WORKING PAPER NO: 354

Innovative Resources and Capabilities in Emerging Economies – their Impact on Firm Performance

Haritha Saranga
Associate Professor
Production and Operations Management Area
Indian Institute of Management Bangalore
Bannerghatta Road, Bangalore – 5600 76
Ph: 080-26993130
harithas@iimb.ernet.in

Judith Beine
University of Stuttgart, Stuttgart Germany
Judith.beine@bwi.uni-stuttgart.de

Year of Publication 2011

Innovative Resources and Capabilities in Emerging Economies – their Impact on Firm Performance

Haritha Saranga* and Judith Beine**

*Indian Institute of Management Bangalore, India

**University of Stuttgart, Stuttgart, Germany

Draft dated: 20th September 2011

Innovative Resources and Capabilities in Emerging Economies – their Impact on Firm Performance

Abstract

Innovative resources and capabilities have been found to be essential to climb up the value chain in most industries. However, development of innovative resources and effective deployment of these resources requires significant investments on a sustained basis, which is a difficult task for domestic firms in many emerging economies, especially if they operated with obsolete technologies under protected regimes for long periods of time. To understand how and what type of resources and capabilities are developed in emerging economies, which are going through institutional transitions from protected to liberalized regimes, we examine various management theories and propose a conceptual framework that integrates relevant theories and helps us study the process of resource and capability development. Based on the existing literature on resource based view and dynamic capability approach, we also frame certain hypotheses on innovative resources and capabilities and their impact on firm performance. We collected primary and secondary data from the Indian auto component industry to test these hypotheses and carried out detailed interviews with industry experts to understand the industry dynamics and the results from our data analysis. We use the proposed conceptual framework and qualitative inputs from industry experts to explain our empirical results which provide very interesting insights into the selection and development of innovative resources and capabilities by the emerging economy firms and their impact on various measures of firm performance.

Keywords

Resource-Based-View, Dynamic Capability Approach, Emerging Economies, India, Innovation, Survey Method, Auto component industry

INTRODUCTION

In the strategic management literature, many theories have been espoused about the nature of the firm (Coase, 1937), how and why firms develop various production capabilities (Williamson, 1975) and how firms differentiate from each other to attain competitive advantage (Porter, 1980; Barney, 1991). While some of these theories focus on what is the best position in the industry to occupy to withstand the forces of external environment and to succeed (Porter, 1980), others explore how to obtain competitive advantage through internal resources and capabilities that are inimitable (resource based view (RBV) proposed by Penrose, 1959). Also, while some of these theories consider a static picture, such as RBV, which considers the competitive advantages generated by the resources and capabilities possessed by firms at a given point in time (Barney 1991); others take into account the dynamic nature of competition, such as the dynamic capability approach, and emphasize the need to continuously create, extend, upgrade, protect and keep relevant the firm's unique asset base (Teece, 2007). There are still others, which try to integrate many of these theories to create greater understanding about the interdependencies between production and exchange relationships (Madhok, 2002), co-evolution of transaction costs and dynamic capabilities (Jacobides 2004) and alternative approaches to attain competitive advantage in rapidly changing business environments (Eisenhardt and Martin, 2000; Winter, 2003).

However, most of these theories were proposed keeping perfectly competitive markets in mind, assuming the existence of well functioning institutional mechanisms and are empirically tested and verified using the data from advanced economies, where these assumptions are mostly valid. Today, the stagnating demand in developed economies is driving firms towards emerging economies, where demand for goods and services is on the rise. The emerging markets, until recently were functioning under heavily protected regulatory regimes that have rendered indigenous firms in many sectors uncompetitive, technologically obsolete, lacking R&D investments and product development capabilities. Opportunities created by the globalization of trade coupled with the increasing economic vows of home countries have forced many emerging countries to open their economies and markets to the multinational enterprises (MNEs). However, in order to upgrade the capabilities of domestic industries and make them competitive, the emerging country governments try to impose regulatory structures that induce local production, technology sharing and other interdependency relationships between MNEs and local players (Giuliani et al 2005). Some of the most popular regulatory mechanisms adapted by the many recently liberalized countries include local content requirements, joint ventures partnerships, customs duties and import tariffs on fully built products. Such regulatory interventions are expected to provide the time and support mechanisms required for upgrading of indigenous firms post liberalization and help them survive the onslaught of global competition as well as enable them to compete in the global arena over a period of time (McDermott and Corredoira, 2011).

