre-existing) supplier capabilities are described as 'low' in most types. Only two types – modular and relational – occur in the context of high supplier capability relative to the nature of the supplied function or product.
- *Weak distinction between 'governance' and interface*. While the framework is seemingly about 'governance' the primary analytical object relates centrally to the nature of the firm-to-firm *interface*. In essence, this interface may be thin (as in modular chains) or thick as in relational chains. However, there is little discussion about what relational chains look like in the *global* context.[37]

Other work has sought to focus on *motives* for outsourcing, particularly non-cost advantages such as risk reduction, accesses to resources and process improvement. However, this study focuses neither on motives (although these are examined) nor on

[37] The examples given relate to embedded networks in Japan and personal overseas kinship and ethnic network. These are difficult to use in the study of global inter-*firm* networks.

relationships as such, but on outsourcing *practices*, particularly on practices regarding the outsourcing of different types of *activities*.

To this end, the recent framework by Schmitz and Strambach (2009) provides a starting point. Their typology has two dimensions. The first one is outsourcing or offshoring within and between organisations – between intra- and inter-organisational connections. The second refers to the extent to which innovation is integrated with production of goods and services. As mentioned in Chapter 2, innovation can be delegated to those who are primarily concerned with knowledge creation and have only a loose connection with the production of goods and services, or it can be delegated to those who are tightly connected to the production of goods and services and have the latter as their primary function (see Table 3.7).

Table 3.7: The ODIP framework

Intra- and interorganisational **Connection between innovation and production**	**Internal**	**External**
Loosely connected	*Type 1* Decentralising the R&D Department; setting up internal knowledge communities	*Type 3* Commissioning research from universities or other organisations
Tightly connected	*Type 2* Delegating the development of new products to subsidiaries; setting up internal centres of excellence	*Type 4* Engaging suppliers of products and services in developing new products or processes

Source: Schmitz and Strambach (2009).

However, this framework can only be used in a modified version due to the following reasons:

- This study is not centrally concerned with firm-internal decomposition and thus renders obsolete ODIP Type 1 and 2.
- The central dimension of loose/tight connection between innovation and production is not made operational for application. In this regard, it seems that the more 'absolute' terminology of *standalone* and *integrated* activities is easier to apply.

- The loosely connected type (standalone) seems to be centrally concerned with R&D, but the framework provides no definition of R&D.

With regard to the last point it is clear that software firms, like other KIBS firms typically 'display wider – or fuzzier – versions of R&D' (Miles, Kastrinos, Bilderbeek and den Hertog 1995: 65). Innovation in services industries typically relies heavily on sources that is not directly associated with R&D (Miles 2007; 2008).[38] It is therefore important to emphasise that the key is the connection (tight or loose) between production and innovation – not between production and R&D.[39] For the purposes of classification, R&D is defined in this study as purposeful and sustained knowledge creation for six months or longer (buyer as well as supplier firms).

3.4.2 A framework

The conceptual apparatus for analysing outsourcing practices draws on the software development lifecycle. However, because the assessment of supplier capability also draws on this, it is important to avoid tautology of the type: 'if the buyer firm outsources activity X, the supplier undertakes activity X and therefore has its underlying capability'. This line of reasoning is commonplace but it limits the depth of analysis, and it is potentially misleading because suppliers may have capabilities at levels that are higher than are needed for any given outsourced activity. This type of tautology is avoided by focusing on the 'highest level' of outsourced activities (in the value chain) and its connectedness with lower levels. In this sense, it is concerned with the nature and length of the outsourced value-chain thread. The proposed framework distinguishes between three types of outsourcing practices. The operational forms are shown in Table 3.8, but some further commentary is needed:

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[38] R&D may take an informal character in many KIBS firms: 'We found informal R&D taking place in "grey" hours [not registered in company accounts] in KIBS involving high elements of consultancy, where the (financial) room for non-client-led and/or non-project-bound R&D seems to be limited' (1995: 66).

[39] R&D is an innovative activity, but innovation does not necessarily involve R&D. R&D is creative work undertaken on a systematic basis in order to increase the stock of knowledge and the use of this stock of knowledge to devise new applications. R&D is a set of activities that may or may not be carried out during different phases of the innovation process. Software development is classified as R&D when its completion is dependent on a technological advance, and the aim of the project must be the systematic resolution of a technological uncertainty. Examples include the development of operating systems, programming languages and new software development tools (OECD 2002).

Table 3.8: Standalone and integrated innovation outsourcing

Category	Includes	Excludes
Outsourcing *production* activities (ODPP)	*Production activities:* • Coding and/or • Code testing and/or • Maintenance	*Innovation activities:* • Low-level design, • High-level design • Requirements
Outsourcing *standalone* innovation activities (ODIP Type 3)	*Innovation activities:* • Low-level design and/or • High- level design and/or • Requirements	*Production activities:* • Coding • Code testing • Maintenance
Outsourcing *integrated* innovation activities (ODIP Type 4)	*Production activities:* • Coding and/or • Code testing and/or • Maintenance plus: *Innovation activities:* • Low-level design and/or • High-level design and/or • Requirements	

Source: Own adaptation, drawing on Figure 3.1 and Table 3.7. Note that ODPP refers to the 'organisational decomposition of production activities'.

- *Production activities*. These are the knowledge-using activities involved in routine service provision or other operational tasks. When such activities alone are outsourced we may refereed to this as the organisational decomposition of production activities (ODPP). The key is that a contract of 'pure' production activities does not extend to the outsourcing of higher end activities.

- *Standalone innovation activities*. This category corresponds to what Schmitz and Strambach (2009) call 'loose connection' between innovation and production activities. It refers to the provision of knowledge-creating services or new product development functions. These are activities concerned with the generation of 'new knowledge', in generally applicable forms or in more specific forms for new applications. Standalone innovative activity may take the form of outsourced R&D.[40] However, 'research' occurs not only in R&D labs. For instance, it may be undertaken by consultants who address a focused assignment. The important point is that these activities are (organisationally) 'de-linked' from production activities.

[40] Cross-licensing of IP and 'off-the-shelf' technology is a reflection of standalone innovative activity.

- *Integrated innovation activities*. This category corresponds to the 'tight connection' between production and innovation activities (Schmitz and Strambach 2009).[41] These innovation activities are bundled with production processes. This category is important because innovation may be 'hidden' in the provision of standard services. This can occur, for instance, when buyers engage suppliers of products and services in the development of new products or processes. This category also bears resemblance to what Bell (2007) calls 'design and engineering activities'. These involve the often-overlooked capabilities used to transform knowledge from generally applicable forms into increasingly specific and concretised forms. In other words, they are typically development intensive. Hence they may be seen as the bridging element between 'pure' knowledge creation (e.g. research), and knowledge use (e.g. manufacturing production).[42] The important point is that this category combines production with some knowledge-creating elements. [43]

3.5 Summary of key concepts and distinctions

This chapter has sought to build conceptual frameworks for the analysis of the key questions introduced in Chapter 2. Table 3.9 provides a summary of the key concepts and distinctions that will be used in the various parts of the analysis. Other concepts and distinctions will be introduced as and when they become relevant to the empirical analysis.

[41] This study uses the standalone/integrated terminology interchangeably with the loose/tight connection terminology adopted by Schmitz and Strambach (2008). Empirical chapters use both sets of terms.

[42] Design and engineering activities are a set of innovative activities which are not typically considered R&D. Yet, these activities can have an important influence on innovation outcomes, not least in developing countries (Bell 2007: Chapter 3).

[43] The inclusion of this category is supported indirectly by recent research, which showed that most multinational corporations (MNCs) tend to locate R&D near production sites rather than near technological clusters (Mariani 2002). Also, In the manufacturing context – particularly in the auto and computer sectors – it has been observed that design functions are increasingly pushed onto or acquired by component suppliers (Humphrey 2003; Kishimoto 2004).

Table 3.9: Summary of the analytical framework: key concepts and distinctions

Factor/Chapter	Key Concepts/Distinctions
New supplier capabilities Chapter 6	• Problem-framing innovative activity • Problem-solving innovative activity • Innovative activity related to implementation/execution • Other innovative activity
Learning – inputs and sources Chapter 7	• Internal client-facing sources • Other internal sources • External client-related sources • Other external sources
Outsourcing Chapter 8	• Outsourcing production activities • Outsourcing standalone innovation activities • Outsourcing integrated innovation activities

4 Methodology

This thesis seeks to specify whether the influence of outsourcing goes beyond the global redistribution of production activities to enhance also innovative activities and capabilities in supplier firms in low-cost countries. However, it is not focused on the degree to which this happens, but rather than on the mechanisms involved in the process. It is generally agreed that *processes* are difficult to unravel through quantitative work and this research relies mainly on qualitative work.

The research presented here has sought to understand the process leading up to 'innovation events' and to assess outcomes. It is important to understand how the study arrived at this sample of 36 events, how it analysed the observed phenomena, and the type of explanation that arose out of this method. The chapter consists of sections with the following headings:

- *The overall population and the selection of firms*: provides background by describing context and elements of the population and the business lines from which the sample was drawn. It then explains how the sample of firms was constructed.

- *Sampling of events – the supply and demand side*: explains how learning/innovation events were sampled *within* the firms. It also explains how a subsample of 12 events in which the buyer side was researched in more detail was chosen.

- *Classification of observations*: follows on from the previous chapters (sections 3.2. 3.2 and 3.3) by explaining some of the problems that arose when classifying observed phenomena in practice.

- *Explanation and built-in limitations*: explains the basis on which the thesis draws conclusions. It discusses the issue of validity and its limitations.

- *Summary and specific research questions*: relates the 'causal model' discussed in this thesis to the mode of explanation and sums up the basis of the core empirical chapters in the thesis.

4.1 The overall population and the selection of firms

The study works with units of analysis at three levels:

- *Business lines* or *industry* subsectors.
- *Firms* operating within these business lines.
- *Events* of learning and innovation within the firms.

The thesis seeks to provide explanations primarily at the first and third of these levels. However, the firm level is key to the sampling procedure. This section presents the sample of firms and relates this samples to the overall population from which it was drawn. In order to do so it is necessary to introduce some subsector distinction and explain how these sectors have developed, particularly with regard to the transition towards innovation.

4.1.1 Defining business segments

As discussed in the previous chapter, quantitative indicators of innovative capability in software firms are not easily constructed (Rousseva 2008). A key assumption that has guided much of the literature on the Indian software industry is that there is an important distinction between 'non-innovative software services' and 'innovative software products'.

The emphasis given to the distinction between services and products originates from pioneering studies of the Indian software industry (Heeks 1996; Subramanian 1992). These studies came out at time when there was a big difference between body-shopping services and the development of so-called packaged software products. This led to the characterisation of the Indian software industry as 'dual sector'.

The approach taken in this study is that the distinction between 'services' and 'products' is unsustainable as an analytical basis for the study of innovation capabilities in the industry. In order to deconstruct the old distinction two steps are necessary. The first

step is to recognise that software is in fact a *services* industry in the conventional use of the term. The distinction between services and products is vanishing within the global software industry. Today products are rarely 'packaged'. Rather they are provided on a 'software as a service' (SaaS) basis (salesforce.com is one of the best examples). On-demand software has been increasing along with corporate IT infrastructures that adopt service-oriented architectures. [44]

The second step is to find an appropriate way of categorising software services. This is not easy because the rapidly growing Indian software industry has become highly differentiated and the activities undertaken by firms are correspondingly diverse.

Since 2006 NASSCOM has used two main categories: 'IT services' and 'engineering and R&D services, and software product exports' (NASSCOM 2006b). NASSCOM's categories are a step in the right direction from the previous crude distinction between services and products, but they are insufficient for analysis in this thesis because they derive from a narrow focus on suppliers. An important issue that then arises is how to construct categories for empirical investigation. This study proposes a new vocabulary that considers the user perspective. It links the activities of suppliers to software demand as discussed and categorised in the previous chapter. The study of forward linkages (i.e. the demand side) informed the definition of business segments. The definition of segments builds on the observation that two main types of activity drive software demand: (i) business processes improvement activities, and (ii) new product development activities.

The approach taken in this study was therefore to define two main software segments.

[44] The discussion in subsequent chapters will show that the distinction between products and services is blurred. This is because many activities combine elements of standardised re-usable artefacts (including own or client 'products') with customised services. For instance, providers of licensable products generate substantial revenues from customisation services. Conversely, certain firms in the custom application development (CAD) business line deploy proprietary frameworks (service products) in the service provision process.

- *Business process software services* (BPSS) concentrate on software for business processes, typically provided to IT departments in customer firms or organisations.

- *Product development software services* (PDSS) concentrate on software that relates to the product development process in customer organisations, typically provided to R&D or engineering departments.

Business segments are meso-level categories introduced to replace the 'old' services–products distinction, while also reducing the complexity associated with a large number of business lines.

Table 4.1: Composition of exports (2005)

Segment/business line	**Revenue (US$ billion)**	**Business lines (percentages)**	**Segments (subtotal percentages)**
Business process software services	**9.97**		**76.3%**
- Custom application development	4.98	38.1%	
- Application management	2.69	20.6%	
- Support and training	1.10	8.4%	
- Infrastructure management services	0.60	4.6%	
- IT consulting	0.25	1.9%	
- System integration	0.20	1.5%	
- Network consulting and integration	0.15	1.1%	
Product development software services	**3.10**		**23.7%**
- Engineering services outsourcing	2.20	16.8%	
- Offshore product development	0.56	4.3%	
- Made in India products	0.34	2.6%	
Total	**13.07**		**100%**

Source: NASSCOM (2006b). The category 'business process software services' corresponds to what NASSCOM classifies as 'IT services' and 'product development software services' corresponds to 'engineering services, R&D and software products'. 'Infrastructure management services' corresponds to what NASSCOM calls 'information systems outsourcing'. 'Engineering services outsourcing' corresponds to what NASSCOM calls 'engineering and R&D services.

Table 4.1 shows a breakdown of export revenues of the two segments – business process software services (BPSS) and product development software services (PDSS) – for the financial year 2005. As shown in Table 4.1, the first segment contains seven business lines whereas the second contains only three.

4.1.2 Criteria for selection of firms

The sample represents Indian-owned firms and does not include subsidiaries of multinational firms. The aim of the study is to examine the dynamics of offshore 'innovation outsourcing' to independent Indian IT software service providers in Bangalore.[45] Firms of varying sizes were included to avoid the inevitable biases associated with studying either only the giants (e.g. Infosys and Wipro) or only the contenders. The purposive selection of a firm sample of 12 Bangalore-based IT software service suppliers used two main criteria:

- The identification of innovation-active firms.
- The representation of different business lines.

The first criterion was to identify firms representing 'the vanguard' rather than the total population. The purpose of this criterion was to increase the relevance of the sample to the central issue, namely, the transition from production to innovation activities in Bangalore. Other studies concerned with related issues have constructed samples according to a grading of capability levels *a priori* (Hobday, Rush and Bessant 2004). However, no published material could provide the foundation for such a grading in this case.

The procedure in this thesis is in some ways akin to Schumpeter's (1982) approach to the analysis of the 'circular flow' which, in the absence of innovative activities, leads to a stationary state (lock-in). He argued that in order to understand how circular flows are broken over time, what matters is what the pioneering entrepreneurs and enterprises do. In this vein, the sampling strategy targeted innovation-active firms. Such firms are

[45] However, several of the firms included in the sample are partly owned by foreign venture capital firms and/or have issued foreign shares. Incidentally, two firms were acquired by US services firm EDS during the period under review. In one case (RelQ), this happened after data collection was completed.

defined in the Oslo Manual (OECD 2005: 59) as 'one that has had innovation activities during the period under review, including those with ongoing and abandoned activities'. The 'period under review' in this study is the five years between 2001 and 2006 and the study considered firms that had engaged in at least one 'innovation event' in this period.

The second criterion is a result of the preoccupation with the space for innovation. It is assumed that these spaces tend to vary across sectors. Since this study only deals with firms from the IT software sector (on the supply side), it is necessary to focus on differences across sub-sectors. As a starting point, it was a priority that the sample should include firms from the BPSS as well as the PDSS segments. It was assumed at the time that choosing a sample with roughly equal representation of the two sectors would allow for some type of generalisation based on representation. However, as will become clearer, the differences within the segments are so big that this is not the case. Furthermore, many firms deal in multiple business lines. This means that these types of representation cannot be made based on *firms* as the analytical unit.

4.1.3 The process of sampling and the structure of the sample

It is important to explain the sampling process because (i) certain choices were made to maximise the power of the explorative aspects of the study, and (ii) these choices have implications for the conclusions one can draw based on study of the sample.

For example, later chapters show the innovativeness of the Bangalore software firms. This is of course partly a result of the way the sample has been constructed. So this finding cannot be used to make generalisations about the Bangalore – let alone Indian – software industry. It can, however, be used to show that the conclusions of much previous research need to be corrected. I refer here to its largely negative conclusions concerning the innovativeness of Bangalore firms. Interestingly these conclusions were reached even though they included some of the firms used in this study. Showing that these conclusions need to be revised is important. Equally, showing why they need to be revised is important: is it a matter of time or method?

More important, however, are concerns with how innovation capabilities were built and discerning variation. Hence the concern to include different segments of the industry and enterprises of different size. Obtaining a sample of firms which are relevant to these

objectives of research and are willing to cooperate is one of the biggest challenges for the researcher. It requires substantial investment in networking.

The eventual sample was arrived at in the following way: a list of potential candidates, containing ten firms, was constructed prior to fieldwork. This list of candidates derived from:

- Own previous fieldwork. I benefited from contacts and knowledge from previous interviews in some of the sampled firms.
- Contacts provided by other researchers[46]
- The realisation that the Bangalore majors – Infosys and Wipro – needed to be included in the sample.[47]

The likelihood of access was key in defining this list, but it was not intended as an exhaustive list. As it turned out, one firm declined to participate due to the proposed amount of time involved. In another case the contact had 'spun off' and created a new firm. However, this firm was then so young that it had undertaken very few projects. A third firm was stalling after initial contact had been made. Importantly, no firm said they could not produce a list of learning/innovation events.

Additional firms were identified during fieldwork with generous help and advice from researchers at the Indian Institute of Management Bangalore (IIMB) and press reports. Based on the criteria above the sample firms were selected 'on the go'. Months were not spent poring through lists and descriptions of firms in order to collect a group of 12 firms while simultaneously discarding hundreds of others that were found not to be innovation-active. Overall, the sampling process was pragmatic, characterised by strategic opportunism. It was strategic (purposive) because it sought to use the criteria described above, but it was flexible (convenience sampling) because all the leads were followed.

[46] Mainly Anthony D'Costa and Carol Upadhya.

[47] Had they not been included, it would have been difficult to create any kind of validity of statements about the state of innovation in Bangalore.

Tables 4.2, 4.3 and 4.4 summarise the characteristics of the sample of firms:

- Table 4.2 shows that this study examines three business lines in each segment.
- Table 4.3 shows the sample firms according to their primary business lines. As seen, these divide equally, with six firms operating primarily within each of these segments.
- As seen in Table 4.4 the size range in terms of employees is vast.

One cannot – by any definition – say that these are the 12 most innovative firms in Bangalore. It is very likely that other firms in Bangalore are equally or more innovative than some of those in the sample. It may be said, however, that these are 12 innovation-active firms, probably representing a larger group of innovation-active firms in the overall population. The degree to which there is also a segment of innovation-*inactive* firms in the population is a moot but essentially open question. Some further reflections on this are provided in the concluding chapter.

Table 4.2: Business lines examined in this study (by segment)

Business process software services	Product development software services
Custom application development (CAD)	Engineering services outsourcing (ESO)
Independent testing services (ITS)	Offshore product development (OPD)
Infrastructure management services (IMS)	Made in India products (MIP)

Table 4.3: Sample firms – primary business lines

Business lines	Primary focus	Additional focus
1. Custom application development	Infosys, Wipro, MindTree, M-Tec	
2. Infrastructure management service	Microland, Wipro	Infosys
3. Independent testing services	RelQ,	Aztecsoft, Infosys, Wipro
4. Engineering services outsourcing	Encore, Sasken	Infosys, M-Tec, Wipro,
5. Offshore product develop-ment	Aditi, Aztecsoft	Infosys, M-Tec, Wipro
6. Made in India products	Cranes, Liqwid Krystal	Infosys

Table 4.4: Sample firms

Name	Established	Engineers employed	Ownership
Infosys Technologies	1981	43,441	Listed
Wipro Technologies	1946	26,184	Listed
Aztecsoft	1995	4,517	Listed
MindTree Consulting	1999	3,000	Private
Sasken Communication Technologies	1989	2,575	Listed
Microland	1989	1,600	Listed
RelQ Software	1998	700	Private
Aditi Technologies	1994	650	Private
M-Tec (Kshema Technologies)	1997	500	Private
Cranes Software International	1991	310	Listed
Encore Software	1990	100	Listed
Liqwid Krystal India	1999	50	Private

Source: NASSCOM (2007a) and interviews. Note: M-Tech and RelQ were acquired by the firm MphasiS/EDS in 2006 and 2004 respectively; MindTree acquired Aztecsoft in 2008; the number of engineers employed is the figure before takeover. All listed firms are listed in India; several have additional listing in the USA.

4.1.4 Implications for the assessment of innovativeness

To recapitulate, the sampling procedure has important implications for the assessment of innovativeness. First, this selective sub-group of firms is deliberately biased to identify those that are 'innovative'. It is not a sample from which anything – or at least very little – about the innovativeness of the population can be inferred. As explained, the sample was designed to serve a different purpose in the research. Nevertheless, it is the judgement of this author – based on conversation with people in and around the industry and upon the sampling process itself – that the deviation is probably incremental rather than radical. It is my judgement that the polarity between innovativeness and non-innovativeness exists as much within firms (at least in large ones) as it does between them.[48]

The next two subsections provide some context regarding the overall segment and history. This is intended to give the reader an understanding of the business lines' place within overall segments and the context of the analysis of the types of innovation.

[48] At a very general level the sampling process itself provides some type of the answer to the question of whether innovative capability exists in the industry. As long as there is any instance of innovative activity in the sample of firms – whether in a biased sample or not – a positive answer is offered at this point. However, this does not take the analysis very far. While the study can say little more about the *amount* of innovation it can dig deeper into the *type*s of innovation that exist.

4.1.5 Disaggregating business process software services

As was shown in Table 4.1, business process software services is by far the most substantial segment. In recent years, this segment has diversified significantly, with a number of new business lines emerging after the turn of the century. This move towards a broader portfolio of business lines reflects the adaptation of the global delivery model (i.e. offshore outsourcing) to new types of IT services. In this segment, the thesis focuses on one 'old' and two 'new' business lines. These business lines are:

- Custom application development (CAD)
- Infrastructure management services (IMS)
- Independent testing services (ITS).

CAD has been the main driver of the Indian software industry for many years. Along with application management, this is the bread-and-butter activity of the industry. CAD alone accounts for almost 60 per cent of total software export revenues. CAD is concerned with the development of new systems whereas application management (AM) is concerned with the maintenance of systems that have already been developed. [49] These activities are, for the most part, of a 'routine' nature. In both cases, the activities provided to the customer rely predominantly on basic software development skills. However, as will be discussed, they do occasionally include innovative activities.

The reliance on routine skills with occasional innovative activity is also a feature of IMS, one of the new business lines in the BPSS segment. The management of corporate IT systems has been outsourced for a number of years, but traditionally it was seen as something that had to be done on-site. Therefore, this is a new segment for Indian providers. However, once off the ground this segment has grown fast. By 2005, it was responsible for almost 5 per cent of software exports.

ITS is also a new business line. It is included in the BPSS category as it is a service related to a particular business process, namely, software testing. However, in reality, this business line is cross-cutting. It is concentrated on a vertical step in the software

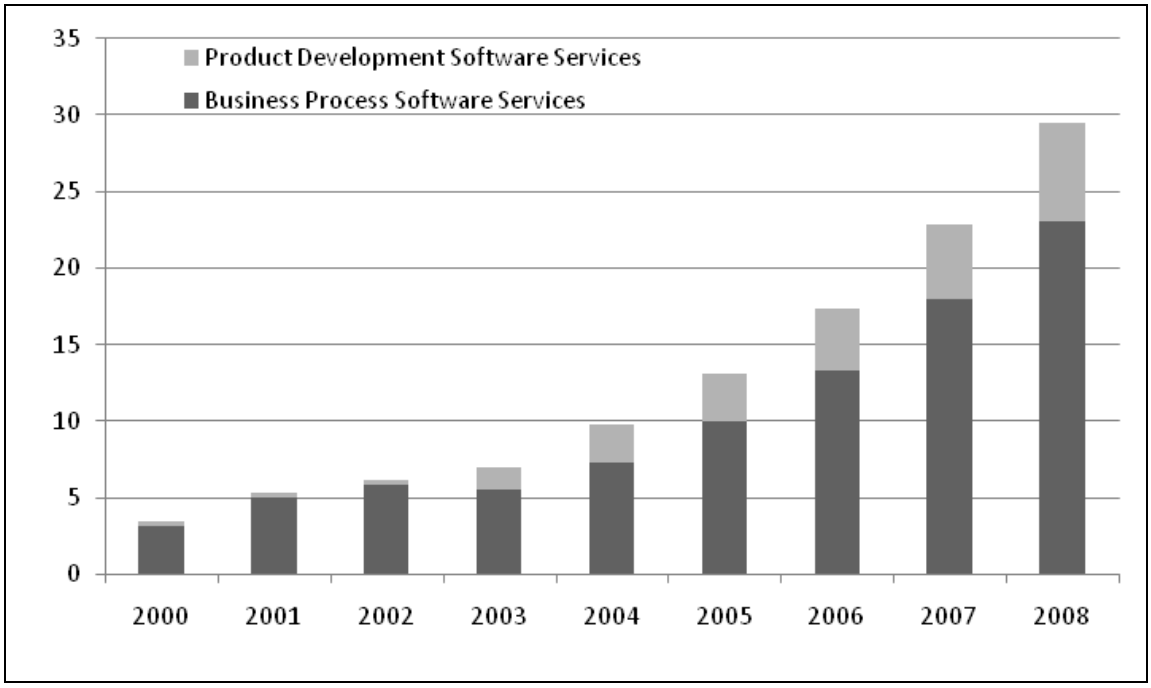
[49] The CAD and AM segments are sometimes referred to collectively as application development and maintenance (ADM).

development life-cycle and testing services are sold in both segments. All types of software need testing so it covers both segments. Until recently, NASSCOM did not collect data on this business line (it was commonly reported as CAD/AM). However, as will be discussed further below it now accounts for a significant amount of absolute revenue.

In the BPSS segment there are a number of business lines (as defined by NASSCOM) that are not examined directly. Some of these are 'inherently' knowledge-based business lines. IT consulting, systems integration and network consulting and integration are all highly skill intensive. All of these business lines are essentially consulting activities.[50] However, an important point to note is that these activities are only reported separately to NASSCOM under certain conditions, namely, if they are provided as standalone activities with separate contracts. In order to reduce risk a customer may commission the consulting activity separately. This creates a potential 'exit point' before the systems development phase is initiated. In other cases, in *most* cases in fact, no separate contract is made. Then it becomes part of a standard CAD contract. The thesis *does* deal with consulting and systems integration activities that are part of CAD projects. This is what is meant when it is stated that some knowledge-creating activities are 'hidden' within routine services.

[50] IT consulting, according to NASSCOM, includes information systems assessment, strategy and planning.

Figure 4.1: Growth of the Indian software industry (US$ billions)



Sources: NASSCOM (2006b; 2008). Prior to 2003, ESO and OPD categories were not reported separately. In 2001 and 2002, PDSS therefore only included MIP.

4.1.6 Disaggregating product development software services

As seen in Figure 4.1, something dramatic has happened in the Indian software industry in recent years. After 2002, the PDSS segment has grown at a rapid pace. This business segment has grown faster than BPSS in the period since 2003.[51] Hence, this category has increased its share of total exports to almost a quarter of revenues.

This is important because most analysts view the PDSS business lines (at least ESO and MIP) as explicitly innovation-centred.[52] If we accept this assertion, the aggregate industry data shows that despite the continuing predominance of business process software (often seen as 'non-innovative'), some more innovation-focused business lines have gained foothold over the last five years. Today these have reached a significant size in absolute terms. By 2006, this segment alone was equivalent to the amount of *total* software exports from India at the turn of the century.

[51] While this is likely to reflect reality, it is also clear that the picture is blurred by revisions in NASSCOM's calculation methods. Engineering and R&D (not products) were shifted to their current category whereas previously they had been calculated as a part of IT services. This accounts for the negative growth in IT services and abnormally high growth in engineering services, R&D services and software products in 2003. This shift reflects the increasing importance of engineering and R&D services and the customer view of activities sourced from India.

[52] NASSCOM and state agencies showcase these business lines as signs of innovative capability and argue that they need to be further strengthened in order to raise the industry's innovation profile.

The three business lines in this segment are:

- Engineering services outsourcing (ESO)
- Offshore product development (OPD)
- Made in India products (MIP).

The first two business lines are 'new' whereas the last is 'old'. However, the statement that these are new business lines needs a qualification. PDSS have been performed in India for a number of years within multinational firms. The pioneers were Bosch and Texas Instruments, starting their product development activities in the 1980s, but during the 1990s a number of large IT firms – such as Microsoft, SAP and Oracle – established subsidiaries for PDSS.

ESO dominates PDSS, representing 16.8 per cent of industry exports in 2005. This business line includes activities such as embedded software, chip design and industrial design services.[53] While established firms and start-ups have been investing in these areas for a number of years, this business line now appears to have taken off. OPD is when Indian companies develop software for overseas independent software vendors. This now accounts for 4.3 per cent of industry exports. MIP, including software packages and licensing of other types of software of intellectual property, amounted to 2.6 per cent. Further description of these business lines will be given below.

The sectoral composition and growth of new business lines is important, but it does not represent a precise indicator of the innovation activities that take place. The data do not reveal the extent to which changes have taken place *within* categories. This is what the analysis of 'events' is intended to do.

4.2 Sampling of events – the supply and demand side

The objective of obtaining an in-depth understanding of the core question – how outsourcing influences the formation of supplier capability – imposes specific chal-

[53] Industrial design services are not software activities and are therefore not included in this study.

lenges. Because the thesis is concerned with outsourcing, it requires an examination of 'both sides' – the demand side and the supply side – and their interrelationships. While previous research has sometimes interviewed different relationships for purposes of triangulation, the present research went beyond this. The 'both sides' strategy was a fundamental principle in the research design needed to address the core question.

The first step in data collection on the demand side – firm sampling within the segments – was described above. The next step was the identification of firm-level innovation learning and events. The study uses such 'learning events' in supplier firms as a focusing device. Such an event refers to an instance in which a firm has done something new (or better) for the first time, indicating a step in the learning process (the accumulation of capability). Such a learning event may be, for example, the undertaking for the first time a customer project that involves new challenges.

The main investigation period for events is the five years between 2001 and 2006. The 36 innovation events occurred within this timeframe (although the 'beginning' of an innovation event can sometimes be difficult or impossible to establish). The five-year 'window' is suitable for two reasons: (i) the reliability of respondent statements is likely to decline if one traces further back than five years, and (ii) the literature indicates that innovation in Indian software firms was limited before this period. However, adopting this window does not mean that the study ignores developments prior to 2001. Rather, the reconstruction of innovation events, the related innovation process and the mobilisation of capabilities go back as far as necessary.

4.2.1 The procedure of supply-side sampling of events

The research sought to identify not only innovation-active firms, but also the most important innovation events within innovation-active firms. The purpose was to concentrate data collection around events that had considerable importance in changing what the firm did.

The adopted procedure was to ask a gatekeeper informant with a good overview of the company (such as a firm founder, chief executive officer (CEO) or other senior manager) to identify the most important 'innovative events' that signified 'learning' in the firm over the last five years. As described above, these events were defined as innova-

tions that enabled the firms to do or provide something new (or do something better) which it could not do before and which had improved the firm's competitive stance. They were also asked to think about different types of innovative event. These informants thus produced a shortlist of innovations or innovative activities (of varying lengths) that were new to the period 2001–2006. The informants were then asked which three of the events he or she considered the most 'important' and the further study followed this choice. However, the shortlisting process gave broader insights into innovative activities in the firm.

In almost all of the cases this process was structured and straightforward. There seemed to be no difficulty for managers to produce a shortlist. However, in some smaller firms only one or two events stood out to the manager as particularly important. The reason for asking for three events was, nevertheless, to gain some variance in innovation types in the empirical material. In larger firms, the problem was of an inverse nature. Here the gatekeeper informants found it difficult to choose three out of the shortlisted events. In large firms such as Infosys and Wipro, many events got onto the shortlist. Thus, a certain element of arbitrary selection was associated with a strong dependence on the gatekeeper's inputs.

Table 4.5 and Table 4.6 show the sampled events and their codenames as structured by business lines and firms. Overall, more than 100 interviews were conducted in India during the latter six months of 2006 and the bulk of these interviews related directly to these events.[54] Open-ended questions about innovation can easily result in the respondent making a sales pitch. The focus on particular events was therefore useful. It meant that questions were specific; and the interviewing of different people about the same event increased the level of certainty.

[54] Interviews were also conducted with relevant organisations such as the Department of IT in Karnataka State and NASSCOM as well as with other private sector firms with relevant insights.

Table 4.5: BPSS events – distribution between business lines

Custom application development		**Independent testing services**		**Infrastructure management services**	
Firms	*Events*	*Firms*	*Events*	*Firms*	*Events*
Infosys	CIMBA	**Aztecsoft**	I-Test	**Microland**	CIO Dashboard Solution
-	Influx	**RelQ**	AsessQ	**-**	IT Security Consulting
-	Tools Group	**-**	RelQ Online	**-**	Network Management System
MindTree	Sales Tool System	**-**	Verticalisation	**Wipro**	Global Command Centre
-	TechWorks				
M-Tec	B/OSS				
-	COMPASS				
Wipro	Lean Software Factory				
	8		**4**		**4**

Table 4.6: PDSS events – distribution between business lines

Engineering services outsourcing		**Made in India products**		**Offshore product development**	
Firms	*Events*	*Firms*	*Events*	*Firms*	*Events*
Encore	VoIP solution	**Cranes**	Global Marketing Network	**Aditi**	Digital Music Distribution Platform
-	Wimax solution	**-**	NISA	**-**	Mifos
MindTree	Bluetooth solution	**-**	SYSTAT	**-**	Product Transformation Services
M-Tec	Build-Operate-Transfer	**Encore**	Mobilis	**Aztecsoft**	ETL Tool
Sasken	Botnia Hightech	**Liqwid**	Codesaw	-	Marketing campaign
-	Multimedia Subsystem	**-**	gyanX		
-	Symbian Competence Centre	**-**	rRapidSuite		
Wipro	Ultra Wideband solution				
	8		**7**		**5**

4.2.2 The demand-side sample

The demand for software is highly heterogeneous. At an abstract level, the demand for corporate software has two sources: business process improvement or product development:

- *Business process improvements* (BPI) typically relate to new ways of organising in-house processes or to relationships with external partners. Examples include new customer relationship or logistics management, or new ways of organising IT systems as firms shift to service-oriented architectures (SOA). Such changes typically involve new software systems provided by an in-house IT department or external providers of customised software solutions (or both).

- *Efforts in new product development* (NPD) differ according to the profile of the buyer firm and sponsor organisation. Two types of product development are important for the analysis of software outsourced to India, both in the field of IT. Primary software industry firms are concerned with developing new software products, whether these are of the old 'packaged' type or whether they are 'software as a service' (SaaS) products provided online. Electronics and telecom buyers engage in the development of new hardware products, although these are often software intensive and include so-called embedded software.[55]

Firms specialised in software development (the primary software industry) are services firms. However, software development also occurs within IT departments of firms operating in other sectors of the economy (the secondary software sector). Customers in the software-outsourcing industry belong to both the primary and the secondary software industry.[56] The 'demand base' for outsourced software services is therefore very diverse. The buyers are IT departments, engineering departments, R&D departments, or product development teams (referred to as sponsor organisations) that use software services to build products or provide solutions for in-house or external use. The nature of the demand for outsourced services therefore varies with the types of

[55] BPI and NPD processes are therefore not necessarily software processes as such, but they form the setting for software use.

[56] The Indian software producers examined in this study belong to the primary software industry.

sponsor organisation and their roles. The first step in constructing the buyer sample was to assemble a base of named customers, divided into the three categories shown in Table 4.7. The actual sample is shown in a later subsection.

Table 4.7: Classification of buyer firms/sponsor units in the sample

Industry	Description	Typical sponsor unit	Shorthand
Primary software industry	Providers of software products and services; product development or project teams	Project Team	ISV
Secondary software industry	IT departments in sectors such as automotive, education, healthcare, publishing, services and technology	IT Department	ITD
Telecom and electronics industry	Product development units that use hardware enabling or embedding software	R&D and engineering departments	ETF

However, it is necessary to provide some further information about the 'population' (the customer base) from which the sample was drawn during the research process. Customers can be divided into names and unnamed firms/organisations. Table 4.8 shows a list of named customers by the buyer segments. The buyer sample is drawn from this list and the purpose of showing this list is to give the reader an impression of the types of firm in each segment.

Unnamed (non-disclosable) customers could not be considered for sampling, yet information about these customers has also informed this research. They can be subdivided into (i) customers named for purpose of research but which could not be included in any written material, and (ii) customers not named at all but mentioned as 'a customer' during interviews.

The list in Table 4.8 is therefore incomplete and does not reflect the total base of relevant customers. As a reflection of the sales profile of Indian software suppliers, the list includes mainly buyers outside India.[57]

[57] The list also includes Indian software firms that have served as customers for other software firms.

Table 4.8: Offshore buyers (named customers)

IT departments	Independent software vendors	Telecom and electronics industry
Addison-Wesley General Electric General Motors GlaxoSmithKline Grameen Foundation Novartis Thomson Toyota Volvo Group	Atari Embarcadero Microsoft Passalong Networks SPSS	Epson Kaga Electronics Nokia NTT DocoMo Motorola Symbian VeriSign

Note: Non-disclosure agreements prevent us from disclosing information and names of certain buyers.

Even though such a base of named customers was established it was not easy to gain access.

4.2.3 Access on the demand side

A key challenge of this research was to investigate processes that are interactive in nature and to examine (rather than 'infer') causal relationships that unfold over vast geographical space. Very little research on inter-firm relationships succeeds in doing this. One exception is the research on the medical instruments industry by Nadvi and Halder (2005). These authors examined changes on the demand side (in Germany) and the supply side (in Pakistan). However, they did not examine concrete inter-firm linkages directly. The latter is what this research has tried to do.

The demand-side 'population' consisted of customers mentioned as 'important' for supplier firms in relation to their own change events.[58] Ideally, the backtracking exercises should include interviews with all customers (and other actors), but in practice this was impossible for two reasons: (i) time and financial resources for this study were

[58] It is useful to contrast with the methodological strategy of Quadros (2008) who studied the effect of ODIP in the Brazilian auto industry, focusing on multinational corporations. The entry-point for analysing these processes was 'top-down' in the sense that the processes were identified through the lead firms' activities. With this strategy, he was able to trace the effects of ODIP in subsidiary auto assemblers and original equipment manufacturer (OEM) suppliers through to their networks of sub-contractors. In the present study, though, the primary entry-point was 'bottom-up' since events and related ODIP processes were identified through the supplier.

limited, (ii) the negotiation of access to customers proved particularly difficult.[59] Therefore, the selection of 12 buyer firms was strategic as well as pragmatic.

With regard to *strategy,* one of the key hypotheses that inform this research is that changing modes of outsourcing has important effects in the supply base. In particular, innovation outsourcing (ODIP) is likely to have ramifications. When thinking about the relevance of ODIP processes, two key distinctions emerge. First, one can distinguish whether intra-firm or extra-firm actors were the primary drivers of the supplier innovation event. In practical terms, this involved focusing on the 'idea' and then looking at 'who' mainly brought this idea forward. Second, one can distinguish whether the domain of change was mainly within the firm or outside the firm (e.g. a customer). Clearly, if mainly intra-firm actors drive an innovation event and the domain of change is within the firm that event is unlikely to be related to ODIP. The potentially relevant innovation events for investigating the direct relevance of ODIP are events in which extra-firm actors are key drivers or events for which the main domain of change is external. Such events were sought to be included the sample.

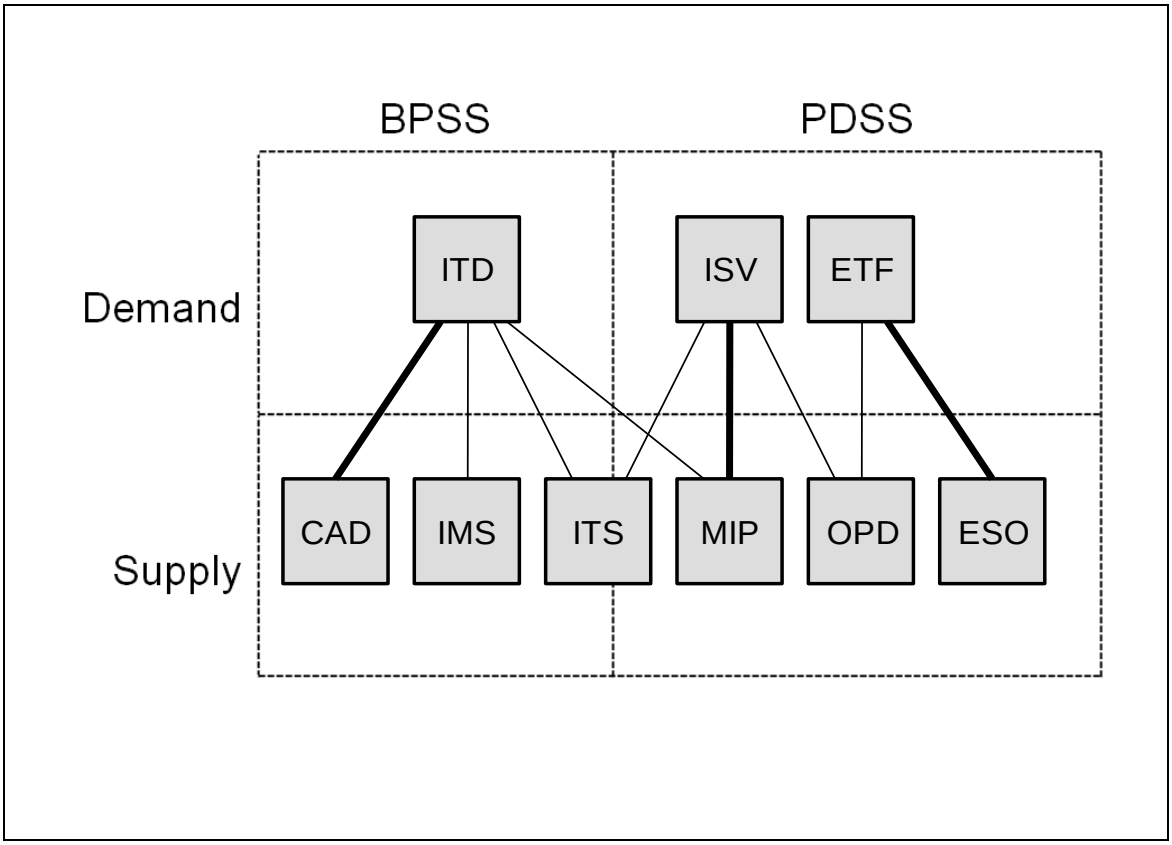
However, with regard to *pragmatism,* the difficulty of gaining access to customers meant that in order to get a substantial base of informants all opportunities were pursued. Therefore, the partner sample is less than perfect. It proved easier, for instance, to follow up on customers of small firms compared to customers of large firms. Larger firms tended to have more ingrained procedures and rules with regard to disclosing information about partners and customers. Ultimately, issues of pragmatism overtook issues of strategy. While not ideal, the process did generate substantial information that is relevant to the discussion about ODIP.

4.2.4 Buyer sample and typical links

It is necessary at this stage to link the two main supply segments to their corresponding demand-side segments. Figure 4.2 makes these links by showing the *main* connections, but it also indicates the links examined in this study.

[59] As formulated by Anthony D'Costa: 'Software firms are notorious for not sharing information because of disclosure clauses they have with clients' (personal correspondence).

Figure 4.2: Demand-side links of business lines



Source: Interviews. Thin linkages indicate linkages that occur in the data (mainly from supply side sources of information). Thick lines indicate buyer linkages that will be analysed, i.e. buyer linkages on which there is 'enough' data to draw conclusions. Coincidently, thick linkages can also be considered typical connections between demand and supply. ITDs are the most important type of customer (volume of sales) for CAD firms/units etc. This is the sense in which later chapters mention 'indicative' buyer supplier cases.

The buyer-side sample of 12 firms consists of buyers from the list in Table 4.8. Table 4.9 shows the final sample of buyer firms. The focal point in each case study was on the project in which innovation outsourcing to India occurred.

As seen in Table 4.9, buyer organisations are located across a range of OECD countries. Most buyer firms were therefore interviewed by phone. However, European buyers were interviewed face to face. In three of the buyer firms, it was not possible to interview informants within the organisation directly. In these cases, the empirical work relies on other informants (industry experts and people previously employed in customers' firms) and written documentation. Appendix 2 lists some of the informants, but others do not appear on that list, as per agreement with the interviewees.

Table 4.9: Buyer sample

Client firm	Sponsor	Location	Case of outsourcing	Type
Auto manufacturer	ITD	Sweden	Customer relationship management sales tool for trucks	CAD
Electronics OEM firm	ETF (Eng. Team)	Japan	Bluetooth baseband integrated circuit	ESO
Independent software vendor	ISV (Proj. Team)	USA	Exact transform and load data warehousing tool	OPD
IT publisher	ITDt.	USA	Digital workspace value-added service	MIP
Internet services provider	ITD.	USA	Billing and operations support solution	CAD
Mobile phone software systems provider	ISV/ETF (R&D Dept).	UK	Build-operate-transfer and innovation partner pro-gramme	OPD
Non-profit organisation	ISV Tech. Centre	USA	Management information system for microfinance	OPD
Online digital media provider	ISV Eng. Team	USA	Online retailing system	OPD
Statistical software vendor	ISV Proj. Team	USA	Product divestment	MIP
Technology and services provider	ITD IT Dept.	USA	Chief information officer dashboard	IMS
Telecom firm	ETF R&D Dept.	Finland	Supply chain reconfiguration	ESO
Transportation services firm	IT Dept.	USA	IT system re-engineering	CAD

Note: Firms listed alphabetically by type; many sponsor organisations are wholly owned subsidiaries.

As will be discussed further in the concluding chapter this study has limitations. The 'both sides' research design (buyers and suppliers) could only be pursued imperfectly as data collection was asymmetrical: the supply-side information is richer and more voluminous than the demand-side information. However, information provided by suppliers was also often useful in understanding processes of corporate restructuring and strategy on the demand side. Whereas suppliers sometimes gave a 'sales pitch' when talking about their own firms, information provided on customer firms was usually more frank (divulging information about problems). Many of these informants had typically worked very closely with these customers and had sometimes worked within them for months or even years as a part of ongoing projects.

In later chapters, indicative buyer suppler cases are examined. These relationships were chosen in order to 'represent' each of the three buyer segments. The aim is to examine and show how types of buyers use outsourcing practices that have differentiated consequences with regard to the 'space' for innovation that accrues to suppliers. There are specificities attached to any relationship, but the cases were chosen to increase the 'indicative' value of the cases by representation of arrows in Figure 4.2.

4.3 Classification of observations

This section discusses problems related to *classification in practice* – that is, classifying observed phenomena according to the frameworks described in the previous chapter. This regards the classification of (i) innovation activities in buyer firms, (ii) inputs and resources in the innovation process, and (iii) buyer outsourcing practices.

4.3.1 Classification of innovative activities

As mentioned, the greatest challenge for the innovation literature is to find ways to measure innovation and innovativeness. Recall that innovative activities were classified into four main types:

- Problem-framing innovative activity
- Problem-solving innovative activity
- Innovative activity related to implementation/execution
- Other innovative activity.

This study has sought to devise a framework that is designed to address issues of innovativeness in the *outsourcing* context. While this provides a better tool than related frameworks (Bell and Pavitt 1995), it is not without problems when ones seeks to classify activities in practice.

- The framework is intrinsically tied to the waterfall software development process model. The waterfall model applies better to some business lines than to others. In general it is well suited to apply to CAD, ITS, MIP and OPD. However, it is trickier in IMS and ESO. This is because the buyer domain is not software as such but (i) management of IT systems (IMS), and (ii) hardware development (ESO). In these cases the classification has relied somewhat imperfectly on generic assessment (high-level 'systemic development' etc.). [60]

- The analysis depended on the examination of systems, their boundaries and their levels. However, boundaries and levels can be very difficult to 'establish' in the software context. In that case, the distinction between problem framing and problem solving can become obscure. The analysis of activities in the software industry is usually an analysis of systems within systems. For example, a software system may be implemented on a chip that is in itself a system. That chip may be integrated into a communications system for an automobile (that is also a system). In this sense, systems definition takes place at various levels and even the *mainly* problem-solving activities at 'the end of the line' involve some degree of problem framing. As mentioned, this project has limited its analysis to the activities of suppliers and the *immediate* higher-level system. This has provided a way forward but it is important to reemphasise here that there have been borderline cases (as noted along the way). As a general principle, this study takes a 'tough stance' by classifying activity as problem framing *when it is con-*

[60] Moreover, the framework is partially suited to the acknowledgment of the 'functional deepening' route to innovative activity. The innovative activity related to implementation/execution is a step forward. However, the discussion of the ITS segment will show that some of the sample firms have begun to supply test consulting services in which they help firms improve their testing procedure. While this does not frame or solve problem related to a system, it may frame the very way software is developed. The important point is that even innovation in this category can cause changes in the division of labour that are relevant to the global distribution of innovation. Yet this is difficult to capture with the present framework.

cerned with defining the process of its immediate use. By emphasising 'immediate use' it is not required that the software vendor defines, for example, the washing machine that contains software, but it must have some significant involvement in the process that defines the electronic system (as distinct from mechanic system) within the machine.

- The 'other' innovation category remains imperfect. It works as a residual category for all events that are not directly related to the development of software systems. They do not represent a distinct 'level' of innovativeness.

- It is worth noting that events may contain elements of several types. Events were classified according to their primary area of change. Where two domains of change were considered of equal importance, it was classified in the uppermost category. For instance, if an event were equally divided between 'Innovative activity related to implementation' (B) and 'Other innovative activity' (C) it would be classified as B. However, this was a rare occurrence.

4.3.2 Classification of sources and inputs into the project learning process

The question raised here is 'what enabled firms to do what they did?' (in observed events). Detailed interviews were particularly concerned with understanding the role of different internal and external actors in bringing about a particular event (who did what). It involved the retracing of the learning processes in and around the projects and the sources involved in this process. This required a further analysis of the innovation resources flowing through these internal and external links.

