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## Outsourcing and supplier learning: insights from the Indian software industry

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**Abstract:** There is increasing agreement that Indian software firms are making the transition from competitive advantage based on low cost to competitive advantage based on innovation. However, there are few insights about how this transition process works. This paper seeks to bring together the outsourcing, global value chains and firm capability literatures. It draws on empirical material focused on learning and innovation 'events' in Indian software firms – their inputs and sources – and makes headway in opening the 'black box' of supplier learning in outsourcing relationships. This paper suggests that learning from customers was important but insufficient for making the transition. Capability formation depended significantly on other channels and mechanisms outside or independent of outsourcing relationships. This paper shows how firms actively mobilised and combined internal and external sources to address spaces for learning and innovation created by outsourcing.

**Keywords:** firm capability; global value chains; India; Bangalore; innovation; learning; outsourcing; software industry; globalisation; technology; knowledge intensive industries; supplier.

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### 1 Introduction

In recent decades, firms in China and India have become major producers of products and services for markets in OECD countries. Observers agree that outsourcing and offshoring from Northern America and Western Europe to these 'rising powers' of Asia has brought about major changes in the global distribution of *production capabilities*. Conversely, *innovation capabilities* have so far remained largely concentrated in the so-called 'West'. However, this is now starting to change. There is increasing evidence that China and India are progressing from production to innovation in a range of different industries (Altenburg et al., 2008). But despite the increasing agreement that offshore outsourcing has a major influence on the shift in innovation capabilities, the literature has only

provided partial understanding of *how* outsourcing changes the international division of (innovative) labour. Few studies have examined how this process ‘works’.

To address this issue, the present paper seeks insights from one of the most prominent cases of ‘transition’ in the global economy – software services in Bangalore (Parthasarathy and Aoyama, 2006; Basant and Chandra, 2007; Chaminade and Vang, 2008). While there are many cities in India with extensive software industry activity, this city in Southern India has become well-known worldwide for its exports of software services (Chaminade and Vang, 2008; D’Costa, 2009). Recent research has shown that Bangalore has become the most important software service hub outside the OECD countries (Arora et al., 2008; Chaminade and Vang, 2008; Parthasarathy and Aoyama, 2006). For the last two decades, the Bangalore software cluster has achieved year-on-year software-export growth rates exceeding 20%. The USA is the main market (60%), followed by Europe (24%). Nationally the Indian software industry has grown faster than the software industries in Brazil, China, Ireland and Israel (Athreya, 2005).

Bangalore software has followed a progressive trajectory towards higher-value services, products and practices, but the low-cost service provision capacity remains important (Altenburg et al., 2008). Even vanguard firms have not undergone a capability *transition* (in which firm replace their production capabilities). Rather the trajectory is one in which firm’s *expand* their competences, strengthening production capacities while simultaneously picking up innovation capabilities. This means that suppliers are not ‘moving up the value chain’ in the normal sense in which firms move into high-value activities and leave low-value activities behind. Rather they are stretching their value-chain thread into knowledge creating activities (Lema, 2011, 2012).

The research presented here seeks to understand the process of building new capability in Bangalore software firms. It seeks to examine the inputs into learning and innovation process and the way in which they are combined in specific learning and innovation ‘events’. The overriding question is how select software suppliers in Bangalore have managed to build and deepen innovation capabilities after 2001.

The next section offers a brief review of the relevant literature. It compares the literatures on outsourcing, global value chains and firm capabilities in latecomer countries to identify the knowledge gaps this paper seeks to address. Section 3 then draws on these literatures to build an analytical framework for empirical analysis. Section 4 explains how the study chose firms for examination and how it analysed the observed ‘events’. The next two sections then provide the empirical analysis. Section 5 shows how two firms combined inputs indistinctive cases and Section 6 examines the firm-internal and external inputs into innovation processes across the sample of events. The last section brings out the key conclusions and insights to the literatures and brings out questions for further research.

## **2 Learning and innovation in offshore outsourcing**

The underlying proposition driving this research is that outsourcing has an important influence on the mounting global redistribution of innovation. While much of the existing literature takes note of this, there are few insights on the key characteristics of the process. To advance our understanding, this section draws on three sets of literature:

- The literature on offshore outsourcing (such as Jensen, 2009; Maskell et al., 2007; Lewin et al., 2009).
- The literature on global value chains (such as Altenburg, 2006a; Gereffi, 1999; Humphrey and Schmitz, 2002).
- The literature on firm capabilities in developing countries (such as Ariffin and Figueiredo, 2006; Bell, 1984; Figueiredo, 2003).

The aim of the section is to bring out the relevant insights and point out where this paper seeks to contribute. The section will identify the key insights, arguments and remaining knowledge gaps about supplier learning in these sets of literature; it will then provide a summarising comparison.

### *2.1 Outsourcing*

The literature on outsourcing has shown that global outsourcing relations are changing: firms are farming out tasks that they used to undertake in-house, that is knowledge-intensive roles, including some innovation and research and development (R&D) activities (Maskell et al., 2007; Lewin et al., 2009). This is different from the early days when Western firms only farmed out certain steps to low-cost economies, mainly manufacturing and standardised services. Innovation activities, on the other hand, remained in so-called advanced economies (Mudambi, 2008). The change was spurred by:

- 1 shifting corporate strategies in which increased offshoring is a mechanism to aid competitiveness (Lewin et al., 2009; Lema, 2010)
- 2 rising 'comfort levels' in dealing with offshore low cost suppliers (Maskell et al., 2007; Tate et al., 2009).

In this way, the literature has shown that firms increasingly 'transfer' knowledge-intensive and innovative steps to the low cost supply base. The literature notes that increasing capabilities in the supply base was a precondition for the new nature of offshoring (Lynn and Salzman, 2007). It also notes that this new wave of outsourcing has induced further learning in the supply base (Jensen, 2009). In this way, the literature suggests that outsourcing is a reciprocal 'learning process' (Maskell et al., 2007; Jensen, 2009). However, most of this literature focuses mainly on the demand-side of outsourcing relations. Learning and innovation in the supply base is a simple (automatic) effect of the strategies of buyer firms based in the OECD countries. The literature rarely examines organisations at the 'receiving end' of outsourcing decisions in detail and the process of learning in the supply base is under explored. When this body of work discusses supplier learning, it mainly focuses on 'what' suppliers have learnt rather than 'how' they have done it. It has examined learning as an outcome without specifying the process. It is the latter which this paper seeks to do.