Therefore, there is a growing need to understand the nature of the firm in the context of emerging economies and address questions such as, how do firms develop various competencies under imperfect institutional structures, how do emerging economy firms that are used to functioning under protected environments respond to sudden competition, what kind of resources and capabilities needs to be developed by domestic as well as MNE firms to attain competitive advantage, what type of institutional mechanisms and policy interventions are required to upgrade capabilities of domestic firms which will enable them to meet market demands? This paper tries to address some of these questions, by integrating various strategic management theories cited above in an emerging economy context, positing several hypotheses and empirically testing them to verify and validate applicability of these theories to emerging economy firms.

For example, the argument behind the co-evolution of transaction costs and dynamic capabilities in an industry (Jacobides 2004; Jacobides and Winter 2005) is that if there is heterogeneity in the distribution of productive capabilities in any given industry, firms choose the activities they are best at in the value stream and specialize in them. In an emerging economy context, the external agencies such as governments and other institutions play a major role in deciding the transaction costs between various upstream and downstream players during the initial phases of liberalization, and therefore can influence upon the type of production capabilities developed by various players. When the liberalization takes place, the incumbent firms already possess certain productive capabilities – which may be described as 'zero-level' capabilities (Winter, 2003) – that are relationship based, networking capabilities (Peng, 2003), which are found to be effective during the protective regimes. The MNE entrants on the other hand bring with them technological capabilities and product development capabilities as their 'zero-level' capabilities, and typically enter new markets with existing product portfolios (Humphrey and Memedovic 2003). During the initial phases of liberalization, being the incumbents, the indigenous firms may have slight advantage over the newly entering MNEs, as market transactions are likely to be relationship based and the networking capabilities of indigenous firms would work in their favor. However, as liberalization gains pace, and as a rule based impersonal transaction regime starts to dominate, MNEs will gain upper hand, since they are more adept at market based transactions (Peng 2003). Therefore, one way to ensure higher value addition by domestic firms is, for the regulatory structure that oversees the transformation process to create sufficient heterogeneity in the capability base that allows higher scope for vertical disintegration and thus create opportunities for domestic firms to build relevant resources and capabilities.

As market led competition intensifies during the later stages of liberalization, higher value addition and better firm performance may only become possible through development of market based resources and capabilities (Peng 2003). However, there are certain market-based resources and capabilities such as development of new product and tooling design etc., which require huge investments and long term commitments to develop. Since many MNEs would have already made significant investments into such resources and possess the innovative capabilities at the global arena, newly evolving emerging economy firms would find it difficult to compete with MNEs at that level. Firstly, the emerging economy firms may not possess sufficient funds to carryout sustained investments into R&D and other innovative resources. Even if they do, they may not be able to compete with their MNE counterparts whose investments are likely to be sunk costs and capabilities are likely to be of much higher order (Winter 2003). This means, the transaction costs of domestic firms are likely to be much higher, especially in industries with shorter product life cycles and which require significant investments to develop innovative product and process development capabilities. For example, empirical and anecdotal evidence suggests that after the markets are completely opened up, in most of the Latin American countries MNEs became the dominant players, while domestic firms were either relegated to lower strata of the industry or worse, completely seized to exist (McDermott and Corredoira, 2011). Therefore, it is important to determine, to what extent the domestic firms manage to develop innovative resources and capabilities that give them competitive edge over other players in the market, and if not what are the alternatives available to them to continue to operate and compete in the industry.

In the current study, we investigate the innovative resources and capabilities developed by the Indian auto component firms and their impact on performance of these firms, after the liberalization has been effected in its full scale in India. The Indian auto component industry provides an ideal setting for this study, since earlier empirical studies have already demonstrated that, unlike many Latin American and CIS economies (Humphrey and Memedovic 2003), the slow pace of liberalization in India has allowed the Indian auto component firms to survive the initial and advanced phases of liberalization through upgrading of quality and technological capabilities (Iyer et al 2011; Kumaraswami et al 2011). Our study goes one step ahead and investigates if the survived firms have managed to develop innovative product and process development capabilities which are essential to progress towards upper tiers and higher value addition, and if so, what is its impact on firm performance.