Building on the framework described in the previous chapter, the analysis of project-based 'capability formation' therefore concentrated on the combination of resources (ideas, investments and knowledge). As explained, the classification about what flows through links builds on the notion of phases in the process: (i) ideas phase, (ii) decision phase, (iii) development phase. However, informants' own intuitive responses to questions about ideas, investment and knowledge were also useful. The primary problem of classification is one of distinguishing knowledge-producing investment from provision of knowledge without investment. Knowledge without investment is typically acquired in codified form. However, if an external actor needed to make an effort to

transfer the knowledge (in a workshop or meeting lasting several days) and if this was scheduled in the decision phase this is classified as an investment.

Four types of source are distinguished:

- Internal client-facing sources
- Other internal sources
- External client-related sources
- Other external sources.

There were two main areas of difficulty. First it could be difficult to determine whether inputs came from a customer or a customer-facing unit. In order to avoid double counting, inputs were classified as client derived unless they were generated more or less independently in the supplier firm. They were classified as buyer derived when the buyer was involved. Inputs were determined as 'prior projects' when buyer's knowledge derived from customer-facing units but not from specific activities undertaken in relation to the event project.

The second main area of difficulty related to the assessment of when knowledge-creating activities could be termed R&D (as defined in this thesis). To a certain extent, this research has drawn on informants' own descriptions of activities. Ultimately, the events were classified as involving dedicated efforts of R&D if they were sustained and evolved over six months or longer.

Another difficulty related to the classification of the internal, local or global origin of inputs. Respondents were asked to assess the importance of each level for each type of resource. Each level could either be deemed relevant (of some importance) or irrelevant (of no importance) with regard to a particular resource. It is important to note that for the sake of simplicity this study defines local linkages as those occurring between organisations within India (rather than within Bangalore).[61]

[61] The relevance of linkages specifically within Bangalore was also examined but not included in this thesis because the findings were not affected.

The analysis of sources assumes in the research design that all three types of resources – ideas, investments and knowledge – are involved in all innovation events.[62] While of course the amount of each these of resources and their relative weight may differ across events, the chapter does not explore this systemically. The analysis is limited to examining the different inputs that generated these resources. It is central to note that different 'sources' may play more than one role in the innovation process.[63] For instance, a customer may provide ideas as well as knowledge.

The analysis includes a discussion of the *number* of different *types* of sources and inputs in the events and it examines whether frequencies differ across different types of innovation. This 'score' gives some indication of the complexity of the innovation process: the higher the number of different types of inputs involved the higher the complexity. It is important to explain here the method by which this research identified and counted inputs from such sources in order to assess their importance in terms of frequencies.

The method of obtaining the scores involved two steps during the interviews. In the first step, informants were provided with a list of types of sources corresponding to Table 3.6 (on page 54). They were asked to identify which *types of sources* were involved (present) and they were asked explicitly to verify the sources that were not involved (absent). After thus having indentified (the number of) sources that were present in the innovation process, the informants were then asked to identify their importance in more detail in the second step (including whether there were multiple instances (interactions) of one particular type, as discussed below). Interviewees were asked to go through each type of source and indicate what *type(s) of inputs* they provided. This second element sought to identify the types of inputs with the use of a list corresponding to Table 3.4 (on page 51), which shows different types of ideas, investments and knowledge.

[62] This is justified by the fact that in no cases did respondents state that no ideas, no investments or no knowledge was involved in an event.

[63] The terms 'source' and 'linkage' are used interchangeably. Strictly speaking the former refers to who/what the innovating firm connects to, whereas the latter refers to the connection itself. Both of these are distinct from 'resources' which refer to the tangibles and intangibles that flow through the connections.

Furthermore, it sought to locate these inputs in phases of the innovation process, often with the use of a drawn 'timeline' that included an idea phase, decision-making phase, and development phase. It is thus important to note that a particular type of source (e.g. customers) could count towards the score one time in each phase. In other words, a particular type of source could provide more than one type of input. Each of these would then count towards the input score. However, they would not count more than once even in the case of multiple interactions within particular source/input combinations.[64]

4.3.3 Classification of outsourcing practices

As set out in Section 3.4 outsourcing is categorised into three main types:

- Outsourcing production activities
- Outsourcing standalone innovation activities
- Outsourcing integrated innovation activities.

Such categorisation is not straightforward due to two issues. The first is descriptive, relating key characteristics of the cases of outsourcing examined. First, in none of the cases could outsourced activities be characterised as 'pure' production activities, as defined in the previous chapter. Buyer firms outsource at least low-level design in all cases. This is already acknowledged in much of the existing literature (Arora et al. 2001; Chaminade and Vang 2008a), and yet it is characterised as production focused. This raises important issues related to (i) the definition of software innovation in this study, and (ii) the way the way this has been defined in the previous literature. In particular, it raised the question of whether low-level design should be considered an innovative activity. In this study the answer is 'yes', but at this stage this is only

[64] They would not count more than once, even if there were more than one actor within a particular category providing the same input. For instance, even if two or more customers provided knowledge in the development phase of an innovation project, this would only count once towards the score. Likewise, if a customer provided knowledge inputs more than once during the project this would also only count once towards the score. This is important because the elaboration of knowledge inputs tended to prompt the lengthiest accounts as informants were asked not only to indicate 'in what form?' (I.e. was it provided in the form of written documentation or did it involve personal meetings) but also to answer the question 'knowledge about what?' This was done in order to indentify forms of knowledge, such as technical or non-technical knowledge.

tentative. Later chapters examine empirically what such low-level design activities involve in practice.

The second issue relates to the classification of standalone innovation outsourcing. This occurs only within one buyer segment and it occurs imperfectly. It is imperfect because it does not exclude coding activities entirely. However, it has been categorised as standalone activity because these programming activities are relatively miniscule compared to design activities. In other cases (classified as integrated activities), the balance is reversed, where programming activities dominate as a proportion of overall activities. In other words, the definition of standalone activities has been loosened to refer to situations in which routine activities (coding) is minuscule compared to creative activities (analysis and design).

4.4 Explanation and built-in limitations

This section makes explicit the built-in strengths and limitations of the study.

4.4.1 Validity

Table 4.10 summarises key information related to reliability and validity. Construct validity and dependability has been discussed implicitly throughout in various section of this chapter. It was sought mainly by interviewing several people for each event (where possible) and by seeking 'both sides' perspectives on selected events. Furthermore, a structured databank of the 36 events was written. It has not been included in the thesis as it amounts to roughly 90 pages. However, this material can be made available to the reader upon request to the author.

The exploratory nature of the study has implications for the type of internal validity that has been achieved. The study is exploratory because (i) it builds on a small sample of innovation events, (ii) information about these events could only be obtained through interviews, and (iii) the data collected encompass a broad range of phenomena. These features of the research meant that hypotheses about the relationships could not be tested for any type of statistical validity. Rather, relationships were 'explored' in order to indicate *why*, *how* and *when* outsourcing practices facilitate the formation of new innovative capability, and to formulate propositions on this basis.

In exploring the relationships, the collection of data started on the supply side for mainly practical reasons. However, this sequence also had a methodological advantage. Starting with the 'dependent variable' reduced the danger of a mono-causal research design, focused narrowly on a particular independent variable (Sayer 1992). The research did not begin with specific types of outsourcing and the aim of 'testing' the implications. The examination was more open-ended, designed to be sensitive to different (contingent) factors involved in the capability formation process. With the use of this approach, the study reduced the risk of false attribution. Where causal relations have been identified, these have been demonstrated with 'thick descriptions' (case studies).

Table 4.10: Validity and reliability

Objective	Tactic	This study
Construct validity (Credibility)	• Use multiple sources of evidence • Establish a chain of evidence • Key informants review draft	• Several people interviewed for each event • Internal documents and web resources used to recreate most events • Internal as well as external perspectives on some events • Buyer and supplier information gathered to establish chain of evidence. • Some key informants responded to and provided feedback on written-up case study
Reliability (Dependability)	• Use case study protocol • Develop case study data base	• Interview guide created and used • Protocol of central themes developed after fieldwork to aid write-up • Write-up of 36 events produced and used as databank
Internal validity (Integrity)	• Pattern matching • Explanation building • Rival explanations	• Purposive sampling • Inductive approach to reduce risk of false attribution • Pattern modelling across business lines • Contingent variables discussed • Different conceptual perspectives adopted and explored
External validity (Transferability)	• Replication logic in multiple case studies	• Generic value chain approach adopted to increase comparability/replication in cases of outsourcing in other industries • Protocol found useful across a large number of events • Basis of conclusions and related steps in the analysis are shown explicitly in the thesis • Specification of idiosyncrasies (in software)

Source: Own table drawing on various sources (Neuman 1997; Sayer 1992; Tate et al. 2009; Yin 2002).

This study uses an analytical framework that could be applied in other outsourcing industries. External validity has been sought by specifying the analytical framework in

detail, by recognising the specific operational method used to conduct classification and by specifying the key areas of potential problems. This increases the potential for meaningful replication and transfer to other outsourcing settings.

4.4.2 Limitations and qualifications

While the sampling procedure explained in Section 4.2 has advantages with regard to producing fresh insights into the main issue, there are also limitations. Three limitations are worth emphasising.

First, the analysis provides little basis for comparing innovativeness between *firms.* Rather, most of the information will be presented in terms of events and business lines (including corresponding buyer segments). An analysis of whether some firms are more innovative than others (within certain business lines) would have required a more focused sampling strategy within a much more homogeneous (or otherwise structured) sample of firms. Limits arise because later chapters will discuss the issue of individual firms' competence leveraging across business lines. However, we have no systemic way of 'testing' whether multi-domain firms reach higher capabilities than 'pure players' do.[65]

Second, the sample gives some indications of the types of innovativeness achieved by firms in the sample across business lines, particularly the 'highest level' reached. However, it provides very limited insight into the volume of innovation that takes place (at different levels). This means that there are few ways of testing systematically whether the events discussed here are 'anomalies'. However, as discussed, it was clear from the event sampling process that in no firm was there any difficulty in identifying three change events. On the contrary, most firms were able to produce a very long list of innovations. Hence, the innovation activities discussed in this section are only a subset of the innovative activities that have taken place since 2001. Similarly, the overview interviews suggest that most firms could have produced quite a substantial number of events that exemplified highest-level activities within the different business lines. In the

[65] The term pure player refers here to firms operating only within one business line. The fact that some firms develop innovative capabilities across business lines is in itself (and self-evidently) an indicator of increasing breadth of innovative capabilities.

CAD business line, for example, the participation in problem-framing activities may not occur in the majority of projects but, on the other hand, it cannot be categorised as unusual. The choice of the project that exemplified this was sometimes influenced by the in-firm contacts of the gatekeeper informant more than anything else.

Third, the analysis of the sample provides very limited opportunity for extrapolating results to the general population. In other words, the findings cannot be generalised. The sample was designed to serve specific purposes related mainly to the examination of the execution of innovative activities. It is not a sample from which anything – or at least very little – about the precise innovativeness of the population can be inferred. An exception to this relates to the basic and less illuminating issue of the existence vs. non-existence of innovative capability in the industry. As was discussed, this has already been addressed by identifying a sample of innovation firms and by finding at least three innovation events in each (often many more). Simple deductive reasoning suggests that as long as there is any instance of innovative activity in the sample of firms – whether in a biased sample or not – a positive answer can be offered with regard to the existence of innovation capability in the industry.

As discussed, the group of firms studied here is important, but they are not the only innovation-active firms in Bangalore (or wider India). In addition, because Infosys and Wipro are included in the sample, it is responsible for a very large share of total exports revenues by Indian-owned software firms. There is good reason to expect that comparable capability levels can be identified in leading multi-domain competitors such as Tata Consultancy Services and Satyam. At least there is no information that leads to the opposite conclusion. This has some significance because collectively these 'big four' account for the bulk of software export revenues from Indian-owned firms.

Fourth, the business lines do not carry equal analytical potential with regard to the main question. The IMS, ITS and MIP business lines deviate to some certain degrees from the three other business lines, which have more straightforward analytical potential. This means that not all of these business lines are equally helpful with regard to all elements of the analysis. Most importantly, the MIP line is not a classic outsourcing-based business line, which means that it deviates from the other five in this respect. However,

this type of deviation means that certain variables can be explored from additional perspectives, which can qualify certain insights.

Fifth, the thesis can only explore the build-up of new capability in a confined sense, focusing at the project level. It mainly explores variables that are internal to the model outlined in chapters 2 and 3 and it does so in a confined time perspective. However, there are external variables (contingencies) that become crucially important in a wider perspective. For instance, the quality of engineering graduates influences the long-term 'upgrading' of the industry (Patibandla 2006). Another factor, which may contribute to the general formation of human resources, is the presence of MNCs, particularly their investment in R&D facilities. Capability transition is dependent on a wide range of contingencies, but this thesis cannot examine all of these comprehensively. This is particularly important in relation to Chapter 8, which widens the scope of enquiry and seeks to discuss root causes.

4.4.3 The mode and logic of explanation

This study uses two main mutually supportive modes of explanation and evidence:

- Examining and showing evidence of patterns (difference and similarities) across events and business lines to indicate causal connections.
- Examining and showing *how* causal relationships 'worked' by drawing on selected 'richer' (more detailed) parts of the case study material.

The first relates to the examination of differences. This mode of analysis is used to explore whether different types of new capability development can be explained by differences in the independent variables. The unit of analysis to construct this type of 'pattern modelling' is the business line. The research did not build differences into the design, but it utilised the variation that emerged in empirical examination of the data, albeit within the defined parameters of innovation-active firms.

The examining of particular events allows one to dig deeper into the causal mechanisms (root causes). From a methodological perspective, the advantage of the events-based approach is that the unfolding of these events may disclose wider patterns that appear less articulated elsewhere. In other words they may carry 'diagnostic qualities': 'A

diagnostic event is, of course, not generalisable in itself, but it gives hints to certain patterns of processes which could and should be looked for' (Lund 1994).

This research has identified such patterns that allows for deeper levels of explanation. However, these could not be examined rigorously and this is why a separate chapter deals with the 'extended focus.' The study did not actively seek 'paradigmatic cases',[66] but the analysis of events enabled the development of insights and categories describing broader 'emerging paradigms' associated with the key segments and business lines studied in this thesis.

However, by focusing on the vanguard (innovation-active firms), the sample firms are 'critical cases', that is, cases that have strategic importance in relation to the general problem (Flyvbjerg 2006). This means that if outsourcing – or rather new modes of outsourcing – has an identifiable influence on the build-up of innovative capabilities in India (the underlying hypothesises of this research), we would expect to find it in the vanguard. Conversely, if does not have an influence on this group, we would not expect to find it elsewhere, that is, in other groups of firms. In other words, the focus on innovation-active firms was a strategic choice aimed at maximising the utility of the case studies.

In a similar vein, the three hypotheses examined in this thesis function as 'null hypotheses' that must be considered valid unless qualifying evidence can be provided. This would confirm the general arguments in the extant literature. However, if such qualifying evidence emerges, new explanations are required.

4.5 Summary and specific research questions

Figure 4.3 relates the overall research design to the logic of explanation that builds largely on differences between business lines and events within those lines. Table 4.11 provides a summary of the core empirical chapters of thesis and shows how the different analyses build on different elements of the empirical material. It also shows how differences will be examined across business lines.

[66] A paradigmatic case is an 'exemplar' or 'prototype'.

Figure 4.3: Modes of explanation in the overall research design

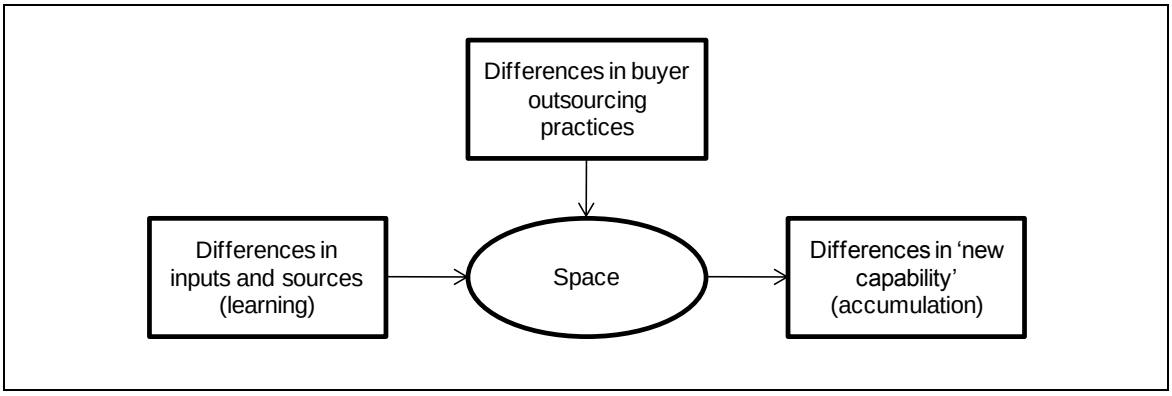


Table 4.11: Summary of empirical basis of core analytical chapters

Variable	Empirical basis	Business lines/segments
New capability (Capability accumulation) *Chapter 5*	• 12 firm-level trajectories	• 2 overall segments ○ BPSS ○ PDSS.
	• 36 innovation events	• 6 business lines ○ CAD ○ IMS ○ ITS ○ ESO ○ OPD ○ MIP
Inputs and sources (Supplier learning processes) *Chapter 6*	• 36 innovation events	• 6 business lines
	• 250+ innovation linkages	• 6 business lines
Buyer outsourcing practices (Outsourced activities) *Chapter 7*	• 12 buyers (12 events	• 3 buyer segments ○ ITD ○ ISV ○ ETF
	• 3 indicative buyer–supplier relationships	• 3 business lines ○ CAD-ITD ○ OPD-ISV ○ ESO-ETF

Table 4.12 restates the core research questions as they are applied to the sample and it specifies the key sub-questions in this context. Furthermore, it repeats the research hypotheses (without citations) for ease of reference. As mentioned, they function in this thesis as 'null hypotheses' that must be considered valid unless the data provides evidence to the contrary. If one or more of these hypotheses are 'rejected' this will indicate areas that are in need of re-examination.

Table 4.12: Research questions applied to sample and sub-questions

Hypothesis from extant literature	Broad questions applied to sample	Sub-questions
The acquisition of innovative capability does not occur at all or is limited to process and organisational capability. In general, problem-framing capability does not spread to suppliers in the outsourcing business (because lead firms keep these in-house or close to home).	What types of capability have the sampled Indian suppliers acquired and demonstrated after the turn of the millennium? How did this differ across business lines?	- What types of peak innovation capability had sampled firms achieved by the end of the main observation period? - How do the sampled events differ in terms of different depths of capabilities across business lines? - What types of trajectory of business development underlie the sampled events in each business line? - Has problem-framing capability been demonstrated by sampled firms? If so, in what business lines?
The acquisition of innovate capability in latecomer firms builds largely on internal effort, but in many cases, and in Indian software firms in particular, linkages in the local/national innovation system would have to buttress the formation of innovative capability.	How did sampled firms build new peak capability during the observation period? What were the main sources of inputs into the sampled event processes? How did this differ across business lines?	- How did firms mobilise and combine resources during the process of preparing and 'implementing' new peak capability? - What were the roles of internal and external sources in the projects/events that underlie the demonstration of peak capability? - How did the mobilisation of resources (input into event processes) differ across business lines? What was the geographical nature of external sources? Were they 'local' and 'global'?
Global client linkages alone do not provide the basis for acquiring high-order capabilities in the software industry. Outsourced activities are focused on labour-intensive production activities. In general, any outsourcing of innovative tasks is closely linked with production tasks, and this limits the scope for building further capability.	How did the outsourcing practices of buyer firms influence the process of building peak capability? How did this differ across business lines?	- How did outsourcing practices differ across buyer segments in the sample? - What were the patterns of integrated and standalone outsourcing? - How did the types of outsourcing influence the opportunity space in which supplier events unfolded?

5 New supply-side capabilities

This chapter is a key building block in the overall analysis of the relationship between outsourcing and innovation activity in India. The first task of the empirical analysis is to examine the types of innovation capability within the six business lines. The key question addressed in this chapter is: *What types of peak capability have the sampled Indian suppliers acquired and demonstrated after the turn of the millennium?*

In order to categorise innovation activities, the framework proposed in section 3.2.2 will be used. A minimum level of innovation activity (Type D) is – as explained – a product of the sampling method itself, but there can be no presupposition about activity beyond that level. In fact the hypothesis derived from the existing literature is that innovative capability is limited to process and organisational capability. In operational terms, this refers to Types C and D. The critical question is therefore whether there was evidence of problem-solving and problem-framing innovative capability (Types A and B) and, if so, in which business lines.[67] The existing literature suggests that Type A does not occur in the outsourcing business, that is, all business lines except MIP.

As mentioned in the previous chapter, the thesis uses the sampled events/projects as 'fixed points' for examining the nature of peak innovative activity within each business line. The main task of this chapter is to examine those events and differentiate them in terms of the four categories of innovative activity (based on the indicators of each type of activity).

Describing events is impossible without context. The subsidiary purpose of the chapter is to provide this context by illuminating the 'transition towards innovative capability' to the extent it has occurred within the sample of firms and the six business lines. This requires some space. The chapter takes the reader on a journey through the 'vanguard' and seeks to enable the reader to observe the transitions and trajectories that have occurred, with an emphasis on the period after 2001. To be more precise, it shows how

[67] Because of the way this question is set up, certain parts of the analysis will 'bundle' Types A and B (problem-solving and problem-framing innovative capability) and Types C and D (process and organisational capability).

the 12 firms pursued trajectories of business development within the business lines that resulted – by the time of the study – in the sample of innovation events.

The chapter is structured along the following headings:

- *Business process software services*: describes three business lines under the BPSS category and classifies the events according to type. Findings are summarised and briefly discussed.

- *Product development software services:* carries on with the three business lines under the PDSS heading.

- *Summary and overview*: pulls together the findings and discusses the types and nature of innovation under each type. It seeks to summarise some cross-cutting trends and provides a tentative discussion of the types of space in which firms have innovated. It also specifies what the residual category of 'other' innovative activities means in practice.

- *Conclusion*: addresses the research hypotheses in view of the material and provides the bridge to the next chapter.

5.1 Business process software services

This section examines the three business lines within the BPSS segment in turn: (i) custom application development (CAD), (ii) infrastructure management services (IMS), and (iii) independent testing services (ITS). In order to understand the nature of innovation efforts and activities in CAD it is useful to examine how these firms have evolved since 2001. This provides the background for describing and classifying events.

Within each business line the discussion proceeds alphabetically, first by firm and the by event. Names of sampled firms are indicated with ***bold italic*** typeface and names of innovation events are noted in *italics*. The section seeks to classify events based on the indicators developed in Chapter 4. Innovation types are indicated with a **bold** typeface. Furthermore, descriptive categorisation of Type D innovation will be noted in brackets.

5.1.1 Custom application development

Custom application development is the development of software applications to the customer's requirements. NASSCOM describes CAD as follows:

> CAD services focus on delivering customised (to client requirement) development of software application and interfaces as well as enhancements of existing software enhancements to existing packaged application or pre-engineered templates and support and provision of custom applications.
>
> (NASSCOM 2007c: 712)

This business line provided the entry-point for Indian firms into the global software industry from the mid-1980s onwards when the staff augmentation model (body shopping) became established. Early movers in this period such as Infosys and Wipro have today become the giants of the industry. However, there are also new entrants such as MindTree and M-Tec.

In 2001, the management team in ***Infosys*** was in intense strategic deliberations concerning how the firm should respond to the slump that had hit the company with the slowdown in the US technology sector at that time. According to one of the company founders, the leadership group realised that the firm had to enter the 'creamy layer' that was occupied by brand-name consultancy houses.

> We realised that we had to compete with, say, IBM and Accenture. We don't want to supply to IBM and Accenture who will take away the cream. We need to enter the creamy layer. If your technological edge vanishes, then who do you compete with? At that time, it was a question of our existence.
>
> (Infosys informant, 28 November 2006)

The new strategy was to develop the company's consulting business, helping the customers to meet business challenges through improvements to business processes. The innovation events in Infosys are closely associated with the initiatives that were made to make this transition.

- *CIMBA* (Customer Information Management by All) was an information system designed to meet new requirements for information management in more knowledge-intensive services. It was concerned with connecting front-end, customer-

proximate activities with back-end systems and processes. The system was developed by an in-house team to address several of the issues of organisational cohesion in the context of global delivery of knowledge-intensive services. CIMBA was conceived and designed in-house to improve communication and collaboration between the company's production muscle in India, the parts of the firm dealing with clients (in locations such as the USA) and the customers themselves. While this system was novel in certain ways – moving the system to a web-based SaaS model – and conceived and developed in-house, it was mainly for 'internal use', improving key in-house processes. This event is therefore classified as 'other' – **Type D** (organisational change to support global expansion as importance and volume of onsite activities increases).

- *Influx* is a proprietary framework and system for business process modelling (BPM). It was a new framework and toolset for business processes engineering consulting, and hence this was a key tool for aiding the consulting element of CAD, a key priority for the firm. The framework and the underlying knowledge base were developed over a substantial period (as will be discussed later) and the process was headed by dedicated resources working full-time on coordination and development. A key element relating to this framework was the automation and codification of business process models into specifications for offshore development. In this sense, it was concerned with taking the global delivery model to the next phase in the evolution of the industry. The many Infosys projects using this framework were concerned with defining customer requirements, thereby indicating activities at the problem-framing level of the waterfall model. In some of these projects, Infosys has interacted directly with end-users to 'capture' and define requirements for business process improvements. [68] This event is classified as problem-framing capability – **Type A**.

[68] Furthermore this event reflects efforts at defining a new business area – consulting – for the Indian software industry. This may even be interpreted as 'novel' in a larger sense because it explicitly sought to integrate and 'automate' the interface between business components that are typically separated in the global software industry, namely, front-end consulting and offshore delivery.

- The establishment of the *Tools Group* in Infosys, an organisational unit to structure and enhance the use of software development tools, was aimed to boost productivity in basic software development processes. It reflects efforts to stay ahead of competitors in terms of the bread and butter of the business. Infosys made an effort to consolidate and increase the use of internal and external software development resources. This effort was tied to a cross-firm incentive mechanism (point systems) for the use of such resources. While this process and organisational change had a documented impact (based on firm-internal studies) on productivity, this innovation falls clearly within the realm of improving existing production – **Type C**.

MindTree was established in 1999 – mainly by a former Wipro leader – with the explicit aim of creating a knowledge-intensive software solutions company. It initially latched on to the US internet economy by providing e-business integration services on the enterprise side, but soon after inception the market took a downturn. As a survival strategy the slump was used to 'build processes for the future' in areas such as tools, methodologies and quality in the more traditional CAD space. Once this business line picked up, a key mechanism for the deepening of domain knowledge and related processes was to develop a strong knowledge management culture and system. Furthermore, MindTree was concerned with following in the footsteps of the established firms by becoming a 'global company' by instituting a strong presence in customer locations. Top management and founders drove this process as an opportunity for building deeper domain competences in the CAD segment as one of key vehicles for upgrading in this segment.

- The development of a *Sales Tool System* for a key player in the global automotive industry reflected such increased domain capabilities. It involved architecture work and the deployment of business-level knowledge. Such cases of customer-specific application development, in which the supplier takes on an end-to-end technical role and deploys domain knowledge, are among the vanguard activities. It is one example of how firms such as MindTree are engaging in change-generating activities in customer firms. As will be discussed further in later chapters, this event shows how buyers and supplies can come together in co-framing requirements. The client undertook the majority of the relational

tasks – interacting with end-users – involved in this business process improvement. The supplier participated in the requirements-level definition of a new system and this event is therefore classified as problem framing – **Type A**.

- The *TechWorks* initiative was aimed mainly at promoting the internal development of re-usable software development blocks, but it was an ingrained element of wider knowledge management (KM) efforts. MindTree has developed a unique knowledge management infrastructure and practices, helping employees to collaborate in building innovative TechWorks (i.e. software blocks and components) for the company. While MindTree has won international awards for its KM practices – with TechWorks highlighted as novel innovation – this event falls into the category of improving production – **Type C**.

In 2004, the start-up-firm Kshema Technologies was acquired by MphasiS – which, in turn, was acquired by EDS in late 2006. It became a wholly owned subsidiary known as ***M-Tec,*** as its mandate was to focus on customers in technology businesses, thus mainly providing the telecommunications industry with CAD services (as distinct from ESO which has telecom and electronics firms as its main customer base). M-Tec also functioned as a centre of excellence for project management within MphasiS.

- One event in this firm involved the development of a *Billing and Operations Support Solution (B/OSS)* for a provider of internet and telecommunication network services based in the USA. This is a set of converged services dealing with support processes such as order taking, bills processing and payment collection for which M-Tec developed 20 new modules and interfaces with third-party application for this 'next-generation solution' (capable of handling new forms of content), and worked with the customer in all phases of development. The system was completely transformed. With no involvement by the customer the project was handled entirely by M-Tec, thereby transcending the 'execution mode' of many projects. The B/OSS event in M-Tec was typical of new-generation projects in the CAD space in which suppliers take on roles that are more independent. This contrasts with cases in which suppliers are primarily assisting customers with their projects. In functional terms, this was an example of a project that went beyond the construction and transition phase and into design, roadmap definition and other knowledge-creating activities. However, the event is a bor-

derline case because M-Tec provided a (large) number new modules and features and this event contains key problem-solving innovation. While this project was essentially a revision of existing systems, with a pre-defined architecture, the changes were so substantial that several elements of the core architecture were redefined. Since the study looks for indicators of the highest-level activities involved this event is classified as entailing problem-framing innovation – **Type A**.

- M-Tec drove the development of *COMPASS*, a Comprehensive Project Analysis Support Solution. This built internal project management capabilities but also enabled the firm to take on project management office functionality for the customer, that is, manage all activities related to a project on behalf of the client. This type of service is relevant in project such as B/OSS mentioned above. M-Tec therefore uses COMPASS not only internally but also to provide programme management services related to customer projects. As an event related to delivery and ongoing services and project management this event is placed in the 'other' category – **Type D** (new project management solutions as advanced customers begin to locate project management tasks with the supplier).

In ***Wipro,*** the early 2000s was also a juncture for change after a growth and consolidation phase during the late 1990s. According to senior managers, Wipro was particularly concerned about an erosion of competitive advantage as MNCs were entering the Indian market and gaining traction in the offshore model in CAD and other services. Wipro, with its strong tradition for diverse business activates, actively sought to venture into new areas of the information technology sector (including IMS and ITS) and aimed at becoming a 'true global company', with a global workforce and capabilities to undertake large projects. Many of these initiatives were coordinated by a newly established Wipro Innovation Council (WIC), which provided funding and guidance for new innovative projects. As will be discussed in more detail later WIC aims to make 'quantum leaps' in certain areas, several of which are reported in this study. One of these is discussed below.

- Through the *Lean Software Factory,* the company wanted to build on its Six Sigma quality and efficiency capabilities and expand this into new initiatives.[69] Based on substantial background preparation and programme definition, these lean principles were not only applied to back-end processes within Wipro, but were also extended to the 'delivery' component that connects with customers. In Wipro, the Lean initiative has been implemented across the organisation and its verticals; hence, it is cross-cutting rather than CAD related per se. However, it is discussed under this heading as CAD is the largest overall business line in Wipro and because the initiative has been most widely used in the CAD field. According to company documents, this initiative had a substantial documented impact as projects applying Lean principals had efficiency improvements in the area of 10 per cent compared to similar-sized non-Lean projects. This event is classified as production improvement – **Type C**.

In *summary*, the 'highest level' reached by the sample firms within this business line is the problem-framing innovation (Type A). Three events contained information indicating activities of this type: B/OSS, Influx and the Sales Tool System. They are discussed further in later chapters. No events indicated problem solving as the 'highest' level. This should not be interpreted as if problem solving does not take place within this business line. On the contrary, interviews with firm informants suggest that problem-solving innovation – in the form of development of system modules – is widespread. [70]

The firms reported a number of production-improving innovations: CIMBA, COMPASS, Lean, TechWorks and the Tools Group.[71] This type of innovations was considered 'important' by informants because they were typically firm-wide initiatives, often with a documentable resource saving impact. They improve competitiveness as typical clients are often very cost sensitive. Moreover, there are indications that some of

[69] Six Sigma is a business management strategy, first developed by Motorola, which seeks to identify and remove the causes of defects and errors in manufacturing and business process. Today it enjoys broad-spectrum application in many sectors of industry.

[70] While it has not been examined systemically, it is intuitively clear that three firms (those indicating Type C and D activities) have capabilities above that level.

[71] Wipro reported one event at this level but no events at higher levels. However, a wealth of circumstantial information suggests that this firm has capabilities comparable to those of the other firms in this category.

these innovations are elements which sustain activities at higher levels. This has not been examined systemically, but an initiative such as CIMBA supports the trajectory of increasing sophistication of activities by better capturing customer knowledge and domain competences. Similarly, it is clear from interviews that an initiative such as the Tools Group deploys tools not only for basic programming but also to aid high- and low-level design activities.

5.1.2 Independent testing services

Emerging during the 2000s, independent testing services is a new business line that grew out of CAD (NASSCOM 2006b). Traditionally considered a low-value activity, testing was usually undertaken in-house by the development teams as an integral part of the software development process. The skills required for testing are similar to those used in development. However, there is increasing acknowledgement that many problems arise when developers test their own systems or products. The critical step for the establishment of this business lines was separate testing from the development workflow. Customers have embraced this service because testing is considered 'non-intrusive'. It provides customers with a 'lower-risk approach to engaging with an offshore service provider' (NASSCOM 2006b: 68).

Over the period 2001–2006 dedicated testing services companies such as RelQ, emerged as significant players, as did separate testing divisions in the large companies such as Wipro and Infosys. Revenues from standalone testing services amounted to US$282 million in 2006. Carving out this space as a separate and independent activity allowed these companies to establish new and innovative processes in this area. Specialised independent testing companies rethought the role of testing in the software development process. By separating testing organisationally, rather than performing testing in-house and often in conjunction with programming, new cross-applicable knowledge bases could be developed for this field, including test standardisation and other formal processes to manage the quality of the software test efforts.

One firm that highlighted innovative activities in this area was ***Aztecsoft***. Unlike RelQ, this firm is not a pure player in the testing segment. Furthermore it provides these services within a specialised vertical market segment (see below on OPD), concentrating on the testing of 'packaged' software products. It entered this space in 2004 with the

acquisition of Disha, a dedicated ITS start-up. With the specialised focus on product testing, this firm has become a provider of 'thought leadership' in this space, for example, by authoring 'white papers'. However, a key motive for entering this space was to reach customers that would normally be reluctant to outsource their development activities. In particular, Disha was a supplier to a major US vendor of software products and operating systems. With the acquisitions and the subsequent creation of Aztecsoft *I-Test*, the firm opened a back door to this important customer. In addition, *I-Test* proved valuable as an internal centre of excellence on testing methodologies that function as an internal consultancy unit, providing services across the organisation.

- The *I-Test* practice in Aztecsoft profoundly changed internal processes (and improved the quality of services) but was ultimately aimed at bringing independent testing services to the market (as a new functional offering within OPD) in order to reach ISV firms that had hitherto been reluctant to outsource development activities.[72] It was a new business line (offering), which was added to Aztecsoft's portfolio of activities; however, it was a business line that was primarily aimed at conducting basic tasks. As a change event that is primarily aimed at enhancing basic software development processes this event falls within the production improving category – **Type C**.

In 1998 ***RelQ*** was the first Indian company to become established as a dedicated software quality and testing organisation. The founders were computer science PhD holders who had backgrounds as software quality consultants in various Indian and US software firms (in India as well as abroad). Based on this experience they were able to develop new frameworks and processes for testing and quality assessment.

Carving out testing as a separate and independent activity allowed the companies to establish new and innovative processes in this area. The firm rethought the role of testing in the software development process. By separating testing from the development processes, rather than performing testing in-house and often in conjunction with programming, new cross-applicable knowledge bases could be developed for this field,

[72] While this falls clearly within the realm of ITS, it is a borderline case between BPSS and PDSS because the service was ultimately aimed at developers of software products.

including test standardisation and other formal processes to manage the quality of the software test efforts. While the provision of standard ITS is a routine-based activity, RelQ (and incumbents in the ITS field) have accumulated the critical mass of specialised expertise in this area that enabled them to enter the field of test consulting and provision of 'transformational services'. Indian ITS firms increasingly engage in testing management and consulting services such as test strategy and quality assurance and certifications.

- A cornerstone of the firm's business was the *AsessQ* framework. This framework was (and still is) used in all client projects – to give price quotes as well as to deem a piece of software 'tested'. In other words, it was used for test-effort estimation (including the choice of methodology), schedules and test-stop criteria. Many software firms do not conduct these tasks in a systematic manner and have no systems to formalise these processes. It was precisely this process of formalisation and codification of a core knowledge base into the AsessQ framework that enabled the firm to open up the independent testing services as a niche for pure-play suppliers. While there were important elements of 'defining a new business line' and consolidation of a new knowledge domain, this event reinforced and deepened the traditional 'downstream focus' of the Indian software industry in the global division of labour (the main focus). It is with reference to this latter view that the event is classified as improving production – **Type C**.
- By 2002, it became clear that specialised knowledge needed to be developed within customer-oriented segments with different characteristics. In a process of *verticalisation,* the management team chose four areas based on the business potential: banking and finance, avionics, games software and enterprise applications. Some of these domains involve mission and life-critical software. Therefore, quality assurance is a major issue in these fields. For some of these areas (e.g. avionics and banking) RelQ emerged as an authorised quality assurance and certification agent. This enabled the firm to take on a consultative role. Similarly, the firm began taking consulting jobs where no actual testing was undertaken but where the firm provided assessment and consulting services to improve other firms' testing practices. In sum, the establishment of domain competency groups in RelQ was part of a much wider process of so-called verticalisation in which the firm was reorganised into groups according to vertical market

domains. While this event shows how RelQ was able to 'do more' (e.g. certification services) it was essentially the implementation of a new organisational structure – **Type D** (organisational segmentation along customer segments as domain knowledge increases in importance).

- The acknowledgement of RelQ's capabilities enabled it to participate in the definition of industry standards. In the field of Java, for instance, the firm has contributed towards the Unified Testing Criteria and as a part of the unified testing initiative (UTI) is the only Indian company authorised to certify with this standard. The Java programs are typically very small and this has enabled RelQ to develop new fully web-based delivery and customer interaction mechanisms in this areas. This became known as *RelQ Online,* a delivery model aimed to digitise all elements of customer interaction and delivery related to the testing of smaller Java applications (typically for handsets) – **Type D** (new online customer interaction model for small projects).

In *summary*, the highest level reached within this business line is innovation related to implementation (Type C). However, the analysis of events in this business line highlights some of the limitations of a framework for measuring innovativeness that is closely tied to the waterfall model. While the emphasis is on testing – which is clearly a part of the 'production chain' in a functional sense – it is clear that from a knowledge perspective some events contribute to a changing division of labour. When RelQ takes on a consulting role – helping OECD customers to improve their software development practices – this is much more a knowledge-creating role than standard services in the testing space. The same applies to standards-based verification services. Yet, these new services do rarely change the basic design of the software, and dedicated testers are therefore not involved in framing and solving problems in the sense discussed in this thesis.

5.1.3 Infrastructure management services

According to NASSCOM, 'IMS encompass all the services that relate to monitoring, managing and enhancing performance of a client's IT infrastructure backbone' (NASSCOM 2008: 212). It is the single most important activity conducted under the heading of information system outsourcing and the terms are used interchangeably. While it is clear that the provision of these services grew out of the software industry,

the bread-and-butter activities conducted in this segment are not mainly concerned with software development as such. However, innovative activities in this business line *do* typically involve software activities.

Standard IMS provision involves a long-term contractual arrangement (a so-called service-level agreement, SLA) in which the provider takes responsibility for managing all elements of a client's IT infrastructure operations. This service segment is a new business line reflecting the recent expansion of service offerings. It was traditionally seen as something that could only be undertaken on-site and hence offshore provision is a relatively new space for Indian companies. The Indian offshore model could be utilised in this new area.

An example of an IMS pure player is ***Microland.*** This firm was focused on internet business during the late 1990s and was hit hard by the US 'market correction' in the early 2000s. The leadership made a choice to focus exclusively on IMS, a business which was seen as more stable and in which the firm could make use of capabilities in the networking business that had been developed in the early 1990s. Despite its relatively small size, it was able to secure several large clients. As this was a new business line innovations reflected efforts defining services and systems.

- The firm developed a *CIO Dashboard* that provides real-time data of underlying critical customer IT infrastructure. The system collects key performance indicators into a central repository; these are then consolidated in a single overview screen, for the use of Microland as well as the customer. It increases transparency to the customer for ongoing systems and services. While this is also oriented towards the user–producer interface, bridging processes and organisational changes, it added an important element – or module – to the customers' systems. It is therefore within the realm of problem-solving innovation – **Type B**.
- Microland has also engaged in *IT Security Consulting* services in the Indian market on behalf of a key US customer (hence providing consultancy services for the customer's clients). The firm ventured from standard IMS activities to the consulting space by offering infrastructure security services. The distinctive feature of this event is that it was provided in an alliance with a major US technology provider that targeted the Indian users. This alliance partner was effec-

tively in charge of choosing solutions (upgrades and patches) to a known variety of problems and the supplier merely engaged in existing services to a new market and under new contractual relations – **Type D** (business model innovation – opening a new revenue stream within existing business line).

- A *Network Management System* (NMS) was custom built (on an open source platform) for a key customer and later deployed with other clients. It significantly reduced costs to the customer by replacing existing tools with cheaper open source alternatives, but as this NMS is deployed primarily to monitor the customers' networks this event is hybrid between improvements to delivery and an improvement to the service itself. This event falls mainly within the production improvement category as it improved already existing tools – **Type C**.

Wipro was the first mover among Indian suppliers in the IMS space. This supplier had a long history in infrastructure management, but mainly as a provider of staff-augmentation resources to IT departments in global companies. At the same time, the firm was competing with OECD-based providers of IMS. These had an advantage because of pooling benefits and the fact that OECD-based providers were preferred because the offshoring of critical IMS to India was perceived as too risky. However, applying the global delivery model to this area – with activities on-site as well as offshore – helped the firm in opening this new area.

- The establishment of the *Global Command Centre* (GCC) aimed at developing the firm into a 'one-stop' solutions provider in infrastructure management, handling all elements of customers' infrastructure elements, such as networks, databases or storage. It has a distributed delivery model with a presence in the USA, the UK and India. A critical feature was the establishment of consumer-proximate back-up and verification facilities that comforted customers while simultaneously leveraging offshore resources for day-to-day maintenance. This was important because certain customer preferences favoured solutions that did not shift the entire operation to India. Hence, it was in the forefront of defining a business line that had not hitherto been provided by offshore suppliers. The event rested on a major process of knowledge-base expansion and consolidation. Major visioning and business definition efforts enabled the firm to apply the global delivery model to this area. 'GCC was a culmination of tremendous R&D

efforts and has been very successful in adding great value to customers' (NASSCOM 2005: 182). While this required some redefinition of existing customers systems, this event is classified as 'other' – **Type D** (business model innovation – opening a new business line).

In **summary**, the highest level reached within this business line is problem-solving innovation (Type B). The assessment of levels is complicated significantly by the fact that the waterfall model does not apply in a neat way.

5.1.4 Summary of BPSS

Within this segment, firms have clearly gone furthest within the CAD business line. The nature of CAD events also sheds some light on the larger processes of transition witnessed by the firms. This transition has seen firms enter the provision of what may be termed 'transformational services'. In a 'standard CAD service' relationship, the provider enters the process after specification has been defined. Therefore, these services facilitate changes within customer organisations rather than efficiencies for specified processes. In the terminology introduced in Chapter 3, they are concerned with inception and elaboration and rely on the capabilities of business analysts and system architects. The important point is that these capabilities can be deployed in connection with advanced CAD projects (as is the case in the innovation events discussed here) and that they may be perceived as consulting activities, even if these are primarily CAD driven.[73]

IMS is a relatively new business line, emerging in India after the turn of the century. Within a short time-span, IMS has evolved from basic provision to change-oriented services, albeit within the boundaries of problem solving. At a minimum, this shows that firms are beginning to undertake some knowledge-generation activities independ-

[73] Thus according to several interviewees, the figures for consulting activity underestimate reality because work that is billed and registered as CAD often contains consulting tasks. For instance, Infosys in its annual report states that 3.5 per cent of services are consulting. These are mainly the revenues generated on a standalone basis by Infosys Consulting, a distinct US incorporated business unit. However, informants in that firm stated that consulting activities were more likely to be in the 20–30 per cent category if one counts in the consulting activities that take place as a part of CAD contracts. Similarity *The Economist* (2007) states that according to the CEO, 'Infosys now generates nearly a quarter of its revenues from consulting'.

ently (e.g. definition of subsystems). However, within Wipro in particular this business line is now being taken towards network consulting, that is, not only management of client infrastructure, but also associated advice on how clients can improve this IT infrastructure (along with possible implementation). While the solid descriptive 'evidence' is vague, informants say that suppliers are now beginning to provide IMS services that re-define the nature of services, hence moving into the sphere of consulting in this segment.

While the provision of standard ITS is a routine-based activity, at least one firm has accumulated a critical mass of specialised expertise in this area that has enabled it to enter the field of test consulting. The firm increasingly engaged in testing management and consulting services such as test strategy and quality assurance and certifications. This does not 'show up' as a trajectory along the software development chain; it reflects a different trajectory of (functional) knowledge domain deepening.

Table 5.1: BPSS events – types of innovation

Custom application development			**Independent testing services**			**Infrastructure management services**		
Firms	*Events*	*Type*	*Firms*	*Events*	*Type*	*Firms*	*Events*	*Type*
Infosys	CIMBA	D	**Aztecsoft**	I-Test	C	**Microland**	CIO Dashboard Solution	B
-	Influx	A	**RelQ**	AsessQ	C	**-**	IT Security Consulting	D
-	Tools Group	C	**-**	RelQ Online	D	**-**	Network Management System	C
MindTree	Sales Tool System	A	**-**	Verticalisation	D	**Wipro**	Global Command Centre	D
-	TechWorks	C						
M-Tec	B/OSS	A						
	COMPASS	D						
Wipro	Lean Software Factory	D						

5.2 Product development software services

This subsection continues with the description and classification of events, discussing business lines within the PDSS segment. The three business lines in this category are: (i) engineering services outsourcing, (ii) made in India products, and (iii) outsourced product development.

5.2.1 Engineering services outsourcing

Engineering services are 'those that augment or manage processes that are associated with the creation of a product or a service' (NASSCOM 2008: 261). Some of the services provided from India under this heading are not software services and therefore are not considered in this study. These are typically design services provided to firms in industries such as automotive, aerospace and construction. In this study, the focus is on the engineering of software components (for electronics products).

Although such ESO services had been provided in India in the late 1990s, the 'take-off' for more broad-based growth in this business line occurred in the early 2000s. As with CAD, the 2001 market downturn in the technology sector hit this business line hard, but paradoxically it came to work to its advantage in the longer run by placing greater emphasis on the costs involved in product development. This business line experienced fast growth from 2003 onwards, growing an average 43 per cent a year in the period between 2003 and 2006. Moreover, this type of service is different from other services because it tends to be relatively labour-extensive compared to other business lines. As it is easily recognised as 'high-tech', many firms often point to activities in this field as examples of innovative activities.

Engineering services can feed in to any industry but, in practice, Indian suppliers are currently focused on technology and telecom customers. They are focused on hardware and software technologies and concentrate on the sub-segment of ESO that NASSCOM terms 'R&D services' because they often involve intellectual property development, which is retained within the supplier organisations. These services are 'providing research and development for hardware and software technologies, as well as software running on embedded systems' (NASSCOM 2008). All the ESO innovation activities in

the sample are oriented towards hardware/telecom clients and most are related to so-called 'embedded software'.

In this segment, a key business model involves the development of software components pertaining to different standards-based technologies used in the telecommunications industry. These equip telecom products with inter-communicative capabilities secured by hardware vendors' use of standards-based technology protocols. Indian firms operating in the ESO space develop software technology components that enable these technologies in customers' products. Such 'embedded software' therefore plays an integral role in the electronics it is supplied with and it is usually written for special-purpose chips integrated into these products.[74]

One firm focusing on IP block development is ***Encore Software***. This firm is focused on R&D for embedded software systems in the field of digital signal processing (DSP) for telecommunications. The revenue base stems from licensing and customisation of IP in this field.

- For instance, Encore developed a *VoIP* (Voice over Internet Protocol) *Solution*, comprising a DSP subsystem (component) with speech coders, echo cancellation and VoIP protocol stacks. Encore also provides integration services and can port the products into customer's solutions. Silicon solution firms that provide turn-key platforms for the VoIP telephony market use these products and services, typically on a licence basis. The VoIP solutions take the form of a modular system component and this event is classified as problem solving – **Type B**.
- Similarly, in 2006 the company completed the development of the *Wimax* MAC (Media Access Control) layer software and began exploring various ways of commercialising this offering. Today, the firm licenses this MAC system and offers integration services for incorporation into the physical layer as well as the application layers. It is a component feeding into a larger system and this event therefore also falls in the problem-solving bracket – **Type B**.

[74] These are software technology components developed by supplier firms that eventually become integrated with the customers' products (chips), on a licence basis, in order to implement communication capabilities according to a standard protocol.

MindTree is another example of a firm with IP development activities.

- The *Bluetooth Solution* produced by this firm is aimed at enabling wireless communication between electronic devises. Bluetooth is a mature technology and over the years, MindTree has become recognised as a leading supplier in this field; the firm has gained voting rights in the key standards specification committee. While this firm has achieved considerable success in this area, the basic operating model limits the firm to problem-solving services, implementing Bluetooth software in larger applications – **Type B**.

As mentioned, M-Tec was focused on the technology-firm market, primarily working on in-house systems, but sometimes also on customers' core product. This supplier engagement in build-operate-transfer (BOT) is a good example. It entered this agreement with a leading supplier of systems software for mobile phones. In BOT engagement, the supplier builds an offshore development centre (ODC), which is later transferred to the ownership of the customer. The supplier builds the ODC with the aim of externalising it as a captive unit of the customer. While this is becoming an increasingly popular mode of entry for many MNCs – not just in the ESO business – it was the first time M-Tec had engaged in this practice.

- The *Build-Operate-Transfer* contract was signed in 2002 and three years later, the ownership of the ODC was transferred to the customer. M-Tec was responsible for a range of practical and administrative issues. However, most importantly, it engaged in developing a pool of resources with technology- and customer-specific competence by functioning as a preferred supplier in the preparation phase. As will be discussed later, this agreement enabled the firm to work on some higher-order activities, but essentially the new-to-the-firm element of this event was the value proposition itself. As a new contractual agreement, this event is the improvement of business relations – **Type C**.