### *2.2 Global value chains*

The literature on global value chains has shown how export linkages can play an important role in promoting learning and innovation in the supply base (Altenburg,

2006a; Gereffi, 1999; Humphrey and Schmitz, 2002; Schmitz and Knorringa, 2000). This approach is *relational*, focusing on linkages in the value chain, between buyers and suppliers in OECD countries and in developing countries. It often underlines the positive influence that these linkages can have on learning and innovation in firms in developing economies. Pioneering work by Gereffi showed that insertion into global value chains led to significant upgrading, that is movement towards increasingly innovation-intensive activities. Low-cost suppliers often upgraded the quality and scope of their services in response to the requests and demands of lead firms in the USA or the European Union. In certain cases, ‘buyers may welcome increasing supply competences as part of a broader strategy of focusing on their own core competences’ (Humphrey, 2004). However, the opportunities that go to suppliers have limits. Building on Gereffi’s early work, a following wave of research showed that innovation and learning was dependent on the governance characteristics of global chains (Giuliani et al., 2005; Navas-Alemán, 2006). The notion of ‘buyer power’ is central. Buyers – or ‘lead firms’ – have a major influence on opportunities and constraints from different sourcing strategies and relations with suppliers. In the words of Schmitz (2007): “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”. However, the literature has not clearly defined the notion of ‘spaces’. Furthermore, the mechanism through which supplier firms can ‘capture’ such spaces remain hidden in a ‘black box’ (Morrison et al., 2008). This paper seeks to add to the global value chains literature in two ways. First, it seeks to provide further conceptualisation of the relations between learning and new spaces in value chain. Second, it seeks to bring out empirical insights about to the extent to which lead firms and buyers not only provide spaces but also provide the key resources needed to innovate in and through such spaces.

### 2.3 *Firm capabilities in developing countries*

The literature on firm capabilities in latecomer countries has made the simple but fundamental point that formation of innovation capabilities depends on strategic intent and the willingness to make the necessary investments (Bell and Albu, 1999; Ariffin and Figueiredo, 2006; Figueiredo, 2007).<sup>1</sup> There is little direct discussion in this literature about how outsourcing and supply relations might influence learning in latecomer firms. On the contrary, prominent studies assume that the main influence runs in the opposite direction. It suggests that build-up of competences is an *independent process* that *allow* latecomer firms to form different types of buyer or parent firm linkages, such as innovation-centred linkages (Ariffin, 2000). Specifying the chain (and direction) of causality is not easy. Ideally, one needs to examine and discuss the causes in a multidirectional fashion (co-evolution), but the immediate task in this paper is to explain the processes and channels by which outsourcing may promote learning in the supply base.

The main point coming out of this literature is that supplier firms must act to capture new opportunity spaces; it is not an automatic process. Martin Bell has made this point persuasively, warning against the danger of viewing insertion into outsourcing arrangements and global value chains as a ‘benign escalator’ for supplier firms.<sup>2</sup> While most scholars would agree with this point, the key task is to bring out into the open some of the main sources and mechanisms involved when suppliers climb the ‘demanding stairway’.

The literature has shown convincingly that paying attention to firm-internal processes is important, but most of the existing literature concerned with innovation capabilities in latecomer firms has focused on industrial sectors such as steel (Figueiredo, 2003) and electronics subcomponents (Ariffin, 2000). This paper therefore seeks to address an important gap by focusing on *business services*, a segment that is gaining increasing importance in range of supply platforms in Asia. Services firms differ from manufacturing and industrial firms in important ways (as will be discussed below) and may therefore merit a separate explanation.

#### 2.4 Comparing and combining the approaches

Table 1 compares essential features of the literatures. All three approaches have different focal areas, strengths and weaknesses. The three approaches differ on the unit of analysis, dimensions of variability and hypotheses about the key mechanisms of capability gain. The task set out here is to draw on all of them for empirical analysis, with a primary view to explore the process and sources of supplier learning.<sup>3</sup>

**Table 1** Outsourcing, global value chains and capability literatures compared

	<i>Outsourcing literature</i>	<i>Global value chain literature</i>	<i>Capability literature</i>
Main unit of analysis	Outsourcing firm ('North')	Inter-firm networks ('North-South')	Intra-firm processes ('South')
Dimensions of variability	Outsourcing motives, strategies and comfort levels	Value chain governance and associated 'space' for innovation.	Absorptive capacity; existing knowledge and learning efforts
Main source of supplier learning and innovation	Not theorised	Learning from lead firms and buyers	Purposeful learning and related investments within firms

Existing literature has noted the need to combine the approaches (Morrison et al., 2008; Ernst and Kim, 2002). Importantly, it has suggested that local capability formation in global networks is dependent on 'absorptive capacity' (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. Yet, the literature does not show how to move from theory to empirical analysis. This is where this paper seeks to contribute.

#### 2.5 The business service setting

As mentioned, business service firms such as software firms typically differ from manufacturing and industry firms on several counts. Services provision is often interactive, involving a high degree of contact between buyer and supplier. The literature on knowledge intensive business services (KIBS), has emphasised that learning typically occurs in client-facing project teams, rather than in dedicated R&D departments or other dedicated knowledge-creation units creation (Miles, 2008; Strambach, 2008; Zhou et al., 2005).

Importantly, most business-service firms are project-based organisations (Whitley, 2006). Two typical features of such organisations are worth noting (Hobday, 2000): First, projects are ‘the normal mechanism for creating, responding to and executing new business opportunities’. Second, the ‘knowledge, capabilities and resources of the firm are built up through the execution of major projects’. This suggests that learning and project execution are inseparable processes. Capability formation occurs – and is best observed – in and around particular projects, not least those that address (new) business opportunities. This project focus is of direct relevance for both substance and method of this research.

Capability building is a process to which many factors contribute. Tracing and specifying the influence of specific factors can be difficult, but focusing on particular projects – whether these are customer projects or other types of projects – carried out by a firm makes this easier. The focus on projects or events is therefore useful in general, but it is particularly relevant in the business services setting where it is likely to capture essential features of the overall learning process.

### **3 Analytical framework**

The overriding question addressed in this paper is how sampled software firms managed to build and deepen innovation capability in the period under review. It seeks to examine the underlying learning and innovation processes when firms moved into new spaces that emerged in the outsourcing setting. To be more specific, this paper asks the following questions: What were the main sources of inputs? Where did they come from? How were they combined? It is necessary to define the key concepts and explain how this paper will address these questions.

#### *3.1 Opportunity spaces*

The notion of ‘space’ refers to an *opportunity for innovation* arising from outsourcing. It involves two kinds of opportunity opened by outsourcing:

- 1 a ‘market’ space
- 2 a potential ‘learning’ space that can enable firms to acquire and deepen their innovation capability (Lema et al., 2012).