We collected primary data on various innovative resources and capabilities during the period 2003-2008 from 74 indigenous auto component firms through personal interviews and questionnaire based surveys. We also collected data on firm's financial performance using publicly available databases. We then investigated the linkages between innovative resources, capabilities and firm performance with the help of empirical analysis. Our analysis reveals interesting insights into the nature of innovative resources and capabilities in the Indian auto component industry and their impact on firm's performance. While the traditional innovative resource, *R&D investments and expertise* seems to have positive and significant impact on firm level performance measures like productivity, return on assets and return on equity, *innovative process structure* which is considered to be very critical in radically innovative product development activities (Takeishi, 2001), does not exhibit any significant association with firm performance. More surprising however is the finding that tooling capabilities in fact have significant negative association with firm performance (return on assets). Our interviews with industry experts explain many of these results and support some of the theories discussed above. Our empirical analysis also supports Peng's (2003) argument that during the later stages of liberalization, network-based capabilities seize to contribute to firm performance and market-based capabilities begin to play a more critical role.

Much less is known about how organizations reject old rules, learn new rules and develop new capabilities when fundamental institutional transformations such as economic liberalization take place (Oliver 1992). Our study thus contributes to the literature on institutional theory by assessing the impact of slow liberalization on firm performance in a high growth industry. This study also contributes to the strategic management literature, firstly by testing the applicability of the theory of co-evolution of transaction costs and dynamic capabilities in the context of liberalization of an emerging economy and secondly by providing empirical evidence on linkages between innovative resources and capabilities and firm performance and exploring the alternative approaches for emerging economy firms to compete.

The rest of the paper is organized as follows. In the next section we discuss the relevant management theories such as institutional theory, theory of upgrading, transaction theory, resource based view and dynamic capability approach, in more detail. In the subsequent section we give a brief background on the evolution of the Indian auto component industry and its current status. This is followed by a section on hypotheses building, a section describing the data collection, description and empirical methodologies used to test the hypotheses. We finally conclude with results, discussion and avenues for future research.

THEORETICAL BACKGROUND

Liberalization has brought significant institutional transformation in emerging economies and has changed rules of the game in both formal as well as informal sense for organizations in these countries. Management researchers (Hoskisson et al, 2000) have pointed out that as emerging economies evolve, institutional theory – which focuses on interorganizational relationships – may first become most relevant, and then later on, resource based theory – which centers around firm specific capabilities – may become more relevant. Drawing upon his vast research on emerging economies, Peng (2003) stressed on the need to integrate the institutional and resource based theories as he explored the strategic choices available to various firms in the face of institutional transition. He developed a two-phase model of market oriented institutional transitions, focusing on a longitudinal process, to move from a relationship based personalized transactional structure to a rule based impersonal exchange regime. To elaborate, during the initial phase of institutional transition, transactions are more impersonal and relationship-based owing to the old protected regimes which favored networked based strategies. As the institutional transition gains pace and more formal regulatory mechanisms begin to shape up, transactions become impersonal, and rule based market led strategies become dominant. Peng identifies the points of inflection in this longitudinal transformation process, predicts strategic choices available to incumbent, entrepreneurial and MNE firms and delineates the corresponding implications for performance. Although Peng's work provides a framework to study the transformation process of firms from protected regimes to liberalized regimes, there is a need to understand exactly how the firms react to various threats and opportunities created by the changing regulatory norms and how do they develop the requisite capabilities to adapt and survive in the rule based markets. Very little is known about how survived domestic firms negotiate various market pressures and develop requisite capabilities, when the institutional transformation starts to mature and rule based market regimes begin to gain supremacy. This is when the resource based theory (RBV), which centers around firm specific capabilities becomes more relevant.

The literature on upgrading, consistently argued that the long-term competitiveness of firms in emerging economies depends on their development of new capabilities that improve on adaptive efficiencies (Moran and Ghoshal 1999). In fact, developing nations very often open up their economies to global players, with an objective to upgrade the technological and managerial capabilities of domestic firms as well as to attract FDI investments into the domestic markets. Market liberalization and entry of MNE auto firms are often perceived as the ideal ways to transfer best practices and technologies to the domestic industry because of the predominant use of the tiered, vertical supply networks, modular systems and lean production methodologies (Sturgeon and Florida, 2004). Automotive firms in most emerging markets typically are the first ones to upgrade their quality, technology and delivery capabilities, due to the mandatory requirements imposed upon them by the MNE automakers and tier-1 suppliers (Humphrey and Memedovic 2003; Quadros 2004; Sturgeon and Florida, 2004; McDermott and Corredoira, 2011). However, over a period of time, these firms would have to upgrade their process and product development capabilities as well, in order to improve their adaptive efficiencies to meet market requirements, especially by the time the institutional transition reaches the advanced phase and rule based market regimes start reigning.