Sasken was one of the firms hit by the technology slump due to its dependence on the US technology sector. The slump spurred a refocusing of the firm from the personal computer (PC) domain to the mobile communications domain. According to informants,

the downturn was used to make investments for the future in this area. All of the events in Sasken reflect the firm's new profile as a pure player in this area.

- Recently, Sasken broadened its portfolio of service offerings from telecom software development and design into hardware design and testing. This was made possible by the acquisition of Finnish firm *Botnia Hightech*. This also deepened the relationship with an important first-tier customer in Finland. The acquisition was aimed at bringing in new competences in hardware design and testing, not least in order to open up contact points in a key Finnish manufacturer of mobile phones. While this event is potentially of high strategic importance, as will be discussed later, it was essentially a case of organisational change and expansion of the business portfolio within the field of services that are viewed as non-core from the customer perspective. It is therefore classified as **Type D** (acquisition to improve customer proximity, new activities and tacit 'product knowledge').
- One of the investments made after the 2001 crisis was concentrated on the development of a comprehensive *Multimedia Subsystem* for mobile phones. Previously, Sasken sold its multimedia stacks to original equipment manufacturers (OEMs) that would use these software components in solutions sold to the handset manufacturers. Today, this suite enables the firm to deal directly with end-customers in the provision of this end-to-end solution on a licence basis. It addresses the Smartphone market with a full-featured application bundle, including media player, videophone, camera and media-browsing applications integrated with optimised audio, video and speech compression algorithms (so-called *codec*). More than 50 mobile phone models have been shipped with this Sasken IP (or parts of it). This IP needs to be customised with each new customer project and the event is difficult to classify in framework adopted here. While the Multimedia suite is a system in its own right, it is also a subsystem of a larger system. This event is therefore classified as primarily problem solving – **Type B**.
- Sasken has built relationships and alliances in the handset ecosystem. For instance, it has become an authorised *Symbian Competence Centre* for the developer of handset operating systems. In this capacity, Sasken provides services to licensees of the operating system (OS). It maintains a focus on software development and integration skills to work with a wide range of technologies for use with the OS. Sasken established a new organisational entity for distinct techno-

logical domain offerings, providing licensees of Symbian technologies with component design, software development and testing – **Type D** (new alliance and organisational change to deepen capabilities in specialised technology domain).

Wipro is also engaged in the development of embedded software and claims to be the largest provider of R&D services in the world. It was one of the first movers in this field and developed its first IPs already in the late 1990s. The Product Engineering Solutions group employs more than 13,000 engineers. Within this group, one of the most established areas is semiconductor IP. In this field the company develops solutions for complex wired and wireless applications and has developed IP cores in technologies such as wireless local area network (LAN), Bluetooth, universal serial bus (USB) (including wireless USB) and FireWire).

- The newest technology in which Wipro has developed such IP is *Ultra Wideband* (UWB). In this relatively new technology area, the firm developed a UWB MAC solution, which is customisable to different types of 'host interfaces'. As is typical of firms operating in this type of IP development, Wipro works with chip design firms to develop solutions for different products such as consumer electronics (e.g. for wireless streaming of video from PC to TV) and PC and peripherals (wireless USB). The UWB solution is another example of a component technology for larger system classified as a problem solving solution – **Type B**.

In *summary*, the highest level reached by the sample firms within this business line is the problem-solving innovation level (Type B). Five events were categorised as problem solving, VoIP, Wimax, Bluetooth Solution, Multimedia Subsystem and Ultra Wideband. Apart from the multimedia subsystem, these events are all similar in nature. They reflect the nature of the business in which suppliers developed customisable software components for enabling communication technology to operate according to interoperable industry standards. The Multimedia suite stands out as a full solution enabling multimedia features in mobile phones. However, as will be discussed, the firm has some difficulty in penetrating the market for this type of solution.

Within this business line, the firms also reported three business-improving innovations. The Build-Operate-Transfer event, Botnia Hightech and the Symbian Competence Centre all fall in this category. These were events of organisational change to improve competitiveness and support further development within business line.

5.2.2 Made in India products

Recent years has seen a certain reinvigoration and growth of the packaged product segment. During the 1990s, some firms had 'mixed' business models aiming to sell products and (unrelated) services under the same roof. However, many firms discovered that developing products and selling products are two different things. Deficient marketing capabilities pushed some firms out of the product business. However, the sector has witnessed a certain degree of consolidation. As in services, there is an increasing specialisation within vertical domains. Few firms have had success with developing horizontal applications aimed at a broad cross-section of users (e.g. enterprise resource planning (ERP) or CRM). Rather, firms tend to concentrate on highly specialised domains.

Cranes Software specialises in products for advanced engineering and statistical analytics. The firm started out in 1991 as reseller of software packages. From the mid-1990s, it became the exclusive reseller of Matlab and slowly became the primary distributor of scientific software products in India. In addition, it established a related training division servicing academic and corporate users. This necessitated the hiring of experts in different scientific fields. From the year 2000, it started its venture into product development. However, Cranes does not develop products from the ground. Rather it follows the acquisition route by drawing on its linkages to scientific software houses. Its core strategy is dubbed acquire-enhance-expand: (i) it acquires a 'neglected' product, (ii) it modernises and enhances this product, and (iii) it then takes these products to the global market.

- For all its products Cranes now retains a combination of engineering teams and respected domain experts. The latter play a vital role in both the enhancement and the expansion phase. In some cases, the original authors of the programs have been brought in and help not only with technical aspects but also with the *marketing network* and strategy. This involved setting up marketing offices with

foreign staff, in an effort of 'going global' in organisational terms to supports the international market-orientation – **Type D** (sales and marketing networks to support global expansion).

- As a part of the strategy just mentioned, Cranes acquired the Engineering Mechanics Research Corporation and its *NISA* product for a Finite Element Analysis, a computer simulation technique used in engineering analysis. The firm also offers related computer-aided engineering (CAE) services to clients in different engineering fields. The firms rewrote the (pre-existing) software and added new features. The event therefore indicates activities at the problem-solving level – **Type B**.
- Cranes Software acquired *SYSTAT*, a statistical software product, from a major producer of statistical software (along with its global base of over 64,000 licensed users) in 2001. The package was completely rewritten in new programming language, and it was modernised and equipped with more than 20 new statistical functionalities. This persuaded users to upgrade to the new version. It rested on the deployment of several hundred 'worker years' of development effort and interestingly, as conformed by the original US author of the product, several aspects of the core architectures were redesigned. This event therefore indicates activities at the problem framing level – **Type A**.

Encore Software has used it capabilities in the electronics field to become a systems integrator of 'affordable information appliances'. The firm has designed four such appliances, aimed at different market segments in developing countries. However, no manufacturing or assembly activities are undertaken in-house.

- For instance, the Linux-based *Mobilis* device is customised for Indian conditions by being low in power consumption and can be set up to use major Indian languages. As hardware product designed developed entirely in-house this event is can be classified as problem framing – **Type A**. However, as it is essentially a

non-software innovation this event essentially falls outside the category of innovation discussed in this study.[75]

Founded in 1999, ***Liqwid Krystal*** set out to develop interactive software development skill-building solutions. Codesaw, discussed below, brought to the market after a few years of existence was aimed at the US market. However, more recently Liqwid Krystal addressed the Indian market in efforts to shift its business model towards learning solution services (as opposed to a licence of technology to firms who provide such services). In this regard, gyanX and rRapidSuite were two new solutions offered to the market, aimed at academia and the corporate sector respectively.

- *Codesaw*, is a 'virtual computer lab' that can run in a web browser. When this solution was developed, it was licensed to leading US IT publishers. These publishers provided the solution as a value-added service with their books on software programming and it was later upgraded with an online skills assessment solution. However, this arrangement failed to generate the user interest that was initially anticipated. In 2004, the firm therefore revisited its business model and mission. Using content and courseware from the IT publishers, Codesaw is made flexible through different modules and is used to provide online learning solutions for the Indian market. Conceived and developed by Liqwid Krystal, this event was a case of problem-framing innovation – **Type A**.
- For the IT educational sector *gyanX* is a customisable online resource tool that includes courses, content and assessment functionality. The firm has secured leading customers, including Infosys and Visvesvaraya Technological University. It builds to large extent on the Codesaw solution and only incremental tweaks were added. There are more elements of 'opening a new market' based on product modification. This event is therefore **Type B**.
- For the corporate IT sector, *rRapidSuite* enables software firms to conduct online tests in the recruitment phase and to undertake subsequent corporate

[75] For reasons of simplicity, this is 'ignored'. The thesis will continue using 36 events rather 35. This decision was made in order to introduce as few complications as possible and because it does not change the overall findings.

training, all on an SaaS basis. However, this event follows largely the same pattern as GyanX and it is therefore **Type B**.

In *summary*, the highest level reached by the sample firms within this business line is the problem-framing innovation level (Type A). All the three firms that reported events within this business line showed evidence of problem-framing innovation activities. It lies in the nature of the own-product development business that firms are framing their own products. However, the nature of business-improving innovations shows that many of the interesting trends within this segment relate not so much to this aspect but rather to the way these firms engage with the global economy and how the products are brought to the market. Two events involved problem-solving activities (Type B), and another two events involved 'other innovation' (Type D). Outsourcing has little direct influence business development in these firms, but a number of other factors of interests to this study are relevant.

5.2.3 Offshore product development

The ESO activities discussed above feed into the product development processes in electronics and telecom industries. OPD activities, on the other hand, feed into software industries. The transition in this business line is akin to the CAD trajectory. Like the global sourcing of services, OPD is becoming increasingly recognised as a core element in so-called independent software vendors.

> Initially, the key driver for these companies was often the significant cost arbitrage opportunity offered by India based vendors. As a result most of the work offshored to India was lower-end activities of coding and testing. Over time, the demonstrated success of India based development centres in delivering not only cost, but also on quality and technological superiority has attracted an increasing level of interest in offshore product development to India.
>
> (NASSCOM 2006b: 405)

Dedicated OPD firms, such as Aditi and Aztecsoft, have emerged and they provide services akin to OEMs and own design manufacturing (ODM). Several larger companies now also provide such services. The line of activities generated export revenues worth US$560 million in 2005.

One of the leading pure players in this space is ***Aditi Technologies***, which was established in the mid-1990s by entrepreneurs returning from the USA. The CEO came from a position as a general manager of a division in Microsoft. During the 1990s the firm concentred on developing its own CRM product, Talisma, while also supplying services, including technology support for independent software vendors (ISVs). In the early 2000s the CRM product business was spun off, (though the founders still hold a majority stake) so the firm could become a pure-play OPD firm. Initially most work was downstream-oriented and typically related to upgrades and add-ons for existing products for which documentation was clear. Today the firm has acquired capabilities for end-to-end new product development.

- For instance, the firm developed an advanced web-application, a *Digital Music Distribution Platform*, for a Seattle-based business to business (B2B). Although this start-up firm was operating firmly within the IT sector, it did not have an in-house engineering team. From a short 'vision document' of eight pages, Aditi developed a complete solution in less than one year. Aditi helped to integrate the solution into the Microsoft media-player as well as eBay. This was considered a vanguard projects as it involved the independent development of entirely new products. There was a large degree of involvement in the conceptualisation phase of the innovation process, which was shifted partly to the Indian supplier. With problem-framing elements undertaken by the supplier this event is situated as **Type A**.
- A similar end-to-end engagement was initiated with a US-based non-profit technology centre. Aditi developed *Mifos*, an open source management information system (MIS) that supports the activities of microfinance institutions. While the project exemplified a new type of engagement, it also spurred a major drive towards agile software development (ASD) methodology. These services are transformational as they enable a new (non-technical) competence profile in buyer organisations. However, this firm has also made initiatives to develop innovative and solutions for customers that are more traditional. This end-to-end development of Mifos involved key problem-framing tasks such as requirement analysis – **Type A**.
- The firm provides *Product Transformation Services* in which the firm helps companies modernise their products in ways that harness new technologies and

paradigms such as SaaS and Web2.0 and improve functionality and user experience. This typically involves major revision of architecture as old designs fail to keep up with new trends and user needs. For instance, Aditi migrated (rewrote) a customer's existing supply-chain management product to the Microsoft.NET framework. In doing so, it created value added by adding new features capabilities to the product. A major component of this arrangement was the migration of existing software products to the technology platform owned by the alliance partner. It was essentially a migration of an existing software system to a new technology platform but since new features were added, this event indicates activities at problem-solving level – **Type B**.

Aztecsoft was founded in 1995 in a small office leased from Software Technology Parks of India in Electronics City, an electronics industrial park just outside Bangalore. It intended to create an excellent Indian software product for the global market (i.e. this firm started off in the MIP business line). In the first five years, the company's major focus was the development of the product, Jpact – Java Powered Access Technology – a product for information access, integration and distribution via the internet, a so-called extract, transform and load (ETL) tool.

- Despite considerable sales and marketing efforts in the USA, the firm was unable to attain commercial success with this *ETL Tool*. Instead, the firm turned to software product development for clients on a contract basis to pay off the product development and related expenses. The firm moved on to the services model as it realised it did not have the resources to market such a product in the vastly competitive US market. Today Aztecsoft is focused on deploying the accumulated and specialised capabilities by providing value-added services. By providing critical product-engineering services rather than just the non-core activities, the firm is helping customers move on to emerging business models in the ISV market. The best example is the transformation of Jpact into a new solution marketed by a key client, a California-based developer of database life-cycle technologies that help companies build, optimise and manage databases. By leveraging the Jpact product the firm was able to quickly create new cutting-edge features as well as entirely new products in order to leapfrog the customer's competition, e.g. in online functionality. While product development and roadmap is

the responsibility of Aztecsoft, the customer is now able to bring an innovative new product to the market under its own brand name. Aztecsoft's *ETL Tool* was a product of a proactive and multi-year in-house product development effort and high-level design was a key feature of the process throughout – **Type A**.

- The capabilities required for managing product engineering are markedly different from, for example, most CAD services. Overall, it requires a higher level of specialisation. Attracting talent is a challenge in the current demand-and-supply gap scenario. In the face of fierce competition from rival firms, Aztecsoft has made targeted and creative initiatives to attract talent; its initiative to attract employees through an extensive *Image Campaign* is an example. Unlike most other events reported here, this event was oriented towards backwards linkages. This event is bracketed as improving commercial relations – **Type D** (campaign to attract talent).

In *summary*, the highest level reached by the sample firms within this business line is the problem-framing innovation level (Type A). Three events reached this level. However, the firms also reported one event in the problem solving (Type B) and 'other' (Type D) categories respectively.

5.2.4 Summary of PDSS

Within ESO, a number of examples have been given of how firms have deepened their capabilities in the standards-based IP development segment. The firms in the sample have benefited from increased demand after the turn of the century (as discussed in the previous chapter). However, it also appears that the basic nature of services provided (*vis-à-vis* those undertaken by customers) have been relatively stagnant. However, there is some indication that firms are now getting into the game at an earlier stage of the technology curve (e.g. UWB and Wimax). [76]

The material provides scarce evidence with regard to trajectories within MIP. Incidentally, one in OPD shows that one attempts at own product development during the

[76] If one wants to dig deeper, the key differentiator within this category is the start date of development with regard to the maturity curve of the standard-based technology. More mature technologies are less risky and generally involve less development time. Another differentiator is the degree to which firms can offer further product realisation services along with the IP blocks.

1990s led eventually to the exit of the firm from this business lines because of the inability to sell (ETL Tool). Other events show that firms have worked on new ways of acquiring brand image (acquisitions) and marketing products. The capabilities in the OPD space grew out of the MIP business line. Both of the two main players in the sample had a background as own brand product developers. While they started out with coding-to-specs activities, the material showed that they are now capable of providing advanced services of the problem-framing kind.

Table 5.2: PDSS events – types of innovation

Engineering services outsourcing			**Made in India products**			**Offshore product development**		
Firms	*Events*	*Type*	*Firms*	*Events*	*Type*	*Firms*	*Events*	*Type*
Encore	VoIP solution	B	**Cranes**	Global Marketing Network	D	**Aditi**	Digital Music Distribution Platform	A
-	Wimax solution	B	**-**	NISA	B	**-**	Mifos	A
MindTree	Bluetooth solution	B	**-**	SYSTAT	A	**-**	Product Transformation Services	B
M-Tec	Build-Operate-Transfer	D	**Encore**	Mobilis	A	**Aztecsoft**	ETL Tool	A
Sasken	Botnia Hightech	D	**Liqwid**	Codesaw	A	-	Marketing campaign	D
-	Multimedia Subsystem	B	**-**	gyanX	B			
-	Symbian Competence Centre	D	**-**	rRapidSuite	B			
Wipro	Ultra Wideband solution	B						

5.3 Summary and overview

The events described in this chapter provide a 'portfolio' of innovation activities that have occurred in sample firms. Describing this full range in some detail was necessary because there is little agreement on what software innovation is. However, certain of the events are more important to this research than others in addressing the overarching question. The most important ones are those that shed light on the following questions: What was the 'highest level' of innovation type in each business level? Was there any evidence of problem-solving and problem-framing innovation capability levels?

Table 5.3 summarises the key results of the analysis, indicating the 'highest level' (the peak) reached within each business line (marked with grey fill) as well as the number of events at each level.

Table 5.3: Types of innovation within business lines

	BPSS			PDSS		
	CAD	**ITS**	**IMS**	**ESO**	**MIP**	**OPD**
Type A	3				3	3
Type B	-		1	5	3	1
Type C	2	2	1	-	-	-
Type D	3	2	2	3	1	1

Note: The grey area indicates the 'highest levels' reached within the respective business lines.

The table indicates that (i) there is a variation in the levels reached across business lines, and (ii) there is evidence of problem-framing and problem-solving innovative activity, but only within certain business lines. In order to elaborate on these findings, this section discusses the evidence of activities at each level in turn.

Table 5.4 shows which events fall in the different categories. It also indicates which of these events for part of the 'sub-sample' which will be discussed further (from the buyer side) in Chapter 7.

Table 5.4: Overview of events across types of innovation

Type	Business lines	Firms	Event code name	Sub-sample
Type A	CAD	Infosys	Influx	Yes
	CAD	MindTree	Sales Tool System	Yes
	CAD	M-Tec	B/OSS	Yes
	MIP	Cranes Software	SYSTAT	Yes
	MIP	Encore Software	Mobilis	
	MIP	Liqwid Krystal	Codesaw	Yes
	OPD	Aditi Technologies	Digital Music Distribution Platform	Yes
	OPD	Aditi Technologies	Mifos	Yes
	OPD	Aztecsoft	ETL Tool	Yes
Type B	ESO	Encore Software	VoIP solution	
	ESO	Encore Software	Wimax solution	
	ESO	MindTree	Bluetooth solution	Yes
	ESO	Sasken	Multimedia Subsystem	
	ESO	Wipro	Ultra Wideband solution	
	IMS	Microland	CIO Dashboard solution	Yes
	MIP	Liqwid Krystal	gyanX	
	MIP	Liqwid Krystal	rRapidSuite	
	OPD	Aditi Technologies	Product Transformation Services	
Type C	CAD	Infosys	Tools Group	
	CAD	MindTree	TechWorks	
	IMS	Microland	Network Management System	
	ITS	Aztecsoft	I-Test	
	ITS	RelQ	AsessQ	
Type D	CAD	Infosys	CIMBA	
	CAD	M-Tec	COMPASS	
	CAD	Wipro	Lean Software Factory	
	ESO	M-Tec	Build-Operate-Transfer	Yes
	ESO	Sasken	Botnia Hightech	Yes
	ESO	Sasken	Symbian Competence Centre	
	IMS	Microland	IT Security Consulting	
	IMS	Wipro	Global Command Centre	
	ITS	RelQ	RelQ Online	
	ITS	RelQ	Verticalisation	
	MIP	Cranes Software	Global Marketing Network	
	MIP	Cranes Software	NISA	
	OPD	Aztecsoft	Marketing campaign	

Note: Sub-sample refers to the events that were also examined from the demand side.

5.3.1 Problem-framing innovation – Type A

Problem-framing innovation activities were identified in nine events in three business lines (CAD, MIP and OPD). The first thing to notice is that these business lines cut across the BPSS and the PDSS segments. The second thing to notice is that two of these business lines are directly associated with outsourcing (CAD and OPD), whereas a third (MIP) is not. The identification of problem-framing activity in MIP is neither new nor surprising, and because problem framing is an inherent feature of this business line, it will be given little further discussion here. However, for analytical purposes these MIP events are important as a point of comparison when discussing issues related to problem framing in later chapters.

The remaining six events are of particular value to this research. In CAD, two of these events (Sales Tools and B/OSS) were particular customer projects, whereas the third (Influx) was a framework to be applied across projects. In all of these events, the suppliers were engaged in requirements definition and high-level design – one clear indicator of problem-framing activity. In OPD, all three events were customer projects in which the supplier was engaged in requirements and high-level design.

5.3.2 Problem-solving innovation capability – Type B

Problem-solving activities were identified in nine events in four business lines. One business line (ITS) did not reach this level. Another (CAD) has clearly reached this level – as the problem-framing events show directly and indirectly. Yet, no CAD events fell into this bracket.

For certain business lines, problem-solving capability was 'the limit'. Two business lines exhibit this characteristic (IMS and ESO) as they had not reached the problem-framing level. These lines are therefore important for analytical purposes because they can help to identify issues related to the difficulty and barriers related to the attainment of problem-framing capabilities. Two events in IMS – CIO Dashboard and Network Management System (in the same firm) – give evidence of 'modular innovations' in the form of confined subsystem improvements to customer networks and ongoing services. Five events in ESO – VOIP solution, Wimax solution, Bluetooth solution, Multimedia Subsystem and Ultra Wideband solution – show very similar characteristics as cases of standards-based software solution for hardware products.

5.3.3 Innovative activity related to implementation/execution – Type C

All business lines exhibited – or are assumed to have – capability at this level. Only one business line did not indicate activities at 'higher' levels (ITS). Events of this type were introductions of new processes and organisational arrangements that were oriented towards enhancing productivity and efficiency and developing new knowledge bases. These activities were initiated through the setting up of initiatives aimed at improving service provision methodology, productivity and/or reducing costs.[77] Some of these events may be said to have a mainly internal focus (e.g. Tools Group). However, another event shows that even process improvements sometimes have a substantial external dimension (NMS). Some of these events exhibit strong Type D features. The I-Test and AsessQ events were centrally concerned with the creation of methodologies to create/enter new business line and revenue streams.

5.3.4 'Other' Innovation – Type D

Table 5.5 lists the nature of each of the Type D innovations. In some ways, these events tell their own story. Interestingly, all of these innovations are external in the sense that they fill a space that is partly external to the firm. We may distinguish between four inductively constructed types of changes:

[77] Overview interviews in the sample firms indicated that a common preoccupation was related to more effective use of software development tools and related methodologies. This included re-usable code or components drawn from external repositories or created in-house. Another preoccupation was efforts at de-skilling', i.e. separation of certain routine activities from the workflows in order for these to be automated and undertaken by less-experienced employees in cross-functional teams. Similarly, most firms across the segments were continually experimenting with and improving development methodology with the use of methods such as Extreme Programming (XP) and Agile. These initiatives were typically tied to knowledge management (KM) tools and initiatives and were typically coordinated or overseen by KM departments. KM departments of Indian software firms have won widespread recognition, not only because of the use of KM, but also because of the development of KM techniques and systems.

Table 5.5: Summary of 'other' innovations

• Acquisition to improve customer proximity, new activities and tacit 'product knowledge' • Alliance and organisational change to deepen capabilities in specialised technology domain • Campaign to attract talent • Online customer interaction model to support seamless interaction small project • Opening a new business line • Opening a new revenue stream within existing business line • Organisational change to support global expansion as importance and volume of on-site activities increase • Organisational segmentation along customer segments as domain knowledge increases in importance • Project management solution to support advanced customers beginning to locate project management tasks with the supplier • Sales and marketing networks to support global expansion

- *Offerings – new business line and revenue streams*. Global Command Centre shows how key events were instrumental in opening up entirely new business lines for Indian firms in the global market (IMS). Other new offerings – IT Security Consulting – were aimed at the local market, but essentially reflected changing relationships with global partners.

- *Processes – new methods for customer interaction and knowledge*. Events such as CIMBA and Compass are examples of cases in which client-related processes were changed. The former reflected initiatives 'extracting' business knowledge from ongoing (and prospective) client relationships; the later reflected an effort to take a larger stake in the relationship by taking on a larger share of the management of projects (in relation to clients). RelQ online was aimed at making customer interaction around small projects more efficient.

- *Organisational arrangements – new organisational units and processes*. Events such as Botnia Hightech and I-Test are examples of cases in which firms used new acquisitions in efforts to redefine and open new relationships with customers. The BOT event is an example of how one firm sought to engage in a new type of contractual relationships that redefined the organisational boundaries between buyer and supplier. The verticalisation event is an example of how one firm sought to consolidate knowledge domains and create better points of engagement (or windows) for clients in different industries.

- *Marketing initiatives – inputs and output markets*. The Global Marketing Network and the Marketing campaign were aimed at building image and new relationships. The latter was oriented towards human resources and recruitment.[78]

Because most events involve several types of change simultaneously, further discussion about their relative importance is difficult. Moreover, such an analysis is not necessary for the purposes of this research.

5.3.5 Some insights regarding trajectories

The analysis of events has given a range of examples of areas in which firms have developed new capabilities. Recall that an event was specified as a process through which the firm became able to do something new or to do existing things better. Some of the information contained in the description of these events gives some indication of how these business lines have moved over time towards increasingly innovative activities, albeit to different degrees in different business lines. This section reflects on and summarises briefly some cross-cutting trends, as they appear from the material collected for this study. Collectively they constitute and support a 'new phase' in the development of the industry after the tech crisis in 2001. Key cross-cutting trends are shown in Table 5.6.

[78] According to NASSCOM (2007b) 'input innovation' is one of the most prevalent activities in the industry. This is indirectly reflected in the rRapidSuite event mentioned above, as this solution seeks to assist firms in more rapid and effective absorption of human resources into the Indian software industry.

Table 5.6: New cross-cutting trends in the observation period

Feature	Description	Evidence from BPSS	Evidence from PDSS
New business lines	Expanding breadth of services; now including a wider array of business lines such as IMS, ITS and OPD	AsessQ; Global Command Centre; I-Test	Digital Music Distribution Platform; ETL Tool; Mifos; Product Transformation Services
New business activities (value proposition)	Shift towards consultancy activities and transformational services; engaging in the definition of systems and products (i.e. Type A and Type B innovations)	B/OSS; Influx; IT Security Consulting; Sales Tool System	Bluetooth solution; Digital Music Distribution Platform; ETL Tool; Mifos; Multimedia Subsystem; Ultra Wideband solution; VOIP Solution; Wimax solution
New engagement modes and models	As is reflected in many events, firms were engaged in processes of internationalisation and 'going global' more broadly. In general, this includes efforts of strengthening on-site activities and integrating them more closely and seamlessly with offshore components	CIMBA; COMPASS; RelQ Online; Verticalisation	Botnia Hightech; Build-Operate-Transfer; Global Marketing Network; Symbian Competence Centre

The key point is that events at different levels need to be seen in conjunction. When viewed holistically, the picture emerges in which forefront events (Types A and B and certain D Types) and supporting events (Types C and D) 'work together' in propelling the industry forward. The thesis returns to these findings in Chapter 8.

It is interesting to note that in BPSS, as one element of the upward trajectory, new business lines have emerged as distinct knowledge domains that grew out of CAD. These have enabled new independent businesses, but multi-domain firms have also used these new business lines to strengthen core CAD services and the provision of integrated services. For instance, firms such as Infosys and Wipro have benefited from the cross-leveraging of CAD and IMS consulting. This is discussed further in Chapter 6. In the PDSS, some events indicate that a process of consolidation has taken place in MIP. Remaining firms invest increasingly in marketing and relational capabilities (see the next chapter) while exiting firms have entered the OPD space. This new business line is in essence a service space. It has transformed software product development from a downstream element of MIP into a core service. The increasing 'service' element of the

product space is also evident in ESO, which has added on new 'implementation service' activities in addition to core IP development and standalone licensing.

5.3.6 Spaces

The chapter has showed – in a very general sense – how sampled firms have innovated in new spaces. Recall that a 'space' is an opportunity for innovation.

It has been mentioned implicitly that some of these spaces are mainly internal – with no external actors exerting direct or significant influence on the size or the shape of the opportunity. However, those spaces are primarily about improving processes. Several firms reported these as 'important learning events' so they are clearly important. However, they are unlikely to produce (on their own) trajectories that sustain growth – nor do they change the division of labour.

Most of the spaces in which firms have innovated are external, either partially or entirely. Partially external spaces relate mainly to interaction mechanisms and engagement models. These may reflect changes in the division of labour, for instance, when firms address the opportunity of supplier-coordinated project management. However, the clearest sign of the changing division of *innovation* labour is associated with spaces that are 'entirely' external. It is primarily in such external spaces that *peak capability* is developed. These spaces are mostly associated with Types A and B. They are signs of a changing position of suppliers in the global economy. In that sense, they are of most analytical value to this study. This is why the sub-sample of events (see Table 5.4) is related directly and indirectly to these types of innovation.

5.4 Conclusion

The key objective of this chapter was to show the types of innovation capability that were achieved by firms in the sample by the end of the observation period. The findings have already been summarised and shall not be repeated here. It suffices to say that the chapter has differentiated between business lines and investigated the depth of capabilities that firms have reached within them.

The evidence described in the chapter runs counter to the hypothesis derived from the literature. It is *not* the case that supplier capability is limited to Types D and C. While

Type B may be less surprising, the identification of Type A in two outsourcing business lines provides evidence that leads to the 'rejection' of the hypothesis. The identification of Type A in MIP was expected as it is not an outsourcing business. However, it was unexpected in CAD and OPD.

The chapter also served as a stepping-stone. Before addressing the key question of the thesis directly, it was necessary to step back and establish whether and to what degree innovation capabilities exist in Bangalore. As mentioned, the literature has tended to be pessimistic in this regard, acknowledging fast growth but emphasising that this contains very little innovation. This chapter has shown that sampled firms have moved over time towards increasingly innovative activities. It has illuminated elements of the transitions and trajectories, and it has shown the nature of the new spaces into which sample firms have moved. In different ways, these are 'innovation spaces'. The previous chapter explained how the sampling procedure itself provided information with regard to innovativeness (because gatekeeper informants thought them innovative). However, 'innovativeness' is a loose concept. This chapter has substantiated what innovativeness looks is by providing the evidence of innovation activity and capability. It described the *ways* in which sampled firms have been 'innovation active' – both within and beyond the expected types.

While this documentation of innovation activities is an important contribution in itself, the main aim of the thesis is to investigate the role of outsourcing in the formation of new innovative capabilities. The next two chapters set out to explore (i) the underlying process related to each event in which innovative capability has been built, and (ii) why Type A and Type B have emerged.

6 Inputs into the innovation process in supplier firms

The previous chapter showed that suppliers have moved into new spaces and have demonstrated new qualities of capability in different business lines. Little is known about how software suppliers build capabilities in the context of outsourcing. Because the events studied represent distinct cases of capability building, the study of their process may help to open up the 'black box' of supplier learning. The key question addressed in this chapter is: *How did sampled firms build capability during the observation period?* In order to answer this question the chapter examines the event projects and seeks to identify the inputs in order to draw out the factors that enabled firms to demonstrate new qualities of capability.

The findings in thus chapter builds on the analysis and data presented in Appendix I, in which the detailed information about frequencies is provided. This appendix also explains how the study defines high, medium, low and no importance. While the identification of the importance of particular inputs is important in itself, a further important question for our purposes is how such sources were combined in the innovation process.

The chapter is structured as follows:

- *Differences between phases, business lines and types of innovation*: draws together the insights by providing a summary of the key features of the 'learning model' identified. It then examines differences across business lines and across types of innovation.

- *Local sources versus global sources*: delves deeper into the exploration of external sources by examining their geography, in terms of 'local' and 'global' sources.

- *Mobilising resources for global opportunities – two examples*: provides examples of 'peak capability' building in more detail.

- *Conclusion* summarises the insights, notes some relevant qualifications and discusses the second research hypothesis.

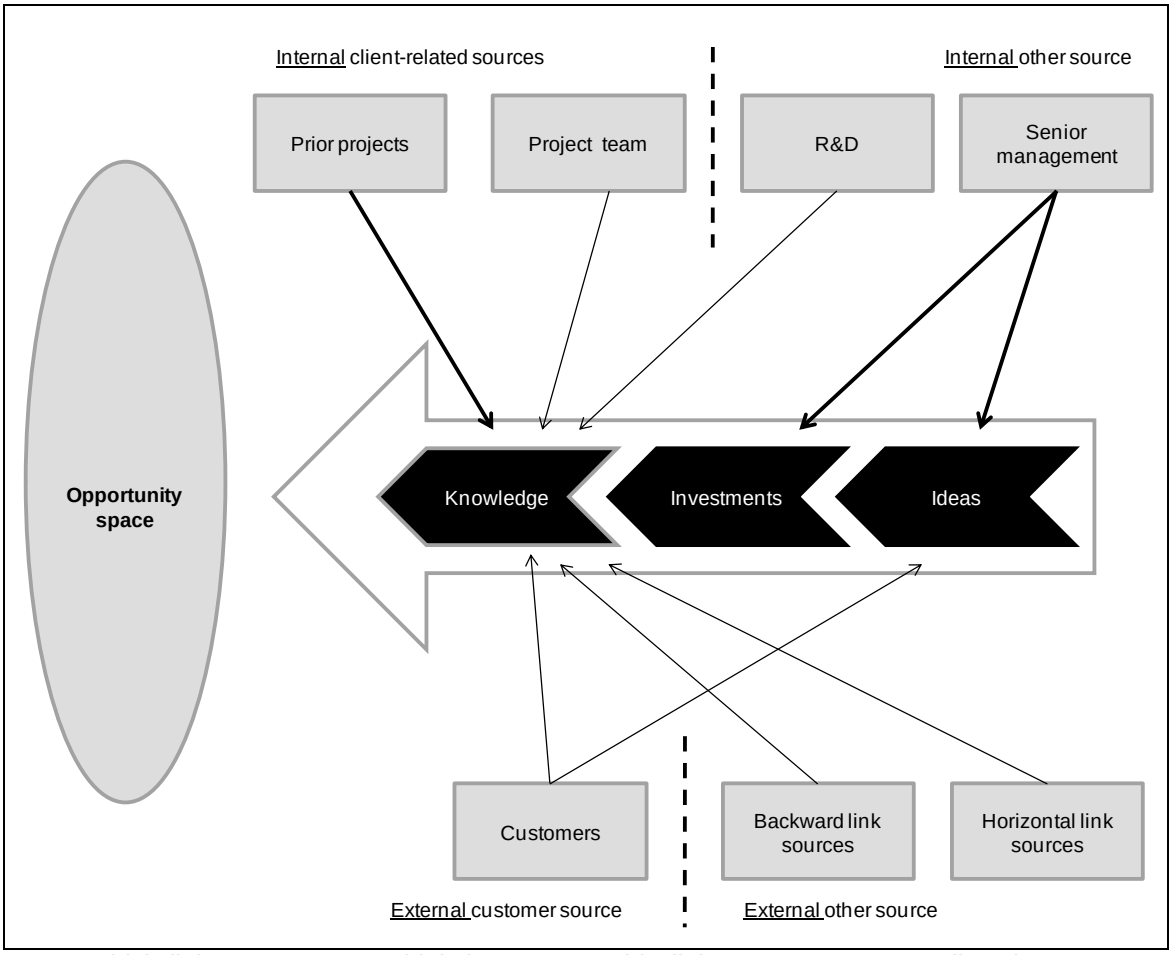
6.1 Differences between phases, business lines and types of innovation

This subsection seeks to summarise briefly the insights gained so far. Together with the next two subsections, it makes a summarising analysis of inputs into innovation events, concentrating on the use of sources in the innovative projects.

6.1.1 Differences between phases: ideas, investment and knowledge

The cross-case analysis (Appendix I) shows that an 'innovation-event model' exists in which some elements are relatively constant (high frequency across cases) whereas other element are more variable (medium frequency across cases). This varies between ideas, investments and knowledge. These features are summarised in Figure 6.1. The figure shows the following pattern:

Figure 6.1: Aggregate-archetypal innovation model



Note: Thick linkages represent high importance; thin linkages represent medium importance. Low frequencies are not depicted.

- *Ideas*: senior management is a highly frequent source of ideas. Customers are often also involved in idea generation.

- *Investment*s: senior management is a highly frequent source of investments for innovation events.

- *Knowledge*: prior projects are a highly frequent source of knowledge. However, a range of other sources are often involved as providers of knowledge: internal project teams, R&D units and non-R&D knowledge initiatives as providers of knowledge; customers, backward links and horizontal links.

The next subsections discuss differences between business lines and types of innovation. As will be shown, some insights emerge from the analysis of the role of different types of source, but more clear patterns emerge when we look at the number of inputs.

6.1.2 Differences between business lines and types of innovation

As just shown, sources of ideas and investments do not vary a great deal, whereas sources of knowledge vary more. Therefore, the study of knowledge sources provides some additional insights. This information is summarised in Appendix I (Table 11.6). Central insights that emerge from this analysis are:

- The frequent use of knowledge acquired from previous projects and generated in present projects is shared between both the BPSS and PDSS segments. This confirms that reliance on knowledge in previous projects is a common feature in learning/innovation in software supplier firms.
- PDSS relies more on R&D processes (internal and external) than does BPSS. It seems clear that the ESO segment has a close association with the use of R&D in the innovation process. This suggests that software services for product development are more dependent on 'hard' forms of knowledge creation.[79]
- Unexpectedly, direct knowledge inputs from customers were slightly more important in BPSS than in PDSS. This is likely to reflect the fact that BPSS had a higher relative representation of Type C and Type D events that in general relied less on direct customer inputs. This was particularly true for those events that addressed what the previous chapter called 'internal opportunity spaces'. [80]

Beyond these insights, the analysis shows few significant patterns of variation across segments. The number of cases is too small to draw strong conclusions from the variations that exist in *knowledge* inputs. For this reason, a large part of this chapter is devoted to qualitative analysis. However, the pattern across business lines with regard to *all inputs* hints at more significant insights from quantitative reasoning. This emerges

[79] Non-R&D knowledge creation is varied within both segments.

[80] Chapter 5 showed how the exploitation of internal spaces are often reflections of efforts to deepen the existing divisions of labour, whereas external spaces – Type A in particular – change the global innovation map.

from Table 6.1, which shows the average number of inputs across business lines *and types of innovation*.

Table 6.1: Use of sources in events across business lines and types of innovation

	BPSS			PDSS		
	CAD	**ITS**	**IMS**	**ESO**	**MIP**	**OPD**
Type A	8.7				7.7	10.0
Type B	-		6.0	8.6	8.0	8.0
Type C	6.5	4.5	6.0	-	-	-
Type D	7.7	7.0	6.5	8.3	4.0	4.0

Source: Drawn from analysis of sources used in innovation events. It distinguishes between low (0–11 of 36), medium (12–24 of 36) and high importance (26–36 of 36).
Note: They grey area indicates the 'highest levels' reached within the respective business lines.

Table 6.1 shows there are internal differences between business lines, meaning that events in CAD tended in general to use more sources than MIP in general (compare Type A and Type D). However, it also suggests that there are patterns in which business lines that have reached a higher level of peak capability also tend to use more sources. For instance, ITS and IMS – both limited to basic forms of innovation – tend to use few sources.

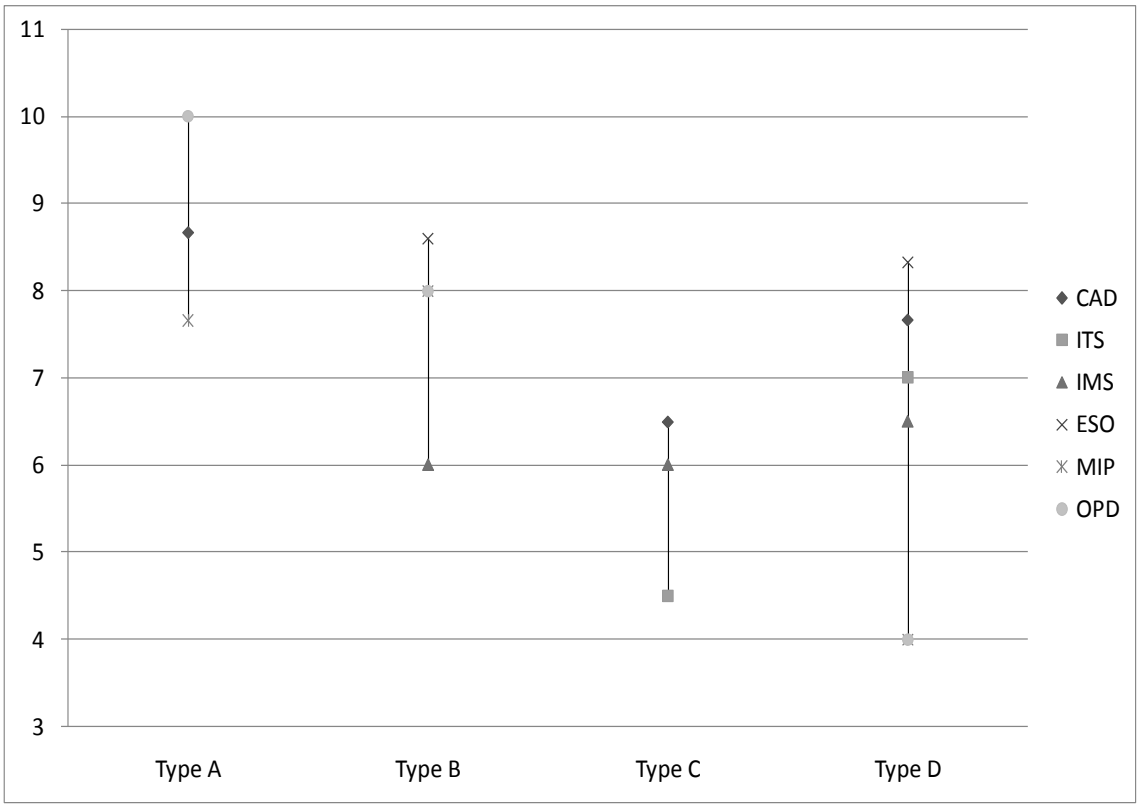
Segelod and Jordan (2004) made an analysis of software firms in OECD, examining their sources/linkages over different project phases. They found that the average number of sources in software projects was 7.0. They only examined external linkages, but they also examined four phases (whereas this study examined only three). The fourth phase was the delivery/go-to-market phase in which the need for external linkages is necessarily high.

In this study, the average number of sources utilised was 7.53 input linkages. However, this covers internal as well as external linkages, but only three 'phases' i.e. types of resources. In this light, it appears that Indian firms use comparatively fewer linkages in their innovative projects. The immediate explanation for this is that European firms tends to be market facing, whereas Indian firms are outsourcing vendors with fewer needs for linkages beyond those to the immediate customer.

The study of differences in 'sourcing' across innovating types provides some additional insights. These differences appear in Figure 6.2. It plots the average number of sources used in different types of event in different business lines. This shows a differentiated

range across the four types. It shows graphically an association between more advanced types of innovation and the use of more sources in the process.

Figure 6.2: Average number of sources across types of event (by business line)



Source: Drawn from analysis of sources used in innovation events.

Figure 6.2 shows that on average, Type A tended to use most sources, and Type B second most. Type C seems to follow this pattern with a range of average use of sources that is lower than Type B. Type D deviates from this pattern. This could well be due to Type D being a 'residual category' with very different types of projects.[81]

This pattern is worth recording because it suggests that the more advanced the innovation, the greater the complexity of the process. This is perhaps unsurprising, but it suggests that the challenge for the innovating company is to *integrate effectively* a

[81] A crude distinction can be made between the 'problem solving/framing types' (A+B) and 'other types' (C+D). This distinction is made in Appendix I (Differences across types of innovation and business lines (Table 11.5). It shows that there are many constant features across all types of events. However, there are also differences. Types A and B relied more on R&D inputs and direct customer inputs. Types C and D relied more on non-R&D knowledge creation efforts (internal knowledge communities, knowledge management and training). 'Other' internal sources were also important to Type D (primarily knowledge from recruits and from acquired units). R&D was relatively unimportant to Types C and D.

higher number of inputs. While this finding is important, findings that are more significant emerged from organisational–spatial analysis. This is shown in the next section.

6.2 Local sources versus global sources

One of the purposes of this part of the analysis was to examine the combination and use of sources in organisational–spatial terms. In order to address this issue, respondents were asked to specify and rank – in importance/criticality to the event – the sources of inputs. Did the inputs come from:

- Inside the firm?
- The local innovation system?
- The global linkages?

Table 6.2 arranges events by types of innovation. It the shows the relative importance of knowledge sources at the three different organisational–spatial 'levels'. It shows that the combination of firm-internal and global knowledge inputs was most common across all innovation events.[82] Inputs from the local innovation system were of little overall importance. There seems to be no immediate clear pattern when local sources were involved (although as discussed below, such a pattern emerges when we factor in business lines).

The discussion below explores these insights further. In particular, it explores the relative roles of the two types of external knowledge sources – local and global – in different types of innovation. It starts with the global level as this was of highest overall importance.

[82] As mentioned, ideas and investment were more prone to internal generation. No table of this kind was constructed for these resources. It suffices to say that ideas provided by global actors were either first or second most important in almost half of cases. With regard to investments, the same was true in one-third of cases.

Table 6.2: Relative importance of internal, local and global knowledge sources

Firm	Event name	Type	Internal	Local	Global
Cranes Software	SYSTAT	A	••	•••	•
Aditi Technologies	Mifos	A	•••	•	••
Encore Software	Mobilis	A	•••	•	••
Aditi Technologies	Digital Music Distribution Platform	A	••	-	•••
Liqwid Krystal	Codesaw	A	••	-	•••
M-Tec	B/OSS	A	••	-	•••
Aztecsoft	ETL Tool	A	•••	-	••
Infosys	Influx	A	•••	-	••
MindTree	Sales Tool System	A	•••	-	••
Liqwid Krystal	gyanX	B	••	•••	-
Liqwid Krystal	rRapidSuite	B	••	•••	-
Cranes Software	NISA	B	•••	••	•
Aditi Technologies	Product Transformation Services	B	••	-	•••
Encore Software	VoIP solution	B	•••	-	••
Encore Software	Wimax solution	B	•••	-	••
Microland	CIO Dashboard solution	B	•••	-	••
MindTree	Bluetooth solution	B	•••	-	••
Sasken	Multimedia Subsystem	B	•••	-	••
Wipro	Ultra Wideband solution	B	•••	-	••
Aztecsoft	I-Test	C	•••	••	•
MindTree	TechWorks	C	•••	••	•
Microland	Network Management System	C	••	-	•••
Infosys	Tools Group	C	•••	-	••
RelQ	AsessQ	C	•••	-	••
Aztecsoft	Marketing campaign	D	•••	••	-
Microland	IT Security Consulting	D	•••	•	••
Wipro	Lean Software Factory	D	•••	•	••
Cranes Software	Global Marketing Network	D	••	-	•••
M-Tec	Build-Operate-Transfer	D	••	-	•••
Sasken	Symbian Competence Centre	D	••	-	•••
Infosys	CIMBA	D	•••	-	••
M-Tec	COMPASS	D	•••	-	••
RelQ	RelQ Online	D	•••	-	••
RelQ	Verticalisation	D	•••	-	••
Sasken	Botnia Hightech	D	•••	-	••
Wipro	Global Command Centre	D	•••	-	••

Source: Informants' rankings. Note that the table is sorted by innovation type, local sources, and global sources.
The following system is used:
First most important: •••
Second most important: ••
Third most important: •
Not important: -

6.2.1 Global sources

The overall importance of the global level identified here contradicts much of the existing literature, which has tended to claim that customer interaction and global integration in the Indian software industry generates little innovation-relevant knowledge. To explore this, we first discuss innovation Types A and B.

Type A and Type B. As it appears from Table 6.2, global sources were central to Type A and B innovations. It is worthwhile pulling together the insights from analysis in Appendix I and summarise the main global sources and their role in Type A and Type B events. They can be summarised under three main headings:

(i) Knowledge from global customer firms.
(ii) Knowledge sourced in global backward linkages.
(iii) Knowledge from horizontal links.

Global customers provided knowledge inputs into almost all Type A and B events. There were few exceptions to this. These exceptions were of two types:

- In three cases firms drew on local rather than global customer sources (as described above).
- In three cases MIP firms did not deal directly with customers, but drew on other types of user information.

In the remaining 14 cases of Types A and B, global customers provided knowledge inputs, often critical knowledge inputs. This reflects that in some cases new capabilities are 'played out' in customer-specific settings. Customer-specific knowledge is required for the completion of the project but the criticality of this knowledge does not relate as much to the root capabilities as to their first-time application.

It can be noted that the majority of the customers in these 14 cases belong to the group of buyers that will be examined in Chapter 7. As found in that chapter, these customers adopted sourcing strategies that did not have a pure cost focus as they sought additional benefits including various types of improvement and knowledge-generating activity.

What this suggests is that, paradoxically, knowledge-*seeking* customers play a key role in *providing* knowledge inputs to suppliers' innovation events. This is because advanced, learning-intensive projects require substantial information exchange. In order to draw on suppliers' change-oriented capabilities, context-specific knowledge is exchanged. This type of contextualised knowledge is used in suppliers' efforts to capture new opportunity spaces (the event) and it is built into the core knowledge base. The next chapter goes into this process in more detail.

Certain buyers open up new spaces, but they also provide a share of the knowledge required to capture these spaces. The case of MindTree's development of a sales tools system will be discussed further in the next chapter. The customer (based in Sweden) wanted to provide a sales tools system for an auto manufacturer in the group (based in France), which in turn wanted to supply this to its sales forces across the globe. Much of the critical knowledge derived from a pre-existing sales tool system and the users of this system (primarily auto dealers). However, it also resided in the sales and IT departments of the auto manufacturer. Information and certain specifications had been organised by the first-degree (immediate) customer (in France) and these were provided formally upon project initiation. However, during the course of the development of the system the company needed to go back to the second- and third-degree customers/users (further up in the value chain) in order to conceptualise the bridge between the existing system and requirements for the new system. This necessitated lengthy consultative interaction throughout the process and MindTree was drawn into this. This knowledge, although generated a substantial organisational distance away, nonetheless helped MindTree in its first-time, end-to end development of such a system.

An important point with regard to 'first-time development' is that while customer requests for innovations are often initially client specific, these may be applicable to subsequent re-use with other buyers or markets. This applies to tools, frameworks and semi-standardised solutions. When a customer firm plays this role, it is referred to as an 'alpha customer'. Such a customer helps in developing a set of capabilities or re-usable frameworks/tools for a particular area by providing requirements, feedback and other resources. Importantly, they often provide significant investments.