Effective exploitation of the market space is dependent on a significant degree of pre-existing capability for undertaking the activity. However, the learning firm needs to stretch this capability in particularly demanding or ambitious projects. It is therefore through such opportunities that firms can realise their learning efforts and it is within such spaces that they can demonstrate observable new capability. ‘Learning’ refers to the various processes that allow firms to accumulate new types and levels of capability (Bell, 1984; Figueiredo, 2003).

### 3.2 Inputs

There is no established way to classify different types of inputs into learning and innovation processes. This paper defines three types as in Table 2: ideas, investments and knowledge.

- 1 *Ideas*: Most learning and innovation-intensive projects have a particular goal – a new or improved product, process or organisational arrangement. The focus on ideas is useful for examining the link between (identified) opportunity spaces and observed project objectives. The focus on ideas and their role in innovativeness is common in management literature (Hansen and Birkinshaw, 2007; Chesbrough, 2007; Santos et al., 2004), but has received limited attention in the literatures discussed in Section 2.
- 2 *Investment*: Firms invest to bridge the gap between existing competences and the capabilities needed to achieve the goal. Firms may invest in hiring people with particular skills or experience or in the development of such skills by existing employees. They may setup internal R&D projects or communities of practice or they may acquire entire firms or business units, or they may form contracts with external firms or organisations (Laperche, 2007; Lauridsen, 2006; Altenburg et al., 2008; Figueiredo, 2003).
- 3 *Knowledge*: Investment decisions typically concern knowledge generation and in embodied or disembodied forms. Firms create knowledge through performing costly R&D activities. However, firms can also attain explicit knowledge without big investment. This includes knowledge embodied in manuals, documentation material or publicly available sources (for example, online) and knowledge embodied in software or other knowledge artefacts. Other forms of knowledge (tacit knowledge) are or may become embodied in people, in technology and in organisational arrangements.

**Table 2** Inputs into processes of learning and innovation

Ideas	<ul style="list-style-type: none"> <li>• Idea for new or improved product</li> <li>• Idea for new or improved process</li> <li>• Idea for new or improved organisational arrangement</li> </ul>
Investments	<ul style="list-style-type: none"> <li>• Investment in people (training internal staff or poaching from outside)</li> <li>• Investment in ad hoc workshops or other activities</li> <li>• Investment in external relationships</li> <li>• Investment by acquiring external firms or business units</li> </ul>
Knowledge	<ul style="list-style-type: none"> <li>• Knowledge embodied in manuals or documentation</li> <li>• Knowledge embodied in software or capital equipment</li> <li>• Knowledge embodied in routines and organisational arrangement</li> <li>• Knowledge embodied in people</li> </ul>

Source: Lema (2012)

While there is certain logic to the sequence of ideas, investments and knowledge presented here, reality was often more complex. For example, new ideas were sometimes a function of deliberate investments in brainstorming and creative thinking.

### 3.3 Sources

It is common place to distinguish between internal and external sources in the learning process (Lauridsen, 2006; OECD, 2005; Figueiredo, 2008).<sup>4</sup> It is less common to distinguish between buyer and non-buyer sources. However, for examining learning in the outsourcing setting and discuss the merits of the approaches summarised in Table 1, it is useful to setup a typology that includes both dimensions as in Table 3.

**Table 3** Sources of inputs into processes of learning and innovation

	<i>Buyer-related sources</i>	<i>Other sources</i>
Internal sources	<i>Internal buyer-facing sources</i> <ul style="list-style-type: none"> <li>• Customer project team</li> <li>• Prior or other customer projects</li> <li>• Delivery units</li> </ul>	<i>Other internal sources</i> <ul style="list-style-type: none"> <li>• Strategic units</li> <li>• R&amp;D units</li> <li>• Non-R&amp;D initiatives</li> </ul>
External sources	<i>External buyer-related sources</i> <ul style="list-style-type: none"> <li>• Customers</li> <li>• End-users</li> <li>• Third party collaborators</li> </ul>	<i>Other external sources</i> <ul style="list-style-type: none"> <li>• Sub-suppliers</li> <li>• Partner firms or networks</li> <li>• R&amp;D institutions</li> </ul>

Notes: These examples are indicative, not exhaustive. The exploratory nature of the study makes feasible an open-ended nature of the framework that includes 'other sources' under each of the four types.

- 1 *Internal buyer-related sources*: These are internal sources directly related to buyers. They include ongoing or prior customer projects in the firm (Strambach, 2008). They also include other client facing teams such as sales departments. The term 'alpha customer' may help in developing new sets capabilities in a particular area by providing requirements, feedback and other resources.
- 2 *Other internal sources*: They include strategic units or initiatives – centrally lead management teams or dedicated schemes for entrepreneurship and innovation (Dutrenit, 2004). They include permanent units such as dedicated R&D departments (Forbes and Wield, 2008) or ad hoc groupings such as meetings and workshops. Finally, they include knowledge management (KM) programmes aimed at forming, sharing and using knowledge within the enterprise (Dutrenit, 2006; Dantas and Bell, 2009).
- 3 *External buyer-related source*: These are external forward linkages (von Hippel, 1988; Schmitz and Knorringa, 2000). This wider literature includes end users (as distinct from buyers) and third-party collaborators.
- 4 *Other external sources*: These are backward linkages (suppliers and technology providers) and horizontal inter-firm linkages (alliance partners, multilateral networks such as 'technology clubs' or competitors) and institutional linkages with R&D

institutes or universities. Finally, other possible source includes general open information sources such as online repositories.

#### **4 Sample and method of analysis**

The study uses 'learning and innovation events' in supplier firms as a focusing device. Such events are instances in which firms have done something new (or better) for the first time, signalling a step in the capability build-up process. This paper examines the core question by drawing on data from:

- 1 a sample of 12 Indian-owned firms located in Bangalore
- 2 36 'innovations events' within those firms (three in each firm).

This section explains the sample composition, the data collection procedure and analytical method.

##### *4.1 Sample*

As mentioned, the sampling process involved two steps: sampling of firms and sampling of events.

- *Firms*: The purposive selection (Flyvbjerg, 2006; Yin, 2002) of a firm sample of 12 Bangalore-based IT software service suppliers used three main principles:
  - 1 identification of innovation-active firms
  - 2 representation of different sized firms
  - 3 representation of different subsector business lines in the broad fields of business-process software services (including custom application development) and product-development software services (including embedded software).

The sample represents Indian-owned firms and does not include subsidiaries of multinational firms.