Studies have found that product and process upgrading often tend to develop at unequal rates and depths, within and across firms, even within the same industry (Schmitz, 2004). The reasons for this could be twofold: Firstly, as discussed in the introductory section, the transaction costs of developing new product and process capabilities for domestic firms would be much higher than the MNEs due to sunk costs of MNEs who already possess these capabilities. Winter (2003) defines these capabilities as ‘zero level’ capabilities as far as MNEs are concerned, while for domestic firms, they become ‘first order’ capabilities. The capabilities exercised in stationary process at equilibrium by a firm are termed as its ‘zero level’ capabilities, while the capabilities that are developed afresh to meet the challenges of the changing environment are termed as first order capabilities, second order capabilities and so on, depending upon the rate at which existing capabilities are upgraded to a higher level. These higher order capabilities, which are developed due to dynamic changes in external environment are defined as the ‘dynamic capabilities’. However, there is much debate and confusion surrounding the definition and usage of term ‘dynamic capabilities’ and how they are different from the ‘resources and capabilities’ defined in the RBV literature. Therefore we formally define and clarify the differences between resources, capabilities and dynamic capabilities below, before proceeding any further.

The Resource-based view is based on the work of Penrose who defined firms for the first time in 1959 as bundles of resources (Penrose, 1959). Following the widely accepted definition of Barney (1991), resources are *"all assets, capabilities, organizational processes, firm attributes, information, knowledge, etc. controlled by a firm that enable the firm to conceive of and implement strategies that improve its efficiency and effectiveness"*. To be more specific, resources are defined as those tangible assets (such as brand names, in-house knowledge and technology, patents, skilled personnel, efficient procedures etc.) that are tied semi-permanently to the firm (Spanos and Lioukas, 2001). Capabilities on the other hand refer to firm's ability to exploit and combine resources through organizational routines in order to accomplish its targets (Amit and Schoemaker, 1993). According to the RBV, companies can generate competitive advantages if they possess strategic resources and exploit them. However, these strategic resources need to fulfill specific characteristics: resources need to be valuable and rare to generate short-term competitive advantages, and they need to be inimitable and non-substitutable to create a sustainable competitive advantage (Barney, 1991).

The static analysis of sustainable competitive advantages of the RBV which only considers the status quo of existing resources and not their development over time has been criticised for its lack of long term perspective. Therefore the RBV was extended in recent years, through the dynamic capability approach (DCA) (Teece, Pisano & Shuen, 1997). The DCA was first outlined by Teece and Pisano (Teece & Pisano, 1994) and further developed by Teece, Pisano and Shuen (Teece, Pisano & Shuen, 1997). Following the DCA, the source of sustainable competitive advantage lies in superior dynamic capabilities, which are described as "the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments" (Teece, Pisano & Shuen, 1997). Hence study of dynamic capabilities, which determine the process of creation, development and combination of resources to enable a rapid adaption to changing environments (Eisenhardt & Martin, 2000), such as in emerging markets, is quite appropriate in the current context. Dynamic capabilities are determined by management and organizational processes of a company, which in turn are influenced by the asset position and paths of the company (Teece, Pisano & Shuen, 1997). Although, the DCA has been discussed increasingly in recent years, its empirical examination is still insufficient and is still in its initial stage (Newbert, 2007).

Therefore, if one is interested in understanding the competitiveness of domestic firms in the emerging markets during the advanced phase of institutional transformation, one has to follow the pattern of upgrading since the initial phase and investigate the path dependency of future capabilities on past and present competencies. It is quite clear from the understanding generated on dynamic capabilities by researchers like Winter (Winter 2003, Jacobides and Winter 2005), that emerging economy firms have to carry out various levels of upgrades and dynamically develop capabilities that not only match current requirements at any given point in time during the institutional transformation, but also create foundation for new capabilities that may be required in the near future. This, at one level requires a long-term perspective and planning about the competitive landscape. However, at the same time, domestic firms have to be cautious about being able to reap benefits from this progressive development of dynamic capabilities, given the level of technological advancements that the MNE competitor's possess and be aware of higher order dynamic capabilities 'trumping' their efforts at lower order capability building (Collis, 1994). Therefore, there is merit in exploring the '*Ad hoc problem solving*' approach, proposed by Winter (2003) as an alternative way of meeting the market requirements in a dynamic environment, rather than investing in development of expensive resources and capabilities whose returns are uncertain. *Ad hoc problem solving* is not a routine, not highly patterned and not repetitious. It typically appears as a response to novel challenges from the environment or other relatively unpredictable events (Winter, 2003). Since *ad hoc problem solving* does not involve significant investments into resources and capability development, but instead makes use of existing resources (such as manpower from different functional areas temporarily shifted to resolve a specific problem or find an innovative solution as per customer requirement), the transaction costs of firms adopting *ad hoc problem solving* approach are likely to be much lower than their counterparts who adapt dynamic capability approach.