Investments took place when customers paid for (parts of) the creative and development activities in the elaboration phase of the software development process. This occurred in innovation related to an improvement in ongoing buyer–supplier relationships. It also occurred in more standard customer projects that were characterised by the fact that both buyer and supplier considered it 'innovative' (in the sense that it necessitated greater than usual knowledge-generation in the supplier firm) and in which problems could not be solved without a preparatory phase of training, workshops and problem solving. Typically, these activities were billed separately or were isolated in the main contract. The CIO Dashboard in which the alpha customer financed 60 per cent of the development cost is one example.[83] Again, the Auto IT case provides another example, as does the B/OSS case. In both cases, customers paid 50 per cent of the costs for training/knowledge-transfer sessions that preceded the initiation of the projects. In the B/OSS case, for instance, the customer designed and arranged for intensive training and knowledge-transfer sessions that went beyond what was specified in the contract. [84]

Knowledge from *backward linkages* in the global economy was adopted mainly by ESO firms that incorporated proprietary technology into their solutions. This depended on the 'open' nature of innovation and product development processes in the electronics industry. This inclusion of off-the-shelf technology was critical to a very small number of top-end (most advanced) events in the ESO segment.

Knowledge from *horizontal links* is also interesting as many of the cases suggest that firms have benefited from various types of information openness in the construction of solutions. The previous section indicated that new opportunities for knowledge acquisition have arisen from sources such as:

- Open source communities (e.g. SourceForge and its contributors).[85]

[83] An informant underlined the importance: '[The customer] is an alpha customer for us. We have a special relationship with them, they helped us developed our six sigma practices; they taught us how to innovate.'

[84] Sasken received very similar services in relation to the development of the Symbian Competence Centre but in this case the costs were indirectly covered by Sasken since this firm needed to pay a (substantial) fee in order to be designated as a certified competence centre.

[85] SourceForge is a web-based source code repository. It acts as a centralized location for software developers to control and manage open source software development.

- Open or semi-open standards networks (e.g. Bluetooth).
- Technology owners adopting open strategies (e.g. Symbian).
- Collaborative knowledge communities (e.g. the UML community).

In sum, it seems that the capturing of new global opportunity spaces has some key recurring external ingredients, including the alignment with alpha customers and the use of information from open and semi-open networks and communities. However, as has been emphasised at various points, the conjunction of such external factors with internal efforts is key. (In order to illustrate how such conjunctions unfold, two examples are given in Section 6.3.)

Type C and Type D. In three cases informants stated that knowledge from global sources was *more* critical to the completion of the event than knowledge generated internally. In developing the Symbian Competence Centre, for instance, Symbian played a key role in training and auditing Sasken capabilities and processes. This enables them to function as a certified competence centre working with third-party users of Symbian technology. It is an example of how some global lead firms actively share knowledge and invest in Indian firm capabilities as the business and innovation process becomes more decomposed.

The most dominant constellation for Type C innovation was the use of internal knowledge generation, with global knowledge as the second most important ingredient. These events using this constellation were largely aimed at improving elements of the customer interaction process. CIMBA and COMPASS are obvious examples. The latter reflects a tendency of some customer firms to locate project management tasks in the supplier firm.[86]

6.2.2 Local sources

Since the limited importance of the local innovation system identified contradicts the hypothesis in the literature it is important to explore this dimension further.

[86] The same is tendency is noted by Tate *et al* (2009) who witnessed changing outsourcing governance structures including 'project management using suppliers resources'.

Type A and Type B. It was noted above that in the first instance, there was no clear pattern to when local knowledge sources were used in the innovation process. However, such a pattern emerges when we factor in business segments. *All* of the occurrences of local knowledge sourcing took place in the context of software product development (MIP or OPD). This leads to the conclusion that there is very little need or scope for local knowledge sourcing in the services business lines, including ESO.

The cases of local knowledge sourcing can be divided into two main types. The first types evolve around the Indian market as an opportunity space. For instance, Liqwid Krystal is now exploiting the booming software industry by licensing out their key online learning and certification tool (rRapidSuite) to two of India's largest software companies, one of which is based in Bangalore (and included in the sample). The Bangalore-based company was the first customer. Critical knowledge and specifications were gathered during exploratory meetings as well as in the implementation phase, where the customer implemented the solution in its large training campus. According to the CEO, location mattered: 'We couldn't find a better test-bed for our new products than right here at home'. The company benefited from local contacts and networks in bringing the product to market as GyanX. Critical feedback was provided by lead users including the Indian Institute of Science (IISc) and Indian Institute of Information Technology Bangalore (IIITB).[87] Today the solution is made available to more than 150,000 students in 128 university colleges across India.

This example shows that as the software industry in Bangalore is booming and diversifying, local market opportunities are emerging for smaller niche firms. Thus, to some extent the software industry in India is becoming a market in itself. Hitherto, such an inter-firm division of labour has been strikingly absent due to conformity of business models focusing on a narrow range of activities within the software development process (Lema and Hesbjerg 2003).[88] Liqwid Krystal is now exploiting some new spaces in the booming software industry by licensing out its key online learning tool

[87] Both of which have courses that use the system.

[88] As emphasised by NASSCOM (2007b), many of the innovation activities of the software industry in India has been concentrated on inputs (i.e. acquisition of skilled labour) because this is the critical bottleneck for further growth of many companies. Liqwid Krystal has exploited this new space.

(rRapidSuite) to two of India's largest software companies, one of which is Infosys. However, it is interesting to note that the initial learning experience was mainly achieved through interaction with a global buyer. This background is elaborated on in the next chapter. [89]

As a variation of this, Aditi Technologies acquired a contract to develop a Microfinance package for the US-based Grameen Technology Centre. In developing this product, the company benefited from interaction with a local user, the non-governmental organisation (NGO) Grameen Kota, which was provided with a beta trial and provided essential feedback. This indicates that there is a space associated with increased awareness of the need for tailored solutions to local problems. It may be seen as an effort to exploit the increasing capabilities in the Indian IT sector in the development of new solutions. Again, it was the global buyer that 'mediated' the link with local market (also elaborated on in the next chapter).[90]

The second type of local knowledge sourcing is the more traditional university–industry linkage. These occurred only in the context of highly specialised software products, where the software developer needed to draw on competences in the distinct scientific knowledge domains. Cranes significantly improved an existing software package, NISA, for finite element analysis (FEA). Close cooperation with the mechanical engineering department in IISc (including a professor becoming a member of the board of the company) enabled the team to add new and advanced features to the product, which were not available in alternative FEA software tools. In collaboration, user

[89] It is interesting to connect the discussion here with the role of initial buyer firm (discussed in the next chapter). This US-based buyer firm had opened its business models, increasingly collaborating with other publishers on the sharing and cross-selling of content. It concentrated increasingly on connecting with users and sourced innovative solutions from outside for this end. However, the solution for online experimental coding and skills assessment, sourced from a Bangalore firm, was not deemed a success and after a few years of offering this solution, it was discontinued. However, during the course of working with this solution, the supplier had developed valuable experience and distinct capabilities. It used these capabilities to address a new growth market: the Indian software industry.

[90] The same applies to Encore Software, a company focused on producing proprietary DSP software for the global telecom industry, but the firm has made several efforts at diversifying into the design and marketing of 'affordable information appliances' (small low-cost computers) to the Indian and other low-cost markets. In developing the Mobilis, feedback from users of previous products versioned and used in the private sector was critical. Local user groups that were given a demo-version of the Mobilis provided the most valuable knowledge. As the Mobilis is aimed at markets in developing economies, the local setting provided a suitable setting for the pilot run. This case is an outlier as it is not only concerned with software development as such.

conferences held at IISc involving different types of lead users have provided advanced insights related to new features and development of the product. Focusing on hard sciences, this company has developed multiple and institutionalised linkages with IISc involving joint laboratories and research programmes. However, this company also has linkages to other knowledge institutions. To develop their statistical analysis package the firm developed close linkages with the Indian Statistical Institute in Calcutta from where a renowned scientist was engaged on a consultancy basis.[91]

Type C and Type D. Occurrences of this type relate mainly to services business lines and activities. Two of these events (I-Test and IT security consulting) contain elements of opening up new activities/business lines, but overall they relate mainly to the strengthening of existing business in a general sense. For instance, when MindTree designed its knowledge management (KM) system, this took the form of open collaboration. During several critical phases the overall 'KM community' (i.e. a network of KM managers from leading software companies in Bangalore) provided inspiration and reference points. For instance, before developing Insight and establishing the principles on which it should be used, the top five software firms of Bangalore were surveyed through on-site visits to understand how they had structured their intranet KM systems. Thus, KM managers in other companies were consulted and were open to information sharing including hands-on inspection of their systems. This survey became critical in the design of the system, for instance, in the decision to integrate it under OpenMinds, the overall KM system. However, most frequently, such best practice surveying took an indirect form, that is, from employees with experience from competing firms, and the knowledge acquired was perceived to be of less importance.

Wipro made used of a local consultancy company, Erehwon Innovation Consulting, in both defining the innovation strategy and in the implementation of some of their chosen 'quantum innovations', including the establishment of the Global Command Centre.[92]

[91] Occasionally, firms may hire faculty from knowledge institutions as domain experts on a consultancy basis. One example given was of a company involved in a project for a US-based bank where an academic expert was engaged to help the team to translate the Basel II requirements into specifications for the project.

[92] It also assisted in the implementation of Lean in software. Erehwon also assisted another of the case study firms in defining strategy but it was not involved in the implementation phase.

These cases of local knowledge sourcing give some indication that process capabilities can be enhanced by drawing on the accumulated competences in the Bangalore software industry.

6.3 Mobilising resources for global opportunities – two examples

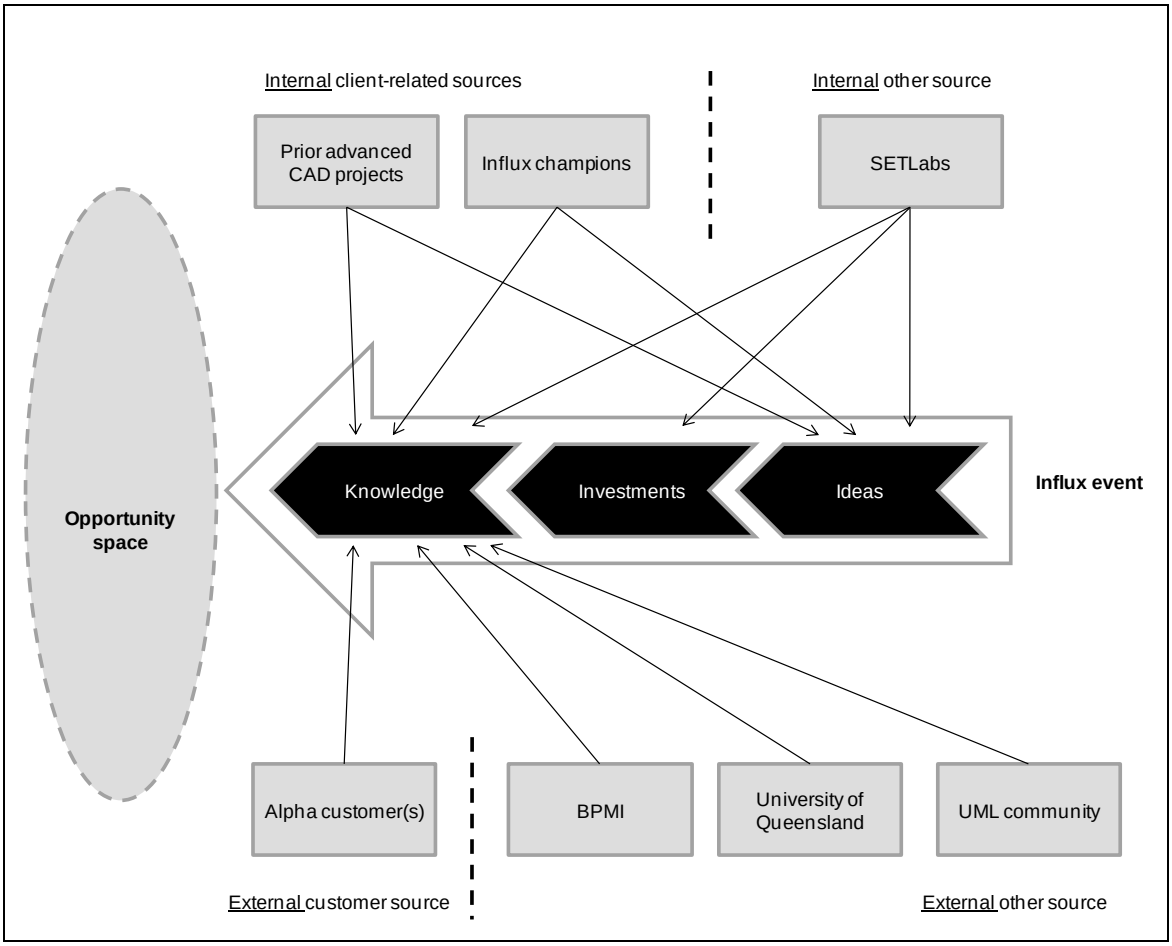
This section presents two cases that illustrate the most significant combination of resources: (i) Influx in Infosys, and (ii) UWB in Wipro. In order to illustrate the event-level process of resource mobilisation, the focus is on how different resources were mobilised and how they were brought together. The descriptions are structured by the type of resource and implicitly by the innovation-phase model covering conceptualisation (mainly ideas), preparation (mainly investment but also knowledge) and implementation (mainly knowledge but also investment)

6.3.1 Influx

To reiterate from previous chapters, Influx is a methodology for translating business objectives into information technology solutions. The framework is aimed at automating definitions of the customer's requirements. The purpose is to bring formality and repeatability to the translation of business objectives into information technology solutions. The framework and software was a significant innovation to the 'product' that Infosys is now able to provide to certain types of customer. Crucially, the introduction of this service greatly improved capabilities in the consulting space. While similar frameworks may exist in pure-play (OECD) consultancy houses this was a major contribution to change and a novelty in bridging the BPM consultancy space and the offshore service industry.

Figure 6.3 summarises the main sources in the innovation processes. According to informants – and consistent with wider information about the event – the internal sources were most important across all three resource types. Global-external sources were the second most important source of knowledge.

Figure 6.3: Mobilisation of resources – Influx



Source: Influx case study.

Ideas: Influx was an internal proactive drive, rather than the result of a specific/explicit customer demand. The idea to build the framework – or rather to consolidate the ideas it embodied – was generated in *SETLabs*, the main R&D department in Infosys. The framework aligns with the aim of SETLabs of identifying technologies ahead of customer need. The idea was conceived during an annual visioning exercise in SET-Labs. However, the ideas and some of the processes precede the establishment of SETLabs. They originated in efforts to support software project architects at a time when the size of projects began to grow in the late 1990s and when the consultancy business began to emerge as an opportunity space. These *prior customer experiences* had identified this space and suggested that tools to aid software project architects could also be applied to the business processes elements of projects.

Investments: A first version was developed by SETLabs in 2001. Initially, nine people worked for one year on the development of Influx as a workable framework and

software tool. Subsequently 40 people from across the organisation have been improving and deploying Influx. It has been used in more than 200 projects and around 300 people have received training in using the system. The development phase involved the consultation of 'Influx champions' across different business units that had been involved in BPM and the generation of case studies from pilot implementations. This framework has been continuously improved and functionalities have been added in six subsequent releases.

Knowledge: Infosys benefited from joining the *Business Process Management Initiative* (BPMI), the leading standards consortium for BPM. Infosys wanted to conform to industry standards and through its connections with the BPMI it received inputs to the creation of specifications for modelling end-to-end business processes. Through interactions with other firms working in similar areas, it helped develop the necessary expertise and it facilitated the creation of specifications. The internal research efforts in this area enabled Infosys to become a standard maker rather than merely a standard taker.

They also established relations with consultants from the Business Process Management Group at the *Queensland University of Technology*. These were partly facilitated by the company's acquisition of an Australian firm specialising in the design, building and integration of business solutions. The development of Influx also benefited from open source modelling language frameworks that were used as a basis for the modelling tools. These were developed by the *Unified Modelling Language (UML) Community*. It participated in the development of open source, non-software modelling language frameworks that were used as basis for its own modelling aid. These external knowledge sources added to the knowledge created internally by exploratory application of the developing framework to selected projects. Two patents have been filed by Infosys.

One of the key changes marking the transition out of the preparation phase was the relationship with a *customer in the logistics and transportation sector* for which Infosys initiated a business transformation imitative (discussed in Chapter 7). This firm acted as an alpha customer. In 2003, Infosys was engaged in an enterprise-wide study of the customer's operations. The aim was to assess the scope for implementing information technology systems to buttress selected processes. As explained by informants, frame-

works such as Influx only 'come alive' and become useful when they are applied in a customer setting: 'no amount of in-house development can substitute for this process'. In other words, the distinction between the elaboration and the implementation phase becomes blurred in the initial collaboration with the alpha customer.

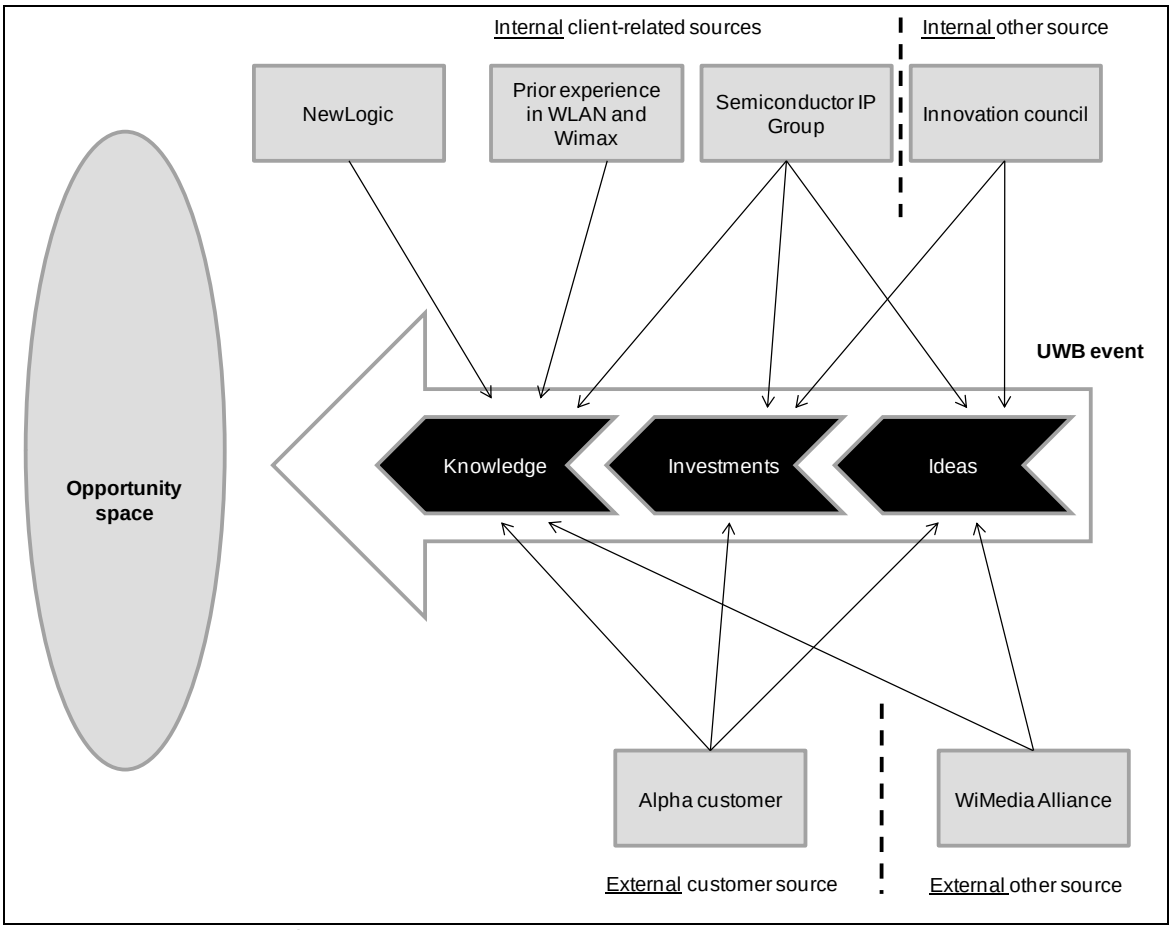
6.3.2 Ultra wideband solution

In May 2005, Wipro finalised its first demonstration of its ultra wideband (UWB) IP. UWB is a short-range data transfer protocol for personal computers and peripherals, consumer electronics and mobile devices. While this technology only started to reach the market in 2008, Wipro had been developing the technology and made it available to OEMs well in advance. It was developed by the semiconductor IP group in Wipro to add to its portfolio of licensable technologies and improve its offerings in product engineering services. It has been modified to different domains.[93] Figure 6.4 seeks to summarise the main sources in the innovation processes.

Ideas: The idea to develop UWB technology was brought into Wipro by the *Semiconductor IP Group's* principal architect. He participated in meetings within the IEEE (Institute of Electrical and Electronics Engineers) Standards Association related to wireless LAN technology. At one point in 2004, it became apparent that there was a deadlock between those firms that wanted to stick to and develop the wireless LAN technology and those who wanted to develop a new UWB standard. Among proponents of the latter were representatives of Bluetooth-SIG who wanted to select UWB for the next generation of Bluetooth. A breakaway forum was established as the *WiMedia Alliance*, an open association that promotes the adoption, regulation, standardisation and multi-vendor interoperability of ultra wideband worldwide. The principal architect continued to follow the discussions and established key contacts. This was how the new opportunity space was identified and how the vehicle to its realisation emerged. One future *Customer*, a key promoter, requested that Wipro should develop (and retain IP

[93] The first is USB, enabling it to go wireless and to be built into devices such as pen drives (wireless USB). Second is Bluetooth, which will benefit from the higher bandwidth. In the future a key area is wireless video streaming and technologies to replace Video Graphics Array (VGA) cables (for monitors).

Figure 6.4: Mobilisation of resources – UWB



Source: UWB case study.

for) the software to go with its solutions. However, it was clear to Wipro that the development of this technology would require a substantial investment.

Investments: A proposal was taken to the innovation council and the proposal phase lasted for six months. During this phase, there was intensive discussion with the customer who agreed to finance some elements of the preparation phase. Development started in early August 2004 and the first demonstration was given in late May 2005, a total of nine months' preparation. It was led by the principal architect and two additional engineers and had a total team of 15 people. Occasionally – when the technology was ready to be taken to the implementation phase – these were working with engineers employed by the customer.

Knowledge: The sources of knowledge were fourfold. First, engineers in the Semiconductor IP group had developed technology for wireless LAN (WLAN) and Wimax and

there was large overlap so that existing expert knowledge could be applied. Second, Wipro acquired NewLogic, an Austrian smaller semiconductor design services provider and supplier of IP cores for wireless applications. This brought in additional capabilities. Third, the customer shared specifications to give more direction to the development process and assisted in key phases. Fourth, continued participation in specification setting in the WiMedia Alliance provided the knowledge necessary to ensure interoperability with other elements in 'ecosystem'.

Direct feedback and comments on the technical specifications of the alliance was mainly provided through emails. Indirectly, however, a greater influence on the evolving technology of the alliance was gained through interactions with the alpha customer. Issues of specification were discussed with this customer and the feedback was channelled through the alpha customer, which was a permanent member of the Media Access Control (MAC) specifications committee in WiMedia.

The customer related to this event was explicitly referred to in Wipro as the 'alpha customer'. This buyer provided inputs in terms of the development process and architecture – and has a good person as contact point. The whole phase of architecture and design of the solution involved the alpha customer. During this phase, interaction took the form of face-to-face meetings around selected milestone in-between mail and telephone calls. There is an incentive for the two firms to stick together and develop new version as the technology matures. Because of a royalty fee, both firms benefit from customer sales. However, the IP belongs to Wipro and subsequent applications with new customers are possible.[94]

The whole phase of architecture and design (the elaboration phase) benefitted from interaction with the alpha customer. During this phase, Wipro interacted with the customer and subsequently Wipro developed a silicon reference model as a demonstration of this new capability domain (used for marketing purposes). This process is typical for advanced innovations related to standards-based intellectual property solutions. Each

[94] An informant explained the business logic: 'We develop the source code and the customer can make chipsets or solutions. But we do not allow them to mess with the source code. Our IP is only a half-cooked meal so there is a lot of downstream support.'

IP block has a core base that needs to be customised for each customer, but the 'linear model' of innovation does not apply in this case. In other words, these bases cannot be completed and tested without being applied in a user setting. Therefore, the development of this core intellectual property is based on the interplay between in-house R&D and application with an alpha customer. Thus, the alpha customer was typically involved in the platform development phase. In this phase requirements, information and feedback provided by the customer fed into the platform development phase.

6.4 Conclusion

This chapter has set out to examine how firms built new peak capability in the sampled events. This question is significant because each of the events are cases in which firms demonstrated *new* capabilities for the first time. They did new things that they had/could not have done before. These new peak capabilities were *innovative* capabilities corresponding to the definition provided in earlier chapters. Therefore, this chapter provides insights into how suppliers build innovative capabilities in the outsourcing context.

We can begin to pull together the insights of the chapter as they relate to the research hypothesis. First, the chapter provides evidence that seems to justify the emphasis that is often given to internal efforts of learning. In itself, this adds little value to the debate.[95] However, the chapter has highlighted how *intra-active* learning unfolded. The evidence confirms that innovation-enhancing assets were typically transformed and coordinated by strategic activities and units in deliberate attempts to link existing and new resources to specified spaces. This was central for 'ideas' and 'investments'. However, client-facing project teams are often the actual loci creating new knowledge and putting it to productive use. The leveraging of knowledge acquired in prior projects was a very predominant feature. In summary, knowledge for new peak capabilities were mobilised: (i) substantially within customer-facing units, (ii) on the basis of a process that linked together resources generated in successive projects, and (iii) with additional R&D and

[95] Thus, in broad terms the findings support the proposition that innovating capability is largely rooted in active efforts. This is unsurprising. The firm-internal level is not always given sufficient attention, but it is well established that firm-level innovation is dependent on strategic intent (Bell 2006; Ernst and Kim 2002). It is also well established that firm-level sources are a prerequisite for the absorption of external sources during the innovation process (Cohen and Levinthal 1990).

non-R&D knowledge inputs. R&D and non-R&D knowledge processes take a largely supporting role, making inputs as and when required.

Second, the chapter has provided evidence that seems to 'reject' the idea that local linkages (sources) are a necessary precondition of the formation of highly advanced forms of capability. Global linkages are (at least) as effective. In fact, the element that appears surprisingly absent in a majority of cases is *local interactive learning*. However, there are some tentative indications of an emerging regional learning trajectory arising in the slipstream of the increasing maturity and diversification of software firms' activities. It arises from the internal and external demand for new services and functions, which has caused some otherwise distinct business lines to connect or spin off wholly new lines of business.[96]

Third, the chapters also provide evidence to 'dismiss' the hypothesis that global client linkages alone do not provide the basis for acquiring higher-order (beyond Type B and C) innovative capability. *Global interactive leaning* is centred on knowledge created in buyer–supplier linkages. The chapter identified the high overall importance of buyers in the sample. Of particular importance to this study is the relatively high level of active involvement and (sometimes) support provided by buyer firms – often so-called alpha customers – in bilateral relationships.

There were key insights into how these findings differed (or did not differ) across business lines. The main insights into patterns across business lines relate to the association between the use of sources in the process and the achieved type/level of innovation. Overall, the acquisition of more advanced types of innovation was dependent on more sources used in the events. It seems to confirm at a very general level that 'deeper' forms of innovative capability are dependent on more-extensive types of effort. However, there was some variability within these patterns. For instance, the ESO business line had a tendency to engage in deeper event processes (more sources) and

[96] Informants suggested that the role of the 'region' in the application of knowledge was still relatively limited, but growing. The data collected for this research data support this view. Previous fieldwork, concentrating on the cluster dynamics in Bangalore during the 1990s growth period, suggested that internal transactions and active knowledge linkages between 'rival' (co-located) software firms were virtually absent (Lema and Hesbjerg 2003).

relied frequently on R&D knowledge creation, but it had not acquired Type A capabilities. The next chapter seeks to examine the role of opportunity spaces in structuring this variability.

However, two interrelated qualifications are worth reiterating. First, this thesis deals with innovation events (projects); consequently, the key focus is on the resource mobilisation activities associated with these particular projects – that is *event-level learning*. The exploration of resource mobilisation was inclusive and open ended in the sense that all project-based occurrences of resourcing were examined – including 'other variables' that were not related to outsourcing. Nevertheless, this thesis can only assess factors to the extent they occur directly in the events. While these projects are undertaken based on wider firm-level efforts and instances of capability formation (and connections between events through knowledge management and other efforts), it is beyond the scope of the thesis to examine *firm-level learning* in a comprehensive way.[97]

Second, the chapter did not deal comprehensively with connections through time between the capturing of opportunity spaces and prior efforts and mechanisms of capability formation in similar areas. The focus on events highlights the formation of 'peak' capability rather than the important underlying base of broader capability. The primary *time perspective* of this chapter was the duration of events. One section in this chapter does deal with resources acquired from previous customer projects. However, the chapter did not elaborate and provide further conceptualisation of these relationships in a wider time perspective. Both of these issues will be addressed in Chapter 8.

[97] Firm-level factors may enable deeper forms of event-level learning. Martin Bell (in personal correspondence) highlights factors such as investment in training in key staff and their secondment in organisations where they acquired new qualities of experience. That such factors are important contingent variables is plausible. Indian software firms invest as much as 6 per cent of annual revenues on training and skill-enhancement (NASSCOM 2008: 94). Furthermore, almost all of the firms in the sample run comprehensive internship programmes to draw in experience from individuals normally based in OECD countries.

7 Outsourcing and bounded opportunity spaces

Having established that significant innovation capabilities have emerged and how they were acquired, this chapter examines the role of outsourcing. The key question is: *How did the outsourcing practices of buyer firms influence the process of building capability in supplier firms?* The previous chapter examined how buyers sometimes provided inputs into the sampled innovative events. While this is an important element of the learning processes – and hence an element of building peak capability – the focus of this chapter is different. It focuses on the creation of global opportunity spaces and on the limits of these spaces.

As shown in Chapter 2, the literature proposes that global supply platforms in low-cost countries typically emerge with a focus on labour-intensive tasks. As outsourcing to these platforms matures, it changes in character and this opens up new spaces. However, according to the literature these spaces are limited as they are chiefly focused on production tasks. This proposition is explored in the present chapter.

This chapter examines differences in outsourcing in sampled buyer firms and the influence this has on the opportunity space.[98] It analyses what the buyer-side material tells us about the outsourcing practices – the outsourced value-chain thread – which buyer firms have adopted. It will also touch upon the strategies or rationales that underlie these practices. The chapter contrasts three different groups of software buyers. These are:

- IT departments (the secondary software industry)
- Independent software vendors (the primary software industry)
- Electronics and telecom industry firms.

Recall that external 'space' is an opportunity for innovation created by demand. Thus, buyers can create opportunities for supplier innovation through outsourcing new

[98] Buyers and partners are anonymous Section 7.1 event though some of the buyers have been named earlier. They remain 'anonymous' here in order to achieve constancy. However, three examples are given in Section 7.1 where names of buyers and suppliers are provided.

activities to low-cost destinations. This chapter reviews the spaces associated with the different types of outsourcing. This requires an examination of their boundaries and their different dimensions. The chapter is structured along the following headings:

- *The connection between production and innovation activities*: examines the patterns of standalone and integrated innovation outsourcing, reviewing the insights generated from the examination of five IT departments in the secondary software industry, four independent software vendors in the primary software industry and three electronics and telecom buyers.

- *The importance of space – three examples*: uses the notion of problem solving and framing as proxies for different degrees of strategic importance. It first takes a broad view before examining three buyer case studies and discuses patterns across buyer segments.

- *Boundaries and the problem of inseparability*: discusses how issues related to separability and modularity influence the opportunity space. It discusses how the type of outsourcing influenced the opportunity space in which supplier firms innovated.

- *Conclusion*: summarises the main insights from the chapter.

7.1 The connection between production and innovation activities

We are concerned not so much with the degree to which buyers outsource innovation activities, but rather with the *way* they are outsourced. To be more precise, the focus is on the way outsourced activities are decomposed and bundled. As shown in Chapter 3, the key analytical foundation of the chapter is the distinction between standalone and integrated innovation outsourcing. The chapter classifies the cases of outsourcing in terms of these two types, indicating the findings with **bold** typeface. An overview of the primary material to be analysed in this chapter – the buyer-side sample – is shown in Table 7.1. This table also shows the related supplier events, including the identified type of capability associated with these events.

Table 7.1: Demand-side firms and relationship with supplier events

Buyer type	Buyer	Related supplier event	Business line	Event type
IT departments	Transportation services company	Influx	CAD	Type A
	Internet infrastructure solutions provider	B/OSS	CAD	Type A
	Technology and services conglomerate	CIO Dashboard Solution (Network Management System)	IMS	Type B
	IT publisher	Codesaw	MIP	Type A
	Auto manufacturing firm	Sales Tools	CAD	Type A
Independent software vendors	Developer of corporate database tools	ETL Tool	OPD	Type A
	Developer of statistical software	SYSTAT	MIP	Type A
	Non-profit technology centre	Mifos	OPD	Type A
	Online digital media provider	Digital Music Distribution Platform	OPD	Type A
Electronics and telecom firms	Manufacturer of electronics devices	Bluetooth solution	ESO	Type B
	Developer of mobile telephony software	Build-Operate-Transfer	ESO	Type D
	Developer of mobile telephony devices	Botnia Hightech (Multimedia Subsystem)	ESO	Type D

Note: Two cases relate to supplier events that were classified as primarily Type D. However, these cases do contain information about Type B activities.

7.1.1 IT departments

Internal IT departments – the secondary software industry – represent by far the most important group of buyers in terms of sales from the Indian software industry. Such departments have emerged as suppliers of IT services to their 'host companies' in a diverse range of sectors. IT departments are mainly concerned with customisation and client-specific solutions.[99]

The Indian software industry is benefiting from an overall increase in the aggregate IT spend of these companies, but even more important is the relocation of corporate IT budgets from internal to external spending (NASSCOM 2006b: 426). IT departments are typically buyers of CAD, the largest business line in India. In contrast to the two other categories of buyer, the software outsourced by IT departments is typically not included in the products and services sold in the market by host companies. This type of software outsourcing is typically for internal consumption, what Flowers (2007) calls 'buy-to-use' outsourcing.

Transportation services company

An example of a far-reaching outsourcing strategy is that of the US transportation services firm. Despite increasing use of IT in all of the company's undertakings, the IT department in this firm remained at a stagnant size. It focused primarily on basic helpdesk functions, with very few software development activities. While this had worked well for a number years, changes were needed for a more radical business transformation envisaged by the firm's management. In 2003, this company made a decision to make a major shift in its business model to strengthen its position in the third-party logistics (3PL) market. In this business the transportation services company takes a greater responsibility for coordinating its customer's supply-chain logistics needs. However, the IT application portfolio, built incrementally over the years, did not optimally support the 3PL business unit. In order to do this it needed IT systems that supported new value-added services such as load building and optimisation. It wanted a

[99] Internal IT organisations can be thought of as dependent software vendors (DSVs). However, a substantial base of independent IT consulting firms that provide customised services is also present in the segment (such as Accenture, EDS and IBM to name some of the largest ones). These may engage in competitive as well as collaborative relations with DSVs.

one-stop IT solution to handle receipt of orders, carrier notification, load building and a tracking website for clients.

While the IT department was capable of keeping existing systems running and improving them incrementally, it needed outside help to design a system that could support the envisaged business processes. While cost drove previous outsourcing, the access to expertise and technological overview drove this engagement. An Indian software company had strong expertise in the logistics domain with more than 1,000 full-time employees working in the transportation unit and a proven record of accomplishment in strategic consulting and business process re-engineering in this areas. This firm was engaged to undertake a major project of *Business Process and IT System Re-engineering*. A cross-organisational team engaged in a business process modelling (BPM) exercise and re-modelled the workflow processes. They designed a system that optimised the order system, integrated off-the-shelf load-optimisation tools and consolidated the customer-facing processes in a web-based interface. The end-to-end outsourcing to an integrated processes consultant and supplier of implementation services secured certain coordination benefits. While IT consulting firms from the local environment could have provided the services as good or better, it was felt that there were strong advantages associated with outsourcing the BPM/consulting assignment (requirement definition) with subsequent implementation phase (downstream activities, low-level design, coding and testing) to the same vendor. This was a case of **integrated** outsourcing of production and innovation activities.

Internet infrastructure solutions provider

The internet infrastructure solutions provider represents a similar but more cautious approach to outsourcing. Initially this firm acquired only staff augmentation services from India. This buyer deployed supplier resources (i.e. staff) on a number of projects, particularly those related to its *Billing and Operations Support Solution* (B/OSS). The buyer had exclusively managed previous projects. However, staff augmentation work on the legacy OSS and related assignments had given selected supplier employees' valuable experience with the system. When the OSS needed an upgrade by adding a billing system for next-generation services, the buyer faced a situation in which most of the people from the original in-house development team had left the company or were engaged in new areas. For this reason, a cross-organisational team from the buyer and

the supplier defined requirements for the new systems jointly. On this basis, the supplier developed the specifications documents, and the buyer then approved these. The supplier undertook and coordinated the remaining stages in the software development life-cycle independently. Hence, this was a case of **integrated** innovation outsourcing. It was the development of system-specific knowledge – developed incrementally by the supplier – that enabled this substantial transfer of the workload. The supplier also drew on its architectural capabilities developed in other client settings. In this way innovation outsourcing became a compelling extension of the outsourcing of routine and largely staff-augmenting services. As the example illustrates, the outsourcing of higher-order functions often reflected the deepening of relationships.

Technology and services conglomerate

In some cases, it is overly simplistic to assume that a firm has only one guiding business model. Different divisions of a firm may have different business models. This applies to the large US technology and services group. Yet there are cross-cutting trends. For instance, the group is renowned for its active stance towards outsourcing and offshoring to India. In the late 1990s, it consolidated most of its shared business process service functions in a wholly owned Indian subsidiary. This subsidiary transformed the main IT department from a cost centre to a profit centre, forced to compete for internal and external contracts.[100] This spin-off company caters for most of the business process needs, but some of the group's information technology needs are coordinated by an in-house shared services division headquartered in the USA. This division is responsible for managing the infrastructure of many business units across the world – with the help of a Bangalore-based supplier. When internal customers pushed for increased transparency in IT infrastructure management services, this firm turned to its Indian supplier of IMS to develop a *CIO Dashboard.* As an outcome the dashboard now reports the status of the entire fleet of systems at all times, including related supplier activities, and provides near symmetrical information levels between users (chief information officers (CIOs) across the world), the sponsor organisation (in the USA) and the supplier (in India). The Indian supplier was the exclusive designer and developer of this dashboard. In this way, as the relationship matured the customer demanded more and more change-

[100] This subsidiary provided customer services, finance accounting and analytics. In 2004, it sold a majority stake to private equity firms.

related tasks and improvements to the services.[101] In this sense, it was a case of **integrated** innovation activities.

IT publisher

The examples provided above all show how some buyers are opening backwards to suppliers. However, other types of behaviour sometimes drive the outsourcing of innovation activities. The US publishing house is a key publisher of books for information technology professionals. An important element in this firm's shift to increased openness was the establishment of revenue-sharing agreements with alliance partners. It established an online portal and coordinated the pooling of its own material with material from other alliance partners. This was one element in a new strategy for strengthening the competitive advantage in the market for IT and software development literature. Another element was to take the business where the users are: online. The firm had realised that it needed to connect more directly with users. In order to strengthen the forward linkages it aimed to bring an innovation to the market: online experimental and interactive learning solutions. However, developing this in-house was not an option. The company had previously been experimenting tentatively with developing a code library, intended as a learning resource for customers. However, it did not put this to use because it did not work. Although the buyer is a publisher of books on software, its key strength did not lie in practical software development. In other words, there was not the required stock of in-house development capabilities. However, the buyer was able to take the next step when the supplier, offering its turnkey online learning solution, approached it. The new *Digital Workspace Value Added Service* enabled users to take smaller pieces of code and then extend it as a 'coding experience'. According to the buyer, this solution was not easy to develop because it required a deep understanding of the programming technologies themselves. The buyer did not see alternative solutions in the market because there were no competitors offering comparable features. During a period in which the buyer actively marketed the solution, the collaboration between the companies was close. The supplier quickly added new features needed by the buyer, such as online assessment (skills tests). From the buyer perspective, the outcome was disappointing. It initially marketed the solution

[101] However, most of these innovation activities related to new subsystems such as the dashboard. These innovations involved design and engineering activities, but these did not relate to the overall system.

with great enthusiasm; it heavily promoted the solution and offered it with around 50 book titles. One of the key potential advantages of this solution was that it enabled the buyer to get closer to the customers. The publishing house mostly sells its books through retailers. However, with this solution, it was able to reach these users directly; users which the publisher would not otherwise have access to and which it could possibly 'persuade' to move from paper products to online products. Nevertheless, subsequent reviews showed that the solution did not generate the amount of activity that it had anticipated. In terms of classifications, this case is ambiguous because it is not a standard outsourcing relationship. Yet, in a sense, it is case of advanced 'full-package' sourcing that is therefore classified as **integrated** innovation outsourcing. According to one informant – an author of a major programming language – this relatively simple innovation was made affordable by the use of Indian resources.

Auto manufacturing firm

The last example in the IT department category is the case of a European auto manufacturer. The IT department had gone through a major phase of transformation when the firm acquired a number of other auto-manufacturing firms. Following these acquisitions, a new consolidated IT organisation emerged. The firm gave the IT department autonomous status along with an order to make a profit. The IT department was still a captive subsidiary of the auto firm, but it now had to compete with other IT services suppliers for contracts within the auto group and for external contracts. It was under tougher financial pressure and needed to define a distinct value proposition to its internal and external customers. This entailed a deepening of customer- and domain-specific competences and an increased reliance on contractors for the deliveries (implementation). However, over time this firm developed a particularly deep relationship with an Indian provider, sharing risks and burdens both ways. This supplier became centrally involved in knowledge generation activities in flagship projects. One of these was the *CRM Tool for Trucks*, discussed in more detail in the next chapter (Auto IT). As the next chapter will show, this was also a case of **integrated** innovation.

7.1.2 Independent software vendors

Independent software vendors (ISVs) constitute the so-called primary software industry. Such firms produce software as their primary business. Sometimes programme managers and project teams from these firms may engage in so-called outsourced product

development, in which the firm outsources parts of the software product development process to an Indian provider. This type of transaction is what Flowers (2007) calls buy-to-build outsourcing.

Developer of corporate database tools

A Silicon Valley based developer of software and tools for corporate databases engaged in advanced outsourcing of software product development. Established in the early 1990s, the firm developed all products completely in-house for the first ten years. However, it had spotted a gap in the market for an *Extract Transform and Load (ETL) Data-Warehousing Tool* aimed at small organisations. However, this was 'brand new work' for the client organisation. It was felt that there was not the critical mass of in-house skills in this area and there was a consensus that the firm needed external help with the development of the new tool. It therefore collaborated with an Indian OPD firm with extensive expertise in the database tools. In a previous incarnation, this supplier was an own-brand developer of the database tool, but this business model was abandoned due to limited sales. However, the supplier was the owner of a tool that proved useful to the buyer. Modified and re-branded, it became part of the client's product portfolio (initially under licence). In order to make this work, the product needed a number of modifications. The supplier coordinated this transformation process. The client, on the other hand, was responsible for feeding in market knowledge generated from user panels and surveys and for helping to make critical decisions on the design and prototyping of the user-interface etc. From the buyer perspective, the time–to-market and overhead expenses shrank significantly due to the sourcing of services across the software development life-cycle. As the supplier had a major stake in product definition as well as in implementation, this was a case of **integrated** innovation sourcing.

Developer of statistical software

Decomposed innovation in the ISV business line can take forms other than distributed or outsourced product development. If assets fail to generate revenues internally, they can become profitable when other firms bring them to market.[102] So far, this has been

[102] As emphasised by Chesbrough (2006a), the open business model concerns not only knowledge sourcing and innovation, but also new pathways to the markets.

the least used route to engaging with Indian software firms, but recently this trend has picked up, also with larger and more market-dominating firms.[103] A US firm concentrated mainly on statistics for business and social sciences, but it was also the owner of a statistical package for use in the hard sciences. This product had become part of the product portfolio with an acquisition made mainly because of access to specialised human resources and strong capabilities in visual graphics (i.e. statistical visualisation). The firm made no new investment in the scientific software package because internal resources were concentrated on the flagship package. Only four programmers were working on the maintenance of the scientific statistics package and this period saw sales decline steeply. The firm choose a strategy of *Product Divestment*. The intellectual property rights to the package were transferred to a Bangalore-based developer of scientific software. In this new setting, more than 200 developers were engaged in a major remake of the product. The Indian firm re-launched an upgraded version with enhanced capabilities and it was able to secure greater market sales figures under the new Indian ownership. This was not case of outsourcing and therefore **cannot be classified** in terms of integrated and standalone.

Non-profit technology centre

A non-profit technology centre adopted a radically new business model. As part of a large global NGO, the technology centre focused on technological solutions in the microfinance space. However, the concentration was not on technical competences as such, but on domain competences: its core role was to understand the particular needs of microfinance institutions (MFIs) and other stakeholders in the microfinance community and to coordinate the technology development process from an organisational point of view. In the words of the director: 'Our core competence is microfinance, not technology. So we decided to outsource.' He referred to the flagship product of the organisation, the *Management Information System for Microfinance*. The organisation did not outsource just parts of the innovation process but the entire technology development

[103] Microsoft was the owner of an enterprise group chat product but recently it sold the intellectual property rights to Aditi Technologies. Five of the top ten global banks (according to Forbes) use this product. The solution is mission critical for firms in which some divisions use it as their main communication and inter-team collaboration tool since e-mail is too slow. These firms were unwilling to upgrade to new software, but as a part of the deal the Indian provider will work closely with the seller to help customers move to a new customer-based platform in the future.

process. The requirement process involved people from both the buyer and the supplier organisations, but the supplier was able to play a critical role since the buyer did not have an in-house engineering team of its own. The organisation was young but 'born open', aiming to create bespoke technology without internal technical resources. This commands a strategy of **integrated** outsourcing.

Online digital media provider

Another example of such a 'born open' new generation of software product developer, is a digital media provider which is discussed in more detail in the next section. It engaged an Indian firm to develop its *Online Platform for Retailing and Legal Sharing of Digital Media*. With its technology development and operations completely outsourced to India, this firm is a new-generation outsourcing firm, focusing on alliance management and new models for revenue sharing with its partners. As the next chapter will show, this was also a case of **integrated** innovation outsourcing

7.1.3 Electronics and telecom firms

Electronics and telecom firms were already pioneers in the location of software development activities in Indian subsidiaries in the 1980s. This study, however, focuses on outsourcing. It examines product engineering and R&D divisions of electronics firms that engage in so-called engineering service outsourcing and outsourced product development. The focus is on clients that acquire software code (components) used in the development of marketable electronics artefacts. In some cases, buyer firms insert so-called embedded software into electronics artefacts (buy-to-build). The software that is outsourced plays an integral role in the electronics product, but it typically remains hidden to the user.

Manufacturer of electronics devices

As a large division of a Japanese industrial conglomerate, this firm is another example of a buyer with multiple business models. Even today this firm engages in-house production.[104] It also undertakes key innovative activities within the firm, but it has an extensive global network of R&D centres, with the most important ones in Japan, the

[104] This firm also markets electronics products under an own-brand name in other product lines.

UK and the USA.[105] The product engineering and development division remains in Japan, but it has become increasingly open towards collaborating with other firms regarding the technologies that go into the products themselves. The use of external licensing has increased. This is where software providers from India have come to play a more prominent role. For instance, this division developed a Bluetooth chip for a hands-free system used in automobile space. The firm needed to incorporate the Bluetooth functionality into the chip platform architecture and customise this to work with a particular radio technology. The firm realised that Bluetooth is a software-intensive technology and chose to outsource the Bluetooth-enabling software component. Rather than developing software for the *Bluetooth Baseband Chip* itself, it would be faster to source this from a dedicated provider. The supplier provided 'product realisation services', involving customisation of the IP block and integration with the buyer's on-chip radio technology. From the customer perspective, Bluetooth is an add-on technology whereas the supplier is among the top players with solutions in this field. Thus, the supplier was able to tap into a large volume of specialised resources (50 people at the peak) in this domain and it significantly reduced the time to market for the product. As this example illustrates, the opening up for Indian software design services relates mainly to components technologies. The Indian provider designed the software component independently and it provided this on a modular basis. While the Bluetooth-enabling software component had some minor ramifications for the architecture of the overall system, overall chip design was the buyer's responsibility. This case is therefore a case of **standalone** innovation outsourcing in a double sense. From the buyer perspective, it is the outsourcing of one part of the innovation process, while production (manufacturing) is undertaken elsewhere. From the supplier perspective, it revolves around design intensive tasks, with comparably few programming resources involved.

Developer of mobile telephony software

A consortium of leading handset manufacturers from Europe and Asia owns and controls this ISV.[106] It is based in the UK, but like most other firms in the telecom space it is heavily globalised and has relied from its establishment on a network of internal

[105] The last of these focuses on the development of application software for PC-based electronics.

[106] It was established in 1998 to create an alternative to the Microsoft CE in Smartphone operating system.

and external providers for certain aspects of technology development. However, the buyer had invented a set of five policy categories for labelling the code. The label denotes the legal arrangements that should underpin development activities. The highest level is confidential source code, which it does not distribute at all. It undertakes all development activities in-house in the UK. Another category is jointly developed source code, which can become subject to co-development involving external providers by special legal arrangement. Driven by cost advantages, one Indian supplier had been a major partner for the development (implementation) and maintenance of certain parts of the code in this second policy category. Operating at this level, the Indian organisation was not initially involved in independent design activities. However, to make more use of the qualified Indian resources for more central parts of the system, it partially acquired the customer-specific resources of the supplier, which was then established as a captive unit. This was a so-called *Build-Operate-Transfer (BOT) Arrangement*. In this way, some source code design activities that are closer to the core of the system (high-level design) relocated to the captive unit in India. The upgrading of offshore activities was associated with a transformation of the relationship underpinnings between lead firm and supplier. This case was essentially a case of **standalone *production* outsourcing** but it shows how the evolution towards the decomposition of innovation activities necessitated the establishment of an intra-firm mechanism for the delegation of the development of new products to a subsidiary (innovation offshoring).

Developer of mobile telephony devices

The last example in this group of buyers is a well-known developer of handset devices. It undertakes the core R&D processes in-house or with organisations residing in its home location. However, this firm moved from a highly integrated structure to the outsourcing of manufacturing and certain 'contextual' R&D processes. Indian firms now play a major role as providers of software services for such contextual R&D. One firm in particular has become a preferred supplier for R&D. The inclusion of this firm in the R&D network was part of a wider effort of supply-chain reconfiguration and strategic management of external relationships. The next chapter presents this case in more detail. This case provides evidence of **standalone *production* outsourcing** (in the form of 'body shopping') as well as separate **standalone *innovation* outsourcing**.