- *Events*: To understand how a stationary state (lock-in) breaks up, what matters is what the pioneering entrepreneurs and innovating enterprises do (Schumpeter, 1982). This focus on the vanguard also guides the research about changes *within* firms. In this vein, the study focuses on the most sophisticated capabilities demonstrated by software suppliers (in the view of senior managers in these firms). Leading managers identified events in which they did something they had not done before. The main investigation period for events is the five years between 2001 and 2006.<sup>5</sup>

The next part of the research examined these events in more detail. The objective was to understand the entire set of procedures and flows needed to complete particular innovations. The method of getting information about the importance of different sources, involved two steps during the interviews. In the first step, informants used a list of *types of sources* akin to Table 3. They identified the types of sources involved (present) and corroborated sources not involved (absent). The informants then identified their importance in more detail in the second step (including whether there were multiple instances of one particular type, as discussed below). Interviewees through each source

and pointed out what *types of inputs* they provided. This second element sought to identify the types of inputs with the use of a list akin to Table 2.

Elaborating knowledge inputs often prompted the lengthiest accounts. Informants indicated the nature of the channels (written documentation or personal meetings) and the nature of knowledge (about technical or non-technical issues). In addition, it sought to locate these inputs in phases of the innovation process with the use of a phased ‘timeline’.

**Table 4** Sample firms (2006 data)

<i>Name</i>	<i>Established</i>	<i>Engineers employed</i>	<i>Ownership</i>
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
Liquid Krystal India	1999	50	Private

Notes: 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.

*Source:* NASSCOM (2007) and interviews

The nature of innovation (that is, what is new to the firm) associated with these events is diverse. Lema (2012) distinguished between:

- 1 problem framing innovation
- 2 problem solving innovation
- 3 innovative activity related to execution of customer project
- 4 other innovations such as new offerings, new processes and new organisational arrangements.

The events span these four types of innovation.

#### 4.2 *Analysis and classification of observations*

The analysis assumed in the research design that all three types of inputs – ideas, investments and knowledge – were involved in all innovation events.<sup>6</sup> A particular source could provide more than one input. For instance, a customer could provide ideas for new products or services as well as knowledge about how to set them up.

To assess the importance of different sources, each of these inputs would then count towards the ‘input score’ (Table 5 and Table 6). However, they would not count more

than once in the case of multiple interactions nor if there was 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 for the customer category. In addition, if a customer provided knowledge inputs more than once during the project this would also only count once towards the score.

Classification was sometimes difficult. For instance, it could be difficult to settle – for respondents and the researcher – whether inputs came from a customer (an external source) or a customer-facing unit (an internal source). The key was to settle whether a customer-facing unit of the supplier firm created them more or less independently. Inputs from ‘prior projects’ was detectable when knowledge came from customer-facing units, but not mainly from activities undertaken in the case study project.

In addition, assessing when knowledge-creating activities were ‘R&D’ or ‘non-R&D’, ad hoc forms of knowledge creation was not always straightforward. To a certain extent, this research has drawn on informants’ own descriptions of activities, but the working definition of R&D was ‘sustained efforts of knowledge creation for six months or longer’.

#### 4.3 *The limited scope of the analysis*

The method was devised to address the question of *how* software suppliers working in global outsourcing industries gain and deepen innovative power. This paper uses the notion of the ‘space’ for innovation and it discusses the learning efforts involved when supplier firms ‘capture’ them. This provides insights into issues of *why* it occurs, including the relative importance of the sources and mechanisms highlighted in the different approaches discussed in Section 2.

However, key aspects of scope are worth noting. The first concerns the ‘organisational scope’ of the focus on learning processes, i.e., the unit of analysis. The key focus was on the resource mobilisation activities associated with particular projects or cases of capability formation – that is sub-firm or *event-level learning*. The exploration of resource mobilisation considered all the observed project-based instances of resourcing– including variables not related to outsourcing. In this sense, it was inclusive and open-ended. This element of analysis extended to the scope partially to the factors such as firm-wide KM efforts and presented some evidence on connections between projects. However, this research has only assessed factors to the extent they occur directly in the events. While these projects sit on top of wider firm-level efforts and instances of capability formation, it is beyond the scope of this paper to examine *firm-level learning* in a comprehensive way, even though non-event factors are likely to be important. For instance, general investment in the knowledge base – such as staff training not aimed at specific projects – is likely to be a key influencing variable.

The second point concerns the ‘temporal scope’. The primary *time perspective* of this chapter was the duration of events. This maximised the value of information about the debate concerned with the currently occurring redistribution of innovation activity associated with supplier build-up of innovation capabilities – rather than the (preceding) redistribution of ‘production’ capability. This means that this paper dealt only partially with connections through time between the:

- 1 learning within new opportunity spaces
- 2 prior efforts and mechanisms of capability formation in similar areas.

The focus on events highlights the formation of new capability in the selected period rather than the important underlying base of broader capability accumulated before this period. Yet, related research has emphasised that many Indian software suppliers have long histories of learning. Arguably, the prior experiences created the absorptive capacity necessary to capture the opportunities opened in new types of outsourcing (Lema et al., 2012).

The analytical focus is on the firm and particular instances of learning related to specific opportunity spaces. The pulling together of inputs from various sources is an active process, managed by staff within the 'innovating firm' (Mathews and Cho, 1999). External factors such the nature of the innovation system and policy setting in which 'latecomer firms' operate are important by assumptions. They may significantly affect the learning process and outcome (Lall, 1993). However, these factors are beyond the scope of the present paper and it does not seek to contribute to the substantial body of work on the role of government policy and innovation system in the Indian software experience (Athreye, 2005; Chaminade and Vang, 2008; D'Costa, 2003; Parthasarathi and Joseph, 2004; Patibandla et al., 2000).<sup>7</sup>

## **5 Integrating inputs for learning and innovation – two examples**

How do suppliers in the software outsourcing industry build capabilities? The sampled learning and innovation events discussed in this study represent distinct cases in which software suppliers have demonstrated new qualities of capability. Therefore, the study of their process may help to open the 'black box' of supplier learning in outsourcing industries.

The period under review (2001–2006) was an inflection point in the capability-building trajectory of the Indian software industry, with an emerging shift from production to innovation capability (Lema, 2009). In the beginning of this period, most of the firms in the sample were in intense deliberation about how they should respond to the slump that had hit the Indian software industry with the slowdown in the US technology sector. Many of these firms were now in position to deepen the substantial production capabilities built during the period double-digit growth rates throughout the 1990s.

This section presents two cases that show how firms combined resources for learning and innovation:

- 1 Influx in Infosys
- 2 UWB in Wipro.