Therefore, in the current study, we integrate various management theories discussed above and empirically investigate which of these theories apply to domestic firms operating in emerging economies with the help of data collected from the Indian auto component industry, with appropriate caveats. In the following section we give a brief overview of the Indian auto component industry and present the research findings obtained so far from the existing literature. We then build our research model in the subsequent sections.

INDIAN AUTO COMPONENT INDUSTRY

The historical development of the entire Indian industry was marked by several phases of economic regulation and liberalization, which also influenced the development and growth of the automobile industry considerably. According to Kumaraswamy et al (2011) three phases of evolution can be distinguished post liberalization: 1992-1997, 1998 to 2002 and post-2002. Building on this we refer to the latest phase as 2003-2004 to 2007-2008.

The first attempts at deregulation of the Indian automobile industry began by defusing the import and production restrictions in the early to mid 1980s (Okada, 2004). Several joint ventures (JV) with foreign, especially the Japanese companies like Toyota, Mitsubishi and Nissan, were approved at this time, including the Maruti Udyog Limited, a JV between the Indian government and Suzuki Motors in 1982, which became very successful in terms of market share and product quality (Tewari, 2001; Sutton, 2004). These JVs, especially the Maruti-Suzuki JV, began to develop a local supplier base (by facilitating technology and equity partnerships between their Japanese suppliers and domestic Indian suppliers) owing to the local content requirements enforced by the Indian government and the appreciated Yen (Okada, 2004). These joint ventures and technology collaborations with MNE firms helped domestic suppliers realize improvements with regard to quality, technology and productivity (Tewari, 2001; Sutton, 2004). The production volumes of the domestic Indian automobile industry increased significantly since the mid 1980s (D'Costa, 1995; Okada, 2004).

Extensive reforms between 1991 and 1992 led to a further economic liberalization of the Indian industry (Singh, 2006; Saranga, 2009). Between 1991 and 1994 local content restrictions were completely lifted (Singh, 2004). Between 1992 and 1997 several OEMs and their direct suppliers – the so called tier 1 suppliers – entered the market through the acquisition of majority stakes in joint ventures or the approved foundation of production facilities on a case-by-case basis (Kumaraswamy et al., 2011).

In 1997 regulatory norms were changed again, forcing the MNEs entrants to build local production facilities and mandating a local content requirement of 50% to 70% within the first five years after market entry (Tewari, 2001; Kumaraswamy et al., 2008). These regulatory changes gave further impetus to supplier development activities because most domestic component suppliers still fell behind quality, productivity and technology requirements of foreign companies (Okada, 2004; Sutton, 2004). Simultaneously, the product complexity and the competitive pressure within the Indian automobile industry increased significantly (Okada, 2004; Sutton, 2004; Saranga, 2009).

The growth of the Indian middle class led to a steadily increasing local demand until the end of the 1990s (Kumaraswamy et al., 2011). In addition, the exports of the Indian automobile industry rose continuously due to the increased foreign demand. Thus the Indian automobile industry could realize an average annual growth of 21 % between 1990 and 1999. Because of this industry growth, a tier-structured automobile industry was formed (Okada, 2004). However, the tier-structure was regarded as not that distinctive by international means, because tier 2 suppliers were often the last link in the supply chain due to the relatively high proportion of value added of the companies (Okada, 2004). Until the end of the 1990s the Indian automobile industry included 400 mid sized and large auto component suppliers, which supplied to at least one OEM. These companies of the so-called organized sector generated in total 75-80 % of the production volume of the Indian industry (Okada, 2004; Wad, 2004). Three primary clusters of the automobile industry were formed in North India around Delhi and Gorgaon, in West India around Mumbai and Pune and South India around Bangalore and Chennai (Wad, 2004; Kumaraswamy et al 2008).

In 2002, the Indian automobile industry experienced a further deregulation, local content and import restrictions on CKD kits as well as local production requirements were effectively lifted. The

Government of India envisaged establishment of an internationally competitive automobile industry in India which can act as an Asiatic export hub for small cars and automobile components through its Automotive Mission Plan (AMP, 2006)[1]. AMP identified automotive sector with its backward and forward linkages as a sector with high potential to increase share of manufacturing in GDP, exports and employment; emphasized the need for long-term competitiveness of this sector through upgrading of new product design and development capabilities, rather than depending on cheap labor and favorable exchange rates. To achieve these objective incentives for local production of small cars, investments into R&D, new product development, world-class facilities for automotive testing, certification and homologation facilities were created (AMP, 2006). In 2004 India signed a free trade agreement with Thailand, which is seen as an essential contribution for the opening up of the Indian automobile industry (Singh, 2004; Kumaraswamy et al 2008). Additional free trade agreements with South Asian Association for Regional Cooperation and ASEAN states were signed in the following years (ASEAN Secretariat, 2011).