7.1.4 Connectedness and sourcing focus

The question posed in this section is how innovation outsourcing practices differ across the three main buyer segments in the sampled firms. Table 7.2 summarises the findings. It shows that there is a surprisingly clear-cut pattern. The electronics and telecom firms (ETF) in the sample outsource innovation activities on a standalone basis whereas IT departments (ITD) and independent software vendors (ISV) engage in integrated innovation outsourcing.

Table 7.2 also shows some of the related findings of the analysis conducted in Chapter 5. The last row shows the types of innovation performed by suppliers in the relevant events. It shows a pattern in which integrated outsourcing is associated with a more advanced type of supplier innovation. This is somewhat counter-intuitive and later sections in this chapter seek to explore this finding further.

Table 7.2: Buyer segments and outsourcing practices

Buyer type	Buyer firms	Outsourcing practice	Related supplier event	Business line	Event type
IT depart-ments	Internet infrastructure solutions provider	Integrated	B/OSS	CAD	A
	Auto manufacturing firm	Integrated	Sales Tools	CAD	A
	Technology and services conglom-erate	Integrated	CIO Dashboard Solution	IMS	B
	IT publisher	N/A	Codesaw	MIP	A
	Transportation services company	Integrated	Influx	CAD	A
Independent software vendors	Developer of corporate database tools	Integrated	ETL Tool	OPD	A
	Developer of statistical software	N/A	SYSTAT	MIP	A
	Non-profit technology centre	Integrated	Mifos	OPD	A
	Online digital media provider	Integrated	Digital Music Distribution Platform	OPD	A
Electronics and telecom firms	Developer of mobile telephony devices	Standalone	Botnia Hightech	ESO	D
	Manufacturer of electronics devices	Standalone	Bluetooth solution	ESO	B
	Developer of mobile telephony software	Standalone (produc-tion)	Build-Operate-Transfer	ESO	B

IT departments

Traditionally, CAD outsourcing to India has tended to follow the pattern in which only implementation activities such as development and testing is externalised to suppliers. Firms kept activities in the requirement stage (i.e. those that connect directly with user-level organisational change) in-house with the sponsor, which has an intricate understanding of the needs of its parent organisation. However, as in other software settings, IT departments can make large financial and engineering resource savings by outsourcing a larger chunk of the software development life-cycle. Most IT departments face the simultaneous forces of growth in demand and a pressure to cut costs. The personnel engaged in requirement activities are most costly in absolute terms as well as in terms of opportunity cost. Experienced business analysts and software architects employed in-house by the IT departments in large organisations need to concentrate on the most mission-critical projects, even if this halts other potential projects. The external demand for innovation (knowledge creation) in client-firm IT departments often exceeds in-house capacity. Moreover, the nature of demand is changing. Because non-IT business units have become increasingly specialised and processes are more IT based, there is a need for consultants from the IT departments who can define the opportunity, scope the work and identify the current and future methods of operation, based on solid domain experience and insights. In this setting, there is a greater need to draw on skilled resources from external organisations for engagement in innovation processes.

IT departments outsourcing non-CAD services indicated similar trends. The cross-cutting feature between the cases reviewed here is the willingness to outsource elements of system definition as well as implementation. Innovation outsourcing in this setting takes the integrated form, in which implementation and requirement activities are bundled within the supplier's domain. Suppliers are engaged not only to create software artefacts (implementation) but also to co-define requirements. [107]

[107] This is an interaction-intensive process characterised by high complexity and tacit knowledge. The buyer–supplier interface is therefore substantially thicker in this type of project, compared to implementation projects in which processes are easy to codify. In end-to-end CAD outsourcing the project-based relationship is typically of a long duration in which the engagement period can last several years. Certain phases tend to be face-to-face intensive and suppliers often post personnel to the buyer premises on a permanent or semi-permanent basis.

Independent software vendors

The case of the developer of database tools shows that outsourcing in the ISV segment is not always as restricted as is commonly anticipated. It is still unusual for core product definition to be 'bought' from Indian suppliers. The firm changed its outsourcing strategy in a core area because a supplier with the right solution was available. An old-generation ISV (but not a large one) has changed its outsourcing strategy over time. The developer of statistical software is also an old-generation ISV that in many ways sticks to a standard and fairly limited outsourcing strategy. Its engagement with an Indian firm is a 'special case' reflecting the emergence of India as a new market for software assets.

By contrast, the two other buyers reviewed here – the digital media provider and the technology centre – represent next-generation ISV. These are start-up organisations with very few engineering resources. These buyers concentrate their efforts on forward linkages and on understanding what users want. The bridge between buyer's vision and supplier's implementation arises through co-design. Recall the example of the outsourced development of a management information system (MIS) for use in the microfinance industry. The firm outsourced all aspects of product realisation (implementation) and depended on the software supplier for inputs into the requirement stage. The two companies approached the requirement-definition phase from two different ends. The buyer's core competence lay in the user domain (microfinance) rather than in the technology. By contrast, the supplier had previous experience of building numerous MISs on a variety of technology platforms. While the specification document stated, for instance, that the system should have a module for a savings account, the supplier laid out the different options for how such an account could work. The decision-making processes related to functional attributes of the system were therefore collective. The supplier provided many design activities, even functional ones (i.e. requirements).

Electronics and telecom firms

Electronics firms are often large players with globalised organisations and supplier networks. In order to identify the software activities outsourced to India, it is therefore necessary to consider the character of the production and innovation networks coordinated by buyer firms. On the operational side, most manufacturing activities are offshored, mainly to independent providers of electronics manufacturing services (EMS). Two electronics buyers had substantial manufacturing activities in India, but the

examined outsourced engineering services to India were unrelated to these operations. On the product development side, these functions were primarily coordinated from the home location. This pattern follows what has been described as the de-linking of production and innovation in the electronics industry (Sturgeon 2002). In this sense the outsourcing of supplier-designed technology components and the related customisation services are technically separated from the physical building (production) of the product (e.g. a chip or a handset). Hence, the outsourcing to India took the form of standalone innovation activities. This finding is supported by information from interviewees on the supplier side. Informants stated that they would 'never' interact with the operational units of buyer firms in this segment.

Because of technical disconnectedness, outsourcing arrangements were also characterised by a large degree of organisational decomposition. In other words, the buyer–supplier interfaces are relatively thin, with the vast majority of work conducted offshore and with relatively limited inter-organisational collaboration. The requirement transfer is typically based on a normal technical requirement document that may be complemented by videoconferences to clear up misunderstandings or even by in-person meetings, depending on complexity. Clients draw on generalised assets (solutions) developed by the supplier, and the main engagement is limited to customisation. Thus the main project-based relationship, in which software components are customised, is of relatively short duration (as opposed to the commercial relationship that may be longer). Whereas the 'engagement period' (project duration) may take many months, the key phases in which buyer–supplier interaction takes place is much shorter. Face-to-face interaction may not be required at all, or it may be limited to a few days.[108]

To be sure, the use of these categories suppresses a great amount of complexity. First, they are not absolute categories. The finding is not that standalone activities for ETF do not involve coding and testing at all. However, these activities are relatively marginal compared to low-level design activities. Conversely, coding and testing activities made

[108] The most communication-intensive phases are at the beginning (requirement transfer and architecture) and sometimes, if the project is complex, also at the end (acceptance testing). The most time-consuming period in which the solution is actually developed (implementation) is self-contained within the supplier domain.

up the majority of person-hours involved in the projects outsourced by ITDs and ISVs. Second, there are several variations within the categories. For instance, the developer of mobile telephony software (BOT event) showed how a captive unit was necessary in order for the firm to move from standalone production outsourcing to integrated innovation offshoring (thereby moving out of the scope of this research). Conversely, the developer of corporate database tools (ETL event) acquired an existing solution almost on a standalone basis, but the required changes to the solution and their implementation engaged the supplier on a basis that was essentially an integrated outsourcing of innovation activities.

7.1.5 The strategic importance of outsourced activities

While this study as a whole is exploratory in nature, this holds particularly true for the present chapter. There are two main reasons for this. First, the assessment of the strategic importance of firm activities is methodologically difficult. There is no agreed method to assess whether certain types of activity or function are more critical than others. Second, the interview material is patchy, with 'asymmetric' information with regard to buyers' perceptions of the strategic importance of outsourced activities. Interview questions on the criticality of outsourced activities (to the buyer) generated some useful information, but we do not have this information from the buyer side in all cases.

With these reservations in mind, Table 7.3 shows the assessment of the strategic importance of outsourced activities across the 12 buyer cases. It seeks to summarise the assessment of the criticality of the activities that have become the suppliers' responsibility in relation to:

a. The types of activity undertaken by suppliers in terms of their problem-solving and problem-framing qualities (as defined in Chapter 3).
b. The types of activity in the same project/event *not* undertaken by suppliers.
c. The centrality of outsourced activities in the sponsor's overall business model.

Table 7.3: Strategic importance of outsourced activities

Firm type	Industry	Buyer firm	Strategic importance
ETF	Electronics	Manufacturer of electronics devices	Low
ETF	Electronics	Developer of mobile telephony software	Low
ETF	Electronics	Developer of mobile telephony devices	Low
ISV	Primary software	Developer of statistical software	Low
ISV	Primary software	Online digital media provider	Medium
ISV	Primary software	Non-profit technology centre	Medium
ISV	Primary software	Developer of corporate database tools	Medium
ITD	Secondary software	Transportation services company	Medium-High
ITD	Secondary software	Auto manufacturing firm	Medium-High
ITD	Secondary software	Internet infrastructure solutions provider	Medium-High
ITD	Secondary infrastructure management	Technology and services conglom-erate	Low
ITD	Secondary software	IT publisher	Low

Note the assessment is based on author's subjective judgement, aided (where possible) by informants' statements.

As seen in Table 7.3, there are tentative patterns of regularity between the buyers' industry and the strategic importance of outsourced activities in the sample. In order to explore this tentative pattern, the discussion gives primacy to the distinction between problem framing and solving. The table then suggests the following differences:

- Outsourcing of problem-framing activities in the primary and secondary software industries – indicating a progression to strategic activities.
- Lack of problem-framing outsourcing in the electronics segment, indicating a confinement to problem-solving activities.

The next two sections are aimed at discussing this pattern in some more detail. They address the issue of problem-solving and -framing activities, viewing these implicitly as proxies for 'more' and 'less' strategic activities. In the three cases presented in the next section, it appears that the proxies 'work', not least because they align with buyers' statements about strategic importance. However, it is less straightforward in some other sampled cases. The three cases were chosen as examples that are indicative of wider trends. However, the capturing of such wider trends is not straightforward. First, the method of adopting the problem-framing/-solving proxy is somewhat imprecise, neglecting the strategic importance of these activities in relation to the buyer's overall

business model. In other words, as will be discussed, technical problem framing may no longer be strategic to all types of buyers.

7.2 The importance of 'space' – three examples

As mentioned, the cases presented here are 'indicative', featuring trends and dynamics of wider relevance. This section looks at the character and evolution of relationships and focuses on the outsourcing (or not) of problem-framing activities. This is then related to the findings of the previous chapter. The three buyer–supplier case studies are:[109]

- Primary software industry firm 'Digital Media Networks' and the outsourcing of product development (OPD) to Aditi Technologies.

- Secondary software industry firm 'Auto IT' and the outsourcing of custom application development (CAD) to MindTree Consulting.

- Electronics firm 'Telecom Corp' and the outsourcing of engineering services (ESO) to Sasken Communication Technologies.

The common trait is that problem-framing activities identify what the software should do and broadly how it should do it. In other words, it relates to the step in the software project life-cycle that deals with *requirement definition*. In the electronics segment, this is associated with overall product architecture and systems integrations. In the primary software industry it relates to the identification of user needs (e.g. from market and customer surveys) and the capturing of these in the definition of functional specifications. The same is true for the secondary software industry, but in this setting there is a much more direct relationship with users. Requirement definition is based on explicit needs and business modelling efforts. This chapter therefore asks whether requirement definition is outsourced or not.

[109] Names of buyer firms have been changed to protect confidentiality.

7.2.1 Digital Media Networks and Aditi Technologies

Digital Media Networks is a privately funded US start-up company in the online digital media business. It was established in 2002 with the idea of a media service engine for legal digital content sharing, as an alternative to illegal peer-to-peer sharing. The founder and CEO previously had a career in Microsoft in which he was a senior sales leader. The firm is 'born open' with a complex business model and revenue-sharing agreements. As a B2B company, this firm focuses its managerial resources on sales, network alliances and strategic management. A strong network of industry contacts helped the CEO to build the business and the various commercial and technical networks it entails. The media service engine was based on Microsoft technology and standards, content was provided by record label companies such as Sony, Universal and Warner, third-party providers such as PayPal provided critical components and outlets were provided by Microsoft Media Player and eBay. The company was the exclusive alliance partner for powering eBay's foray into the music download business.

With an inherently open business model (discussed further in the next chapter), the decision to outsource the entire product development to an offshore provider was an easy one – it was inherent in the business plan. This decision had been made for three primary reasons. First, it was believed that time to market for the flagship solution was crucial for the success of firm. However, it was felt that it would not be possible to quickly build a team in-house with sufficient knowledge and experience as such a team was not easy to assemble in the USA. Second, it was important to have the ability to ramp up and down effortlessly once the major phase of creation was complete and to ramp up again for the second release. Such flexibility could not be achieved with an in-house team. The third reason was the combination of rich experience and low cost. Most important, the firm was attracted by the ability to get inputs to the project from an experienced product development firm. India was the key location for a firm specialised in outsourced product development.

As the very foundation of Digital Media's business, the solution provided by Aditi was mission critical. The initial requirement had been described in just an eight-page 'visioning document'. This became the starting point for Aditi Technologies, a Banga-

lore firm specialised in OPD.[110] This document formed the basis for proposal building and preparatory activities. Requirements were then settled during a one-week meeting at the Digital Media office. Thus, Aditi was closely involved in the requirements-definition stage. As explained by the CEO of Digital Media, some of the requirements came from the supplier's ability to envisage usage scenarios. When asked about whether there was a concern that the supplier would not understand the end-user scenario he replied:

> There were things they thought of that we missed. This Group at Aditi, there were many things they brought to the table that added value. I would like to think that we thought of most of the usage cases, but there were things they brought to the table that we hadn't even thought about. So I wouldn't say that they don't understand the consumer situation, again there were many cases were they did add value there.
> (Digital Media Networks informant, 8 November 2007)

For Digital Media Networks, the focus on sales and the management of a new business model were enabled by a far-reaching outsourcing strategy in the sphere of technology. It was decided very early to outsource the development of the core technology platform to Aditi. The availability of the supplier's R&D services allowed for an operational business model focused on customer-facing activities and management of alliance relationships. This was dependent on the supplier's depth of competences in the involved technology domains, which could aid technology decisions for the system as well as the ability to provide end-to-end solutions from vision to launch.

The independent design of this type of application was a new experience for the supplier. However, the problem was solved by leveraging competences within the cluster. A number of people were brought in from Talisma, an MIP company, to provide specific expertise in product architecture and design functions that had not previously been provided in the OPD space. This was facilitated by an ownership overlap between the two firms. Five experienced 'project leads' were brought in from Talisma to work

[110] The CEO in the buyer firm drew on his personal relationship with the founder of the supplier firm, whom he knew from their coinciding employment at Microsoft. A sense of trust resulting from this network connection was a key element in the decision to ally with this particular supplier.

on the inception-framing stages of the project (problem-framing activities).[111] This example shows that the rise of innovative OPD services builds on previously accumulated capabilities in other business lines, not least the MIP business lines.

The radical outsourcing strategy was not adopted without problems. At the outset, the leadership in Digital Media had envisaged a business model with no in-house technical resources. This strategy needed to be revised. The main complicating factors were about communication between non-technical (buyer-side) and technical (supplier-side) people in the distributed work environment. The division of labour which was originally envisaged did not work. The buyer came to realise that a certain amount of overlap was needed. As the CEO explained, 'you need to have technical people on your side who completely understand the vision of the project' in order to effectively manage the relationship with the offshore provider. Therefore, an in-house technical team was gradually built to improve the work process for the release of the second version of the system.

7.2.2 Auto IT and MindTree Consulting

For more than 30 years, until 1998, Auto IT was the in-house IT division of a European auto manufacturer now specialising in trucks and buses. In 2001, the Auto Group acquired Renault Trucks and Mack Trucks and its IT services division was consolidated in Auto IT, which had become a wholly owned subsidiary. The new organisation was to play a new role, offering its services in the international marketplace for software development services. In the same year, the organisation initiated a competitive-sourcing programme and established relationships with suppliers in Poland and India, in order to reduce costs, speed up deliveries and learn from skilled partners. The outsourcing practice grew rapidly and the customer base expanded beyond the capacity of the organisation; it was therefore clear that a strategy of internal competence transition was needed. This strategy had two main elements. First, Auto IT needed to establish a new role for the organisation, one that was closer to the customer and with more of the

[111] These two companies had a shared history but split up at the turn of the century (when the OPD opportunity arose) in order not to jeopardise relationships with OPD customers concerned about core competences. The company initially handled support activities for Microsoft. Talisma was conceived from the experiences of the Microsoft support team. In this sense, the evolution can be traced further back to other functional roles.

deliveries managed by suppliers. Second, it needed internal employees – now perceived as 'high-cost employees' – to move up the value chain, 'out of the technical areas and over to the business side of things' (Auto IT informant, 13 June 2007).

A key element in the definition was the experience that was gained from collaborating with MindTree Consulting, a spin-off from Wipro. According to the CEO, the relationship with MindTree 'is the only true partnership of Auto IT'. Already in 2001, Auto IT had engaged MindTree to build and maintain a new global dealer management system (DMS) for its trucks division. The system was eventually rolled out in 18 countries and was perceived as 'mission critical'. MindTree's independent development of the system and the effective building of new skills showed Auto IT that increased outsourcing to capable suppliers could support a new growth strategy.

Over time, MindTree has become more closely involved in the outsourced projects, and the supplier is involved in complex tasks in the software development life-cycle. It no longer merely develops systems to Auto IT's specifications, but also participates in the development of those specifications by finding resolutions to user requests. A good example was the development of a CRM sales tool for a leading trucks manufacturer. With external financing, this was a critical project with high visibility. The decision to engage MindTree in the end-to-end development of the system was rooted in a 'critical situation'. The packaged legacy CRM system for pre-owned trucks was being phased out by the provider, and the customer urgently needed a new system in its place. However, the proposal initially developed by Auto IT, which deployed in-house resources for the critical phases of the project, had a budget and a schedule that was far beyond what the customer was willing to accept. After deliberations among the board, it was decided to challenge MindTree by giving them key responsibility for the project, in order to avoid the loss of an important business opportunity. However, there was also a more fundamental reason that was to do with the difficulty of transferring complex knowledge. As an informant in MindTree explained,

> They wanted to develop the system themselves and then involve us in the next phase of back-end integration. That was the initial plan they presented to the management. But [the executive vice president and head of Auto IT's 'region international'] felt that this was not right. He knew us very well. He said: 'You say that you will involve MindTree in Phase

> Two. But when it comes to Phase Two, you will come back and say that MindTree does not have the business knowledge of Phase One, so we cannot involve them. So don't make that mistake. Involve MindTree from the beginning.' That is when the whole plan changed. Later on they told us that it was one of the best decisions they had taken.
>
> (MindTree informant, 18 July 2007)

MindTree was able to draw on its experience of working on and developing CRM systems for customers in other industrial domains. However, MindTree used this 'generic knowledge' in this business-critical project within Auto IT. It was able to do so because of the close relationship between the two firms. A full-time MindTree manager is posted permanently on site, with access to the entire Auto IT organisation. Key personnel in the supplier firm have accumulated customer-specific knowledge and competences incrementally, which has enabled them to add value and provide Auto IT with new ideas capabilities for innovation in new projects. Such a process has occurred in several domains, and this has enabled them to cross-feed knowledge between projects and domains. As the Head of Global Sourcing explained,

> Over time, they built a lot of competence in the after-market area over the projects they did in that area, and they were able to cross-feed between projects to also further develop the ideas and put them into the next project in the same domain area.
>
> (Auto IT informant, 20 June 2007)

This type of cross-feeding is what Chapter 8 refers to as competence leveraging. This competence leveraging in the supplier firm was one factor that enabled new sourcing strategies in the buyer firm. Ultimately, this was related to organisational transformation. In a short time-span, Auto IT made a complete transformation from an organisation that was part of a large and vertically integrated company, to an IT consultancy organisation with a changed corporate model. It has broadened its forward linkages by competing in the global market and its backward linkages through competitive sourcing. This has initiated a process of internal competence transition and a corresponding transition in outsourced services. Today, 27 per cent of the consultants engaged across projects are sourced from contractors. It now uses external ideas and innovative competences from India for its Auto IT signed solutions.

7.2.3 Telecom Corp and Sasken Communication Technologies

In the early 1990s when Telecom Corp introduced its first Global System for Mobile Communications (GSM) handsets to the market, the company was able to undertake all processes in-house, even the design of its own chips. As an industrial conglomerate, Telecom Corp could internalise all stages of mobile phone development, including R&D, design, assembly and manufacturing. However, over time, this strategy was abandoned. Throughout the 1990s and continuing in the 2000s it sold off parts of the corporation to focus on key processes, using the newly formed firms as suppliers. During the 1990s, the value of purchases grew three times faster than the value of sales. During the 2000s, the firm consciously worked to reduce R&D spending and rely more on an external network of providers. A key driver of this process of externalisation is the increasing complexity of technologies and supply chains, factors that make it impossible to undertake all innovation processes in-house. A distinction developed between elements and processes that were 'core' and 'context' respectively.[112] The latter included so-called commodity R&D and technology, which was now acquired in the market.

A fraction of this contextual R&D was provided by Indian firm Sasken Communication Technologies, a firm specialised in IP development and outsourced engineering services for the handset industry. For instance, Telecom Corp made some use of video-application and codec[113] licensing from Sasken. These are subcomponents and commodity inputs. As stated by an informant in Telecom Corp: 'There has been some licensing of certain application and features, but they are not really key components.' The relationship between the two firms was strengthened in 2005 when the venture capital arm, made a US$3 million investment in Sasken. Despite this, Sasken was unable to license out or work on more critical technology and processes for Telecom Corp. Sasken had developed core applications such as an integrated multimedia suite, but the supplier was unable to sell this to Telecom Corp:

[112] According to the Chief Technology Officer in Nokia, Pertti Korhonen, 'Nobody can master it all … You have to figure out what is core and what is context.' Quoted in Engardio and Einhorn (2005).

[113] In telecommunications, (short for coder/decoder) a device that encodes or decodes a signal. Codecs can be implemented in software or hardware.

> The problem for Sasken is that multimedia happens to be one of the key areas for [Telecom Corp]. … In order for Sasken to sell their subsystem it would have required that [Telecom Corp] makes a decision to withdraw its own in-house developed subsystem and replace it with Sasken's and start paying money to Sasken for the licensing and the further development. The control over that subsystem would not have been inside [Telecom Corp]. … There are certain areas there in which [Telecom Corp] would like to keep the control in its own hands. This multimedia subsystem and multimedia applications and services are those things that are not likely to be outsourced or licensed from outside.
>
> (Telecom Corp informant, 27 July 2007)

Sasken was not the only Indian firm that supplied Telecom Corp with outsourced engineering services. Wipro, a major Indian service provider, was a key source of outsourcing and staff augmentation services for particular Telecom Corp projects. Wipro was a part of the R&D supply chain in a major way. However, certain core hardware and software design and testing services (including radio frequency testing) were not outsourced to this supplier. As an informant stated, there are certain types of process and knowledge that Telecom Corp keeps under Finnish control.[114] The reason was a concern within Telecom Corp about dependence on this large firm for critical resources. There were certain types of knowledge that it did not want to put in the hands of this supplier. Rather it sourced these services from a small number of Finish firms. Most of these adopted 'follow sourcing' strategies, and went global in order to service Telecom Corp in new markets such as China and India. This led to Sasken becoming part of the innovation chain, but there were clear limits to the involvement.

Telecom Corp had a very close relationship with Botnia Hightech, a small Finnish supplier of design and radio frequency testing services. Leading managers in Botnia had an employment history in Telecom Corp. However, Botnia was not globally oriented and did not have the size to venture abroad as was required by Telecom Corp. For this reason, Botnia was put under pressure to merge with Sasken in order to service Telecom Corp in Finland and globally (in India and Mexico). As a result, Sasken acquired Botnia in 2006. This act of supply-chain coordination exercised by Telecom Corp was initiated for two primary reasons. The first was to ensure that the particular engineering service

[114] This informant was a senior manager in Botnia Hightech (see below) and a former manager in Telecom Corp.

capabilities of Botnia could be scaled up globally. The second was to create some counterbalance to Wipro and to develop a degree of control over certain R&D services outsourced to Indian organisations. On the other hand, this reconfiguration of the supply chain – a global *re*-composition of the innovation process – provided Sasken with an opportunity to move into new competence areas, such as advanced hardware testing, which had previously been out of bounds for Indian suppliers.[115] However, it did not enable the firm to move into mission-critical R&D such as high-level design services or a licensing implementation service for key components such as multimedia applications.

This section has illustrated some of the dynamics that may 'push out' problem-framing activities in primary and secondary software industries and 'hold back' these activities in the electronics buyer segment. It showed that requirement definition – the core of buyers' problem-framing 'platform' – is sometimes open to suppliers. In other words, certain buyers have provided substantial space for suppliers' deployment of innovative capabilities in high-order value-chain tasks. In order to explain *why*, and in order to explain the differentiated opportunity space across segments, the next section discusses the roles of the boundaries of these spaces.

7.3 Boundaries and the problem of inseparability

In this section it is suggested that the inclusion of 'strategic' elements in the portfolio of outsourced activities is influenced by 'technical factors', namely, the inability to separate strategic from non-strategic activities. To develop this proposition it is first necessary to discuss some of the salient characteristics of the segments. It does so by drawing on elements from the previous chapter, namely, the issue of standalone and integrated outsourcing.

The increasing complexity of product development in the electronics industry is the main driver of standalone innovation outsourcing to India. Even developers of subcomponents cannot generate/attract and maintain all resources and capabilities internally. This is not a novel insight. Other studies of the globalisation of innovation reach a similar conclusion. Cooke (2005), for instance, showed how biotechnology firms

[115] This route was strengthened when Sasken's new Finnish unit coordinated the acquisition of Nokia's Adaptation Software R&D entity in Bochum, Germany, in 2008.

pioneered open innovation on a global scale, in order to overcome intra-firm knowledge constraints by tapping into the regional knowledge capabilities of clusters. Ernst (2005a) showed how lead firms in the electronics industries used Asian suppliers for chip design. In both industries, innovating firms draw on knowledge from the global supply base and absorb it into their own products. They concentrate on the integration of new knowledge and resources for the development of new products. Hence, they play the role of systems integrators.

This is typical of complex industries in which different firms with different competences are required to handle the various stages in the product development process (Brusoni 2005). This chapter has shown how this type of industry organisation drives specific activities in Indian software firms, such as those performed in the engineering services segment. Cost was as an important element in the 'location' of these activities (in India), but cost did not drive the opening up of innovation in its own right. The complexity of knowledge was the main driver of openness and cost-competitiveness arose in the second stage.

The outsourcing of integrated activities is different because the knowledge-seeking and cost-reduction elements came together in opening the innovation processes and underlying business models. In this sense, it is a novel form of open innovation and it has proven to be an immensely important category for the analysis of software innovation outsourced on a global scale. Yet, it is not on the radar screen of the open innovation literature.

This new form of innovation outsourcing is prevalent in the primary and in the secondary software industry. In the first instance, the pressure to cut costs and speed up the development cycle is driving software organisations to outsource non-core activities. However, when this decision has been made there are sometimes compelling reasons for incrementally adding higher-order activities. This not only solves the common problem of finding generally skilled software engineers in adequate numbers, but it also relieves constraints related to highly skilled internal resources. These are now able to concentrate on high-priority projects or move into non-technical business activities altogether. These organisations reduced the opportunity costs of internal resources by relying on

outsourcing some high-end activities. By shifting over to what one informant termed 'the business-side of things' internal staff undertake activities that create more rent.

Innovation outsourcing also reduces the substantial coordination costs associated with up-front investments undertaken during the elaboration phase. Business analysts and software architects construct the high-level design and the specifications at this stage. They need to write these specifications in a highly detailed form if the buyer intends to transfer them to a supplier who will take over during the construction phase. However, these investments can be externalised by involving the supplier in the elaboration phase. In other words, there are 'linkage economies' at play. Because the supplier firm performs high-level design activities as well as execution, it increases the efficiency of each of these activities. The supplier relies on the cognitive proximity of in-house staff in order to 'transfer' these specifications to the execution team in the offshore development centre.

As will be argued in the next chapter, there is a key difference between outsourcing guided by core-competence strategy and outsourcing by firms that have adopted an open business model. D'Costa (2003; 2004) is the scholar who has undertaken the most in-depth assessment of the constraints associated with the core-competence paradigm of software outsourcing. He showed that one of the key constraints arose from the way outsourcing relationships were structured:

> No firm wants to co-locate critical projects overseas due to coordination and communication problems … These problems arise because of the 'modular' approach to software development. Each project/product is decomposed into self-contained modules, each with varying demand on tacit knowledge, making it possible to co-locate certain modules in certain places. However, the tension between increasing coordination costs and the criticality of certain modules limits what can be done offshore in India. Total learning with modular projects is constrained since exposure of Indian engineers to innovative projects is only partial. This hinders domain and systems integration expertise, spheres of considerable import for building competence. It also limits 'transferability' of tacit knowledge as user-based interaction is constrained. In addition, rising costs in the more user-driven iterative process makes geographically dispersed modular software outsourcing risky, thereby limiting suppliers market exposure.
>
> (D'Costa 2004: 57)

I found this confirmed in my own previous work. Because of the 'modular approach' to software development, learning possibilities in the supply base tended to be constrained because exposure to critical capabilities and end-users was limited (Lema 2009b). The findings of the present study suggest, however, that outsourcing can show different features.

In the core-competence business model, buyers seek to limit outsourcing to implementation activities. These implementation activities are easier to codify than higher-order activities. However, buyers sometimes seek to leverage supplier assets in higher-order activities. This means that that the buyer needs to draw the supplier into the architecture and sometimes even the 'vision' of the project (see Table 3.1: Phases in the development of business software). Activities at these stages are much more difficult to codify and the previously 'modular' pinch-point interface between buyer and supplier changes character.

The literature led us to hypothesise that requirement definition will be kept in-house by buyer firms. This was addressed in Section 7.1.5. However, as the three case studies showed (or rather two of them), the advent of new models means that in reality this is not clear-cut. The case material suggests that there are differences between buyer segments in this regard. Electronics and telecom firms mainly outsource problem-solving and innovation support activities. Engineering services tend to feed into highly coordinated networks and innovation processes in which Indian service providers play a specialised and bounded role. The buyers provide carefully defined and limited spaces in which suppliers can operate. In the software buyer segments (primary and secondary), the forefront firms do not always follow such a practice. As the case studies illustrated, suppliers are now often invited to participate in requirement-definition activities in a substantial way.

These differences are related to the pattern identified in the previous section which distinguished between standalone and integrated innovation activities. Using this terminology, the overall pattern that emerges is:

- When innovation takes a standalone character, software suppliers are not engaged in problem-framing activities.

- When innovation and production is integrated, there is greater scope or incentive for involving suppliers in problem-framing activities.

The case studies indicated that innovation emerges as an incremental extension of 'standard' outsourcing and it becomes subject to competition and market dynamics. However, these constraints are only translated into innovation outsourcing because assets that were until recently perceived as 'core' are shifted from 'fixed' to 'variable' status in the client organisation. Software architecture capabilities, for instance, have become more variable. Buyer firms may deploy their own architects or use those of a supplier. This is where the integrated type of innovation outsourcing differs from standalone innovation outsourcing. The development of products and systems is exactly what is outsourced. The logic that enables the sourcing-in of new knowledge and licensable commodity technology but prohibits the externalisation of 'systems integration' does not apply. This is why this type of outsourcing is associated with more opportunities for involving suppliers in problem-framing activities.[116]

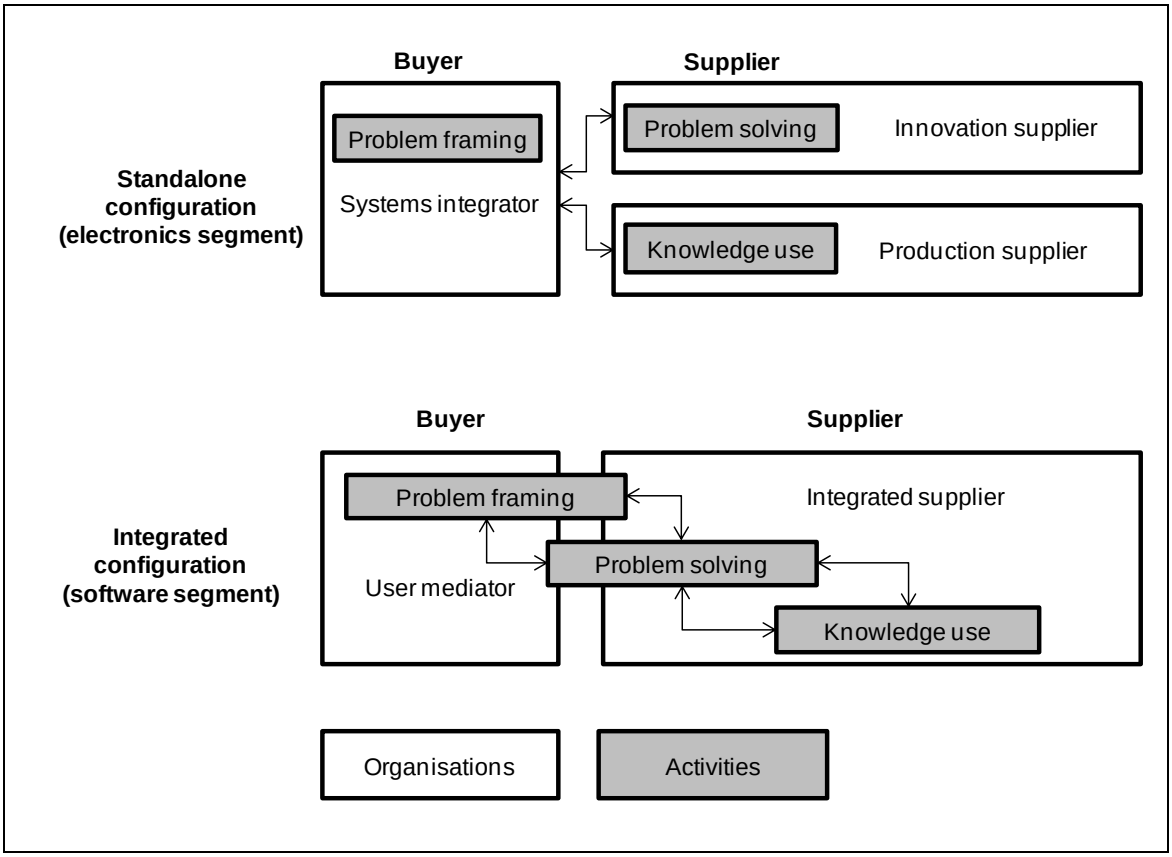
These findings are somewhat counter-intuitive. Because standalone innovative activities are undertaken within the realm of innovation (e.g. new product development), it is easy to assume that these are 'most proximate' to problem framing. However, loose connectedness means that different roles – for example, systems integration vs. modular component provision – can easily be assigned to separate organisations. Typically, there are relatively modest interactive requirements. In this way, there are limits to functions of the product development processes that are externalised to software suppliers. First, only software-related functions are outsourced. Physical product design and related activities are typically kept in-house (or outsourced to specialised providers of hardware design services). Second, the interface between the software component and the overall product is specified by the overall product design (and the technical standards). This has implications for the division of labour between buyer and supplier. The buyer is

[116] This insight is generated not only from the examination of buyer–supplier relationships and information provided by client informants. Fieldwork on the supplier side that investigated 'innovation events' showed that suppliers operating in tightly connected settings were much more likely to engage in requirement definition than were 'de-linked' suppliers.

overseeing the design of the overall product (e.g. a chip or wireless device) and defines the functional requirements of the component. These specify the behaviour of the component and the interface (external design). The supplier is left with responsibility for non-functional requirements (such as performance, security and reliability) and internal design. Hence, the value-chain thread for which suppliers are responsible is relatively short.

Conversely, because integrated innovation activities are undertaken in tight connection with production (i.e. implementation) it is easy to assume that these are the 'furthest away' from problem framing. However, this is not the case. This is because some problem-solving activities are difficult to codify in the software industry. If buyers want to outsource problem-solving activities, they typically need to open up for elements of the problem-framing processes. It is not always possible to draw a clear dividing line between problem solving and problem framing. It is this limit to codifiability, and the resulting needs for buyer–supplier interaction, that explains why co-framing of requirements was widespread in the tightly connected relationships that were studied in this research. Buyer firms expanded the outsourced value-chain thread from implementation activities all the way into the realm of problem framing. It is not easy to stop and draw a clear line of demarcation at the stage of problem solving. Figure 7.1 illustrates the difference between the standalone and the integrated setting in this regard.

Figure 7.1: Problem framing in standalone and integrated innovation outsourcing



Source: Own figure.

This does not mean that the distinction between core and non-core (or strategic and non-strategic) has vanished. It has shifted to somewhere else. The key innovation processes – those that provide the most value in new business models – are becoming non-technical. Instead of focusing on product and systems development, managers focus on developing new business models in which the critical component is the customer interface. Internal resources are deployed in the areas that enhance user knowledge and sales capability, in managing other external relationships and in capturing rent from new business models. The issue of core innovation arises mainly in firms that are willing to let go of component knowledge (problem solving), while they seek to retain architectural knowledge (problem framing). In this scenario, architectural knowledge is what matters and knowledge spill-over arising from buyer–supplier interactions is a dangerous threat. However, when the rent-generating processes move forwards towards the user, the strategic importance of architectural knowledge is reduced. This insight applies to the software industries, but not to electronics. It does show, however, that the 'modular view' and the associated vision of labour division have limited applicability

for a new generation of firms for which competitive advantage and profitability increasingly lie outside technical areas.

Interestingly, related research on the German software industry generated findings which support the findings presented here: 'Software firms in Germany re-focus on higher-value tasks which often depend very heavily on vertical knowledge and – quite often – on experienced based knowledge of the customers business processes generated over long term relationships' (Oswald 2008: 72). Consistent with the findings of this research, Oswald found that buyers keep high-level design activities at home in most cases, but vanguard firms are now beginning to outsource these to offshore locations.

As these dynamics evolve, new upper boundaries emerge. Technical problem framing, and sometimes even certain aspects of non-technical problem framing, have become less strategic for certain buyers. The new strategic core lies increasingly in non-technical areas and the customer-facing units. This was clearly expressed by buyers. As an informant stated: 'We do not want to bring in someone else to take the layer between us and the customer' (Auto IT). Controlling access to the customer is increasingly vital.

A delicate situation can occur when buyer and supplier engage in joint requirement definition that is intrinsically tied to the user setting. To deal with this situation, firms invoke the concept of 'ownership', a non-legal term used in the software industry normally to ensure the individual encapsulation of interdependent objects (modules) by the assignment of modification rights (as opposed to reading rights) to pieces of code. With reference to joint requirement gathering for the B/OSS project, a supplier project manager explained that although they may have 'reading rights' (in the figurative sense), they do not have ownership.

> The activity is owned by [the buyer] and we don't intend to take that ownership. We want them to own it because it is interfacing with the customer and they do have a very good understanding of the business processes. We are clear both ways that they don't want us to own that activity. They still want to maintain the customer relationship and interaction.
> (M-Tec informant, 18 October 2007)

With reference to this general relationship level, informants at the management level in supplier firms echoed this. As one the founders of Infosys stated, suppliers need to

respect the strategic concerns of buyers. The most demanding element in buyers' innovation process is the anticipating of user needs. For buyer firms in the software industries, cognitive and cultural proximity to their own client or customer base is therefore a core capability. Increasingly, this is the new Holy Grail, and outsourcing vendors are confronted with a boundary which is essential for furthering business relationships. In the words of the Infosys manager: 'This is where the boundary is and that has to be respected.' In other words, the upper limits of the current innovation space are clearly defined. It is vital for business relationships that there is a clear agreement on these upper boundaries.[117] The danger is that mutually beneficial relationships are turned into competitive ones.

Recent literature – discussed further in the next chapter – has described the decreasing role of corporate R&D labs and the corresponding increase in the use of external R&D. However, most of the literature has mainly focused on research and development of new (patentable) knowledge.[118] It has focused on 'R' rather than 'D'. However, the cases discussed and analysed here are development intensive, with very little traditional research content. While this is true across the three user segments, the analysis suggests that the nature of the outsourcing of software innovation services differs markedly across segments.

Many current studies have equated strategic activities with R&D. However, this study has not adopted a narrow focus on 'standalone innovative activities' but sought to examine innovation activities more broadly by including the set of activities grouped under the heading of 'integrated innovative activities'. This section shows that this broad view was warranted. It is not possible to measure the distribution of different types of innovative activities outsourced to India, but standalone innovative activities – the traditional focus of most reports and studies on the subject – are demanded by a

[117] Nandan Nilekani, then CEO at Infosys: 'You have to be close to your customers. That is what companies need to do. They do not want to outsource that, and they shouldn't. But everything else can be outsourced' (quoted in Nussbaum 2006).

[118] Similarly, much of the debate on offshoring of innovation has focused on R&D for adaptation to local market needs, technology monitoring and the cost and availability of scientists and researchers in emerging countries (Gammeltoft 2006; UNCTAD 2005). The case presented here does not follow the typical pattern of internationalisation of innovation that is driven by lead firms' need to conduct R&D to adapt products and processes to local conditions.

group of buyers that connect to a relatively small business line in the Indian software industry. By contrast, the groups of buyers that connect to substantial business lines (most notably CAD) are also those who create the demand for integrated innovation activities. By inference, the conclusion is that integrated innovative activities are quantitatively much more substantial than standalone activities.

Moreover, integrated innovative activities are not only more substantial in quantitative terms, they are also more important with regard to 'transformative potential'. First, the section has shown that there is 'a way out' for the majority of business lines that have hitherto been constrained by forced lock-in. Second, it has shown that, in contrast to standalone activities, there are much more elusive, and perhaps faster moving, upper boundaries for integrated innovation. Unexpectedly, the study did identify innovation activities that extended beyond problem solving within this category. The space for innovation seems to have changed considerably in some cases. The danger of 'lock-in' in the current literature may have been overstated.

7.4 Conclusion

The key objective of this chapter was to examine how the outsourcing practices influenced the process of building new capability in supplier firms. The chapter has sought to discuss the way and degree to which changing sourcing practices creates new opportunity spaces. It discussed how these spaces differ across buyer segments and whether this helps to explain differentiated innovation levels across business lines in the supply base.

The chapter showed that outsourcing practices differed across business segments. The pattern of integrated and standalone innovation outsourcing seems to be sub-sector specific. To some extent, the standalone type is an 'anomaly', which occurs only in specific settings of relatively high codifiability. It is unlikely to be widespread outside the ESO/embedded software space. The integrated type, on the other hand, is 'applicable' to a much wider array of business lines, including those that are responsible for the bulk of Indian software exports, most notably CAD.

The evidence in the chapter confirmed that the outsourcing of innovative tasks is closely integrated with 'routine' production tasks, but it rejected the hypothesis that this limits

the scope for further capability building. In fact, it provided evidence which suggested that this tight integration between knowledge-producing and knowledge-using tasks is associated with the occurrence of capability types of a higher order than the outsourcing of standalone innovation activities.

This chapter has already touched upon the 'absolute' upper limits of currently available innovation spaces. These were related to the proximity and management of relationships with end-users (see section 7.3). However, it has also suggested that there is considerable room for negotiation *up to that point*. It provided an explanation of why this is so – mainly because the opportunity spaces have fuzzy boundaries. Often, these spaces are not clearly defined. The space is extra difficult to define in tight connections. The contours are fluid, becoming clearer only in the course of the interaction with the supplier. The client is looking for a solution but does not know exactly where it lies and what it entails. The supplier, on the other hand, tries to provide a solution but is stretched to the limit in its efforts to come up with a way forward. It is this stretching to the limit and the eventual provision of new problem-framing solutions that move suppliers into new qualities of capability.

The basic conclusion arising from this chapter is that the nature of opportunity spaces influences how far the levels of 'demonstrated' capabilities on the supply side can go. However, as has already been emphasised, bigger spaces do not necessarily lead to capability or types that are more significant. As observed in Chapter 6, the ability to pull in and combine inputs from multiple sources is essential for advances in innovation and occupying the growing space. While this is important, the key insight arising from this chapter is that some business lines seem to be associated with wider opportunity spaces. The 'size' of the spaces seems to be a key mediating factor in the relationship between outsourcing and suppliers' capabilities. The innovative events 'captured' by the sampling procedure – particularly Type A events – reflect the emergence of *new* and *larger*

opportunity spaces.[119] This provides an explanation for the finding of the previous chapter that intensity of activities in the event build-up phase was not the only apparent explanation for the level of demonstrated capability. The opportunity space works as an intervening variable that plays a key role in structuring outcomes.

The discussion about space in this chapter was based largely on ex-post knowledge. In other words, when the supplier progresses into problem-framing activity, the research hypothesised that the space was 'big' and vice versa. There is no immediate way of specifying the space ex ante in this study. Defining the 'size' of the space is a matter for future research. It is not easy to 'quantify' the size of these spaces at a stage when buyers and suppliers themselves would find it difficult to do this, let alone communicate it to a researcher who wants to compare across events and business lines.

In addition, the distinction between problem solving and problem framing is not in the buyers' minds. Their language was more vague referring to (in CAD) 'the tasks of high-cost employees' and 'the business side of things'. In most cases they want a specific and often pressing problem solved, and this then becomes a slippery route to 'value-chain creep' in which suppliers enter the loci of problem-framing activity.

The buyers are of course not oblivious or powerless in relation to this value-chain creep. When it happened, it was because it was in the buyers' immediate interest. Some of the buyers tended to prefer suppliers that could provide strategic advice related to designing and increasing the utility and value added of projects. These buyer firms are expecting more value from their software process suppliers than just the traditional cost advantages derived by outsourcing the delivery of IT services. It suggests that broader issues of outsourcing and the relationship with buyer business models may be at play.

[119] Buyers may not 'allocate' these spaces randomly, but mainly to relatively strong suppliers, such as those included in this sample. The probability that a supplier wins a contract with opportunity for new qualities of innovative activity depends on levels of capability that somehow proximate those needed in the prospective project. However plausible this proposition is, the present material does not allow us to test it. Rather, the key focus in the previous chapter was on the process of building capabilities *inside* these spaces. This is distinct from capability building that allows firms to enter these spaces in the first place.

Furthermore, the chapter showed that in some cases the outsourcing strategy evolved because of cumulated experience in the outsourcing of projects to India. In other words, the cases showed that 'comfort levels' rose over time. In the cases reviewed, the propensity to outsource software work that is more innovation intensive than past work seems to depend on the 'quality' of competence that was 'demonstrated' by suppliers in previous projects. The qualities of competence essential to undertake the particular type of innovation intensity involved in prospective projects were proven to buyers over time. This may be referred to as the 'supply-side dynamic'. Sometimes, some of these proven capabilities were customer specific; unique knowledge developed over time by the suppliers was central to the outsourcing of more advanced projects, which often generated cross-applicable solutions. Chapter 8 discusses the issues of supply-side dynamism and business models further.

8 Causation by interaction

This thesis examines the connection between outsourcing and the build-up of innovation activities. In this chapter, the analysis is pushed further, with some more tentative theoretical and empirical observations. As set out in the introduction, this chapter proceeds to the extended focus.

The guiding proposition – informed by the three previous chapters – is that the period under review was an inflection point in the process of capability building, with an emerging shift from production to innovation capability. The main emphasises so far has been on *whether* and *how* these new qualities of capability have been built. Comparatively little explicit attention has been given to *why* (and why *now*) innovative software services from India emerged after the turn of the millennium.

There are, of course, a number of factors that explain this, including state reform (Heeks 1996; Pinglé 1999), public investments in education and research (Kumar and Joseph 2005), cross-border labour mobility (Commander, Chanda, Kangasniemi and Winters 2008; Saxenian 2002) and spill-over effects from foreign direct investment (Balasubramanyam and Balasubramanyam 2000; Patibandla and Petersen 2002). These factors have contributed to the rise of *production* capability in the 1980s and 1990s and are also important for the rise of *innovative* capabilities in the 2000s. However, even if taken together, they cannot explain the recent rise in innovation capability. As shown in previous chapters, outsourcing played a critical role. This chapter suggests that a fuller understanding requires that one should dig even deeper, examining dynamics on the demand side and the supply side and the connection between the two. To this end, this chapter extends the conceptual framework in three steps and uses illustrative case material from the fieldwork to suggest that these steps are not just conceptual but real. The analysis is tentative but seeks to lay the ground for further research.

The chapter contains four main sections:

- *Structural changes and phases of development:* puts the main findings of this thesis in historical context and explains further the phenomena in need of (theoretical) explanation.

- *Extended framework I – competence leveraging*: builds further on Chapter 7 to specify in more detail the learning dynamics that can arise from multiple customer interaction.

- *Extended framework II – the supply-side dynamic (co-evolution)*: discusses the feedback mechanisms that can arise when new qualities of capability are demonstrated. It distinguishes between direct and indirect feedback mechanisms and their influence on buyers' outsourcing practices.

- *Extended framework III – business model opening*: introduces the proposition that changes in firm-level business models lie behind the practice of firms in areas concerned with their software development and production that has led to the outsourcing of (opportunities for) innovation by suppliers. Business model opening is a key factor that has provided space for competence leveraging and allowed the supply-side dynamic to unfold.

8.1 Structural changes and phases of development

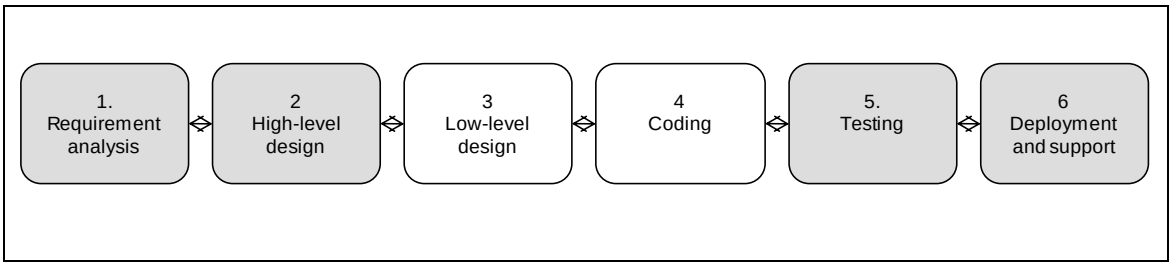
This section argues that the vanguard of India's software industry has evolved over three main phases that are closely related to outsourcing practices.