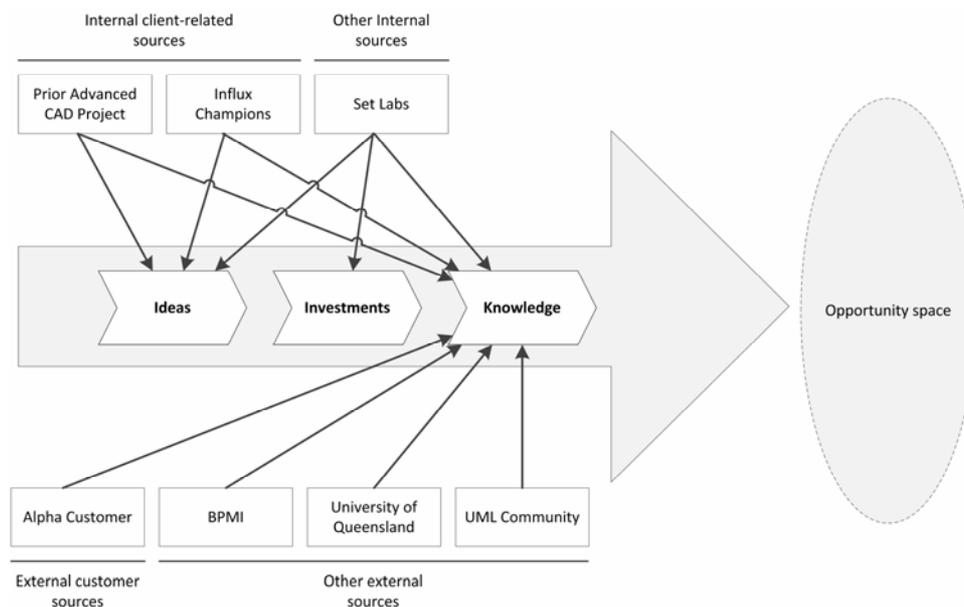
These examples show key event-level processes, focusing on how firms acquired the inputs and how they brought them together in the selected projects. By illuminating these issues, this section will also show how the analytical framework created information about use of sources in supplier firm innovation events. It is necessary to start with these cases in order to provide an illustration of some of the important mechanisms involved. Section 6 will then provide a cross-case analysis that draws on the full sample.

### 5.1 Influx in Infosys

- The space*: The most important strategy for upgrading in the software service segment after the turn of the millennium was to acquire capabilities for IT consulting. Broadly speaking, the supplier firms wanted to move beyond coding to client-given specifications. They sought to define a business model in which they also engaged in providing consultancy advice regarding IT and software needs for their customers. Up until then, this role was undertaken by in house teams in buyer firm or by pure-play consultancy houses based in OECD countries, but sourcing strategies were beginning to change (Lema, 2010). Supplier sought to stretch the offshore service industry into the business-process management consultancy space.

For this end, Influx is a method for translating business objectives into information technology solutions. The framework aids the ‘automation’ of defining customer requirements for software solutions and brings formality and repeatability to process. The framework and software was a significant improvement to the ‘product’ that Infosys could provide. It improved skills in the consulting space, enabling the firm to undertake higher value added projects. Figure 1 summarises the identified sources in the Influx innovation process.

**Figure 1** Mobilisation of resources in Influx event



- Ideas*: SETLabs, the main R&D department in Infosys, produced the idea behind Influx during an annual ‘visioning’ exercise.<sup>8</sup> The framework aligns with the aim of SETLabs of ‘identifying technologies ahead of customer need’. However, the ideas and some of the processes precede SETLabs (setup in 1999). They originated in efforts to support software project architects when the size of projects began to grow in the late 1990s and when the consultancy business began to emerge. Prior customer experiences had identified this space and suggested that tools to aid project architects

were – if extended – applicable to the business processes element of projects. It could therefore promote Infosys planned foray into the software consultancy space.

- *Investments:* SETLab staff developed a first proof of concept in 2001. Initially, nine people worked for one year to make a workable framework and software tool. Much of the investment made in this early period was to raise the ‘theoretical’ competence levels in business process consulting and related absorptive capacity. The development phase also involved setting up a network of ‘Influx champions’. This network spanned different business units involved in BPM and it promoted the generation of case studies from pilot implementations and sharing of experience and knowledge through workshop and in electronic documentation. Forty champions from across the organisation were responsible for using and improving Influx as a part of the development phase. In 2006, around 300 people had received training in using the system.
- *Knowledge:* To complete this innovation, Infosys benefited significantly from engaging with outsider sources, particularly from joining the business process management initiative (BPMI), the leading standards consortium for BPM. Infosys wanted Influx to conform to industry standards and it received inputs to creating specifications for modelling business processes. Through interactions with other firms working in similar areas, it helped develop the necessary expertise. In addition, the internal research efforts in this area enabled Infosys to become a standard maker rather than merely a standard taker in BPMI. At the time of fieldwork, Infosys had filed two patents coming out of this work.

SETLabs also setup relations with consultants from the Business Process Management Group at the Queensland University of Technology. This benefited from Infosys’ takeover of an Australian firm specialising in the design, building and integration of business solutions. Influx also benefited from integration of open source modelling language frameworks developed by the unified modelling language (UML) community.

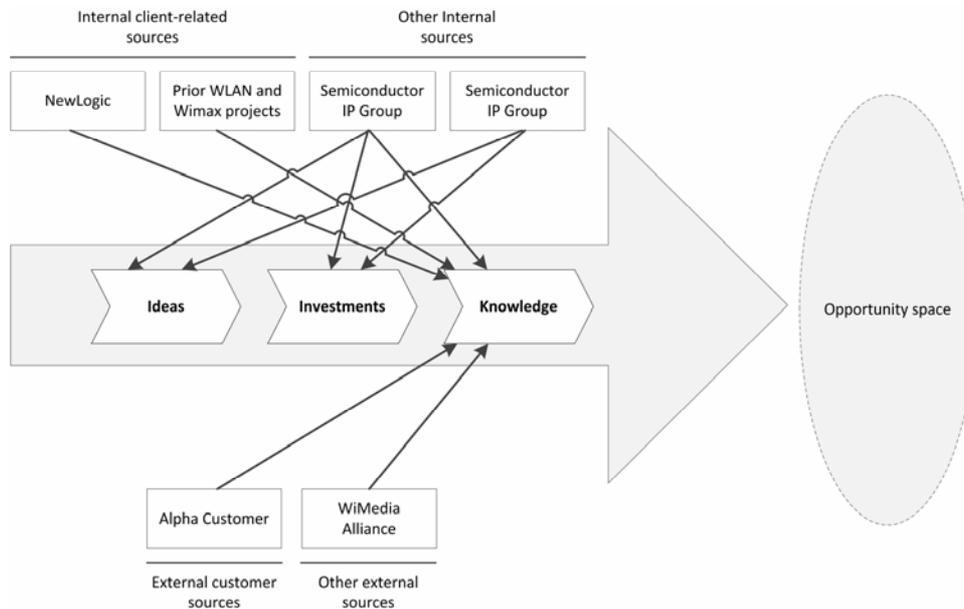
The first significant application of Influx was important. It helped to turn the potential consulting space into a real space. The ‘alpha customer’ was a logistics and transportation firm that used Infosys to redesign its entire IT system. This was the key milestone marking the transition out of the preparation phase.<sup>9</sup> Infosys used influx to undertake an enterprise-wide study of the customer’s operations and design new systems according to a specified business goal. The client wanted to enter the so-called third party logistics market.<sup>10</sup> Infosys therefore designed a full system to cater for the entire 3PL business process, from online ordering to load building and freight visibility. It was necessary suspend a legacy system and build new system to include upstream and downstream connectivity and new functionalities such as load optimisation and load building, based on off-the-shelf solutions. This experience gave valuable information, channelled through the network of champions.