As a consequence of many of these initiatives the car production in India increased by 14% per annum and volume of the auto component industry rose by 18.7% per annum between 2000 and 2010.[2] The global economic crisis in the recent years merely led to limited growth losses in the Indian automobile industry due to the strong domestic demand and India's independence from trade with Western industrial states (Marr/Reynard, 2010). The high growth potential of the domestic market and favorable regulatory environment have encouraged many foreign OEMs such as Suzuki, Hyundai, Ford, Nissan – Renault, Toyota, GM, Honda, Volkswagen to make significant investments in India in a bid to make it the base for compact car production[3]. Many of these OEMs (Suzuki, GM, Ford, Honda, Hyundai and Mercedes Benz) and their global tier-1 suppliers (e.g., Bosch, Delphi, Valeo, Magna, Caterpiller, Cummins etc.) slowly began to establish their design and research centers too in India, since it makes sense to develop these small cars in India itself, owing to the low cost and availability of skilled engineers, also since final component and sub system suppliers can be integrated

[1] http://www.dhi.nic.in/draft_automotive_mission_plan.pdf
[2] www.acmainfo.com.
[3] http://www.acmainfo.com/pdf/Status_Indian_Auto_Industry.pdf

into product development activities from the very beginning. This gave rise to plenty of opportunities for the domestic Indian suppliers, who possessed product development capabilities, to participate in the new product development activities of foreign OEMs and garner supply contracts for newer models.

INNOVATIVE CAPABILITIES AND RESOURCES OF DOMESTIC INDIAN AUTO COMPONENT SUPPLIERS

According to the theory of Industrial organization, in the face of varying market threats and opportunities, a firm must find a favorable position in the industry from which it can best defend itself against competitive forces, or even influence them in its favor by adopting appropriate strategies (Porter, 1980). The RBV on the other hand postulates that the key to a firm's success lies in its ability to create distinctive resources and capabilities that differentiate it from competitors (Dierickx and Cool 1989). Both these views are complementary, in the sense, while the former takes an outside-in view of how firms should respond to changes in the industry, the latter takes an inside-out view by assuming a firm's resources and capabilities determine its positional advantage (Wang and Ahmed 2007). Both these views have merit in their arguments because many a time changes in an industry could be exogenous such as the regulatory reforms brought about by emerging economy governments. When such external changes take place, due to the path dependency of capabilities, only firms that have channeled its resources towards change trajectory of the external environment would be in a position to develop the appropriate capabilities and reap the full benefits.

For example, given the slow pace of liberalization in India, we can divide it into two phases, early phase, where some amount of protective norms were still in place (pre 2002) and late or advanced phase, when all protection was removed and markets were completely opened up (post 2002). Earlier studies (D'costa 1995; Okada 2004; Saranga, 2009, Iyer et al, 2011; Kumaraswami et al 2011) have already documented that many component firms made use of the existing networks and low cost capabilities to exploit market opportunities during the early phase. The lack of strong institutions and support infrastructure, such as legal framework to protect patents, easy access to capital through bank loans etc. increased the value of network-based capabilities during this early period. However, as more and more layers of protection were peeled off, stronger institutional and support structures (such as NATRIP[4]) were put in place, firms began to upgrade their resources and capabilities to meet the market demands and the transaction costs of certain activities began to decrease due to the vertical disintegration of various production functions and co-development of backward and forward linked industries. **Figure 1** depicts this institutional transition and co-evolution of transaction costs and dynamic capabilities in the Indian auto component industry.

By the time all restrictions on imports and FDI investments were lifted in 2002, i.e., during the advanced phase of transition, the Indian automotive industry was undergoing tremendous competition, due to the entry of a large number of international assemblers, a significant variety of new product introductions and resulting price pressures (Okada, 2004; Sutton, 2004; Saranga, 2009). The reduction in custom duties coupled with the FTA with Thailand and other ASEAN countries (Singh, 2004; Sáez, 2006) increased the threat of auto components imports from China and Thailand into the Indian market, threatening the survival of many component firms. Simultaneously, the automobile assemblers were trying to rationalize their vendor bases, preferring to source assemblies and sub-assemblies (instrument clusters) from fewer number of suppliers, rather than large number of individual parts, to reduce complexity and increase operational efficiencies[5] (Kumaraswamy et al 2008). This phenomenon, while on the one hand distanced some suppliers from assemblers, also opened up many opportunities for domestic suppliers who were until then supplying simple parts, to upgrade to more complex parts and/or sub-assemblies, which involved higher value addition.