First phase – 1980s. Networked computers gained a foothold in businesses in the USA and the EU in the mid- and late 1980s. This shift to networked computing created a huge demand for software services, some of which was provided by Indian firms. A handful of early entrants – including Infosys, Microland and Sasken – emerged in this period in India. 'The onsite service model emerged as the dominant business model by the end of this period' (Athreye 2005a: 26). This staff augmentation (or 'body-shopping') model emerged in the 1980s but was in fact the dominant mode up until the late 1990s (Lema 2009b). There were technical reasons for the dominance of this model, primarily poor communications technology. This meant that Indian engineers depended on air travel to customer sites in the USA and the EU. However, it is argued here that there was another reason as well: staff augmentation reflects a firm's or an IT department's need for corporate control. These organisations did not need to outsource services to external providers that would carry out software development activities

independently, but they could still gain significant cost advantages. It was a first step in this process of vertical disintegration, but production systems remained closed within the firm. The value delivered to customers was almost exclusively in the form of labour-cost savings.

Second phase – 1990s. The dramatic boom that occurred in the 1990s – mainly in the second half – had its roots in two new sources of demand, namely, the booming US internet economy and the so-called Year 2000 (Y2K) problem.[120] In this period, a large number of suppliers entered the market. The establishment of the first Indian software technology park in Bangalore in 1991 provided access to satellite links for data transfers and communication. This is when the so-called offshore model of software development became established. A large number of supplier firms – including the majority of those discussed in this research – entered the market in this period. During the 1990s, the Indian software industry became firmly rooted in the emerging offshore model and was dominated by routine-based tasks in the field of standard application development and maintenance. This niche was complementary to the changing nature of external lead firms that were increasingly following 'core competence' strategies. Indian firms became virtual extensions of their customers' IT departments, thereby helping them to achieve greater operational efficiency (Lema 2009b). The focus of Indian firms in terms of value-chain activities is shown in Figure 8.1

Figure 8.1: Outsourced activities in the 1990s (extant literature)



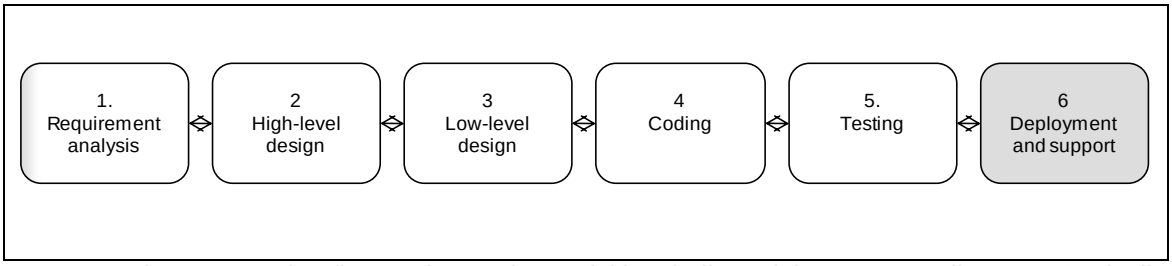
Source: Chaminade and Vang (2008a). Grey activities = not outsourced.

Third phase – 2000s. The emergence of the third phase has been examined in this research. The cases and trajectories of innovation outsourcing discussed here are reflections of a new tendency to adopt more far-reaching outsourcing practices. Begin-

[120] This arose because early dates in computer systems were typically written in two digits (e.g. 99) rather than four (e.g. 1999). This meant that many systems could not work after the turn of the century.

ning after the 2001 slow-down in the IT sector, buyer and supplier alike have reconfigured their business models, increasingly emphasising outside knowledge and capabilities. New strategies and sourcing frameworks have defined a more inclusive role for suppliers. The vanguard Indian firms have diversified their lines and business and developed new domain competences. Vanguard suppliers have developed domain expertise and frontline capabilities, and they are no longer only in execution mode. They also take part in the processes that define and transform customers' or end-users' IT and software systems. This type of function is referred to as 'transformational services'. However, as has been discussed, these end-to-end services are also transformational in a more fundamental sense: the sourcing of transformational services allows firms to restructure their business and redefine the way in which value is captured. The services provided by leading-edge suppliers influence elements of the core business strategy of selected customers. The new increased range of value-chain activities is shown Figure 8.2.

Figure 8.2: Outsourced activities in the 2000s (this thesis)



Source: Chapter 5. The figure shows the activities indicated by case studies, not 'typical' outsourced activities. Grey activities = not outsourced.

Table 8.1 and Table 8.2 show these phases from the perspective of demand and supply respectively. These are overlapping trends. To this day, buyer firms make use of staff-augmentation services. Both the staff-augmentation and the core-competence strategies are alive and strong in the 2000s. However, while these are still dominant, the impact of more far-reaching outsourcing strategies is beginning to show. While this is particularly true where companies have succeeded in developing strong relationships with their suppliers, it is clear that firms in general now expect a greater level of innovation in the supplied products and services.

Table 8.1: Demand-side trends (IT departments and ISVs)

	1980s	**1990s**	**2000s**
Focus of outsourcing firm or business unit	Focus on achieving scale capacity without changing internal practices	Focus on systems development and retention of core technical tasks such as high-level design	Focus on customer interaction and domain understanding of customers/users business. Relationship capabilities – forwards and backwards
Sourcing practice	Body-shopping – onsite capacity boost	Outsourcing of programming tasks (uni-directional knowledge flow)	Outsourcing of integrated innovation activities

Note: The table describes the emergence of *trends*, not successive phases. It draws on Chapter 7 and sources cited in this section.

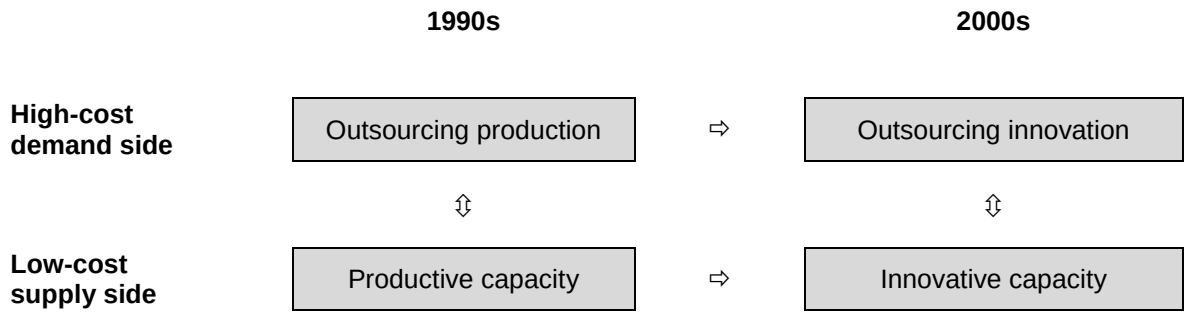
Table 8.2: Supply-side trends

	1980s	**1990s**	**2000s**
Export business lines	CAD	CAD/ESO	Expanding breadth of services – BPSS and PDSS
Business activities (value proposition to customers)	Staff augmentation (Indian firms as people providers)	Operational efficiency (Indian firms as non-core virtual extensions to customers)	Comprehensive solutions and Innovative services (Type and Type B)
Engagement model	On-site	On-site/offshore	Global – on-site consulting and offshore implementation

Note: The table describes the emergence of *trends*, not successive phases. It draws on Chapter 5 and sources cited in this section.

By highlighting the co-evolution over time of practices and capabilities in the most advanced buyers and suppliers this thesis shows that there is a strong mutual reinforcement in the evolution of innovation orientation in software. As illustrated in Figure 8.3 this shift has occurred between the 1990s and 2000s.

Figure 8.3: Co-evolution: from production to innovation



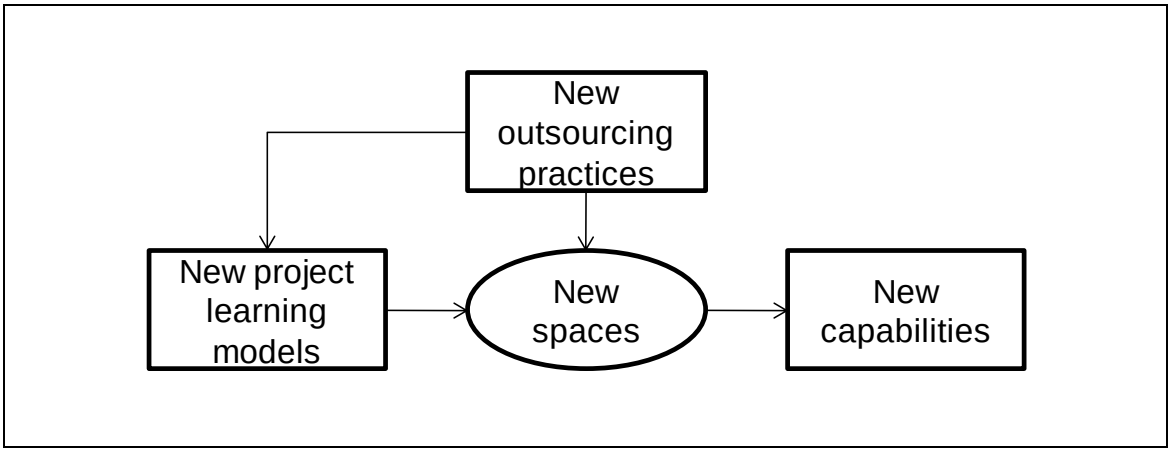
Source: Own figure.

The remainder of this chapter seeks to provide further theoretical framing and some additional evidence in order to make sense of these findings. This extension of the theoretical framework is essential in order to understand the bigger picture that provides a context for core findings of this study.

8.2 Extended framework I – competence leveraging

At this point, it is necessary to review the theoretical framework, starting with the new 'learning models' that give rise to new qualities of capability. The starting point for this is the insights provided in Chapter 6, which showed that the learning models could not be seen as wholly independent variables. Rather the outsourcing buyer often had a direct influence on the learning process in the sense that it was an important provider of useful resources (mainly knowledge). Customer interaction was particularly important in Type A and B events. Chapter 7 then suggested that this is often the case when buyers adopt new outsourcing practices. Knowledge-seeking buyers engage in deeper forms of information exchange and this gives rise to new learning models in buyer firms. However, where the previous chapter looked at individual cases (projects) in isolation, one can identify added significance by acknowledging the occurrence of multiple projects within the supplier firm. This can give rise to learning dynamics with increased transformative potential. Figure 8.4 introduces the direct learning effects from outsourcing to the 'model' introduced in Chapter 2. The remainder of this section seeks to illustrate how this connection works. For this end, it is useful to return to the subject of software suppliers as KIBS and project-based organisations.

Figure 8.4: Direct learning effects from outsourcing



Source: Own figure.

8.2.1 Software firms as KIBS – the interaction with customers

Software suppliers, like other KIBS firms, often develop their solutions in close interaction with the customer. As is typical of KIBS, innovation may focus on this interaction as much as on traditional product and process characteristics (Miles 2004). Some authors have invented new concepts such as 'servuction' (i.e. services production) to put emphasis on the relation between services firms and their buyers in the services innovation process (Gallouj 2002). In order to conceptualise the interaction process with customers this study uses the following vocabulary:

- *Extraction* occurs when the supplier can make use of knowledge developed in a specific customer relationship for purposes that are more general. This is also referred to as knowledge harvest.
- *Consolidation* occurs when the company seeks to integrate the harvested knowledge into the 'original' knowledge base and prepare it for general use. This occurs when the firm translates new knowledge into frameworks and routines.
- *Application* occurs when the firm re-applies consolidated knowledge in new customer settings. For instance, providers of customised business software services integrate different stocks of knowledge and tailor them to customer needs in discrete projects.[121]

[121] This vocabulary is akin to what Strambach (2008) refers to as contextualisation, de-contextualisation and re-contextualisation. This part of the conceptual framework draws heavily on her work.

When KIBS providers apply consolidated knowledge in new customer settings they contribute to the innovation process of the buyers of these services (Strambach 2001). In this way suppliers leverage competences across different customers. This is a central feedback mechanism from the KIBS industry to the buyer industries.

8.2.2 Competence leveraging

As has been discussed, capability formation in the supply base may rely on different mechanisms and may take different routes. In order to explore this, this study uses the concept of competence leveraging: the exploitation of an existing stock of competences and its use in a new domain (Sanchez 1994). This concept can serve as a focusing device to explore the dynamics of the formation of innovation capabilities in the outsourcing context.[122] This type of leveraging can occur *within suppliers* and *between suppliers.*

With regard to intra-firm leveraging, Navas-Alemán (2006) compared local and global value chains and showed that some Brazilian footwear and furniture firms operated in several value chains simultaneously. Such 'multi-chain' firms showed the highest attainment of 'upgrading'. Similarly, Lee and Chen (2000) argued that this type of leveraging enabled Taiwanese suppliers to use accumulated capabilities to exploit new markets and make the transition from production (of electronics goods) to innovation activities such as design and engineering. While there are strong indications that competence leveraging is central to capability formation, there are limited insights into how such leveraging actually works within supplier firms. The existing literature does not bring these intra-firm dynamics into the open.

From a theoretical perspective, there is reason to believe that intra-firm leveraging may provide a particularly strong recipe for competence-based growth in supplier firms with multiple business activities in different domains. The supplier firm develops capabilities cumulatively in each domain, and it deepens these domain competences when working with different customers. Once multiple competence bases are in place the firm may

[122] The literature uses the term leveraging in different ways. Mathews (2006: 2) uses the term to refer to the situation in which a firm can 'secure more from a relationship than the firm puts in'. I use the term to refer to a situation in which one or more firms combine competences from distinct domains and apply them in new areas.

then benefit from the cross-leveraging of these bases. As argued by Strambach (2008), providers of KIBS are likely to employ such a strategy (see also Baaij, Bosch and Volberda 2005). KIBS therefore play a vital role in facilitating the leveraging of competences between customer domains, and new dynamics arise when knowledge and capabilities from different domains combine in different ways.

8.2.3 Competence leveraging within supplier firms

Leveraging within firms is intrinsically tied to interaction with customers in different domains.[123] In order to explain this intra-firm level it is necessary to reflect on the deepening of capabilities (a) at the domain level, and (b) across domains.

Knowledge deepening at the domain level. The review of customer cases showed that the 'shift' of standalone and integrated innovation activities to India was driven by a number of factors, including the prospects of access to specialised capabilities and more generic manpower resources. Typically, this drive unfolds within specific business lines and domains.

Learning processes unfold as interactions between the available knowledge stock and the application and development of this knowledge in specific domains and customer settings. In this way, the learning process that is initially project based becomes cumulative between projects. It involves the interrelated phases of extraction, development and application of knowledge.[124]

[123] The emphasis on leveraging here does not mean that supplier firms do not undertake innovation activities independently of customer interaction. Other parts of the thesis have shown the importance of customer-independent activities. These activities sometimes take the form of 'R&D' typically undertaken in specialist units in supplier firms. In the field of software for business process improvement, for instance, suppliers may engage in activities to define frameworks and models for business process modelling or next-generation enterprise software architecture. In the field of software for new product development, suppliers may engage in 'IP development', typically the creation of proprietary software that enables various forms of functionality (e.g. wireless LAN) in customer products. Such independent innovation activities may indeed feed into the buyer's innovation process at a later point. Thus, the sale of a software product or solution – even when customised – may rely on such prior independent in-house R&D efforts and investments. Other innovative activities may be organisational in character, performed independently of customer interaction.

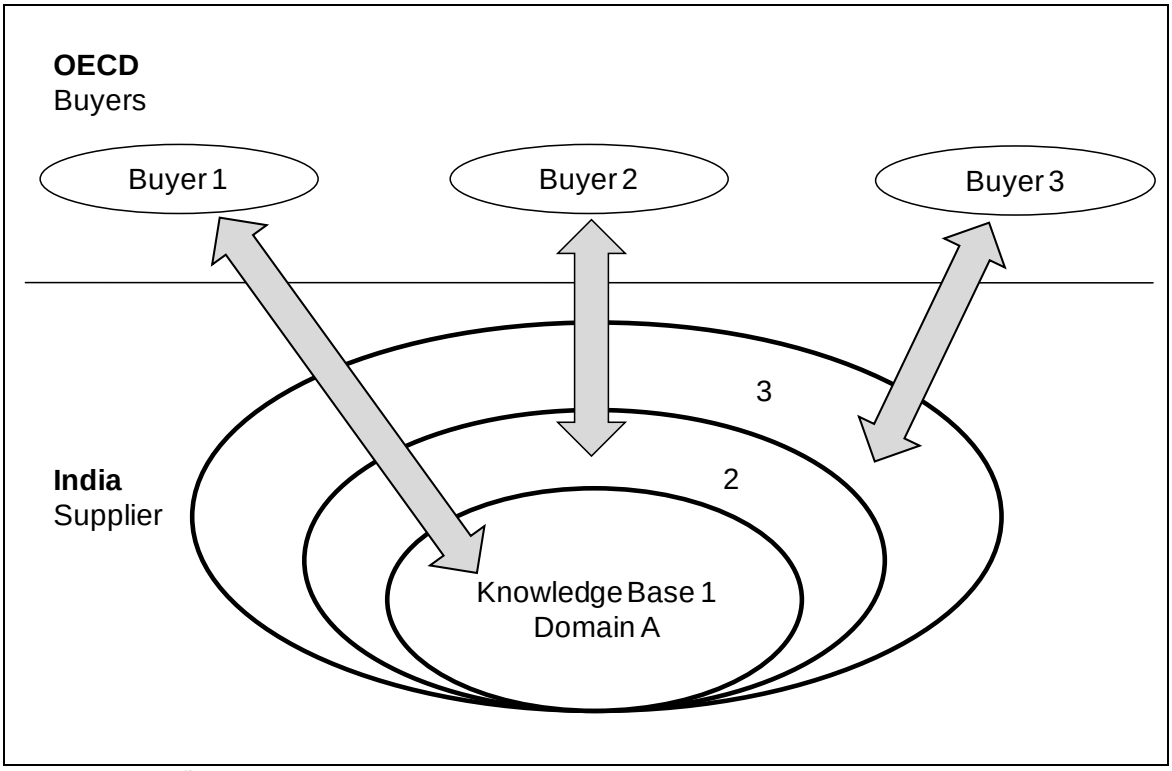
[124] I thank Srini Rajam, CEO of Ittiam, for drawing these dynamics to my attention and for providing a sketch for Figure 8.5.

Extraction: As discussed, the development of frameworks and tools is often aided by so-called alpha customers whose needs are aligned with/complementary to the strategic intent or vision of the provider. Many innovation events were expressions of the development and use of such standardised frameworks combined with the 'knowledge harvest' associated with their initial and subsequent applications. This can be applied with new customers or with same customer in new projects. Recall the example of how MindTree was cross-feeding knowledge and capabilities between different projects in Auto IT.

Consolidation: The use of corporate knowledge management (KM) systems is critical for consolidation. As discussed, these systems have all been put in place by major suppliers, some of which make KM an organisational trademark. MindTree, for instance, has been widely recognised for its dedication to cross-company KM initiatives. One element of MindTree's KM programme involves the 'operational harvesting' of knowledge that seeks to incorporate experience from every single project into the knowledge repository. Another example is Aditi's experience with Digital Media Networks and the development of a new end-to-end product development offering.

Application. These existing stocks of knowledge are often embedded in standardised frameworks, models, practices and routines primarily related to a functional objective. While much software work in the offshore-outsourcing context is shaped by the nature of requirements from customers, the use of these frameworks means that the suppliers are also pushing ideas forward in the processes of application.

Figure 8.5: Domain knowledge deepening



Source: Own figure.

While every software development project is unique, it will rarely start from an entirely clean sheet to solve the business problems. It does not include repeated tasks as in a manufacturing setting, but it does involve codified process frameworks and re-usable artefacts, plans, schedules and so on, as well as tacit knowledge vested in 'experience'. As depicted in Figure 8.5, the continuing process of knowledge extraction, consolidation and application amounts to a gradual (incremental) expansion of the knowledge base, as the supplier firm works with new customers in a particular domain. The important step is the explication of accumulated experience in particular customer projects. This process and the new knowledge base it produces may open up opportunities for the supplier to add value in new customer projects within the same domain.

Competence leveraging across domains. The previous section limited the discussion of competence leveraging to interactive processes occurring within business lines. However, as discussed, buyer firms outsource across multiple functional domains. This has given rise to dynamics on the supply side that cut across functional domains at the firm level. In order to capture this it is useful to make the distinction between horizontal (functional) and vertical (sectoral) knowledge domains. This distinction seems particu-

larly relevant because of the critical importance of domain capabilities and because the structuring of supplier firms along vertical and horizontal lines is exactly what happened in the Indian software industry at the turn of the century (Lema and Hesbjerg 2003).[125]

At the firm level, the single-domain analytical focus is sufficient for smaller specialised firms. However, larger firms (such as MindTree, MphasiS, Infosys and Sasken in the sample) work along multiple domains.

The case of Infosys is a particularly good example. As in most leading supplier firms, two overlapping types of organisational entity structure this firm:

- *Industry business units* (IBUs) focused on vertical user domains. The vertical industry domain groups are further divided along sub-sector lines. Furthermore, they include offshore development centres (ODC) for particular customers with ongoing relationships.

- *Horizontal business units* (HBUs), also referred to as enterprise capability groups, focused on functional domains. These are sometimes subdivided into technology areas such as the Infosys SAP Practice.

Currently the firm has five verticals and six horizontals as shown in Figure 8.6.[126] In order to connect seamlessly with customers the vertical organisational structure takes primacy. The IBUs are built around cross-functional teams related to different functions both within horizontal domains and also across them. Much vertical-domain competency building is a 'top-down', customer-oriented process. The domain knowledge experts and the IBU heads are typically not based in India but in the 'market location' in proximity to customers. This domain knowledge is critical to the company's efforts at supplying solutions that register closer to the core of the customers' business.

[125] Lema and Hesbjerg (2003) used the terms 'verticals' (customer domains) and 'horizontals' (service lines).

[126] In addition, two geographically focused units, the India business unit and the new growth engines unit (focusing on China and other high-growth economies), were established to address new market opportunities.

Figure 8.6: Domain competence grid at Infosys technologies

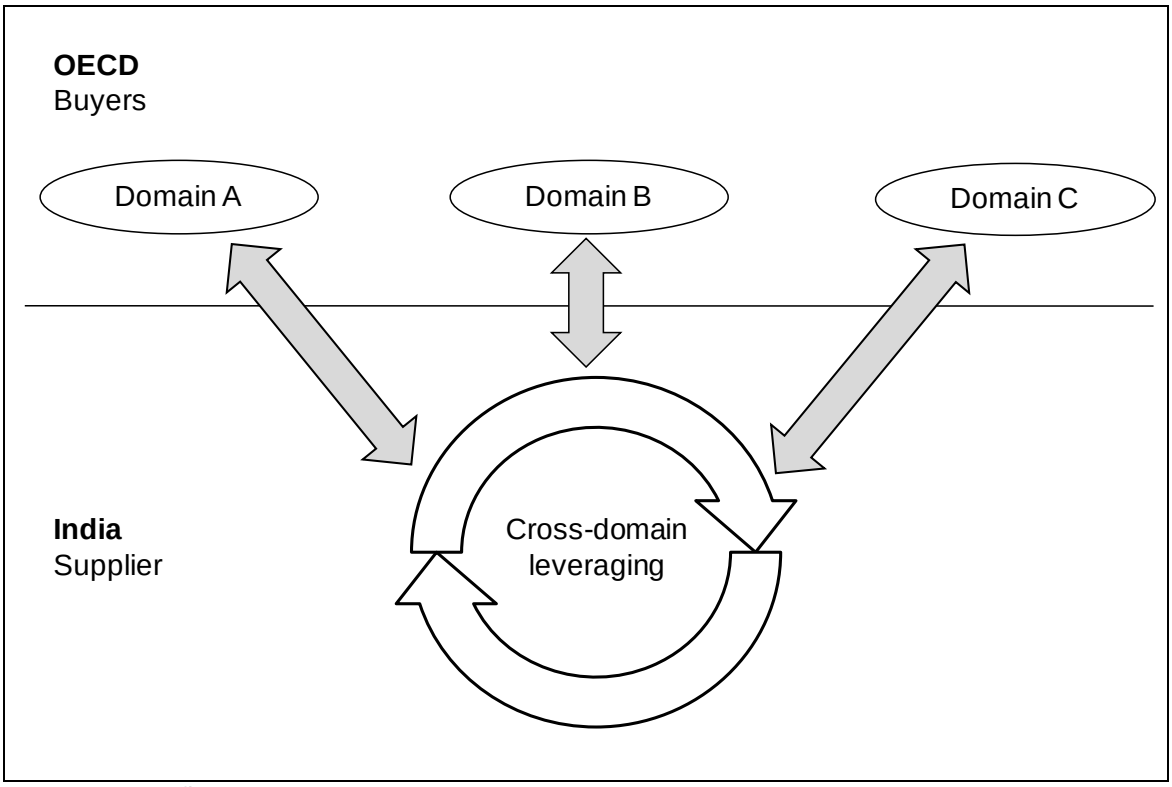
	Banking & Capital Markets	Communications Media and Entertainment	Energy, Utilities and Services	Insurance, Healthcare and Life Sciences	Manufacturing	Retail, Consumer Product Goods and Logistics
Consulting Solutions						
Enterprise Solutions						
Infrastructure Management Services						
Product Engineering and Testing Services						
Independent Validation Solutions						
Systems Integration						

Source: Infosys marketing material; interviews.

Because most HBU members deploy across vertical groups (at any given point in time); these constellations are 'virtual' in nature. This deployment is managed on a demand basis. For example, teams from independent testing services will work as 'internal' consultancy teams, depending on client demand for testing across verticals such as banking or healthcare. Each horizontal area has its own group of practitioner domain experts that develop 'solutions' that are applicable across customer domains, for example, automated testing frameworks in the field of testing. However, the horizontal groups are also supported by a group called Software Engineering and Technology Labs (SETLabs) assigned with a client-independent capability-building function. This organisation scans the external world for technology trends and creates new frameworks and solutions. In addition the company also has a 'domain competency group' (now part of the consulting solutions HBU) that engage in more forward-looking and proactive capability deepening in vertical domains. This group is charged with scanning the external environment and engaging in professional settings to build vanguard industry-specific expertise.

This process of extraction, development and application of knowledge is facilitated by the constant reshuffling and combination of vertical and horizontal domain specialists. This mobility in the 'expert layer' of staff results in the intersection of knowledge and related capability dynamism in the supplier firm. It amounts to a cross-feeding of knowledge and capabilities between sponsors working in different horizontal and vertical domains, as illustrated in Figure 8.7. Such cross-domain application of capabilities was evident in many innovation events. As mentioned, such events were often related to bodies of knowledge or frameworks with potential for repeated application.

Figure 8.7:Cross-domain leveraging



Source: Own figure.

A good example is Influx, the proprietary framework and system for business process modelling developed in Infosys. It was a new framework and toolset for business processes engineering consulting – a core problem-framing activity – and it enabled the automation and codification of business process models into specifications for offshore development. In this sense, it was concerned with taking the global delivery model to the next phase in the evolution of the industry.

Upon completion of projects, so-called 'Influx champions' across different IBUs are debriefed and involved in case-study generation with the aim of strengthening the framework in general and in the specific vertical domains in particular. The experience is then fed back to the Influx team. It has been used in more than 200 customer projects. The customers work in a wide range of vertical domains including banking and capital markets, energy, logistics, manufacturing and retail. In functional terms, assignments spanned consulting, enterprise solutions and systems integration. The important point is that Infosys is able to provide capabilities and knowledge that draw on the practices of other firms in the customer domains and in other domains. This provides Infosys with a strong knowledge base for consultancy services and advisory work provided to the customer.

To give another example, the processes of competence development and leveraging are built into the framework for delivery of value-adding activities provided to the customers in MphasiS (M-Tec). These value-adding activities are described as deriving from processes in which MphasiS is 'Understanding and representing stakeholder requirements through *pre-field activities* and requirement analysis, while leveraging domain expertise … [and] sharing best practices *gleaned from our myriad projects* and highlighting areas for improvement through business process re-engineering and technology' (MphasiS 2008, emphasis added).[127]

Curiously, the concept of the 'innovation system' is useful as a loose metaphor for what goes on *inside* supplier firms. These firms combine different stocks of knowledge and tailor them to customer needs. This involves labour rotation and joint action between different business units and it gives rise to significant knowledge spill-over from project to project. This requires flexible organisational structures around distinct capability domains and this enables multi-domain suppliers to achieve within the firm what certain clusters achieve between them. Almost 20 years ago, a similar observation was made in

[127] Pre-field activities refer to de-contextualised (abstracted) knowledge development and consolidation related to the specific class of problem. This is aimed at enabling a holistic view of possibilities and stakeholder requirements that may not be obtained already by customers. It is based on research efforts but the team will also 'seek past experience' within the business analysis group, which coordinates a virtual network of intra-firm domain experts. This enables the leveraging of expertise and best practices that can be built into solutions.

a different part of the world. Analysing the importance of flexible specialisation in Germany, Sabel (1989) observed this types of organisation was not only present in regional economies, but also within firms: 'As large firms reorganise, they try to recreate among their specialised units the collaboration characteristics of relations among firms in the flexible specialisation economies' (Sabel 1989: 103). This was exemplified by the 'Bosch Model' in which the German supplier of technology and auto parts had achieved a level of dynamism between different units located in Baden-Württemberg which was otherwise normally associated with collaboration between firms.

This section has sought to explain how the real dynamics on the supply side can only be detected when one looks beyond particular projects. The provision of comprehensive solutions draws on previous projects, and the connection that suppliers make between projects and customers in different domains augment the learning dynamics on the supply side. Cross-domain knowledge leveraging enables suppliers to provide offerings with new functional and qualitative properties. The next section suggests that this capability – on top of the emergence of new supplier capabilities in general – has an important influence on buyers in key business lines.

8.3 Extended framework II – the supply-side dynamic (co-evolution)

The literature on offshore outsourcing tends to focus on either the demand side (e.g. Maskell *et al.* 2007) or the supply side (e.g. Hansen *et al.* 2008). While the two sides are rarely examined in conjunction, it is acknowledged that outsourcing is dyadic, with a reciprocal relationship between buyers and suppliers.

The idea is most clearly expressed by Sturgeon and Lee (2005), who suggested that in certain conditions outsourcing is mutually reinforced. They observed a virtuous cycle between increased strategic outsourcing and the emergence of a global supply base in the electronics industry. Capability formation in the supply base was important to this process. 'Once new supplier competencies are in place, they can be used as a basis to develop relationships with other lead firms, and can influence future lead firm decision making regarding strategic outsourcing' (Sturgeon and Lee 2005: 36). In other words, the increase in scale and capacity of the supply base makes additional outsourcing attractive. Drawing on these authors, Memedovic sums up the argument:

> Deepening of vertical specialisation and rising capabilities in developing countries are creating a self-reinforcing, co-evolutionary cycle that is driving global economic integration forward: fast and continuous changes in international division of labour drive the global engagement up; global engagement drives capabilities up; and rising capabilities tend to attract more investment and customers.
>
> (Memedovic 2008: 229)

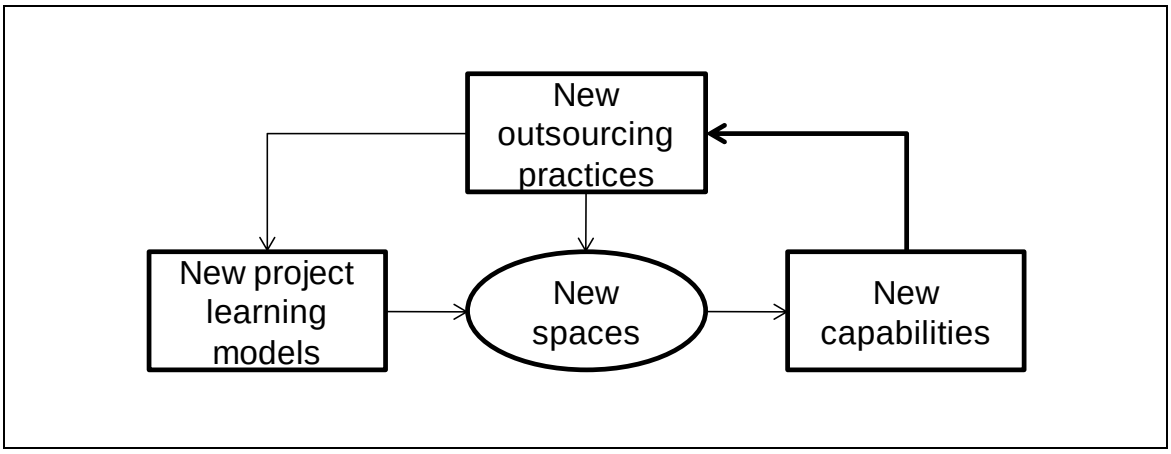
However, it is possible that co-evolution in outsourcing is not only about *scale* but also about *direction and quality*. The potential deepening of outsourcing relationships may entail a qualitative transformation of outsourced activities and significant structural change on both sides.[128]

The literature on offshore outsourcing tends to assume that the impetus comes from the buyer side, at least in the first round. As discussed, there is no automaticity in the build-up and deepening of capabilities in the supply base, but in certain circumstances outsourcing can be an important learning opportunity for developing country firms (Hansen *et al.* 2008).

In a second round of iteration, the deepening of capabilities in the supply base can have important feedback mechanisms. It is widely recognised that the effective 'level' of supplier capabilities is important in shaping industrial organisation patterns (Chesbrough 2003b; Christensen 2006; Gereffi *et al.* 2005). Simply put: 'The availability of competent suppliers influences whether and to what degree lead firms outsource' (Altenburg 2006a: 504). For this reason, the effective transformation of capabilities in the supply base is likely to have important ramifications.

[128] As mentioned, the relevance of the co-evolutionary lens to the analysis of outsourcing is evident in the research on the electronics industry undertaken by Sturgeon (2002) and Sturgeon and Lee (2005). In this industry, the shift from vertically integrated firms to core competence firms was associated with the emergence of a new global supply base for so-called 'manufacturing services'. The strategy of disintegration and the ability to codify transactions in this industry was central to large-scale outsourcing of manufacturing activities. These were externalised to suppliers with high competence levels. While the analysis did not address the question of how suppliers acquired capabilities in the first place, the key message was that they could now become providers of turnkey solutions. Lead firms focused on upstream functions such as branding and product definition, whereas suppliers focused on an entire range of end-to-end downstream production tasks. The upper limit of the co-evolving complementary specialisation between buyers and suppliers was the outsourcing of generic, base process competences within the sphere of production. Because linkages were 'thin' (highly codified) these did not provide the tacit knowledge necessary to make the transition to innovative capability.

Figure 8.8: The supply-side dynamic



Source: Own figure.

The idea that new capabilities have feedback implications with regard to sourcing practices – as illustrated in Figure 8.8 – is not new. This is suggested explicitly by Schmitz and Strambach who argue that supply-side organisations 'do not stand still … they develop a dynamic of their own, and they change the environment in which large client firms operate' (Schmitz and Strambach 2008: 13). Thus, the most recent literature notes the possibility of a 'supply-side dynamic', but the exact ways in which this might occur are not clear. This thesis aims to take a further step in unpacking these dynamics.

In order to unpack this dynamic it helps to distinguish between direct and indirect feedback mechanisms. *Direct feedback* mechanisms transmit in a straight line between suppliers and buyers, as the former develops customer-specific competences and the comfort levels of the latter rises. This widens the range of options for further outsourcing at the unilateral level. *Indirect feedback* mechanisms are the external effects of increasing supplier capabilities at the multilateral level. These create new options for the 'demand base' as a whole. This means that openness and outsourcing that are initially practised by only a few firms may therefore set in motion a co-evolutionary process, in which supply and demand are recursively moving towards higher-level activities at the aggregate level.

Chapter 7 identified some degree of 'innovation push' in the sense that customers push it out. However, innovation outsourcing also has supply-side drivers – 'innovation pull' – in the sense that suppliers pull in the innovation activities. This is what happens when

suppliers build capabilities in new spaces. In the sphere of production outsourcing in the electronics industry the push-and-pull phenomenon has been described by Sturgeon and Lee (2005). However, this process seemed to hit a wall: it was limited to production and problem solving. Suppliers had become drivers of outsourcing in their own right, but mainly in the sphere of production.

The question is whether similar dynamics unfold – and whether they may be even stronger – in the sphere of problem-framing innovation. In other words, does the involvement in problem-framing activities facilitate the development of such an 'own dynamic' in the supply base?[129] This chapter therefore concentrates on the cases in which the outsourcing of problem-framing functions has been identified.

8.3.1 The supply-side dynamic

The supply-side dynamic has direct and indirect feedback mechanisms.

Direct feedback mechanisms are those that transmit between individual buyers and suppliers as they deepen the outsourcing relationship. Over time, the cognitive frame in which outsourcing decisions are made is increased. This is the learning curve on the buyer side (Maskell *et al.* 2007). The frame expands not least because the buyer's 'comfort level' rises as supplier capabilities become 'proven' over time.

Equally important is the learning curve and the development of client-specific knowledge on the supplier side. In other words, proven capability levels increase over time and because suppliers get to know the clients' systems, the scope for outsourcing is increased over time. In many cases, the move to innovation-oriented outsourcing projects reflected an evolving relationship between buyer and supplier. As argued by NASSCOM, some buyers are beginning to utilise global sourcing to drive strategic imperatives: 'This evolution of expectations, towards an increasing emphasis on

[129] I distinguish implicitly between two types (or levels) of capabilities. These two types are: (i) innovation capabilities that permit suppliers to *exploit* new opportunities created by openness. As was discussed, these are mainly problem solving; (ii) innovation capabilities that enable suppliers to *deepen* the process of innovation in outsourcing relationships. These are mainly problem framing. In the second stage capabilities became wide and deep enough, not only for firms to partake in end-to-end outsourcing across the software development life-cycle, but also to induce further outsourcing of requirements activities.

beyond-cost benefits, is observed to be closely correlated with the offshore experience of the buyer' (NASSCOM 2008: 87).

As an example, take the case of the internet solutions provider mentioned in Chapter 7 (section 7.1.1). This firm had relied on staff augmentation services from a small Indian supplier for many of its projects, including a comprehensive OSS. However, the in-house part of the team that had been involved in developing the so-called 'legacy system' had been effectively reduced because of stress and exhaustion (referred to as 'burn-out') among some of the most critical employees. Hence, this team was effectively diminished to a size below the threshold needed to manage the development of the new system actively. Previous projects had been managed exclusively by the buyer. However, staff augmentation work on the legacy OSS system and related assignments had given selected supplier employees valuable experience with the system. Despite bids from competitors – including large and powerful ones – the project was allocated to the particular supplier because of its system-level knowledge and price competitiveness. While previous projects had relied to some limited extent on co-design skills, this project required independent design skills the supplier had developed over time, but mainly in relation to smaller projects. The supplier was in a good position to take on this role and develop the system 'from concept' because of the previous staff augmentation work on the legacy system. In this way the deepening of outsourcing relationships, from 'routine' to higher-order activities, sometimes reflected the accumulation of domain- and customer-specific knowledge that had been transferred to the supplier. From the buyer perspective, innovation outsourcing became a compelling extension of standard services outsourcing. On the supply side, firms could benefit from the exploitation of the knowledge that had become embodied in its staff as a by-product of previous engagements. However, the leveraging of competences between projects (within or between buyer firms) depended on deliberate and systemic capture and transfer of learning from project to project.

Another example is the IT department in a major US technology and services conglomerate. By relying on 'total outsourcing' for IMS, this organisation effectively became a 'virtual sponsor', employing only a very small number of people to oversee the activity and manage the relationship with the supplier. The buyer had initially relied on staff augmentation for its NMS but had shifted the entire execution capacity to its suppler. In

this setting, the process improvements related to the service were best placed with the supplier. This arises when suppliers have been so closely engaged in the development of systems that the best critical mass with intimate system knowledge exists in the supplier firm and hence the supplier has become equally or better equipped to define and implement change processes (at a lower price). In some cases, the buyer has no or very few in-house resources for the selected areas. Hence, the change and knowledge creation processes are offloaded onto suppliers who work intimately with the selected areas on a day-to-day basis.

This is not to suggest there is always a smooth transition. The move to outsourcing higher-level activities was often prompted by crises on the buyer side. The key point is that supplier capabilities gave the buyer a new way out of the crisis. Such crises were very often the extra push that led buyers to exploit customer-specific knowledge developed in supplier firms. The boundaries were often pushed in the efforts to overcome particular problems. This can be seen as the occasional fuel injection that often keeps the firm-level co-evolutionary cycle in motion. However, there are also inter-firm effects. The vanguard projects are of crucial and direct importance to the buyer. However, the wider significance arises because the capabilities developed in the supplier firm during these projects can be deployed with other customers. This is referred to as indirect feedback mechanisms.

Indirect feedback mechanisms are the externalities that arise from the use of a shared supply base. Hence, the feedback effect is not 'appropriated' by a single buyer firm. Rather, it transmits between multiple actors. They arise not from the customer-specific knowledge in the supply base, but from the more generic domain capabilities that are developed over time. Whereas the direct feedback mechanisms are easily observable in the study of relationship trajectories, the indirect feedback mechanisms are more 'in the air'. Yet, they are detectable in buyer practice as well as evident from informants' statements. Furthermore, they have wider implications because they allow – or even induce – buyers to change their outsourcing practices and ultimately their business models. What goes on in India and other service supply bases has now begun to influence strategic decision in some segments of the primary and secondary software industry in OECD countries.

As a start-up firm, Digital Media Networks is a good example. Outsourcing to India was inherent in the business plan even before the firm's inception. The venture might not even have been possible had the firm not adopted its vanguard outsourcing strategy. In this sense, the Indian supply base has allowed the firm to emerge at the forefront of a new-generation software as a service (SaaS) ISV in which the back-end technology operations are completely outsourced. The main energy is devoted to non-technical tasks such as sales and alliance management. Without an in-house engineering team, it could depend on the external provider to facilitate the right technology choices and build a competitive solution from just a vision. As a start-up firm, the management could build and grow the firm while the Indian collaborator was responsible for all technology needs. Indirectly, they benefited from other firms' OPD projects that had helped Aditi to gain domain knowledge and architectural capabilities.

In the case of Auto IT and MindTree Consulting direct and indirect mechanisms merged. MindTree had previously developed a dealer management system for Auto IT and had gained high competence levels in the aftermarket area. MindTree was able, for this reason, to partake competently in the inception and elaboration phases of the CRM sales tools project. They were able to cross-feed client-domain-specific competences between the different projects they provided for Auto IT. However, they were also able to draw on the experiences developed from working with other clients on CRM systems in other settings, and then use this knowledge in the processes. In other words, competence leveraging on the supplier side occurred in the client-specific relationship as well as between clients. In this way the relationship with MindTree was a key enabling factor in Auto IT's efforts to transform its business model. This enabled MindTree to add value to Auto IT in the defining phases of the project. It is precisely for this reason that problem-framing experience equips vanguard supplier firms with the dynamic capabilities that induce further` outsourcing in a profound way.

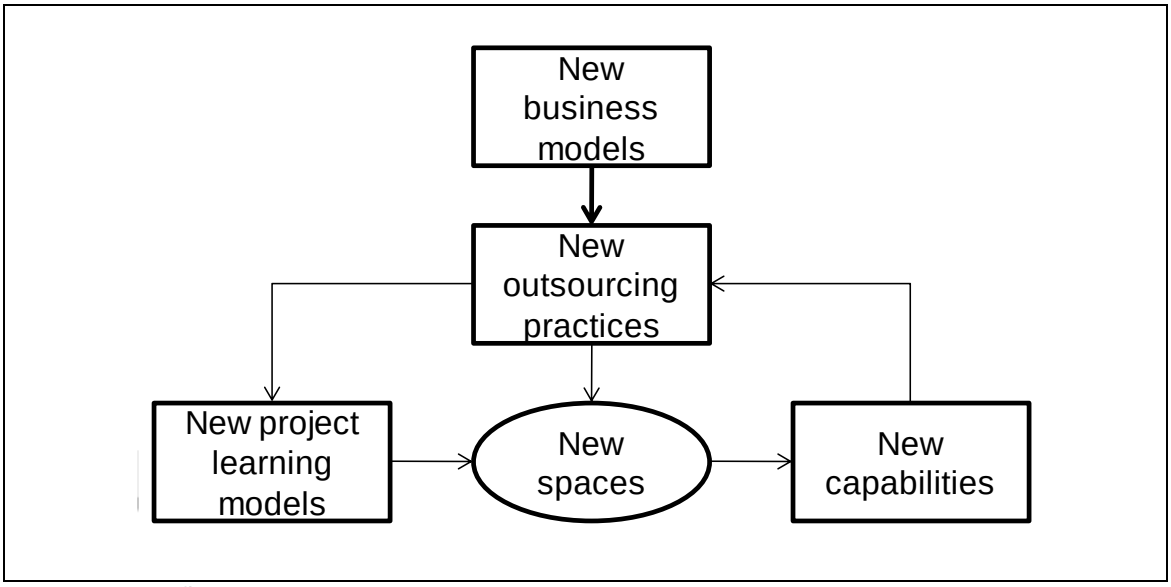
This dynamism associated with the cross-feeding of knowledge and capabilities between domains has emerged with the transition of customers to more open-sourcing strategies in which sponsors actively seek to capture value from outside. Increasingly customers sought to leverage the capabilities of supplier-firm experts and other resources that had developed because of dealing with projects of similar nature with other customer.

8.4 Extended framework III – new business models

Offshore outsourcing of production activities and routine services is an established phenomenon. This first wave of outsourcing reflected the shift from the closed, vertically integrated business model (Chandler 1977; Williamson 1981) to the core-competence business model, in which 'non-core' activities were increasingly outsourced (Sturgeon 2002). In other words, changes in corporate models provided the root cause for the production outsourcing wave.

This section seeks to provide theoretical framing and anecdotal evidence to suggest that the dynamics in the 2000s were enabled by an emerging paradigm on the buyer side: the open business model. The opening of business models may have been a key enabling factor that allowed self-reinforcing dynamics in the outsourcing industry to unfold. Moreover, they were key in driving the emergence of knowledge-seeking outsourcing strategies. This relationship is illustrated in Figure 8.9 and the first step is to draw on theory to explain why business models have changed.

Figure 8.9: The role of changing business models on the demand side



Source: Own figure.

Note that the concept of 'new business models' is not located within the circular 'loop'. This is because the broad business models of large firms are unlikely to be directly influenced towards 'openness' as a result of the demonstration of innovative capability in software in Bangalore. Rather, the idea is that the nature of the broad business model in such organisations arises as an exogenous variable influencing what happens in the

specific case of how they approach their software activities in the IT department.[130] This may then be reinforced by increasing supplier capabilities in second iteration. However, in smaller organisations such as Digital Media Networks, increased availability of low-cost innovative capability may be influencing the core business model itself.

8.4.1 Notions of core competences and the limits to outsourcing

The link between business models and outsourcing practices is found in notions of core competence and related decisions regarding the boundary of the firm. It is therefore useful to start the discussion of business models with a brief review of the notion of core competence. Palpacuer (2000) predicted that lead firms will ensure (i) the internal development of core competences (ii) the quasi internalisation of so-called complementary competences and (iii) the externalisation of standard competencies. The question is, however, what firms perceive as 'core'.[131] As this research has shown, the boundaries between some routine (standard) and innovative functions are blurred, at least in the software industry. In conceptual terms there is also considerable ambiguity with regard to what the core competences of lead firms are. Three notions of core competences can be discerned.[132]

First, the literature on global value chains has debated the possibility of functional upgrading of suppliers (Humphrey and Schmitz 2004b), i.e. acquiring new functions in the chain to increase the overall skill content of activities. While some studies have been optimistic, arguing that supplier can move from specified production tasks, over own design to own banding (Gereffi 1999), most value chain studies have suggested that supplier firms' competences remain limited to production. In reviewing this literature, Schmitz found that the main obstacle to functional upgrading into more knowledge-creating tasks was lead firms' core competence strategies:

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[130] It is more plausible at a much higher (more aggregated) level of analysis. If one could examine outsourcing firms across global industries, it is possible that there might be a strong positive relationship between (i) the changing experience of increasingly pervasive and increasingly 'deep' (i.e. innovative) outsourcing, and (ii) a rising propensity among large firms to adopt broadly open business models.

[131] In Palpacuer's (2000) model, whether competences are core, complementary or standard is essentially determined by the degree of asset specificity, ranging from high specificity of tasks and underlying capability (non-commodity capabilities) to low specificity of tasks and underlying capabilities (commodity capability).

[132] In defining the latter two of these we draw on Christensen (2006).

> The source of power in global value chains lies increasingly in non-production activities, notably in branding, marketing, product development and the coordination of inter-firm relations. The lead firms (global buyers) focus on and invest in these activities as they regard them as their core competence. It is thus not surprising that these lead firms do not share this core competence with their suppliers and in some cases try to prevent them acquiring such new competences
>
> (Schmitz 2004: 4).

As this quote indicates, there is a literature that has argued that the core competence model de-links production from innovation. This is particularly visible in the work of Sturgeon (1997).[133]

The second, view of core competences puts less emphasis on functional competences and more emphasis on knowledge and technology domains (Prahalad and Hamel 1990). Thus, the core/non-core distinction is a more complex issue that cuts across production and innovation tasks. Growing out of the management literature, this view prescribed that firms should focus deeply on a limited set of knowledge domains, such as distinct business lines or technologies, they should ensure a large degree of centralised authority and they should seek to minimise external knowledge spillover. This notion of core competences was closely associated with the 'not invented here' (NIH) syndrome which devalues the relevance of externally created knowledge and innovations. According to Christensen (2006: 36), 'introvert modes of innovation were argued to be the standards to be met for large successful companies'. While the importance of absorptive capacity (Cohen and Levinthal 1990) was acknowledged, it was viewed from an internal competence position. Absorptive capacity was a by-product of internal R&D, it was limited to knowledge in closely related (i.e. core) areas and it was focused on bringing in external knowledge 'spillovers', rather than direct and purposefully transmitted knowledge.

[133] Sturgeon (1997) described the organisational de-linking of production and innovation activities in the electronics industry. This notion continues in later work (2002), but more emphasis is given to the fact that turnkey suppliers undertake a whole range of activities including new logistics tasks and some elements of design. While this was viewed as a sign of upgrading, it was not seen as innovation. Rather innovation was almost exclusively defined as product definition. The innovation process remained 'closed' within buyer firms.