## 5.2 *Ultra wideband solution in Wipro*

- *The space:* The increasing complexity of product development in the electronics industry have opened new spaces because product developers – even developed of subcomponents – cannot generate and maintain all the necessary resources and competences and capabilities internally. An important demand has emerged for

software components pertaining to different standards-based technologies used in the telecommunications industry. The solutions equip telecom products with inter-communicative capabilities secured by hardware vendors' use of standards-based technology protocols. The challenge for Indian suppliers is to develop solutions that address new and emerging technologies. To address such a challenge, Wipro completed the first demonstration of its proprietary solution for the emerging the ultra wideband (UWB) protocol in May 2005.<sup>11</sup> Figure 2 summarises the main sources in the innovation processes.

**Figure 2** Mobilisation of resources in UWB event



- Ideas:** The idea to develop UWB technology came from Wipro's semiconductor IP group. The principal architect in this group took part in meetings within the IEEE (Institute of Electrical and Electronics Engineers) Standards Association related to wireless LAN technology. In 2004, it became obvious that a deadlock divided 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, the WiMedia Alliance, was an open association that promoted the adoption, regulation, standardisation and multivendor interoperability of UWB worldwide. The principal architect continued to follow the discussions and setup key contacts.

The new opportunity space was now clear and the vehicle to its realisation gradually took shape. One future customer, a key promoter of UWB, requested that Wipro should develop (and keep) IP for the software to go with the customers product. However, it was clear to Wipro developing this technology would need a substantial investment.

- *Investments*: The semiconductor IP group (a customer facing unit) came up with the idea indirectly, but the formalisation took place the Innovation Council (a strategic unit). The semiconductor IP group lodged a formal proposal with The Innovation Council in Wipro.<sup>12</sup> During this phase, there was also intensive discussion with the customer who agreed to finance elements of the preparation phase. Development started in August 2004 and SIP demonstrated the solution in May 2005, totalling a nine-month preparatory investment in training and R&D. The principal architect and two additional engineers had a total team of 15 people. Also, Wipro bought NewLogic, an Austrian smaller semiconductor design services provider and supplier of IP cores for wireless applications, not in relations to this particular event, but to strengthen this field more broadly. This brought in added skills and people.
- *Knowledge*: The sources of knowledge were threefold. First, engineers in the Semiconductor IP group had developed technology for wireless LAN and Wimax. Since there was an overlap, existing expert knowledge gained through previous projects was applicable. Second, the customer shared specifications to direct to the development process and helped in key phases. The whole phase of architecture and design of the solution involved the alpha customer. To completed and test the core solution developed by Wipro it was necessary apply and test it in a user setting. During this phase, interaction took the form of face-to-face meetings around selected milestone in-between mail and telephone calls. Third, 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 came mainly through e-mails.

Integrating internal and external inputs was not trivial. Whether the locus of innovation was mainly a customer focused project (as in the UWB case) or a central units (as in the Influx case), carrying out the innovation depended on the pulling together of inputs of various types. The next section will discuss the relative importance of different types of sources.

## **6 Sources of learning and innovation**

This section examines the key sources used in the process by which sampled supplier firms moved into new spaces. It intends to provide an outline by summarising the patterns across the 36 events. Did inputs come from the inside or the outside? Did they come from buyer-related sources or other sources? The answers to these questions provide key insights into the channels and mechanisms of capability building in and around the chosen projects. The section starts by providing an outline before discussing the three types of inputs in turn.

### *6.1 Overview*

Table 5 and Table 6 show the 'importance' of different sources based on the frequency of their involvement in the sampled events. The cross-case analysis shows that some firm-internal sources were rather constant (high frequency across cases) whereas other element were more variable (medium and low frequency across cases). Unsurprisingly,

the comparison of the two tables shows that firms' internal sources were of significant importance.

External sources ranged between medium and low frequency. Knowledge inputs came from various sources whereas ideas and investments came from a more narrow range of sources. The following subsections discuss the patterns and the methodological problems involved in their interpretation. It also provides comparative references to the cases discussed in the previous section and wider perspectives and explanation where relevant.

**Table 5** Internal sources

	<i>Ideas</i>	<i>Investments</i>	<i>Knowledge</i>
Internal client-facing sources			
Prior project	•	-	•••
Project teams	-	-	••
Delivery units	•	-	•
Other (sales)	•	-	-
Other internal sources			
Strategic units	•••	•••	•
R&D units	•	•	••
Non-R&D knowledge creation	-	-	••
Other (acquired units; recruits)	•	-	••

Notes: This data is drawn from the analysis of sources used in innovation the events.

The highest possible 'score' means that a particular input-source combination was present in all events (36 out of 36 events). The lowest possible score means that this combination was not present in any of the sampled events. The table distinguishes between absent (0 of 36), low (1–11), medium (12–24) and high importance (26–36).

Key: • = low; •• = medium, ••• = high; - = absent

Source: Lema (2012)

**Table 6** External sources

	<i>Ideas</i>	<i>Investments</i>	<i>Knowledge</i>
Client-related sources			
Customers	••	•	••
End-users	•	-	•
Third party collaborators	•	•	•
Other (client's consultants)	•	-	-
Other external sources			
Backward linkages	•	-	••
Horizontal link sources	-	-	••
Traditional R&D institutions	-	-	•
Other (public institutions; open sources)	-	•	•

Source: See Table 5

## 6.2 *Ideas*

As shown in Table 5, strategic units within the innovating firms – senior management and formal schemes for intrapreneurship and innovation – were the most frequent source of ideas for the sampled innovative projects. These often played a role in creating ideas and in deciding which projects to take forward.

Both events discussed in the previous section show how important management is for creating an impetus and sustaining momentum for innovation and learning and for directing the processes. SETLabs played this role in Infosys and the Innovation Council in Wipro. They were deliberate attempts to link existing and new resources to specified opportunity spaces, thereby simultaneously acquiring and demonstrating new qualities of capability. By interpretation, it appears that strategic units selected from opportunity spaces and matched these spaces to overall firm strategy and existing assets and capabilities.