This market scenario forced the domestic automotive firms to build product and process development capabilities, which were required to exploit the market opportunities. The earlier quest for quality and efficiency improvements had to a large extent created cost, quality and delivery competencies in the domestic suppliers (Iyer et al, 2011). However the current situation demanded innovative resources and capabilities to take part in the product and process development activities of

[4] NATRIP – National Automotive Testing and R&D Infrastructure Project, provides specialized facilities to the firms in the Indian automotive indsutry for testing, certification and homologation processes

[5] The automobile assemblers preferred to source at the assembly/system level from a fewer number of tier-1 suppliers and delegated sourcing of constituent parts, assembling them into systems and management of the corresponding suppliers to the tier-1s, whom they increasingly referred to as partners.

the OEMs and the Tier-1 suppliers. Although most of the MNE product development activities involved incremental modifications to the existing products to customize to the Indian markets, due to the increasing cost pressures, the MNEs were also exploring involvement of local suppliers in the radically new product development activities for future models[6]. Since the demand for automobiles in the developed markets of the US, Europe and Japan has stagnated and the markets in emerging economies are exhibiting significant growth potential, most auto assemblers' focus has shifted towards the emerging markets. Given that customers in these emerging markets are price sensitive coupled with the differences in fuel efficiency norms and infrastructural issues, auto assemblers are trying to develop new products with an emerging market focus[7]. Many MNE assemblers also plan to introduce new versions of existing models, with higher customization to Indian market as well as higher local content to reduce costs[8]. To achieve these objectives, as mentioned earlier, some MNE assemblers and tier-1 suppliers established their R&D centers in India and are carrying out co-design and co-development of new products with the Indian suppliers (reference required).

Integration of suppliers in co-development requires the assessment of the innovativeness of the suppliers besides the frequently applied supplier evaluation criteria such as price, quality and delivery capabilities. The innovativeness describes the aptitude of a supplier to realize new products or processes (Wang & Ahmed, 2004). Based on the theoretical perspectives of the RBV and DCA these innovativeness indicators are categorized along innovative resources and innovative capabilities of suppliers (Wang & Ahmed, 2004).

One of the most popular measures of innovative resources are the human resources. These comprise the number of R&D employees as well as their absolute or relative share in the total number of employees (Wasti & Liker, 1997). Furthermore, the qualification level of the employees can be judged along their education, training and experience (Souitaris, 1999). The share of employees with a high educational degree or the frequency and number of trainings can be considered as indicators

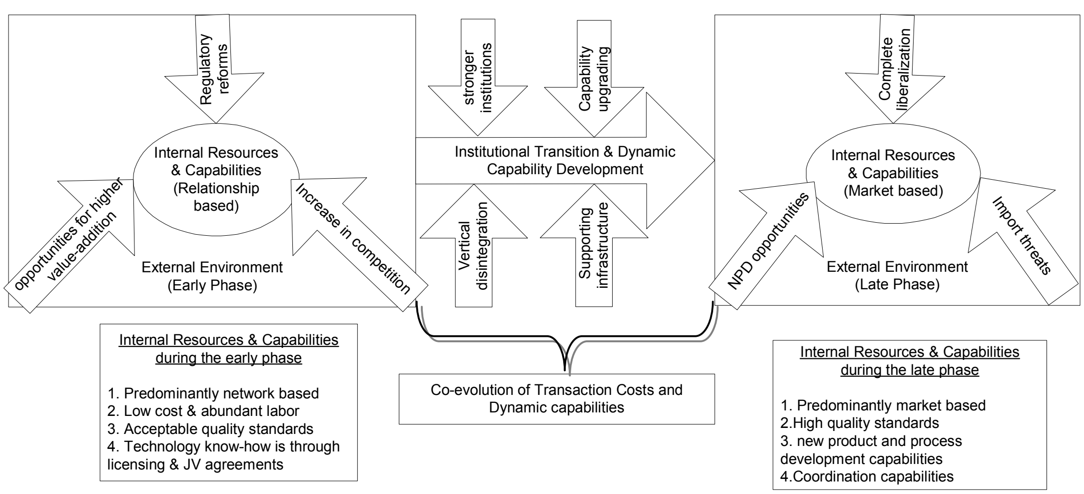
[6] Interviews with the industry experts
[7] Toyota Innova is one such example, which is developed specifically for the Indian market
[8] Honda Jazz, latest version is an example of customization to Indian market and increased local content resulting in lower price