In the third view, the deep and narrowly specialised core competences give way to systemic and integrative competences. This happens because of the changing context for innovation, which includes the trend of further de-verticalisation, the global extension of markets and the increasing complexity of innovation. Lead firms' definitions of core competences and strategic resources change and many even turn to new (modular) designs that *encourage* suppliers and subcontractors to take responsibility for design and innovation. They also begin to invest in technology entrepreneurial firms rather than in their own R&D centres (Lynn and Salzman 2007).[134] As argued by Christensen (2005), the result is corporate strategies that are not compatible with the *traditional* core competency perspective (Prahalad and Hamel 1990; Sturgeon 2002), even though firms of course specialise in what they (perceive to) do best. Even though lead firms still specialise, they are beginning to open their business model, as will be discussed further below.

Interestingly, this third paradigm seems to be largely driven by developments in the supply base. In the electronics industry the gradual shift from supply platforms to innovation hubs in Asia meant that lead firms abandoned the not invented here syndrome and increasingly resorted to 'taking what's on offer'. However, these dynamics were not confined to electronics. The tendency for specialised vertical and horizontal domain knowledge to emerge in small firms influenced trends in the division of innovative labour between large firm and small firms in general:

> This means that small firms often develop new agendas for technology-based business opportunities for large firms, and in order to explore and exploit these opportunities, large innovative firms must put greater emphasis on the dynamic/adaptive, open/extrovert, and systems integration sides of their competencies than what is traditionally associated with the core competency perspective
>
> (Christensen 2006: 36).

None of these views imply that buyers do not specialise in key domains or functional tasks. There will always be 'core' and 'fringe' activities within the processes of specialisation. The distinction between problem framing and problem solving (Brusoni 2005) captured this. Not all activities in the innovation processes are strategic (core) to

[134] As in the case of Telecom Corp investing in Sasken.

all firms. System integrators use the division of innovation labour to outsource certain parts of their R&D, but there the problem-framing function is a core capability. Such firms use the supplier landscape to create and capture value. Christensen (2006) emphasises that core competences are unlikely to become wholly obsolete, but he shows that such firms are more aware of the danger that core competences can become 'core rigidities' (2006: 59). Firms follow diverse strategies and therefore the three core competence perspectives may continually co-exist. However, there is little doubt that they also indicate an evolution in corporate worldviews which has paved the way for new business models.

The next sub-sections will define and discuss the emergence of 'open' business model in more detail. However, a particular pertinent question is whether or not the open model will make core competences obsolete (Christensen 2006). The answer is 'yes' if one adopts the shallow view of core competence (as in some global value chains research).[135] In this view the outsourcing of innovation activities is to move beyond – if not leave behind – the core competence model. The answer is 'no' if one adopts the broader view of core competences which emphasises the ability to coordinate and integrate otherwise separated knowledge and systems. Firms may disintegrate elements of the innovation process itself including crucial R&D. As argued by Carpay *et al.* (2007: 256), 'there is no conflict between open innovation and core competence in outsourcing R&D'. The evolution of core competences does, however, signify a broader change in corporate business models with important implications for space that accrues to suppliers.

8.4.2 Corporate restructuring: from closed to open business models

A business model is the way a firm generates value and captures a share of this value (Chesbrough 2006a: 2). It is widely acknowledged that value arises in a series of activities that bring a product or service from its conception to its end use. This series of activities is the value chain; and the capturing of value is dependent on a key asset, resource or position in the chain that brings competitive advantage (Porter 1990).

[135] It is this 'traditional' and narrow view which underlies the 'core competence business model' that will be discussed in the next section.

The shift from closed to open business models can be seen as a three-stage process. In the closed business model, the first stage, firms could systematise innovation across different business units in order to build competitive advantage in existing and new product markets. This depended on large R&D budgets and strong research capabilities. Firms took control over a long thread of activities in the value chain and became known as 'vertically integrated firms', in which economic activities were guided by a visible hand (Chandler 1977).

It became apparent during the 1990s that firms' strategies were changing. In this second stage, firms were increasingly developing higher degrees of strategic focus, thereby concentrating on select core competences in the value chain. This was enforced as a way to achieve excellence, cut costs and maximise shareholder value. The core-competence strategy is dependent on the development and recurrent deepening of distinct capabilities that allow for innovation rents. This is only possible when the business model is hard to imitate by incumbents. For this reason 'there is an incentive (a) to outsource non-core activities; and (b) to avoid any leakage of core competence to suppliers' (Altenburg 2006a: 505). Innovation and the definition of products and services for specialised markets often became the key focus for building core competence (Lazonick and O'Sullivan 2000; Prahalad and Hamel 1990). By contrast, firms increasingly outsourced production activities and other non-core functions to external providers. Core-competence strategy and increased codification led to the organisational de-linking of innovation and production, with the former undertaken by lead firms and the latter by specialised supply bases concentrating on so-called 'non-core functions' (Sturgeon 2002).

In the third stage, the open business model, even the innovation process becomes organisationally decomposed. Lead firms reap savings in time and costs in the innovation processes by leveraging external development. The development of new products and systems involves multiple firms, with the different parties dividing the work of innovation. This division of innovative labour is central to the open business model:

> An open business model uses this new division of innovation labor – both in the creation of value and in the capture of a portion of that value. Open models create value by leveraging many more ideas, due to their inclusion of a variety of external concepts. Open models can also enable

> greater value capture, by using a key asset, resource, or position not only in the company's own business model but also in other companies' businesses.
>
> (Chesbrough 2006a: 2–3)

The organisational decomposition of the innovation process is associated with new corporate structures, managerial priorities and firm boundaries. Many firms have accepted, more or less voluntarily, that they cannot control all innovative activities in the value chain. This study uses 'openness' as a term that encompasses open business models (corporate restructuring for new modes of value capture) and the associated changes in innovation management and strategy.[136] The shift towards openness has gone furthest in 'high-tech' industries such as computers, information technology and pharmaceuticals – and mainly in large firms. Yet there are signs that it is now expanding to other industries and smaller companies (Chesbrough 2006b).

Table 8.3 shows the three phases of business model described above. Three related variables change over time: the business focus and associated degrees of vertical integration/disintegration, and the related sourcing practice.

These are ideal types; in reality, firms rarely fit neatly into one of the categories. The shift to openness is a gradual process rather than a sweeping change. However, the fundamental force driving the shift to the open business model is the increasing availability of external sources of innovation (Chesbrough 2006a). Firms that do not use the resources and external opportunities available in the open innovation landscape may fail to compete effectively. This requires an opening up towards actors in the external world (such as suppliers, customers and rivals), but it also entails internal transformation.

[136] A closely related concept is that of 'open innovation'. This refers to a new model of innovation, which is an antithesis to the vertical integration model where internal innovation activities result in internally developed products and services. In this new model, firms increasingly draw on external innovation (Chesbrough 2006b: 1).This model is a result of the pressure on firms to reduce in-house research (basic and applied) in order to concentrate primarily on new product development, i.e. the realisation of architectures and systems (Chesbrough 2003c).

Table 8.3: Business models

	Closed business model	Core-competence business model	Open business model
Focus of firm or business unit	Focus on internal economies of scale. In-house production and innovation	Retention of internal innovation advantage in chosen competence field and focus on selected functional capabilities.	Focus on systems integration and the leveraging of external ideas, resources and knowledge assets.
Sourcing practice	No or little outsourcing. Vertical integration	Outsourcing of production activities. Selective disintegration	Outsourcing production and innovation. Expanded disintegration
Literature	Chandler (1977)	Prahalad and Hamel (1990); Sturgeon (2002)	Chesbrough (2006a); Lazonick (2008)

Table 8.4 shows the stylised characteristics (indicators) of the open business model and it contrasts these with the closed model. These are used in the empirical discussion of whether or not buyer firms are adopting open business models.

Table 8.4: Analysing business models – key indicators

Closed		Open
The firm bases value creation on internal knowledge assets	⇔	The firm bases value creation – in part – on key knowledge assets and resources in other companies businesses
The firm's innovation activities are undertaken in-house (development costs are internal)	⇔	The firm's innovation activities are undertaken internally as well as externally (substantial development costs are external)
The firm locates the management of innovation in the R&D unit	⇔	The firm locates the management of innovation in every business unit of the company
Risks and rewards accrue to the firm alone	⇔	The firm shares risks and rewards with external partners in the innovation process
The firm's business model is self-contained	⇔	The firm's business model connects with the business models of customers and suppliers
The firm perceives knowledge spill-over as a regrettable cost of doing business	⇔	The firm perceives knowledge spill-over to partners as a potential source of improved competitiveness
The firm perceives its innovation task mainly as a matter of 'technology' (developed in the R&D unit)	⇔	The firm's innovation task includes the reinvention of the business model itself.
The firm uses internal pathways to the market	⇔	The firm uses internal and external (indirect) pathways to the market (new revenues from divesture, spin-off and licensing)

Source: Adapted from Chesbrough (2006a: Table 5.2), drawing also on Leung (2007) and Vaitheeswaran (2007).

The indicators defined above are therefore only the starting point. Further analysis entails a deeper examination of the types of innovation activities that are outsourced and the degree to which these are 'core'. The problem is, however, that this analysis easily falls into the trap of ex post rationalisation: 'if the activity is kept in-house, it must be core and strategic'. The key is therefore to investigate firm and supplier trajectories

8.4.3 Software buyers

This study did not examine systematically how wider business models influenced buyer firm sourcing strategies. However, although empirical data was concentrated on outsourcing, some evidence emerged as a by-product of that focus. In order to discuss the elements related to business model trends and changes it is necessary to briefly discuss BPSS and PDSS separately. Can the differentiated outsourcing practices identified earlier be explained by differences in overarching business models? Can the outsoaring of problem-framing activity be explained by the adoption (by some buyers) of an open business model?

Buyers of business process software services: The main buyers of BPSS are IT departments. An important element of the sourcing practices of the sample firms in this group of buyers was the deliberate use of suppliers' assets in their innovation efforts. They seek cost reduction and external asset leveraging not only in the construction part of the project life-cycle, but well beyond. The IT departments include suppliers in important innovative activities. In order to explain this it is useful to examine the wider changes that gave rise to it.

In many buyer firms, innovation outsourcing was still nascent but it was the culmination of efforts in corporate restructuring which entailed a shift away from the old integrated IT department. [137] The advent of the 'open network' approach to corporate governance is central. It means that business activities and internal supply chains become variable

[137] The nature of IT departments' CAD outsourcing has changed in important ways over the last ten years. In a survey of 290 senior IT managers (Overby 2007), it was found that more than half of those who made use of offshore outsourcing were satisfied with the level of innovation provided by the offshore supplier. Satisfaction levels were highest for those who outsourced to focus on core business and gain access to specific skills, whereas those who stated that cost saving was the main reason were the most dissatisfied. But the majority of respondents expressed a need for the suppliers' further engagement in innovation activities.

and subject to market conditions. Large firms have gradually forced the IT department in the secondary software industry to operate under more market-based conditions. In many cases, firms have spun off the IT department as separate (but often wholly owned) companies, which must bid for (internal) projects alongside rivals.

The trend within this segment has been increasing organisational detachment from parent organisations. They have typically not been part of the revenue-generating engine of the firms. Rather they have featured on the 'expenses' side of the balance sheet. However, parent organisations now demand that IT departments make a profit and they expose them to competition in internal as well as external markets. With budgets that are more independent these new IT organisations also look outside the parent organisation for growth opportunities and for solutions to immediate problems. In this setting, many IT departments have aimed to become more vertically specialised. This poses great challenges as they must transform their organisations and upgrade the competence profiles of the in-house employees. Outsourcing is the other side of the equation. Corporate changes are translated into new sourcing frameworks in which more of the deliveries are transferred to suppliers. These organisations shift assets out of old functions, but they want to do so while also increasing business revenues. By engaging suppliers in new activities, they sometimes also reduce the internal assets that used to support these activities. [138]

Interviews with 'global sourcing' managers in IT departments revealed that parent companies sometimes pushed for the reduction or specialisation of fixed assets and offloaded more high-end work to suppliers. From the point of view of the firm, software outsourcing, even when it was innovative and mission critical, did not relate to a core profit area of the firm (such as new product development) but to supporting functions. For the typical IT department itself, software development and other aspects of soft-

[138] This need is illustrated by the recent changes in the IT department in British Airways (BA). The use of suppliers from India to undertake higher-order activities enabled the IT department in BA to increase the number of projects it carries out without taking on more internal staff. 'Its own staff, meanwhile, have had the opportunity to move out of software development and support work and into different roles, such as business analysis.' Interview with the Head of IT delivery in BA for a *Financial Times* special report (Thomas 2007).

ware-related IT system management is – or was until recently – a core activity. However, from the overall organisational point of view it typically is not.[139]

Buyers of product development software services: In the sample, ISVs and electronics and telecom firms represent the buyers of PDSS. As was shown, both groups have adopted important elements of the open business model. There are similarities between these two groups, both of which engage in buy-to-build outsourcing.

Time to market is essential in both these segments and this increases the global competition for design and engineering resources. The search for resources that can help transform new ideas and knowledge into workable solutions is intensifying. In many cases it is much faster to draw on specialised capabilities possessed by others than it is to generate these capabilities in-house. There are internal qualitative constraints related to specific skills. However, a somewhat different but less acknowledged type of constraint sometimes drives this type of outsourcing. These are quantitative constraints arising not from the lack of specific or specialised skills *per se*, but rather from the lack of *enough* skilled resources to develop products on time. Interviews and case material from both groups showed that such capacity constraints arising from tight engineering labour markets in some OECD countries were an important incentive to use India as a new supply base for innovation resources. [140]

There were also crucial differences between the two groups. Starting with ISVs, outsourced product development emerged as a labour arbitrage practice with a clear division of labour between buyer and supplier. In many cases, the buyer was solely responsible for all activities in the requirements stage and all design activities, whereas Indian software providers would concentrate on implementation services, including coding, quality assurance (testing) and documentation. There are indications that most large and dominant ISVs (of the likes of Microsoft and SAP) remain close to this model. If they shift innovation for new product development to India at all, they keep

[139] Yet innovation processes and organisational change at the firm level is typically highly dependent on underlying and facilitating IT systems.

[140] While quantitative and qualitative are two sides of the same coin, the quantitative constraints probably play a larger role in the opening up of innovation processes towards India. However, the empirical basis of this study does not allow for a quantification of their relative importance.

this in-house in their own subsidiaries. However, ISVs without their own subsidiaries are different. They have begun to transfer design activities to Indian suppliers. ISVs that adopt open business models lead this trend. This may be a trend that cuts across the ISV segment, but it is particularly visible in smaller start-ups that define a vertically narrow competence profile for their organisations. In this type of ISV, the technology operations are almost completely outsourced. This allows for a new breed of entrepreneurs and managers to build technology organisations without large in-house engineering teams.

The electronics and telecom buyers in the sample are of a different nature. They have complex organisational structures, with multiple R&D centres and across the globe, mainly in the USA, Europe and Japan, but increasingly also in China. On the software side, the buyer firms in this segment had all made use of staff supplementation (body-shopping) services provided by Indian suppliers – and to varying degrees continue with this practice. In this mode, buyers hired support staff employed by Indian organisations for particular projects, mainly for routine activities such as testing and technical writing. The shift to the outsourcing of software design activities to India is a much more recent phenomenon. This is part of an open systems model of innovation in this segment. The sample firms are large and they operate in an industry in which open innovation is an established practice. However, openness had clear boundaries. Firms were cautious about the knowledge distributed to suppliers.

Summary: In terms of openness, the ISVs (the primary software industry) shared many feature with the IT departments (the secondary software industry). Some buyers from the primary software industry were young upstarts. The 'old guard' of established software companies did not seem to be at the forefront of innovation outsourcing to India, although elements of the open business model were present. While these do outsource innovative activities to India on a substantial scale, the shift is incremental and carefully guarded.[141] By contrast, some young upstarts have adopted an aggressive outsourcing strategy, relying on Indian firms for mission-critical activities. In some

[141] To some extent, this may reflect a research bias because more established primary software firms might simply be more secretive about their outsourcing practices.

firms, the outsourcing of the technical elements of the innovation process became an ingrained element of the business model.

Some firms in the secondary software industry use a similar strategy. It was often the 'mother organisations' in which IT departments reside (or who own them) who pushed the shift to openness in the secondary software industry. The quest for shareholder value is important in the definition of new roles for IT departments. While most secondary software industry buyers still confine their orders to implementation, a vanguard of firms has begun to outsource design and requirements activities. The next chapter examines in more detailed the nature of outsourced activities and the limits of innovation outsourcing.

The electronics and telecom firms had shifted to open business models already in the 1990s (but the broad-based use of India as a resource base is a more recent phenomena). However, areas such as product definition and other aspects of problems framing were guided by closed business model philosophy. This underlines that even though many of these firms are adopting important elements of the open business model, this is often an extension of the 'old style' core competence model, rather than a radical departure from it. Even where firms have gone furthest, they seem simply to have decreased the scope of the 'core', or shifted it forward in the value chain (towards end-use).

Chapter 7 suggested that the new 'core' for certain buyers increasingly lies in such non-technical, customer-facing areas of requirement analysis. Other aspects of requirement analysis and software architecture tasks that rely only on generic domain capabilities have become less 'core' for such buyers and these were transferred to supplier firms. Because suppliers had become *systemically* involved in the standard operating practice of some of these buyer firms, we have discussed this in the context of business models (rather than projects alone). The new tasks which are transferred to suppliers in these models are clearly not commodity tasks, as most of them are subject to non-repeatability and hence a certain degree of asset specificity. In extreme cases, buyers would face severe crisis (or for small buyers, even collapse) in the case of supplier pullout.[142]

[142] The issue of the consequence of a hypothetical pullout was included in the event-related interviews (see the questionnaire in Appendix II).

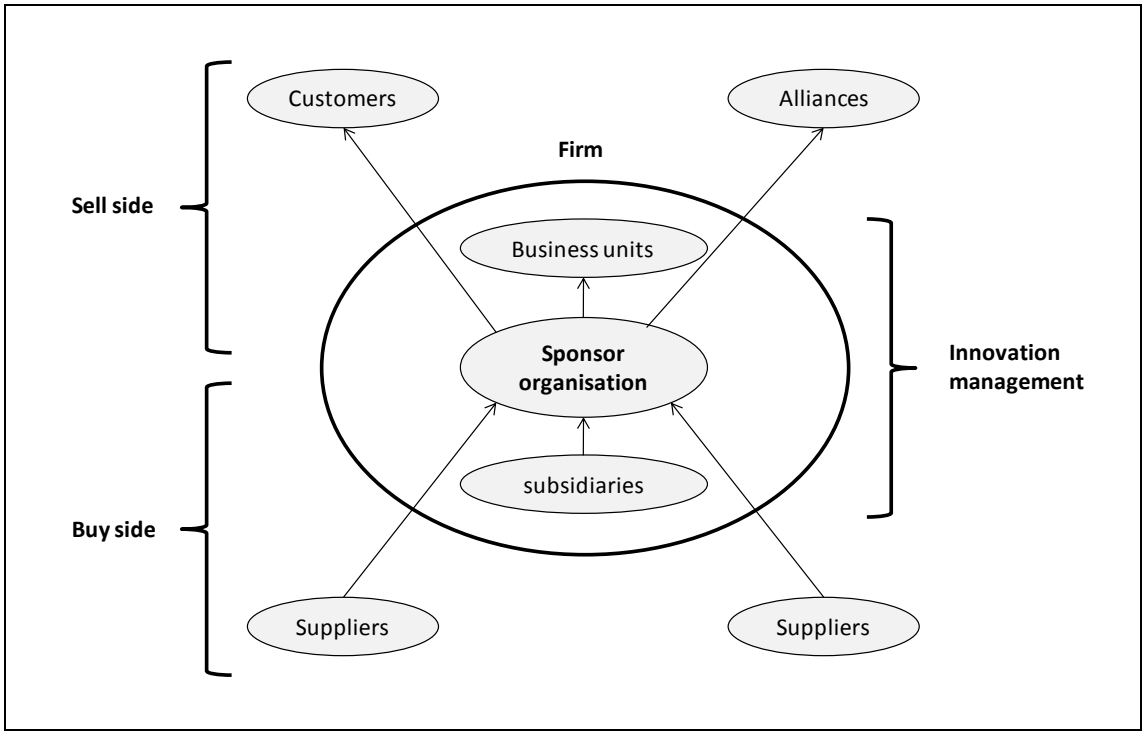
However, the sustainability of these relationships was based partly on trust. Both buyers and suppliers pointed to the potential negative consequences of putting relationships in jeopardy (loss of trustworthiness as perceived by market actors) and the limited actual scope for opportunism due to the centrality of user and partner relationships 'owned' by the buyer firm.

8.4.4 Opening of business models and innovation outsourcing to India

The question of how outsourcing behaviour in the software industry was associated with wider aspects of business behaviour, summarised as the adoption of 'open business models', is tricky. The concept of open business models covers a broad-ranging portfolio of firm behaviour; and the root causes of openness and new outsourcing practices are difficult to disentangle. However, some insights can be gained by focusing *specifically* on buyer business models.

Using the material also included in this thesis (i.e. the same buyer firms), Lema (2009a) puts the *sponsor organisation* at the centre, i.e. the buyer firm business unit or department that manages the outsourcing relationship with an Indian supplier. The findings are relevant for the issues discussed in this chapter so it is worthwhile to summarise these in some detail. Lema (Lema 2009a) discusses the buyer business model by highlighting three dimensions. The first dimension is the 'sell side', i.e. linkages with outbound flows of products and services and inbound flows of financial resources. The second dimension is innovation management at the level of firm, particularly the degree and nature of decentralisation of innovation processes (such as from the R&D department to other business units). The last dimension is the buy side', i.e. inbound flows of products and services and outbound flows of financial resources; this third dimension is mainly expressed by outsourcing to Indian suppliers. These three dimensions are shown in Figure 8.10.

Figure 8.10: The sponsor organisation and three dimensions of the business model



This work brings out the centrality of the buyer (sponsor) focus on the interface with alliance partners and customers (end-user), and shows how (changes in) the three dimensions are interrelated. The analysis shows that half of the twelve sponsor organisations exploit (deploy) their resources and capabilities beyond the 'host firm'. Their resources are used in the business models or innovation processes of external customers/partners. These organisations can be described as being 'genuinely open' on the sell side of the business model as they share their assets with other firms or deploy them in other firms' innovation processes. The material indicates that although only half of sponsor organisations are 'genuinely open' on the sell side, the majority are deeply involved in innovation processes of other business units in the wider host firm.

A common feature of sponsor organisations in the case study material was that they had become increasingly autonomous within the firm in financial terms but they had moved closer to other departments in terms of knowledge creation. In most cases, the innovation tasks in the sponsor organisation reflect the decentralisation (including the decentralisation of innovation) within the firm.[143] This type of decentralisation was particu-

[143] This is what chapter three, echoing Schmitz and Strambach (2009), referred to as ODIP Types 1 and 2.

larly pronounced in the case of IT departments. They were increasingly required to innovate and provide impetus for innovation in other parts of the firm. However, the decentralisation of the innovation process was also visible in the electronics and primary software industry. Moreover, five cases indicated that the sponsor organisation had been charged with a mandate to reinvent their own business model, often with a more fine-grained segmentation of the innovation process and the re-focusing on (new) select innovation areas. Sponsor organisations were drawn into providing inputs into the innovation process of other parts of the company or into external customers.

While the dynamics require further investigation, it seems that changes on the selling side (and associated re-skilling and deployment of resources), through changes in innovation management, often created a *vacuum* in the organisation, thereby prompting changes on the buying side. The forward re-deployment of internal resources is central because the innovation resources that are pushed ahead in the value chain (either internal or external) are different from those that are sourced from suppliers. Ultimately, in advanced cases, this difference can be expressed as the distinction or division between non-technical and technical elements that may develop in the case of 'advanced' innovation outsourcing. The key point is that openness on the buying side (innovation outsourcing to India) was driven by other aspects of change in business models forwards in the value chain.

However, such openness was not only driven from above. A further finding of relevance is that sponsor organisations, when defining their business model, were significantly influenced, by the changing outsourcing landscape in Bangalore. In some case studies, respondents' information suggested that the opening of business models were directly influenced by the attainment of general and customer specific capabilities by suppliers. This was particularly important when shifting gear in business model opening. The supply side dynamics and issues related to linkages and trust were particularly important in cases of 'advanced' outsourcing in a 'second stage' of openness. The next subsection seeks to disentangle stages in the opening of business models and their organisational and geographical manifestations.

8.4.5 Disentangling drivers of organisational and geographical change

It is important to re-emphasise the point made in the introduction to this section, namely that *analytically* the core issue here is about a two-step process.[144] The first is about business model opening per se. It can be limited (closed) or substantial (open). The second is about the (subsequent) geographical (re)location of innovation activity. It can be limited to relocation within the US or EU (centralised) or it can cross the distance to the new increasingly innovation-competent supply base in India (dispersed).

This distinction is important to maintain because only a few existing industry case studies are concerned with cross-border open innovation processes and these have concentrated mainly on innovation processes 'distributed' between OECD countries (Christensen *et al.* 2005; Cooke 2005). The studies that are explicitly concerned with location suggest that innovation is likely to be geographically concentrated within OECD countries and often within 'knowledge regions' in such countries:

> Open Innovation benefits may be more readily achieved in regional clusters, since the effect of networks on innovation is magnified by geographic proximity
>
> (Simard and West 2006: 225).

In sum, the open innovation literature suggests that open business models (the organisational dimension) increases the propensity to search for innovative solutions outside the firm, but they largely confine this search to the innovative regions in the OECD countries. There is change along the organisational dimension but not along the geographical. Since this thesis has identified changes along both dimensions, it is important to seek to disentangle the drivers.

Furthermore, this research has identified differentiated degrees of innovation outsourcing. In crude terms, these degrees of outsourcing correspond to an initial stage of innovation outsourcing and a second stage of advanced outsourcing. With a few exceptions in which start-ups were 'born open', buyers tended to proceed gradually. This is central because the key drivers of each stage are different – or rather, they are

[144] This thesis has not included any buyer cases where firms moved towards an open business model but did *not* shift knowledge creating activities to India.

cumulative as firms are confronted with more reasons for further outsourcing as it proceeds from the first to the second stage. Table 8.5 seeks to maintain these central distinctions while summarising the drivers as observed in the empirical work.

Table 8.5: Drivers of outsourcing of knowledge-creating software services to India

	Organisational dimension: Business model opening	**Geographical dimension: The shift to India**
First stage: Drivers of 'initial' innovation outsourcing	*OECD* • Increasing autonomy and financial responsibility of individual business units within corporate networks • Imperatives for internal transformation ('upgrading') of firms and business units • Time-to-market objectives in the face of capacity constraints (insufficient base of skilled human resources) • Access to external capabilities	*OECD (demand side)* • Increasing cost of skilled human resources in OECD • New communication technologies • Existing global networks of suppliers
		India (supply side) • Comparatively low cost of skilled personnel in India • Increasing domain capabilities • Tacit knowledge acquired through on-site work • Global engagement models
Second stage: Drivers of 'advanced' innovation outsourcing	*OECD* • Strategic focus by buyers on business analysis and the customer interface • Non-separability of advanced tasks	*OECD (demand side)* • Further awareness of supply base capabilities • Increasing buyer comfort levels and trust
		India (supply side) • Cross-domain leveraging capability in supplier firms • Increasing relational capabilities

Source: This thesis

The drivers noted in Table 8.5 differ to some extent from the drivers typically highlighted in discussions about (i) 'openness', i.e. the organisational dimensions and (ii) the 'globalisation of R&D', i.e. the geographical dimension. Most notably, there are factors that seem less important in the software case than in other industries, such as computers, pharmaceutical and autos. With regards to the *organisational dimension,* the factors typically highlighted include the increasing complexity of R&D, the need for specialised skills, and the growing ability to codify certain innovation processes (Ernst 2005a; Pavitt 1998). With regard to the *geographical dimension* most existing studies include the ability to adapt products to local markets, learning from new growth markets, and

technology monitoring (Gammeltoft 2006; Rasiah, Wad and Chandran 2008; UNCTAD 2005). These factors appear to be of subsidiary importance in the software case, compared to the factors highlighted in Table 8.5: Drivers of outsourcing of knowledge-creating software services to India

The reasons for these differences are primarily related to sectoral specificities. While software innovation of the types conducted by buyers is also increasing in complexity, most of the cases were not primarily driven by the need to obtain unique technological knowledge, as in the case of pharmaceuticals (Cooke 2005), electronics (Ernst 2005b) and automobile vehicles (Strambach 2009). Rather it was driven by access to *adequate*, often substitutable, technological knowledge in sufficient volumes needed to innovate. It was preceded by an increasing ability to codify knowledge-using processes (software production), but it was not driven primarily by an increasing (subsequent) ability to codify innovation processes, as is often highlighted (García-Muiña, Pelechano-Barahona and Navas-López 2009). New methods of exchanging *tacit* knowledge were much more important in this regard. Furthermore, the local Indian market did not appear to be a driver of innovation events, nor did the monitoring of local technological advancements.

These observations do, however, need to be accompanied with some qualifying considerations. Most importantly, there are important differences between the buyer segments. The electronics and telecom buyer segment complies much more closely with the extant insights. Some of these firms, even market leaders like Nokia, cannot generate all the resources needed to innovate internally. They are becoming increasingly dependent on access to particular knowledge-domains and solutions sourced in the market. There is also sometimes a pressure on firms to reduce in-house research (basic and applied) in order to concentrate primarily on new product development, i.e. the realisation of architectures and systems (Chesbrough 2003c). They do this by integrating systems made up of components provided by both internal and external sources and this is enabled by the separability of system elements. They have not moved from the first to the second stage (driven by a strategic focus on the customer interface) of innovation

outsourcing and hence they continually retain the technical problem framing of high-level systems and solutions and keep critical processes in-house or close to home.[145]

Finally, it should be noted that the drivers of innovation outsourcing have been observed (mainly) from the sub-firm level: the focus of this thesis has been on particular innovation events. While this primary focus on the sub-firm level is particularly salient in understanding the sources of innovation, it sheds only limited light on the firm, industry and sector-level drivers, including the root causes of openness, and how and why they differ across buyer segments. Future research on openness and innovation outsourcing to low-cost destinations should systematically consider cross-industry differences, including modularity, appropriability, type and intensity of R&D etc., and ultimately differences in the way value from innovation is created and captured by lead firms and suppliers.

8.5 Concluding discussion

This chapter has sketched out a co-evolutionary trajectory starting with the outsourcing of production and then moving gradually towards innovation. While the extant literature has noted the possibility of such a trajectory, it has not conceptualised this trajectory clearly, nor has it subjected it to empirical examination. This chapter has made some exploratory headway into this issue.

Previous chapters showed that there has been a lot of progress in building up innovation capability, but disentangling the causes is difficult. There is a top-down (buyer to supplier) and a bottom-up (supplier to buyer) dynamic that have begun to reinforce each other. In this section the study has sought to give a historical explanation of how this process got underway and then gained momentum. It is not possible, based on the present empirical information, to shed equal light on all the causal mechanisms involved. Nor is it possible – based on the examination of specific buyer–supplier relationships – to examine these trends at the level of the industry. Yet Table 8.5 seeks

[145] This explains the difficulty/inability of suppliers to move into problem framing processes, as discussed in Chapter 7. For instance it was discussed how Telecom Corp keeps certain components in-house or with Finnish suppliers.

to hypothesise the wider impact of the interplay between the dynamic from above and below as identified in this chapter.

Table 8.6: Interaction of the dynamic from above and below

Buyers (above) **Suppliers (below)**	**Supplier-specific openness**	**Supplier-independent openness**
Buyer-specific capabilities	*Relationship co-evolution* Buyers open new space to specific suppliers and these suppliers develop customer-specific competences	
Buyer-independent capa-bilities		*Industry co-evolution* Suppliers leverage generally applicable competences across customers in different knowledge domains

Source: Own figure.

Co-evolution unfolds at the relationship level (unilateral relationship co-evolution) as well as the aggregate level (multilateral industry co-evolution). The information in this thesis provides stronger evidence of the former than of the latter. To some extent, this reflects the fact that in methodological terms industry co-evolution is difficult to examine empirically. In order to do this one would need detailed aggregate data on buyer inputs and supplier outputs over a long period. Such data does not exist, partly because of quantitative measurement problems and partly because buyers are located in many different parts of the world.

Yet, this thesis provides certain insights – or hints – into how the dynamic unfolds. Previous chapters showed that relationship co-evolution – often based on a very supplier-specific type of openness on behalf of the buyer – was also associated with a high degree of resource provided by the buyer. Buyers may benefit passively from information exchange with the buyer, but in relationship co-evolution, the buyer is often an *active* provider of resources (ideas and investments). Over time, however, the supplier may consolidate buyer-specific competences and develop generally applicable

competences (bottom arrow). This was discussed in Chapter 5 and in this chapter. This development of new capability – along with a range of other factors – induced the shift to supplier-independent openness in established firms. It also enables the establishment of new open start-up firms on the demand side (Table 8.5, right arrow). The analysis in the two proceeding chapters showed that relationship-specific as well as supplier-independent openness guides buyer strategies. The material does not provide the basis for determining the balance. Yet it suggests that to some extent relationship-specific co-evolutions may develop, like rings on the water, to include more firms across buyer segments.

In order to understand the dynamic interaction between firm-internal and global (often customer-derived) sources in capability formation processes, the chapter used the concept of competence leveraging. Such competence leveraging was a key mechanism in the development of innovative capability. The adoption of open business models has facilitated the deepening of domain knowledge across a variety of business lines. The engagement in multiple business activities gives rise to intra-firm synergy effects, arising from the connection of different knowledge domains. In advanced cases, strong suppliers draw on distinct knowledge bases to make choices about (customers') technology and IT-enabled business processes. In this way, the strong Indian suppliers now need to 'know more than they sell'.[146] They do not dilute their core capabilities by operating in multiple business lines; rather the leveraging of knowledge and experience across these business lines is becoming a core capability in itself.

This dynamism sets strong Indian suppliers apart. The literature already recognises that there are systemic dynamics that reinforce outsourcing. Sturgeon (2002) showed that suppliers could spread their assets across many customers, effectively reducing the cost of deploying particular assets, compared to what any individual customer could do internally. This increases the scope for further outsourcing. However, the supplier dynamism described here gives rise to a different systemic effect. Indian firms have

[146] Paraphrasing Brusoni, Prencipe and Pavitt (2001), Stephen Flowers (2007) argued that on the demand side certain lead firms have relied on IT outsourcing (within Europe) to the extent that they know 'know less than they buy' – thereby diminishing their in-house capacity to make informed choices about critical infrastructure.

become shared resource bases, increasingly for innovation activities, which diffuse knowledge and competences across sectoral and functional domains in customer locations. They provide customers with an opportunity to engage in knowledge-focused sourcing. This plays a role in changing the innovation processes in buyer firms. The Indian supply base has become a 'supply-side dynamic'.

Much of the literature on offshore outsourcing tends to assume (often implicitly) that the impetus comes from above, driven ultimately by factors such as the shortages and high costs of engineering workers in OECD countries. Buyers make decisions about outsourcing whereas suppliers merely respond to these decisions. While it is true that buyers ultimately decide how and what to outsource, this chapter has shown that the supply base has an important influence on the conditions in which these decisions are made. In multi-domain firms, systemic gains could be derived from the cross-feeding of projects and buyer-related knowledge in the supply base. In this sense, there are new systemic advantages to be gained for outsourcing companies that adopt more open business models.

Increasing capabilities and competence leveraging had important feedback effects. Some of these feedback linkages were direct and relationship specific. Others were indirect, accruing to the wider demand base for particular services. Buyers find incentives to source or outsource increasingly advanced activities and services because of the cost-effective availability of innovative services. This 'supply-side dynamic' not only accelerates outsourcing, it also changes the very notion of what outsourcing is about. It has induced immense organisational change whereby buyers have been rethinking mission statements and operating models. It suggests that the accumulation of innovation capability in India has ramifications for the rest of the world.

The chapter showed that the supply-side dynamic has helped in pushing software offshore outsourcing through various stages, ultimately influencing the business models of software buyers. Over various phases and at impressive speed Indian firms have reinvented value proportions and business models. Of course, India is not the only destination for software outsourcing. However, according to informants on the buyer side, firms in India have been at the forefront all along, and have been in the vanguard in changing the mental model of outsourcing from cost and efficiency to innovation and

change. India is the primary reference point in the landscape of software outsourcing and it has acted as an important demand-side driver of business model transformation in the customer base. Hence, it has facilitated changes in not only the scale of outsourcing but also the direction. The dynamics of co-evolution were not only self-reinforcing, they were also transformative.

Other chapters of this thesis have examined issues related to the current boundaries and limits. The empirical examination of these boundaries concentrated on the 2001-2006 period. However, as this chapter has shown, the limits have changed with the maturation of the Indian software industry and it is likely to evolve further in the future. A crucial question is how this will affect the economic power balance between the current demand-bases (the loci of buyers and lead firms in OECD countries) and the supply bases (the rising economic powers in the East). Will the further outsourcing of innovative tasks (i) create mutually beneficial relationships whereby buyers shift to higher value activities, shedding more and more complex activities to Indian suppliers, but keeping them in a complementary and subordinate function? Or will it create relationships that entail risks for the buyers who may eventually lose their competitive edge in problem-framing and customer-related activities?

There is little doubt that Indian firms are gaining increasing competence power, stemming from technical and service capabilities that are difficult to replace at the *price* which is currently offered by Indian firms. However, it is important to maintain the distinction between the specific (individual) inter-firm relationship and the systemic level (collective) of the software outsourcing industry. As mentioned, many buyers would face a crisis in the event of supplier pullout, but this crisis would be mitigated by the availability of other Indian suppliers offering roughly the same competences at roughly the same price. There are of course issues of asset specificity involved in any innovation event, but there is also a life beyond these individual innovation cycles and most software innovation can be (and is) codified with detailed documentation *after* they have been implemented. This reduces asset specificity.

As argued by Sturgeon (2009), the ability to switch suppliers, even among a small base of suppliers, enables the buyer to keep supplier power in check. Crucially, the tacit knowledge that suppliers bring to the table provides them with some scope for negotia-

tion, ‘but the thick linkages they must forge with buyers may be hard to replicate with other buyers in time to avoid severe hardship’ (Sturgeon 2009: 130). The threat to lead firms does therefore seem to arise at the systemic level, by the collective transformation of the supply base, rather than at the level of particular supplier relationships. It is still too early to tell whether Indian firms as a ‘class’ will challenge the competitive edge of lead firms in problem-framing and customer-related activities – or rather, in what time frame this will happen. The immediate task of the researcher is to understand better the mechanisms by which buyers (seek to) maintain their leadership while opening their business models.

9 Conclusion

The underlying hypothesis that drove the thesis was that outsourcing has a major influence on the formation of innovation capabilities in developing countries. Some recent literature suggests that offshore outsourcing in a variety of sectors has extended from the provision of simple services to advanced and innovative activities (Engardio and Einhorn 2005; Lynn and Salzman 2007; Maskell et al. 2007). However, the recorded changes on the demand side have not been followed up with systematic assessments of the changes and consequences on the supply side. The main aim was to examine whether the supply-side changes include the acquisition of advanced innovation capabilities and how the relationship between outsourcing and the formation of new capability in the supply base 'works'. The key question was *whether and how outsourcing influences the formation of advanced innovation capability in developing country supply bases.* This concluding chapter summarises the main steps of the empirical analysis and reflects on the key findings. However, this chapter aims to do more than just summarise these findings. It also seeks to emphasise some of the fresh insights that should guide further research in this field.

9.1 The research hypotheses revisited

The thesis was informed by the general literature on supplier capabilities in outsourcing and value-chain relationships (Hansen *et al.* 2008; Mudambi 2008; Schmitz 2007b) and the specific literature on the software industry in Bangalore/India (Arora *et al.* 2008; Chaminade and Vang 2008a; D'Costa 2009; Dossani 2006). Running through both of these literatures is the clear view that supplier capability in the outsourcing context extends at best to basic innovative capability. In Chapter 2, the underlying rationale for this view was summarised in the three research hypotheses that guided the core focus of the thesis. However, the findings in the empirical chapters of this study provided grounds for the qualification of these hypotheses in major ways. They also provide grounds for the formation of alternative/new *post hoc* hypotheses, as summarised in Table 9.1. The following three sections unfold these conclusions and discuss their implications for the literature. The last section then proceeds to the extended focus in order to provide 'the bigger picture'.

Table 9.1: Research hypotheses and conclusions

Hypothesis from extant literature	Conclusions (*post hoc* hypotheses)
The acquisition of innovative capability does not occur at all or is limited to process and organisational capability. In general, problem-framing capability does not spread to suppliers in the outsourcing business (because lead firms keep these in-house or close to home).	A segment of Bangalore software suppliers have entered a new phase of building innovative capability. This capability is not restricted to process and organisational capability but extends to problem framing innovative capability.
The acquisition of innovative capability in latecomer firms requires firm-internal effort, but the local/national innovation system plays a major role in generating innovative capability.	The acquisition of innovative capability builds on the combination and active integration of firm-internal and global sources (mainly customer sources). Direct linkages in the local/national innovation system are relatively insignificant for the formation of new innovative capability in outsourcing firms.
Global client linkages alone do not provide the basis for acquiring high-order capabilities in the software industry. Outsourced activities are focused on labour-intensive production activities. In general, any outsourcing of innovative tasks is closely linked with production tasks, and this limits the scope for building further capability.	Outsourced activities focused on labour-intensive production activities can (over time) provide a stepping-stone for acquiring high-order innovative capabilities. Concentration on innovative tasks that are closely linked with software production tasks does not limit the scope for building further capability in key software business lines.

Source: Existing literature (reviewed in Chapter 2) and the findings of this study.

9.2 The rise of innovative software services in India

To explore the dominant view, this thesis examined what types of peak capability sampled firms have acquired and demonstrated after the turn of the millennium, giving specific emphasis to the existence of advanced innovative capability. As discussed in Chapter 2, the literature has tended to be pessimistic in this regard – even in the case of Bangalore – acknowledging fast export growth but emphasising that this contains few and limited types of innovation (Arora 2006; Arora *et al.* 2008; D'Costa 2009; Dossani 2006). Furthermore, the extant literature tends to emphasise that capability deepening has been concentrated on 'process capability' (Athreye 2005b).

This research has sought to contribute in this area by specifying the type of peak capability that has emerged since 2001. It concludes that some firms have not only acquired process and organisational innovation capabilities, but also customer-focused problem-solving and problem-framing innovative capability. Contrary to expectations, the study found that the deepening of capabilities in core services and product functions (Types A and B) was just as pronounced as process and organisational capability (Types C and D) in the creation of new innovative capability in the sample. The existence of problem-framing capability (Type A), was particularly surprising given the prevailing

view in the literature that advanced innovative activities remain located in OECD countries and that only basic and routine innovation is outsourced to suppliers in developing countries (Chen 2008; Schmitz 2007b; Schmitz and Strambach 2009; Sturgeon 2002).

The identification of advanced (problem-framing) innovative capability suggests that a segment of suppliers have progressed to an unexpected stage of innovative service provision. It does not suggest, however, that India will abandon low-end work in the immediate future. The industry is likely to take the high road and the low road simultaneously. While industry segmentation is commonplace, the novel feature of this case is that this segmentation also exists within firms and even within particular projects. The findings support this conclusion by showing that production and innovation capabilities are rarely deployed separately. They tend to go hand in hand. The sample as a whole indicates a steadily progressive trajectory towards higher-value services, products and practices, but the low-cost service provision capability remains important. Even vanguard firms have not undergone a capability *transition* (in which production capabilities are replaced). Rather the trajectory is one of capability *expansion*, involving the strengthening of production capabilities alongside the acquisition of innovation capabilities. This means that suppliers are not 'moving up the value chain' in the normal sense, in which high-value activities are acquired and low-value activities are left behind. Rather they are stretching their value-chain thread in the upward direction.

9.3 New opportunities and constraints in software outsourcing

Seeking to explain the identified expansion of capabilities, the study examined how outsourcing influenced the types of capability acquired by suppliers. This was pertinent because the existing literature has emphasised that global client linkages in offshore outsourcing are unlikely to provide the basis for firm-level build-up of innovative capability, let alone advanced innovative capability (Arora 2006; Dossani 2006). The literature stresses that offshore outsourcing has emerged as a cost-driven phenomenon, and the scope for building innovative capability is constrained by the prominence of activities with high labour requirements (Chen 2008; Mudambi 2008).

However, the observed trajectories of capability expansion lend support to the proposition that innovation activities outsourced to supply platforms are likely to take the form

of integrated innovation activities. This is important because integrated innovation activities are overlooked in much of the literature that deals with the globalisation of innovative activities (Ernst 2006; 2008; Gammeltoft 2006; UNCTAD 2005). This literature is mainly preoccupied with easily 'visible' forms of innovation, undertaken in an R&D department and appropriated by patents. Many analyses focus on a too-narrow set of data, and they miss the hidden dimension of globally mobile innovation activities. Integrated innovation activities are often 'hidden' and therefore off the radar screen of research. This study has shown how difficult it is to unravel what is going on and suggests that there is an unfortunate blind spot in the literature. Integrated innovation activities are 'silent but significant', and the significance arises not only in terms of their volume dominance (compared to standalone innovation), but also in terms of their potential for further deepening.

In order to explain this potential for further deepening it is necessary to recall the counter-intuitive findings presented in Chapter 7: in settings in which there is a tight connection between production and innovation activities (integrated innovation activities), there is greater scope for involving suppliers in problem-framing functions. The integrated category may therefore provide a bridge to the next step in offshore outsourcing. Buyers are unlikely to look offshore for providers of standalone 'software R&D', such as new operating systems or new programming languages. However, as shown in chapters 7 and 8, IT departments and independent software vendors may build on their experience with the outsourcing of software design activities to take a step further and give suppliers the responsibility in the entire chain of software development activities, including those that define the system or product. The analysis suggested that the primary and secondary software services industries exhibit characteristics that may reinforce such a path. Some of the buyers in these segments are induced to push in this direction as they benefit from the linkage economies achieved by suppliers: the provision of multiple value-chain activities improves the efficiency of each one of them.

Yet, there are limits to the outsourcing of advanced innovative activities. In order to recognise this, the concept of problem framing needs to be unpacked. In particular, the study found that problem framing combines technical and non-technical elements. While there is clear evidence of frequent supplier participation in technical activities, participation in non-technical activities is (still) a rare incident. However, the findings

suggest that in a rapidly changing world it is a fallacy to view the limits to innovation outsourcing as given. It is not feasible to assign 'fixed values' to categories such as strategic and non-strategic. The thesis has shown that supplier firms have accumulated innovation capabilities – not despite the interest of buyers but often *because* of the interests of buyers.

9.4 Moving into new spaces

Much of the literature on outsourcing emphasises that outsourcing is a learning process (Jensen 2009; Lewin, Massini and Peeters 2008; Maskell *et al.* 2007). However, 'learning' in the supply base is often assumed rather than studied. Capability formation is sometimes seen as a simple effect of buyer-firm strategies; firms at the 'receiving end' of outsourcing decisions are frequently not examined in depth. By implication, the literature has provided only partial understanding of how outsourcing changes the international division of (innovative) labour. Recognising that the learning process in supplier firms is still a 'black box', a recent article has argued for the need to pull together the global value-chain approach and the capability approach (Morrison *et al.* 2008), but it does not itself provide empirical analysis, nor does it suggest how this 'fusion' can be operationalised. Conversely, the literature on learning and acquisition of innovative capability in latecomer countries (Ariffin and Figueiredo 2006; Bell 1984; Figueiredo 2006) has made important methodological advancements and provided guidance to research on capability building, but it has little to offer on the specific issue on capability building in outsourcing, let alone the services industry context.

This thesis has taken a step in the direction of cross-fertilising the global value chain and learning literatures by bringing intra-firm processes into global value-chain analysis. The starting point was the acknowledgment that new buyer interest creates new opportunities, but these opportunities are not transformed into realities automatically. To unpack this, the research has conceptualised the process in terms of (i) the emergence of new opportunity spaces, and (ii) the processes by which suppliers mobilise and combine resources to fill them. The study has then sought to provide a first-hand account of the events/projects in which suppliers have attained new qualities of capability. This integration of the literatures is difficult, but the focus on particular 'innovation events' made it possible.

The study has provided evidence which supports the proposition that the degree (and nature) of firm-internal investment and effort is one of the most important contingent factors – if not *the* most important factor – that determine whether the shift in outsourcing models translates into the dispersal of innovative activities. The combination of global *and* firm-internal resources was critical and tended to go hand in hand in the learning process. This blending process is inevitably one that occurs *within* firms in the supply base and one that needs to be actively managed. The integration of inputs is not trivial and the complexity of the innovation process increases with the attainment of deeper qualities of capability. The challenge for suppliers is to manage increasingly complex processes as the transition from production to innovation proceeds. This suggests that even though many supplier firms exploited their initial positions in global value chains to develop striking innovative capacities, the changing demand conditions and reconfiguration of value chains did not transpire into a 'benign escalator' for supply-base firms.[147]

However, the thesis has also shown how buyer firms have sometimes provided not only the space, they have often also contributed with critical resources (ideas, investments and knowledge) needed to build the innovative capabilities of suppliers. From a supplier perspective, this may give rise to cautious optimism. This is reinforced by the fact that critical advances were made 'on the ground', in and across customer-facing units, not just in 'R&D labs'. While the latter was important for the most advanced capabilities, the thesis has emphasised the importance of innovation activities that are connected with production activities in ongoing client projects. The initially basic capabilities arising from the cumulative development of capabilities in customer projects can act as seedbed for further substantial deepening.

These findings are surprising from the perspective of the extant literature on the Indian software industry and the specific case of Bangalore. Most of the existing literature on the Indian software industry searches for local linkages (Balasubramanyam and Balasubramanyam 2000; Chaminade and Vang 2008b; Parthasarathy and Aoyama 2006; Vang and Chaminade 2006). As was discussed in Chapter 2, one dominant

[147] The term 'benign escalator' was used by Martin Bell in research meetings at SPRU and IDS.

hypothesis in the literature is that the main route to innovative capability is through the local innovation system. Some authors have made the stronger claim that innovative capability cannot develop unless the industry is re-oriented drastically to become closely coupled with the local market and its supporting institutions (D'Costa 2006). This study suggests that the current strategies, priorities and practices of leading managers – focused mainly on *intra*-active learning and global linkages – may be more effective than commonly anticipated. The evidence suggested that the existence of strong local inter-firm linkages in the cluster was not as important as the literature suggests. Despite the proposition in the theoretical and empirical literature, it was found that 'local' sources of capability were often of a second order, only critical in a non-outsourcing business line (MIP).

In other words, the evidence suggests that competence leveraging *within* firms in the supply base is more important than competence leveraging *between* clustered suppliers. This does not mean that location is unimportant – far from it. There are important endowments and passive externalities that accrue to firms located in a dynamic hub like Bangalore. Nevertheless, it seems that leading software vendors in Bangalore have achieved dynamics within the firm comparable to what certain clusters have achieved between firms.