Delivery, sales and R&D units were also sources of ideas in certain projects and the same goes for newly acquired firms. Occasionally, the idea originated in a customer-facing unit, but it formalised and firmed up when a strategic unit became involved. In this way, it can be difficult to distinguish between direct and indirect sources.

On the role of external sources of ideas, customers sometimes played an important direct role. Customers often transferred ideas for innovations deliberately, for instance, in the form of a suggestion or a proposal. Certain buyer firms requested new types of services responding to new types of need and this could spark internal learning projects related to new functions or technologies. Overall, client-related sources played some role in idea generation, while other external sources were of little overall significance.

Related research has shown that willingness of some buyers to ‘externalise’ ideas for development by suppliers in India depended on these buyers’ own adoption of ‘open business’ models (Lema, 2010). This aligns with the proposition in the literature on open innovation posits that more and more firms are beginning to ‘distribute’ ideas for external realisation when it is their own interest to do so (West et al., 2006; Christensen, 2006), but it shows that such strategies beginning to influence geographically dispersed inter-firm relations.

## 6.3 *Investments*

The most frequent source of investment across cases was senior management within the sampled firms (strategic units) which was ‘highly important’ (Table 5). For example, this includes investments in activities such as training, hiring of recruits with specialist skills, coordination workshops or networks and in creating new artefacts (such as proof of concept models). Recall that SETLabs drew on its own budgets to take forward the Influx project and that WIC supported the development of the UWB solution. Such central financing and organisation was important, but tended to be less formalised in smaller firms.

External investment did not match internal ones, but they were significant. They came from various mainly client-related sources, for instance when a learning-intensive project involved buyer-promoted training or when customers paid for (parts of) the creative and development activities in the elaboration phase of the software development process, such as in the case of UWB. Sometimes, the buyer and supplier made a separate ‘time

and materials' contract or the main contract isolated these outlays for internal preparatory training activities such as workshops or courses. They did this when the supplier firm did not fully master a needed technology or skill. The case study material includes examples of buyers who financed between 50% and 100% of expenses for such preparatory investments.

Investments from inside and (particularly) outside were often transaction specific, at least initially. But in particularly learning intensive relationships – such as the relationship between Wipro and the UWB alpha customer – suppliers deliberately undertook investments with a wider view to using invested experiences to build cross-applicable frameworks and solutions. These framework and solutions are then relevant to multiple buyers. Both of the case studies in Section 5 illustrate this important part of the wider learning process observed in the sampled firms.

#### *6.4 Knowledge*

The use of knowledge gained during prior projects was the most used internal source. It was 'highly important'. Sometimes firms engaged in deliberate efforts of leveraging knowledge gained from experience – with the aid of KM tools and repositories – and sometimes people-embodied knowledge was most important. Statements like 'we already had most of the knowledge we needed' were common. These statements are difficult to verify and triangulate in a strict sense. Nevertheless, informants were often able to reconstruct a trajectory that culminated in specific events. Most informants had no difficulty in listing several prior projects that had helped to create capabilities and knowledge instrumental to the event. The knowledge

Whereas prior projects were important for the leveraging of existing knowledge, project teams involved in respective innovations were often instrumental in creating the added knowledge needed for particular types of change. Additional internal knowledge-production filled specific gaps needed to achieve various types of objectives (capturing new spaces).

Developing core base solutions often required a large element of in-house R&D, sometimes undertaken in client-facing project teams (R&D services), rather than in denominated R&D departments. Influx was based on activities undertaken within an 'R&D lab'. But as is typical of business process software services (BPSS), this was a fuzzier version of R&D activity (Miles, 2007). Product development software services tend to depend more on R&D, as is signified by the UWB case where R&D was focused on the software-hardware interface. Sustained efforts of knowledge creation organised in R&D departments (or as R&D outside R&D departments) were of 'medium importance' overall.

Non-R&D knowledge creation was also of medium importance. The client-facing nature of most innovating teams is important in shaping the knowledge creation that occurs. It is often concerned with adapting frameworks and ideas to client settings and feeding applied knowledge back into the learning and innovation process. Non-R&D efforts sometimes occurred in workshops or 'jams' (online Web 2.0 collaboration for exploration and problem solving).

KM teams were often central to organising or hosting such events. These KM teams also oversaw compulsory project debriefings (which included evaluations and information about people and their roles). The electronic documents form part of firm-wide databases. Therefore, these programmes play key roles in creating knowledge

flows across the organisation and through time. They also help to identify ‘other internal sources’ such as people with specialist knowledge, for example, people from acquired units.

On external sources of knowledge, customers and end users played a key role in providing critical knowledge in many innovation events. In many events, the Indian companies had become co-creators of innovation in specific end-customer projects (Lema et al., 2012). Both the cases in Section 5 show how knowledge development was a joint activity involving team members from both buyer and vendor in key phases of the events. Many of the customers involved in the innovation events adopted sourcing strategies that did not have a pure cost focus, but required knowledge-generating activity.<sup>13</sup>

Global backward linkages were only important occasionally and mainly in firms building embedded software where solutions incorporate proprietary technology components. 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 few events in the sample.

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

- 1 open source communities
- 2 open or semi-open standards networks
- 3 technology owners adopting open strategies
- 4 collaborative knowledge communities.

I am referring here to sources such as the business process management initiative, the UML community and the WiMedia alliance utilised by Infosys and Wipro. The availability of such sources reflect what has been described as the organisational decomposition of the innovation process (Schmitz and Strambach, 2009).

In sum, capturing new global opportunity spaces had some typically recurring external knowledge ingredients, including alpha customers and the use of information from open and semi-open networks and communities. However, the combination of external and internal knowledge in different types of embodiment was the central process. The learning process centred centrally on harvesting knowledge from learning intensive projects and using it in the wider organisation. This is discussed further in the next subsection.

### *6.5 Summary and concluding analysis*

The approaches discussed in Section 2 differ substantially in emphasis on the main sources of supplier learning and innovation, that is, learning from lead firms and buyers and purposeful learning and investment within firms. The analysis in this section drew on an overview of the total sample of events and on frequencies of occurrence of different types of internal and external inputs and linkages. It shows that supplier firms drew significantly on their own resources to innovate, something that is often overlooked. However, firms combined sources from both the top and bottom rows of Table 2. Clearly, internal and external sources were highly complementary.

The 'outsourcing specific' setting made the involvement of sources from the left hand column of Table 2 important, but again it is important to not to overlook the important role of 'other' channels outside these relations, that is the sources in right hand column. Although buyer firms created new spaces, they were only partly and partially involved in providing the critical inputs for their exploitation. Buyer firms' 'provision' of inputs was necessary but not sufficient. Exploiting new spaces involved processes that often worked significantly through channels that were independent of outsourcing relations. These are important insights in their own right, but it understands the process that is critical.

This paper has provided evidence that suggests that suppliers build capabilities through a cumulative process that works through time by linking learning in one customer project with application of knowledge and capabilities in later ones. The cases hint at an important aspect of how the learning process worked. While addressing new spaces, suppliers simultaneously acquire and use contextualised knowledge, specific to one setting. Later, this experience forms part of the core and more widely applicable knowledge base as the knowledge is decontextualised. In other words, innovations such as those examined in the examined 'events' are initially client specific, but later become applicable to reuse with other buyers or markets.

## **7 Conclusions**

There is growing consensus that outsourcing has a major influence on the global shift in innovation capabilities, but the mechanisms remain obscure. The starting point of this paper was the acknowledgment that outsourcing can create new opportunities for supplier firms, but these opportunities do not become reality automatically. To unpack this, the research has conceptualised the process as:

- 1 new opportunity spaces
- 2 the processes by which suppliers 'mobilise' and combine resources to fill them.

The study has then sought to provide a firsthand account of events in which suppliers have gained new qualities of capability.

### *7.1 Main conclusions and lessons for theory*

Much of the outsourcing literature stresses that outsourcing is a learning process (Maskell et al., 2007; Lewin et al., 2009; Jensen, 2009). However, this literature assumes that learning occurs in the supply base, sometimes seeing it as a simple effect of buyer-firm strategies. Firms at the 'receiving end' of outsourcing decisions are often not examined in depth and there is a weak conceptualisation of how supplier learning 'works'. By implication, the literature has provided only partial understanding of *how* outsourcing contributes to changes in the international division of (innovative) labour. By bringing out some of the mechanisms of capability formation on the supply side, this research has illuminated the hitherto invisible end of the 'reciprocal' learning process (Maskell et al., 2007).

The literature on global value chains suggests that learning from lead firms and buyers is key (Gereffi, 1999; Schmitz and Knorringa, 2000; Altenburg, 2006b). This paper has showed that this learning can be important in outsourcing, but it has also

highlighted that it is insufficient on its own. In fact, one of the key contributions of this paper was to bring light to the relative importance of mechanisms associated with ‘learning from global buyers’ and ‘firm centred learning’. It has suggested that outsourcing-independent sources and mechanisms are necessary ingredients when supplier firms seek to exploit opportunities created by outsourcing. Internal and external sources go together in the learning process. This blending process is inevitably one that occurs within firms in the supply base and one that needs to active management. The changing demand conditions and reconfiguration of value chains was not a ‘benign escalator’ for supply base firms.

Recognising that the learning process in supplier firms has so far been 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). This paper has sought to provide a framework and method for doing this by bringing in the intra-firm dimension the capability approach. This is in line with the broad argument in the capability approach (Bell and Albu, 1999; Figueiredo, 2007) to the to the empirical analysis. The findings support the proposition that the effectiveness of firm-internal investment and effort is an important contingent factors – if not the *most* important factor – determining whether outsourcing translates into ‘dispersal’ of innovative capabilities.

## 7.2 *Questions for further research*

This research used a purposely selected sample and a limited number of observations to provide in-depth insights. In this sense, the research was exploratory and did not set out to ‘test’ hypotheses in the conventional sense. This paper has illuminated central aspects of how supplier learning unfolds in the context of outsourcing (when it does). By contrast, it has provided few insights with regard *when* or *whether* (at all) such learning is likely to arise out of insertion into global value chains. The method adopted here is less useful when it comes to answering questions about variability in the connection between outsourcing and supplier learning. Key dimensions of variability were brought out in Table 1, but this paper has shed limited light on variations in the relationships between:

- 1 outsourcing
- 2 spaces for innovation
- 3 effectiveness of the exploitation of these spaces by suppliers.

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 and firm-wide capacities would be more likely to capture more demanding project opportunities than firms with lesser capabilities would be. What kinds of outsourcing (or value chain ‘governance forms’) create significant spaces and in what circumstances? What kinds of supplier firms exploit these spaces most effectively and why? What are the main distinguishing features of those who do compared to those who do not? These are important issues for future research.

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## Notes

- 1 This literature is often referred to as the technological capabilities (TC) literature, but recently it has expanded the scope to the analysis of learning and innovation more broadly. Hence, this paper will refer to it simply as the 'capability approach'.
- 2 The term 'benign escalator' was used by Martin Bell in research meetings at SPRU and IDS. The danger is to see outsourcing along value chains as resulting in upgrading automatically.
- 3 This paper sheds uneven light on the cells in Table 1. The dimensions of variability are critical as they may help to untangle *when* innovative capability does and does not build-up. However, the goal of this paper is more modest: to address the question of *how*, by examining sources the sources of supplier learning. This point is discussed further in the concluding section.
- 4 The terms 'source' and 'linkage' are used interchangeably. Strictly speaking the former refers to who or what the innovating firm 'connects to', whereas the latter refers to the connection itself.
- 5 The five-year 'window' is suitable for two reasons. First, the reliability of respondent statements is likely to decline if one traces further back than five years. Second, the literature suggests that economic activity in Indian software firms contained little innovation before this period and the key focus is on new capabilities that emerge in or in relation to the carrying out of outsourced projects. However, adopting this window does not mean the study ignored developments before 2001. Event reconstruction went as far as necessary.
- 6 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.
- 7 It is worth noting, however, that the firm-level material used in this paper suggests tentatively that specific promotional policies played a limited role as inputs into the learning process of sampled firms for the period 2001–2006. Furthermore, the external sources identified originated mainly outside India. This suggests that 'local interactive learning' involving co-located firms was dwarfed by learning mechanism involving global linkages.
- 8 SETLabs is short for Software Engineering and Technology Laboratory.
- 9 As explained by informants, frameworks such as Influx only 'come alive' and become useful when applied in a customer setting. 'No amount of in-house development can substitute for this process'.
- 10 In the 3PL business, firms manage a full range of door-to-door loading, storage and distribution services, many of which are provided by external service providers.
- 11 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. The base solution developed by Wipro was cross-applicable and could be used in different domains including devices such as Wireless USB and Bluetooth.

- 12 The Wipro Innovation Council (WIC) reviews innovation proposals from employees or units 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.
- 13 Learning-intensive projects require substantial information exchange. Knowledge-seeking customers therefore play a key role in *providing* knowledge inputs to suppliers' innovation events.