9.5 The bigger picture

As mentioned, the identification of the outsourcing of problem-framing functions to suppliers was particularly unexpected. It runs counter to the proposition that the 'quality' of outsourced innovative activities is limited to 'problem solving' (Schmitz and Strambach 2009), 'subsystem design' (Chesbrough 2003c) or simply 'routine low-end innovation' (Chen 2008). The proposition found in the literature is that integrative capability in technical fields is strategic to buyer firms and that the strengthening of supplier capabilities in these realms is against their interests. Chapter 7 suggested that there are indeed forces that hold back outsourced problem-framing activities (concentration in OECD countries); but there are also other forces that push problem-framing activities forward (global dispersion). In order to explain these dispersive forces the study introduced certain aspects that could only be explored tentatively. These aspects related to buyer business models and value-chain co-evolution.

9.5.1 The emergence of new business models on the buyer side

It is an apparent paradox that advanced and high-value innovative services are offshored to low-cost suppliers, even though most of the literature advises against it (Jensen 2009: 7). This paradox arises because the basis of the existing literature on offshore outsourcing is largely based on the core-competence perspective. However, drawing on the literature on the open business models, this thesis has sought to provide an explanation by showing that innovation outsourcing is not 'irrational' behaviour.

The (re)focusing of buyer organisations on new and increasingly non-technical capabilities has gone hand in hand with an increasing need for external knowledge-creating functions. Some buyer firms were trying to push innovative activities onto suppliers – not to hold them back. They perceived outsourcing of innovative activities as an opportunity for business transformation and increased competitiveness. In this new model, customer firms have turned their attention to the self-perceived new foundation of competitive advantage. This also means that for some buyers the 'spill-over' of systems-level (problem-framing) knowledge to the supplier is no longer a regrettable by-product, but an opportunity for deepening the buyers' own business strategy. The new niche focus is concentrated on forward linkages to the customer and on linkages to key partners. The technical coordination of production and innovation processes is no longer as important as the non-technical functions and the management of relationships. Wider arrays of lead firms' assets have become variable. Buyers have pushed strategic priorities and fixed assets to a higher level; the control of relationships forward in the value chain is the key aim for a new cadre of buyers. While it is clear that firms pick elements of the open model in selective ways and the fully fledged adoption of this model is not sweeping the offshoring community, it is also clear that the traditional core-competence perspective has limitations with regard to the outsourcing of advanced services.

A more fundamental problem of the core-competence concept is that it has tautological propensities because it seems to suggest that if firms outsource activities they must be 'non-core' by definition. It may become difficult to distinguish 'rational' outsourcing practices if we stretch the concept too far. In the end, it may add very little to our understanding of the changes that drive current trends in the global economy. This

thesis has suggested that the open business model may provide an explanation for some of these changes as they have occurred in the global software industry.

It has long been recognised that firms from the 'centre' of global capitalism search the globe for resources (and markets) that increase their profit and ensure their survival in a competitive landscape. However, this quest might now be taking on qualitatively different forms.[148] From a learning perspective, it seems that these new forms are associated with 'empowering exploitation' of the knowledge resources of developing countries. Whereas certain types of production outsourcing may be associated with weak or limited learning exponentials, the types of outsourcing examined in this thesis seem to have far-reaching potential. When vanguard buyers provide suppliers with new spaces for capability building they are contributing to changes that have consequences for the entire software outsourcing industry.

9.5.2 Changing the outsourcing landscape: co-evolution

The dynamics in the supply base are often 'assumed' and described simply as functions of the amount and type of lead-firm outsourcing. However, this thesis has shown that suppliers do not just react; they combine ideas, investment and knowledge to capture new spaces. In this sense, the impetus for industry evolution comes not only 'from above'. Strong suppliers affect the outsourcing landscape – changing the terms and conditions of competition across a range of segments.

In a sense, this is an obvious outcome of increasing supplier capabilities. However, as emphasised by Schmitz and Strambach (Schmitz and Strambach 2009), very little is known about these processes and the factors that make them happen. This thesis has therefore sought to show some of the mechanisms of this 'supply-side dynamic'. In particular, the deepening of capabilities can give rise to the leveraging of competences across customer domains and this may become a supply-side dynamism in its own right. The thesis found that intra-firm competence leveraging was central to the build-up of advanced innovative capability. Because software is a multi-purpose technology and because most software suppliers work in multiple business lines, these firms have been

[148] Dunning (1993; 2000), highlighting asset and knowledge-seeking investments, has described similar dynamics in multinational firms.

able to continually use existing capabilities in new domains. The cross-feeding of competences across customer domains provides a dynamism that enables the provision of innovative and value-adding services.

These new capabilities offer innovative services at low cost. This bears some resemblance to what Zeng and Williamson (2007) have described as Chinese 'cost innovation' (by which they refer to the development of new products and services at a low cost). The emergence of actors that are 'cheap but innovative' may be disrupting certain 'usual patterns' in the global economy, not so much because they create direct competition, but because they change the competitive outlook for buyer firms indirectly.

These processes are easiest to detect and explain at the level of inter-firm relationships. The study showed that demonstrated innovative capability in preferred suppliers was one of the factors that encouraged some buyers to take on a much more coordinating role by concentrating on enhancing the processes that generate rent (in forward linkages) and on managing the interface between these user needs and systems development (in backward linkages). They achieve significant direct cost savings as well as opportunity cost advantages because key employees can be 'freed' from necessary operational tasks and switched to new strategic tasks.

In this way, the empirical material reviewed in this thesis suggests that in the software industry, the changes in the developing world have had a significant impact on development in the OECD. This appears when we interpret the findings in an evolutionary perspective. There was very limited offshore outsourcing of software to low-cost destinations before the Indian 'offshore model' emerged in the 1990s. As has been argued, Indian firms and their customers were the pioneers who developed the offshore model in software, including its frameworks, systems and practices. They also drove the transition to transformational outsourcing, which combines production and innovation activities. OECD-headquartered consultancy houses are now mimicking the value proposition of Indian firms, expanding their offshore development centres in India at a rapid pace. India is thus taking centre place in defining the forefront of software offshoring.

In other words, the Indian software industry is spearheading the big changes in the global software-outsourcing industry. This thesis suggests that the rise of innovative capabilities in India has deepened the outsourcing strategies in certain software buyer segments. The use of Indian providers for end-to-end solutions becomes a new opportunity for business model redefinition and this redefinition changes the strategic parameters and the outlook of buyers. Whether this is likely to occur in other sectors is an open question. While there remain structural barriers, there are indications that 'what used to be part of the "periphery" is now driving changes in the "centre"' (Schmitz 2007a: 57).

9.5.3 Joining the dots

For analytical purposes, it was necessary to have a core focus that proceeded with the analysis in manageable steps, focusing on the demand side and the supply side one at the time, and within a confined observation period. However, the real significance of the findings emerges when the two sides are brought together by 'connecting the dots' over time and vast geographical distance. This is what the extended focus of this thesis has tried to do. Chapter 8 argued that a novel element of this case was the ability of the supply base to develop capabilities to first exploit and then accelerate demand during various stages.

In itself, the suggestion that outsourcing is a two-way relationship is not novel. However, very few empirical studies have brought the dynamics into the open and shown how such an interdependent relationship unfolds over time. When the dots are connected in this case, the picture that emerges is one of an in-built transformative force. While this dynamic has unfolded since the beginning of the offshore software-outsourcing industry, the thesis has argued that new buyer practices have made them stronger. The potential for supply-side competence and capability leveraging arising from knowledge-driven outsourcing (brain shopping) are far greater than from cost-driven outsourcing (body shopping).

While this study pursued the co-evolutionary relationship in imperfect ways, the research unearthed an element of reality that escaped other studies. Much of the existing literature remains caught in 'methodological localism', limiting empirical analysis and discussion to the local innovation system (Chaminade and Vang 2008a; Parthasarathy and Aoyama 2006). Many empirical studies made during the last decade have con-

cluded that ‘the majority of software work undertaken in India is low-end’ and that the industry is ‘locked in’ to a growth model based on labour costs. Indeed, the author’s own work (Lema 2009b; Lema and Hesbjerg 2003) and the work of others (Arora *et al.* 2008; D'Costa 2003; 2004; Dossani 2006) have mainly concentrated on some of the forces and factors that have so far rendered innovative activities relatively immobile in the global software industry. While there is no doubt that much work is still ‘routine’, this study shows that outsourcing practices and the associated change on the supply side break existing patterns. There is some indication that the innovation capabilities developed in vanguard firms are not only significant, but also strong enough to influence the very direction in which the industry is moving.

Furthermore, it is interesting that the history of successive studies on the Indian software industry in the global division of labour provides another example of a general problem alluded to by Bell (2006). Research about global change and re-structuring of the division of labour only wakes up very gradually to the fact that a dynamic process is under way. Each successive study suggests that its snapshot observations constitute a steady state, and few studies seek to ‘join the dots’ that indicate a continuous process of change.

9.5.4 Interpreting the findings and issues for further research

This thesis has given evidence which provides insight into the main proposition that outsourcing has an important influence on the location of innovative capability and, ultimately, on the division of innovative labour in the world. However, as a piece of exploratory research, this study marks the beginning of an enquiry, not the end. The material and findings provided in this thesis have covered substantial ground, but there are still many limitations and open questions with regard to the conclusions that one can ‘infer’ from the results provided here.

The study presented here provides important insights into the direction of change in an important outsourcing industry, but the thesis does not have the empirical basis to assess how widespread this change is. The study does not suggest that innovation outsourcing is ‘sweeping’ the global software industry. As has been emphasised, it is clear that this trend exists alongside more established core-competence strategies. The study shows, however, that some buyers have begun to supersede the core-competence strategy, but

methodologically this was pursued in imperfect ways. Most importantly, the empirical material on the demand side did not symmetrically match the data on the supply side in terms of depth and breadth. The data enabled the detection of new sourcing practices emanating from the opening of the business model as a significant new development with important ramifications for suppliers. Thus, the study suggests that open models ultimately lie behind the practices of firms (in the area of software development) that have led to the outsourcing of innovation by suppliers. Future research should seek to further operationalise the distinction between 'open' and other models and find ways to examine and measure its 'strength' and role in driving innovation outsourcing.

Furthermore, the study does not suggest that (innovation) outsourcing is the only factor that influences the 'global shift' in innovative activities towards emerging economies. Rather, this shift – to the extent that it occurs – is influenced by a multitude of variables in both the 'old' and 'new' innovative regions (Altenburg *et al.* 2008). Substantial state investments in innovative capability and experimental policy initiatives, for example, have hitherto been key factors, and they are likely to remain important in the future. While the Indian software industry emerged in part as a by-product of prior industrial policy (Patibandla 2006: 110), direct public action may often be a necessary condition. In other words, the extent to which global dispersion of innovative capability to countries will proceed is likely to depend on key contingent variables. Future research should identify these contingent variables and address their role in transforming opportunities into realities.

There is a need for new research, but in a sense, the changes observed in this thesis indicate that history is repeating itself. Three decades ago, at a time when the world was seen as divided between a core and a periphery, a group of authors brought the new international division of labour to the world's attention: the world economy was undergoing a profound structural change that was forcing Western companies to reorganise their *production* on a global scale. This change was brought about by the relocation of production to what they termed 'new industrial sites' (Fröbel, Heinrichs and Kreye 1980: 15). This study contributes to a new body of literature that suggests that the international division of labour is entering a new phase. Companies are beginning to bring together efforts of old internationalisation with new corporate models and practices, thereby reorganising the global distribution of *innovation* activities. Once

more research on the international division of labour is observing a new epoch in the making.

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11 Appendix I: Inputs into innovation processes

This appendix provides an analysis of the inputs into the innovation events. A large part of the analysis uses tabular presentation of the evidence regarding the overall 'importance' of different types of source to different elements of the innovation process. This importance is essentially an expression of frequencies across all 36 cases. It uses the distinction between low (0–11 of 36), medium (12–24 of 36) and high importance (26–36 of 36). However, a substantial part of the chapter is concerned with giving a range of examples of 'highly important' internal and external sources. The appendix is structured as follows:

- *Internal sources*: examines intra-firm inputs under the two main headings, client-facing units and 'other' units.

- *External sources:* examines extra-firm sources, client sources and 'other sources'.

- *Differences across types of innovation and business lines:* shows in tabular form how the findings differ when disaggregated according to innovation type and business line.

11.1 Internal sources

This subsection examines internal inputs to innovation events. Internal sources are categorised as either (i) client-facing units, or (ii) other internal units. These are examined in turn.

11.1.1 Internal client-facing sources

Table 11.1 shows the role and importance of the different client-facing units appearing in the material related to the mobilisation of resources. The most important of these (medium and high importance across the cases) are marked in bold typeface.

Table 11.1: Internal client-facing sources

	Ideas	**Investment**	**Knowledge**
Prior projects	Low (6)	Absent (0)	**High** (27)
Project team	Absent (0)	Absent (0)	**Medium** (23)
Sales	Low (1)	Absent (0)	Low (6)
Other	Low (1)	Absent (0)	Absent (0)

Source: Drawn from analysis of sources used in innovation events. It distinguishes between low (0–11 of 36), medium (12–24 of 36) and high importance (26–36 of 36).

The overall picture is that client-facing units were primarily responsible for the generation and provision of knowledge, rather than ideas and investments. This role is played by prior projects and project teams.

Prior projects were highly important sources of knowledge. Some of this knowledge reflected deliberate efforts of leveraging knowledge gained from experience. Statements like 'we already had most of the knowledge we needed' were common. These statements are difficult to verify and triangulate. Nevertheless, informants were often able to reconstruct a trajectory in time that culminated in the initiation of events. Most informants had no difficulty in listing a number of prior projects that had helped to create capabilities and knowledge instrumental to the event.

Deliberate knowledge management – discussed further below – was important in bridging prior project-based knowledge to ongoing events. An example was the Auto IT project in MindTree. As a vanguard project, it depended on knowledge and capabilities built cumulatively in different client-facing parts of the organisation. The project required knowledge and experience from (i) knowledge related to the development of CRM systems in general, (ii) automotive domain knowledge, and (iii) experience in advanced end-to-end systems development including requirements and high-level architecture. In order to bring together these different expertises the system was used to build a team with these competences

To a limited extent, prior projects helped to generate 'ideas' that formed the basis of events. When trying to trace with informants the idea that lay behind the project/event, it was sometimes a product of previous projects. However, in the majority of cases senior management mediated these ideas (as discussed below). It was often in such previous projects that future opportunity spaces were spotted in some vague form.

Working in and with customer firms provided the impetus to set in motion an event process. There is some indication that prior projects are more important to idea-generation than the numbers suggest.

Client-facing units sometimes function as antennae that provide signals to the senior management. Take the example of Microland and their development of the CIO Dashboard. The initial drive came from the internal need for preparatory analysis and information to handle the 'tickets' (fault reports) in ongoing customers business. While it became increasingly clear that Microland itself was in need of a new system to detect and handle faults, the idea of launching the project arrived when it became clear to senior management that this could be extended as a dashboard that would add visible value to the client.

Project teams. Client-facing project teams often deal directly with the client who has created an opportunity space – or who has created a bridge or pathway to an opportunity space.

Whereas prior projects are important for the leveraging of existing knowledge, project teams were often instrumental in creating the additional knowledge needed for the event. While knowledge creation in project teams sometimes proximates R&D, this is not the typical form of knowledge creation. Rather, the client-facing nature of these teams is important in shaping the type of knowledge creation that occurs. Much of this knowledge was generated in the interaction with particular clients, adapting frameworks and ideas to client settings and feeding applied knowledge back into the innovation and learning process.

Teams are often multifunctional, consisting of employees with different skill bases. Crucially, 'the event' is often nested in these teams and the project duration is typically equivalent to the beginning and the end of the core event.[149]

[149] Except that the ideas for utilisation of opportunity spaces or other types of strategic capability building often precede the formal establishment of the project group and the capabilities created during the event may be exploited after the completion of the project.

In many software-outsourcing relationships, the supplier benefits because of a high degree of information exchange which arises as an 'externality' of the transaction. Unlike other industries, intensive interaction is a necessity in certain types of outsourcing. This type of knowledge is acquired by customer-facing project teams. It is used in the respective projects and in future projects. A range of examples of knowledge provided directly by the customer is given in the next section.

Other client-facing sources (including sales). Few other client-facing sources seem to dominate the event processes. To a limited extent, sales teams were able to feed in relevant knowledge, but mostly in events that addressed internal opportunity spaces.

Other. One 'other source' was a delivery unit.

11.1.2 Other internal units

Table 11.2 shows the role of these other internal sources.

Table 11.2: Other internal sources

	Ideas	**Investment**	**Knowledge**
Strategic units	**High** (31)	**High** (29)	Low (1)
R&D	Low (1)	Low (1)	**Medium** (15)
Non-R&D knowledge creation	Absent (0)	Absent (0)	**Medium** (15)
Other	Low (3)	Absent (0)	**Medium** (12)

Source: Drawn from analysis of sources used in innovation events. It distinguishes between low (0–11 of 36), medium (12–24 of 36) and high importance (26–36 of 36).

The overall picture that appears is that there is a split between one type of source (strategic units and initiatives) that is important for ideas and investment, whereas a range of other internal sources – R&D and non-R&D – are important in generating knowledge.

Strategic units were involved in a majority of cases. Not least with regard to 'ideas', management played a role in formulating ideas and in determining which events to take forward and which ideas to abandon. They were engaged in selecting from a range of opportunity spaces and matching these spaces to overall firm strategy and existing assets. In some events ideas originated from prior customer interaction in the firm. In other cases, ideas were brought into the firm by senior management, ultimately originating in other firms in India or abroad.

The other type of strategic unit that is included in this category is formal schemes related to intrapreneurship and innovation. These were most important in certain firms and events and will be discussed later.

In most cases, the most important source of investment was attributed to senior management, sometimes traceable to the annual strategy meeting or the like. This insight is also supported by the analysis of knowledge sources. In many cases, the sources of knowledge were direct results of traceable investment decisions made by management. This includes investments in:

- Concept papers
- Proof of concept models
- Recruits
- Special interest groups
- Training
- Workshops.

The key role of management is perhaps unsurprising because managers are ultimately responsible for investment decisions and – particularly in small firms – they can often bring in critical experience and knowledge, often from prior workplaces. [150] Another key role is related to investment decisions concerned with active learning efforts of various types. Some of these efforts are R&D based, whereas others rely on other forms of knowledge creation.

The Wipro Innovation Council (WIC) reviews innovation proposals from employees and allocates funding and support if they are successful. Hence, they are involved in all phases from idea generation to idea incubation to execution. Progress is reviewed frequently and funding may stop at any time. A key benefit of this is that it takes the financing of innovation off the operational budget. Previously, according to informants,

[150] There may be some degree of bias because leading managers often were the gatekeeper informants involved in selecting events.

the innovation process was confined to everyone's spare time and hence good ideas did not get the attention they may have deserved. All areas of business are considered in the council. More than 50 innovation projects have been executed. These projects span many areas: this is exemplified by the council's involvement in all Wipro events in this study:

- Processes and delivery (Lean)
- Technology and development of intellectual properly (UWB)
- New business lines (Global Command Centre).

Similarly, in MindTree the Bluetooth solution was chosen to go through the MindTree Incubated Networking Technologies (MINT) scheme. This scheme works on building blocks for emerging telecom networking technology areas.[151]

R&D. Sustained efforts of knowledge creation are important sources of knowledge in a significant number of cases. This was related not least to cross-applicable frameworks or systems (such as modular and customisable components in the ESO segment). Use of R&D was not spread evenly across all types of event. Most efforts at this level are aimed at in-house base frameworks and capabilities that can be deployed across a range of customers.

These efforts were mainly undertaken within dedicated R&D units. However the development of core base solutions in this area requires a substantial element of in-house R&D, but it is undertaken in client-facing project teams (R&D services).

Aztecsoft's *ETL Tool* was a product of a proactive and multi-year in-house development effort, but it was customised and sold on an OPD basis. The development of *Codesaw* in Liqwid Krystal was based on a multi-year investment effort in order to build the core solution. By contrast, subsequent but important improvements such as the addition of online assessment capability were implemented with a minimum preparatory investment. At Cranes the substantial development of new functionalities for *Systat* and *NISA*

[151] A parallel scheme is called MindTree Incubated Strategic Technologies (MIST).

rested on the deployment of several hundred 'worker years' of development effort and leverage of the knowledge bases in premier Indian research institutes to create state-of-the-art products in the statistical and scientific MIP space.

In the services space, key firms have established dedicated R&D units. SETLabs (Software Engineering and Technology Labs) in Infosys is a good example. This unit was established in 1999, and today it employs over 500 researchers. It has created several process frameworks, methodologies, service platforms and re-usable knowledge artefacts. Even a smaller firm, Microland, has established Microland Labs (ML^2) 'with the key intent to acquire new skills, augment existing skills and simulate customer environment for trouble shooting'.

Non-R&D knowledge creation. New knowledge was produced or transformed internally in order to fill specific knowledge gaps needed to achieve various types of objective (capturing new spaces). This type of deliberate knowledge creation was typically organised as workshops or 'jams' (online Web 2.0 collaboration for exploration and problem solving). To give one example, Aditi needed to make step-change headway in agile software development (ASD) in order to capture the space presented by the Mifos project. Employees from across the firm were invited to contribute to an online knowledge base, key people in the team read widely on the process methodology and 'international hotshots' in ASD (open source principles of organisation) were hired to arrange workshops in Aditi.

Knowledge management repositories were not frequently cited as a source of knowledge – maybe because they are seen as a vehicle of knowledge rather than a source as such. Out of 12 case firms, 10 had formal knowledge management programmes. However, a good example is MindTree's award-winning programme, established in 2003. KM as a practice had been evolving since inception in 1999 through various 'communities' related to different areas, such as technologies (e.g. J2EE/Java) or functions (e.g. business analysts). Today a full-time knowledge management team is responsible for overseeing all activities related to knowledge management systems, processes, structure and policies. Such teams oversee an often compulsory project debriefing (which includes information about people roles) which is filed in the system

for future use. Hence, these programmes may play key roles in creating knowledge flows through time.[152]

Training was involved in a small number of cases, often in the form of 'scaling' the knowledge created in workshops within the firms or between the firm and a client.

Other sources include units such as a project management group and an information systems group. However, the key types of 'other' non-client in internal sources were extrovert sources:

- Acquired units
- Recruits.

Neither of these sources was critical in the overall picture, but they did play a key role in some individual events. In a very small number of cases, acquisitions were mission critical to the event, as they brought in new asset. Wipro brought in capabilities to the UWB development process from Newlogic, an Austrian semiconductor design services provider and supplier of intellectual property cores for wireless applications. Mind-Tree's acquisition of Finnish firm Botnia brought in complementary and customer-specific capabilities. RelQ's acquisitions of French firm International Testing became an element its processes of verticalisation and domain competence deepening.

Aztecsoft drew on this type of investment for its independent testing services centre in which customers (including some of the world's largest independent software vendors) can have their own products tested before release. The capabilities involved in this type of testing are different from testing which occurs as an integrated part of the software development process. To acquire these capabilities the company bought a dedicated testing company based in Pune in western India.

[152] The issue of the knowledge linkages through time was also captured by questions such as 'how was knowledge from the event integrated into the firm?' and 'how has this knowledge been exploited subsequently? Because events often resulted in re-usable assets, these systems were utilised in future exploitation of events. Take the case of embedded software components in an ESO space, such as Bluetooth. Each subsequent customer application could build on the knowledge management system to draw on previous experience of the application in different settings.

Recruits featured in some cases and, in a few, they appeared of crucial importance for some events.

11.2 External sources

External sources are divided between (i) client sources, and (ii) other sources. These are discussed in turn.

11.2.1 Client sources

Table 11.3 shows the role of external client-related sources. The overall picture that appears is that customers proper stand out as 'providers' of ideas and knowledge across the cases.

Table 11.3: Client-related sources

	Ideas	**Investment**	**Knowledge**
Customers	**Medium** (13)	Low (7)	**Medium** (18)
End-users	Low (1)	Absent (0)	Low (6)
Third party collaborators	Low (5)	Low (2)	Low (4)
Other	Low (1)	Absent (0)	Absent (0)

Source: Drawn from analysis of sources used in innovation events. It distinguishes between low (0–11 of 36), medium (12–24 of 36) and high importance (26–36 of 36).

Customers played an important role in providing ideas and knowledge. In most cases *ideas* were transmitted actively, for instance, in the form of a suggestion or a proposal. Often the interaction with a particular customer (or multiple customers in a particular field) provided an impetus or even a direct request. Certain buyer firms requested new types of service and this could spark internal learning projects related to new functions or technologies.

The passing down of ideas often occurred when customers had identified a need or problem that could be addressed with (changes in) the supplier's services in terms of practices or scope. With regard to scope it was a customer, for instance, that suggested Aditi should engage for the first time in end-to-end product development in a project evolving around the creation of a relatively complex web application. The initiating product idea was referred to as a 'vision' rather than a clear idea. This left open a very wide scope for joint collaboration in the interface between the idea and elaboration

phase. For this end a core team of Aditi employees was moved on-site to translate a 'vision document' into functional specifications.

Similarly, in the case of the online assessment solution it was an important global lead customer that provided the idea. The customer saw a large potential for improving its information technology learning solutions by adding the assessment capability. Hence, while this was implemented for the lead customer in the first instance it subsequently enabled the firm to reconfigure its business model and open up the growing Indian market for information technology training product and services. The assessment of skills remains a highly critical issue in the Indian software industry.

Requests for learning-intensive projects by customers were sometimes accompanied by opportunities for *investments* in learning/innovation projects (events). According to informants, indirect investments were much more widespread and broad based. However, it is also more difficult to pinpoint from a data collection point of view because they occurred in various phases and were typically not thought of as 'investments' but as 'contributions' by global actors and are hard to distinguish from knowledge. Such 'contributions' were made in terms of time taken out to deepen the relationship and this was not always considered an investment by informants.

One way in which such contributions were made can be illustrated by the case of Aztecsoft's ETL Data Integration Tool.[153] For the development and enhancement of the product to meet the customer's needs, the gathering of requirements was facilitated by the customer, in particular by the organisation of client panels and events. Furthermore since the customer had developed its own product it was able to suggest ways in which to improve the product for the intended markets. As the business relationship matured and the customer established an in-house team dedicated to the package, the customer made investments in the 'relationship' and made efforts to ensure that all the project team members in the two firms understood how they could and should interact with their counterparts. According to the buyer, substantial upfront investments (of time

[153] The contributions made by the customer are easily detectable in this case because the legal and responsibility-level ownership initially remained within the supplier, whereas the package was marketed by the buyer on a contractual basis.

rather than hard costs) constituted 'hidden overheads', but these investments in relationship management proved well spent in the long run. Furthermore, the contact to end-users (discussed further below) was mediated by the buyer but it essentially enabled the supplier to innovate on behalf of the customer by following a lead-user strategy.

However, in smaller number of cases, when a project required the mastering of a particular technology or skill which was not fully developed in the supplier firm, a separate small time and materials contract was sometimes made to co-finance preparatory training activities such as workshops or courses (in addition to the main contract for work). The investment decision was typically made and negotiated somewhere in between the idea formulation and elaboration phase of the events. The investments themselves were typically concentrated in the elaboration phase. While such investments were of crucial importance in small number of cases, most firms relied on firm-internal investment.

Knowledge linkages to customers' firms were of very high overall importance. Customers and end-users played a key role in providing critical knowledge in most innovation events. This was the single most important element of external 'sourcing' across the events examined. Thus, customers and end-users played a key role in providing critical knowledge in many innovation events. This was the single most important element of external sourcing across the events examined. The purpose of this subsection is to provide a brief overview of the various ways in which knowledge was acquired through forward linkages. It distinguishes between learning from buyers and learning from end-users.

In some events the Indian companies had become co-creators of innovation in specific (internal or external) end-customer projects. In these cases, knowledge development was often a joint activity involving team members from both buyer and vendor. The core knowledge generation element was typically a phase of joint definition of requirements and architecture, typically of an entire project. The supplier was brought along on the project because of specialised competences, typically in a specific technological/functional field, but also sometimes because of industry domain competences.

The OSS project provides an example. The supplier was working alongside the customer in all phases of development, including inception and elaboration, launch and stabilisation and next release planning. The key knowledge came from the customer in the form of access to previous product architecture and from 'knowledge transfer' sessions. During the whole project duration there was close interaction between buyer and supplier, facilitated by dedicated physical infrastructure key personnel, who were on-site throughout the period.

End-users. Another type of forward knowledge acquisition is learning directly from users. Direct linkages were identified primarily in the advanced events in the software product business line (made in India products). Cranes, for instance, inherited surveys of Systat users when this product was acquired. This formed the basis of the 'product transformation' that was subsequently carried out. However, Cranes also employed selected lead-users in US academic institutions to work as consultant and idea-providers. Some of these worked very closely with Cranes (and some spent several weeks in their Indian office).[154] Contact with end-users was sometimes indirect, as discussed immediately below.

Third-party collaborators. In some cases, firms received inputs from third-party collaborators. It is worth mentioning Aditi, which developed its product transformation service offering based on a particular project that was initiated by a key alliance partner (and an owner of a platform technology). The alliance partner wanted a US-based ISV to migrate its flagship product to its own technology base. Therefore, the alliance partner wholly financed Aditi's development of a proof-of-concept (POC) for the transformation and functional improvement of the ISV's product. In this case, investments made in the elaboration phase were billed separately and to a different organisation. In this case, a key driver in adding new functionalities came from information (and some limited interaction) with end-users in the USA that was facilitated by the external partner. These interactions were initially aimed merely at 'getting a sense of the thing',

[154] As an informant explained, 'They went to certain key customers and they asked, "What do you need? What do you want?" and they tried out certain things. So they had, in fact, a fairly small focus group of people who pushed them hard and who told them "this is what we don't like about Systat". And they fixed it. It's that simple.'

with the aim of creating such improvements. Thus, the alliance partner had mediated and coordinated information contact to selected end-users who could give Aditi insights into the product and the needs of the end-users. This ultimately enabled the firm to innovate on behalf of the customer.[155]

11.2.2 Other external sources

Table 11.4 provides an overview of other external sources. The overall picture of non-client external linkages has two main features. First, external sources are mainly involved in the provision of knowledge. Second, these knowledge sources are spread across a number of categories. This reflects an overall relatively frequent occurrence of external sources, but not of one particular type of external source. Examples of each type are given because of their particular importance in individual cases.

Table 11.4: Other external sources

	Ideas	**Investment**	**Knowledge**
Backward linkages	Low (1)	Absent (0)	**Medium** (13)
Horizontal link sources	Absent (0)	Absent (0)	**Medium** (14)
Traditional R&D institutions	Absent (0)	Absent (0)	Low (6)
Other	Absent (0)	Low (2)	Low (6)

Source: drawn from analysis of sources used in innovation events. It distinguishes between low (0–11 of 36), medium (12–24 of 36) and high importance (26–36 of 36).

Backward links. Backward linkages were of medium importance. Software tools can be considered 'capital goods' of the software industry and there are linkages to software tools providers. According to informants, software development tools are among the most important factors in overall productivity increases. However, this is not easily captured, nor is it necessarily important in innovation events. The use of these tools is so fundamental to the software development process and its improvements that these tools were rarely mentioned by informants. Exceptions are mentioned below.

[155] Insights from this firm also show that customer-mediation of linkages also occur with regard to linkages to actors other than users. In a different event the customer provided specific information related to the third-party systems (including eBay and PayPal) in which the system needed to be integrated and the customer was largely responsible for mediating interaction with these actors.

First, an enterprise project management (EPM) tool was used for the development and implementation of the COMPASS system. For this event M-Tec relied primarily on knowledge and training provided by the project management institute (PMI) a global standard setting organisation in the field. However, it used HP (Hewlett-Packard) to supply a base software system (Mercury) which was then customised to support the processes defined by M-Tec. Along with the system itself M-Tec also received on-site training and consultancy services from HP related to system integration. Second, as already mentioned, a Tools group was created in Infosys as a single point of contact for interaction with third-party software development tools providers aimed at structuring and optimising the use of such tools. While the most important source of knowledge was a collaborator that had created its own organisational entity for the same purpose, a lot interaction occurred with the providers of tools themselves.

The above examples are cases in which suppliers' products and services are mainly for internal use in processes innovations. Hence, they are only indirectly embedded in the provision of services to customers. However, in certain cases – particularly in the R&D and products lines – knowledge was embedded in components that are integrated into the final solution on a licence basis.

Thus, there were linkages to technology component providers. A good example is Sasken's Multimedia Subsystem for mobile phones. Depending on the specific customer requirements for its system, Sasken will have up to 90 per cent of required capabilities in-house. Remaining specialised components/skills are sourced from outside in order for Sasken to take on the role as a comprehensive solutions provider. The company has therefore developed relationships with Israeli suppliers in the field. These transactions are rarely one-off or thin in nature. For instance, IXI Mobile provides an application framework and for this Sasken has secured a dedicated development support team at the supplier's sites in Israel and in Ukraine.

Knowledge was sometimes also supplied by non-software KIBS such as general consultants. When Wipro developed its Lean initiative, it brought in consultants from Japan to help it formulate a Lean strategy. Wipro contacted several other consultancies, but eventually there was nobody who had any experience with Lean in the software

context, but these were still mentioned as a part of the journey. It also made use of a local consultancy firm for its innovation strategy development.

Horizontal link sources. Standard organisations and networks were important in a small number of cases, mainly in the products space, but also in services. The increasing shift towards open standards in many fields – not only in the hard technology domain, but also with regard to business processes – has eased entry for certain Indian firms into innovative activities.

In developing their *Bluetooth* solutions, MindTree's participation in the Bluetooth Special Interest Group (SIG), a standard-setting organisation, was important in securing specifications for interoperability of an evolving technology. As capabilities increased MindTree itself became important in Bluetooth standards development and enhancement after gaining voting rights as an associate member (as distinct from board member). Furthermore, the participation in the Bluetooth SIG has been the key point of contact for alignment with strategic customers.

Observation of best practice in other competing firms was noted in a few cases. For example, the establishment of the Tools Group in Infosys was modelled on the earlier establishment of a similar group with the same functions in one of the world's predominant software corporations. While Infosys employees had been exposed to this idea through their work with this customer and alliance partner, there was little or no active collaboration.

Linkages to 'non-traditional institutions' such as open-source repositories/networks were of more central importance to some events. These may be viewed here as 'institutions' simply by virtue of being a non-firm establishment. In these cases, firms' sourced knowledge was embodied in semi-standardised software solutions (akin to semi-manufacture in the world of industrial production). These solutions were integrated as components into the final solution and therefore they may be viewed as earlier stages in the knowledge development process. Such linkages were not widespread as the main source of external knowledge (two cases) but they often took the role as a supporting form of external knowledge.

Microland's Fault Reporting Tools, for instance, were constructed on an open source base (Open NMS). Previously these fault-reporting tools were licensed at a significant cost from a major third-party information technology company. Thus, in this case embodied technology was freely available to use in a process innovation. Significant customisation was needed but the open source base was a key component in the overall innovation. Another case in which open source components were used directly in the innovation processes is MindTree's TechWorks.

Traditional R&D sources. Linkages to traditional knowledge institutions do occur in the case material, but not as frequently as one might expect. It happened mostly in special cases in the MIP segment. For instance, Cranes established close connections with Purdue University and gained access to resources relevant to the further development of Systat. Connections to academia were also mentioned in other cases, but these appeared marginal. In general, it was argued that linkages to academia were increasing in importance along with the criticality of domain competences.[156] This is exemplified by the case of Influx.

Other sources. Other external sources include written external sources (of information) and financial institutions (as sources of finance for investments). None of these were critically important across cases.

[156] Hence, these links were not only formed with software technical institutions, but from a much broader field. For instance, one informant mentioned that a European academic expert had been hired to ensure compliance of an information system developed for a customer ion the financial industry with Basel accord regulations on operational risks. However, such instances do not appear in the events-based material. Only in two cases were such linkages mentioned.

11.3 Differences across types of innovation and business lines

Table 11.5: Knowledge sources structured by type of innovation (frequencies)

		Internal client facing				Other internal				External client related				Other external			
		Prior project	Project team	Sales	Other	Strat. units	R&D	non-R&D	Other	Custom-ers	End-users	3rd party	Other	Back-ward	Horizon-tal	R&D	Other
Framing solving	A (9)	••	••	•	-	-	••	•	•	••	•	•	-	•	•	•	•
	B (10)	••	••	•	-	-	••	•	•	••	•	•	•	•	••	•	•
Other	C (5)	••	••	-	-	-	-	••	•	•	-	-	-	•	•	-	-
	D (12)	••	••	•	-	•	•	••	••	•	-	-	•	•	•	•	•

Note: The number of events in the different innovation categories is noted in brackets. Tables 11.5 and 11.6 distinguish between 'occurrence in 50 per cent or more of events in given category' (••), 'occurrence in less than 50% of events in given category' (•), and 'absent in given category' (-).

Table 11.6: Knowledge sources structured by business line (frequencies)

		Internal client facing				Other internal				External client related				Other external			
		Prior project	Project team	Sales	Other	Strat. units	R&D	non-R&D	Other	Custom-ers	End-users	3rd party	Other	Back-ward	Horizon-tal	R&D	Other
BPSS	CAD (8)	••	••	•	-	-	••	••	•	•	-	-	-	••	••	•	-
	ITS (8)	••	••	-	-	-	-	-	••	•	-	-	•	-	•	-	•
	IMS (4)	••	••	-	-	-	•	••	-	••	-	-	-	••	•	-	•
PDSS	ESO (4)	••	••	-	-	-	••	••	••	••	-	-	-	•	••	•	•
	MIP (7)	••	•	••	-	-	••	-	•	•	•	-	•	••	•	••	•
	OPD (5)	••	••	-	-	•	•	•	•	••	••	•	-	•	•	-	•

Note see Table 11.5 for explanation of symbols.

12 Appendix II: Interview schedule and list of informants

This appendix reports the key generic interview questions and a list of informants.

12.1 Interview questions

All sample firms were asked a number of generic questions in order to obtain comparable information. Note however, that most interviews centred on event-specific questions based on pre-obtained information

12.1.1 Suppliers – gatekeeper Informants

Historical background of the firms

When was the firm established?

How was the firm established?

What is the background of the founders?

Economic and business profile

How many people does the firm employ?

What is the trend of the enterprise's performance over the last five years?

What type of markets does the firm serve (verticals)?

What type of services does the firm offer (horizontals)?

What is the firm's competitive advantage *vis-à-vis* other software providers?

How was this developed/sustained over the last five years?

Overall identification of key innovation events (2001–2006)

Examples of events include:
The creation of original intellectual property
Creation of new software package
Changes in business and organisational process
Changes in software development processes
The creation of added value for customers
Changes leading to clear differentiation from competitors
Implementation of new marketing and clients acquisition/retention strategies

Which activity, project, contract or programme represented or is associated with an important step forward in terms of what the firm was able to do (marking a clear 'before and after')?

[List the details of the key events in the following sections]

Details of innovation event X

When did the event 'begin' and 'end'?

What types of changes characterise the event?

What was the firm able to do after this event?

How was this different from what the firm was able to do before the event?

Was this event mainly driven by the firm itself or by external collaborators?

How was the new knowledge integrated into the firm?

How has this knowledge been exploited?

[Repeat section E for the total number of events noted]

12.1.2 Interview schedule – innovation events

Types of changes/innovation

Did the event involve:

- The creation of original intellectual property?
- Creation of new software package?
- Changes in business and organisational process?
- Changes in software development processes?
- The creation of added value for customers?
- Changes leading to clear differentiation from competitors?
- Implementation of new marketing methods?
- Implementation of new customer retention strategies?
- Other:

What types of changes were most important?

Changes in the product/service offered?

Changes in the process?

Changes in the organisational arrangements?
Changes in the area of marketing?

What was the firm able to do after this event?
How was this different from what the firm was able to do before the event?

Local collaborators
Did any local actors provide ideas, investments, or knowledge during the process?
Who were the local actors involved in the event?

MNC subsidiaries:
Providers of KIBS:
Venture capital firms:
Clients / Customers:
Suppliers:
Competitors:
Universities:
Research institutions:
Trade associations:
Public support institutions:
Standard organisation:
Non-profit business networks or organisations:

What was the purpose and nature of the relationship(s)
What was the role of the external collaborator(s)?
How did you interact?
What was the nature of your contract?
Did information flow predominantly from your firm to the collaborating organisation or the other way?

Foreign collaborators
Did any 'global' actors provide ideas, investments or knowledge during the process?
Who were the foreign actors involved in the event?

Clients / Customers:
Venture capital firms:

Providers of KIBS:

Suppliers:

Competitors:

Universities:

Research institutions:

Global standard organisation:

Global business networks:

What was the purpose and nature of the relationship(s):

What was the role of the external collaborator?

How did you interact?

What was the nature of your contract?

Did information flow predominantly from your firm to the collaborating organisation or the other way?

Role of the custumer (if any)

Name of customer:

How important is this customer in terms of revenues?

How difficult would it be for you if the relationship stopped tomorrow?

How difficult would it be for the customer?

How do you communicate?

How often did staff from clients visit?

How often are they consulted by phone / email / videoconference etc?

When do you consult with clients about technical issues?

How are specifications defined?

How are they given to you?

What did the customer provide apart from the opportunity to sell?

Did you have any contact with the end-user?

What do you offer this client that other firms do not?

Has the relationship with this customer developed over different phases? Please describe

Firm-internal preparations

Did any firm-internal actors provide ideas, investments or knowledge during the process? Who and how?

What preparatory activities were initiated before this event?

Did the firm undertake R&D in activities in relation to the event?

What was the biggest challenge and how did the firm overcome this?

How was the new knowledge integrated into the firm?

How has this knowledge been exploited?

Was this event mainly driven by the firm itself or by external collaborators?

Importance of different sources

Who provided the idea(s) that underlie the event?

Who provided the investments during the process?

Who provided the critical new knowledge during the process?

Please the rank the relative importance of internal, local and global sources. What sources are first, second and third most important?

The process

What types of problems or challenges arose during the phase of change?

How did you resolve it?

What would have enabled you to take this innovation even further?

Further contacts

Please provide contact details of your collaborators

12.1.3 Interview schedule – buyers

The Indian vendor

What capabilities of the Indian vendor are most important to you?

- Operational production capabilities, to provide cost-effective solutions?
- Innovation capabilities? (What kind and why?)

How would you rate each of these capabilities at the Indian vendor?

What capabilities have increased most during the course of your relationship? How have they changed over the last five years?

How has the vendor contributed to innovation in your organisation? Do you feel that mainly you or the vendor drove this?

The relationship

How has the vendor invested in your relationship?

What do you give the Indian vendor apart from business? What capabilities have you helped to improve and how?

Who undertakes requirement analysis and high-level design? Has this changed over the last five years?

How are specifications transferred to the vendor? Has this changed over the last five years?

What is the importance of the vendor's on-site teams and/or offices close to you?

What third-party organisation and collaborators have been involved in your relationship?

How do you communicate?

How difficult would it be for you if the vendor suddenly discontinued the relationship?

Do you put the vendor in contact with end-users?

Has the relationship developed over key phases? Please describe?

What have been the key challenges?

The customer

How does outsourcing relate to the overall competitive strategy of the firm?

Has this changed over the last five to ten years? How?

In what ways have the Indian firms – or other offshore providers – influenced this change?

What percentage of your overall work is outsourced to the Indian vendor?

Do you feel that you are outsourcing parts of your innovation process? If so, are these strategic innovation activities?

What activities are you most reluctant to outsource?

How has your strategy for involvement of the Indian vendor changed over the last five years?

12.2 List of informants

Note that confidentiality clauses prevent the disclosure of certain names and companies. Named informants are listed below:

Adkoli, A., CEO, Liqwid Krystal

Ahluwalia, B., Vice President - Delivery, Aditi Technologies

Almeida, N., VP Products, Liqwid Krystal

Bala, S., Vice President - Solutions Delivery, Wipro Technologies

Balaji, C. R., Senior Vice President, MphasiS

Banerjee, K. K., Vice President, R&D Services, MindTree

Bose, M., Executive Director, Tamara Capital Advisors

Bowman, C., Consultant, Bridgewater College

Chandrasekran, V., CEO and Managing Director, Aztecsoft

Choudhary, N., Program Manager, Tools Group, Infosys

Conard, G., Director, Grameen Technologies

D'souza, A., General Manager, Indo-German Chamber of Commerce

Datta, C., General Manager, MindTree

Datta, R., General Manager, Knowledge Management, MindTree

Deodhar, Y., Manager, IPValue India

Desai, V., Marketing and Relationships, TUI InfoTech

Deshkmukh, V., Executive Vice President and COO, MindTree

Deshpande, P., Senior Vice President - Global Head Quality and Project Management Office, MphasiS

Deshpande, V., CEO, Encore Software

Dinesh, K., Co-founder and member of the board, Infosys

Doraswamy, A., Executive Vice President, CodeTheatre

Enghoff, S., Director, Scientific Concepts

Envall, A., Head of Competitive Sourcing, Volvo Information Technology

Gandhe, M., Director - Strategy and Corporate Dev., Sasken

Ganesan, K. S., CTO and Vice President Engineering, Microland

Gidwani, S., Director Sales and Marketing, Liqwid Krystal

Goparaju, S., Vice President and Head - SETLabs, Infosys

Govindarajan, V. R., CTO, Aztecsoft

Gupta, M., Principal Influx Consultant, Infosys

Heda, S., Chief Operating Officer, Microland

Hoefner, G., Executive Vice President, Siemens Information Systems

Honnungar, V. S, Executive Vice President, CodeTheatre

Iyer, S., Vice President - Marketing, Microland

Jaworski, D., CEO, Passalong Networks

Joshi, R.W., Vice President and Head - European Operations, L&T InfoTech

Joy, S., HR Manager, MphasiS

Jyrkka, H., Director, Business Development, Botnia High-tech

Kakal, C., Senior Vice President and Global Head Enterprise Solutions, Infosys

Kapooria, A., Corporate Communications, Cranes Software International

Keshavarmurthy, R., Vice President CAE R&D Services, Cranes Software International

Keskilammi, M., Director, HW Business, Botnia High-tech

Khan, S., Assistant Director - KM, MindTree

Kittu, R., Senior Marketing Manager, Aditi Technologies

Kochikar, V. P., Associate Vice President, Infosys

Koppar, A., President, MphasiS

Kottayil, J., Executive Director, State of Bavaria India Office

Krishnan, G., Business Development Manager, iCOPE Technologies

Krishnan, M., Manager - Business Development and Planning, RelQ

Krisnan, R. G, Technical Manager, iCOPE Technologies

Kulkarni, T. R., Director, KEONICS

Kumar, P., President - Services Division, Sasken

Kumar, S., Senior Vice President - Group Head - Quality, Infosys

Kumar, S., Engineering Manager, iCOPE Technologies

Kuni, R., Group Head - Productivity Office, Wipro Technologies

Laxman, K., Associate General Manager, MphasiS

Lohse, J-M., Senior Executive Advisor, Value Leadership Group

Louis, J., Senior Vice President, MphasiS

Madtha, J., General Manager, MphasiS

Mangalath, D., CTO, Wipro Technologies

Mehra, B., Lead - Corporate Planning, Infosys

Mehta, V., General Manager - Innovation, Wipro Technologies

Menon, R.B., Sr. Vice President - SYSTAT, Cranes Software International

Moitra, D., General Manager - Research, Infosys

Mukhejee, S., Sr. Product Marketing Manager, Wipro Technologies

Mukherjee, I., Marketing Manager - Europe, Satyam

Mutalik, A., CEO, CodeTheatre

Mutalik, P., Group President, RelQ

Nagaraja, N. S., Associate Vice President & Principal Architect, Infosys

Naidu, B. V., Director, STPI Bangalore and Hyderabad

Nakra, D., Managing Director, iCOPE Technologies

Nandagopal, N., Vice President, SAP Labs India

Narayanan, S., Senior Engagement Manager, VeriSign

Narsani, A. K., CEO, Brain League IP Services

Naryanan, L., Chairman, NASSCOM

Natarajan, K. K., President and CEO, MindTree

Neumann, C., President, SAP Labs India

Pani, N., Senior Editor, Economic Times

Parthasarathy, J., Additional Director, STPI Bangalore

Patil, P., Chief Operating Officer (M-Tec), MphasiS

Pierce, S., General Manager of Product Development, Microsoft

Praharaz, R. A., Chief Knowledge Officer, Jataayu Software

Prasad, H. C., Associate VP - Applications, MphasiS

Pundir, A., Senior Manager, NASSCOM

Rajam, S., CEO, Ittiam

Rajeswhar, Head - Tech Support Operations, Microland

Ramadath, S., Manager - Symbian Competence Centre, Sasken

Ramanchandra, R. G., Knowledge Manager, IBM India

Ramaswami, B, President and Managing Director, Sonata Software

Reddy, R. W., Head - Corporate Communications, Microland

Sadagopan, S., Director, Indian Institute of Information Technology

Sahay, P., R&D Coordinator and Research Scientist, Sasken

Sahrawat, R., Vice President, NASSCOM

Schumacher, P., CEO, Value Leadership Group

Sharma, B., Vice President - Head of Sales, MphasiS

Sharma, S., Secretary General, ITSMA

Shenoy, S., Sr. Manager HR, MphasiS

Shinde, C. L., General Manager, Aditi Technologies

Siik, T., Partner, Nokia Growth Partners

Singh, J., Officer on Special Duty, Department of IT, Karnataka

Singh, S., Group Project Manager, Infosys

Sorensen, L., Country Leader: Learning, IBM India

Sreedharan, P., Head - Corporate Communications, Cranes Software International

Sreenivasan, V., Vice President, Strategic Relations and Consulting, ITC InfoTech

Srikanth, B. R., Product Manager, Sasken

Srikanth, S., Director and COO, RelQ

Srinivasan, R., Mission Lead Quantum Innovations, Wipro Technologies

Srinivasan, T. R., Vice President - Global Service Delivery, Microland

Srivastava, M., Country Manager, Evalueserve

Stroustrup, B., Engineering Chair Professor of Computer Science, Texas A&M

Subramonian, S., Project Manager, Infosys

Talwai, A., CEO in residence, e4e

Thakar, S. R., Consultant - Business Development Europe, L&T InfoTech

Thimmaya, P. P., Senior Correspondent, Economic Times

Timmerbacka, H., CEO, Botnia High-tech

Ulrich, D., Consultant - Business Development Germany, L&T InfoTech

Uphadya, C., Professor, NIAS - IISc

Varadarajan, R, Consultant, Synthesis

Varghese, V., Senior Marketing Manager, Aditi Technologies

Vasuku, M. P., Vice President, Technology Solutions, Encore Software

Venkatesh, G., Chief Technology and Strategy Officer, Sasken

Vidyashankar, M. N., IT Secretary, Department of IT, Karnataka

Wait, J., Chief Publisher, Safari Books Online

Wandile, V., Architect - Semiconductor IP Group, Wipro Technologies

Wilkinson, L., General Manager, SPSS