(Souitaris, 1999; McDermott & Corredoira, 2010). Another frequently used financial resource indicator is the R&D investments as a percentage of total turnover of the firm or industry sector (Petroni & Panciroli, 2002;). Also the supplier's royalty expenses give indication of its innovative resource configuration. Moreover the supplier should possess a structured innovation process as an organizational resource, which enables parallelization of development activities and do justice to their temporal and content wise interdependences. Such a structuring of innovation processes can be supported by a stage gate process, a process to parallelize development activities or an integrated product development process (Flynn, Flynn, Amundson & Schroeder, 2000; Tatikonda & Montoya-Weiss, 2001).

Since there were many market opportunities during the study period, for domestic suppliers that possess appropriate innovative resources to be integrated into the product development activities of national and multinational OEMs, which in turn would have resulted in supply contracts for higher value added components and subassemblies, we posit our first hypothesis as follows:

Hypothesis 1 (H_1): Domestic component suppliers that possessed greater innovative resources outperformed their counterparts in the Indian auto component industry during the study period.

Figure 1. Integration of various management theories in the context of Indian auto component industry



Innovative capability refers to a firm's ability to develop new products and/or markets through alignment of its orientation with innovative processes and behaviors (Wang and Ahmed 2004). As discussed above, firms have to invest in innovative resources, such as R&D, skilled manpower, technology licensing etc. and put in place new product and process development structures, to be able to develop new products and processes. Simultaneously, it is also important that the firms and its employees are capable of exploiting and combining these innovative resources through their organizational routines to produce new products and processes in order to grab market opportunities[9] (Amit and Schoemaker, 1993).

Earlier studies have found that one of the most critical innovative capabilities of suppliers for new product and process development include if and to what extent the supplier is able to design and develop the required tooling to manufacture new products (Lamberson, Diederich & Wuori, 1976; Insiti and Clark, 1994). Another important capability seems to be the willingness and the ability of suppliers to support customers with engineering capabilities (LaBahn & Krapfel, 2000). Also, it has been found that if the supplier possesses the ability to conduct simultaneous engineering (SE), he can be integrated quite early into the development projects of the customers (Sarkis & Talluri, 2002; Spekman, 1988). The supplier's previous experience with product and process development projects is also considered to be an indicator of innovative capabilities (Handfield et al., 1999; Souitaris, 1999; Sarkis & Talluri, 2002). Therefore, the frequency of the supplier's integration into development projects of customers and the innovation degree of these projects can be used to measure this particular capability (Veloso & Kumar, 2002; Soderquist & Godener, 2004). Other important indicators could be the number of innovation awards and quality certificates such as ISO/TS 16949, which are specific to automotive industry (Schiele, 2006; Croom, 2001). In addition the number of registered patents of suppliers is a widely used indicator to measure its innovative capabilities (Galbreath, 2005; Hoetker, 2005).

[9] In fact, Wang and Ahmed (2007) treat resources to be 'zero order' element, being the foundation of a firm, and capabilities to be 'first order' element which whould result in improved performance as capabilities demonstrate a firm's ability to deploy resources to attain a desired goal. Please note that this classification is quite different from Winter's (2003) classification of lower and higher order capabilities, which we mentioned earlier.

According to Wang and Ahmed (2007), the higher the dynamic capabilities a firm demonstrates, the more likely it is to build particular capabilities, as dictated by its business strategy. Since the domestic Indian component firms had demonstrated the ability to build dynamic capabilities such as cost efficiency, TQM, TPM, JIT deliveries etc. during the early phase (Iyer et al, 2011; Kumaraswami et al 2011), one would expect at least some firms to have channeled their existing resources and capabilities to build new product and process development capabilities when they foresaw the market opportunities during the advanced phase (list of innovative resources and capabilities measured in this study are described in Table 1 below). Empirical evidence suggests that a firm's innovative capabilities contribute significantly to better performance (Leiponen, 1998; D'Este, 2002). Based on the above arguments, we posit our second hypothesis below:

Hypothesis 2 (H_2): Domestic component suppliers that possessed greater innovative capabilities outperformed their counterparts in the Indian auto component industry during the study period.

Table 1 Indicators for the evaluation of the innovativeness of suppliers categorized in innovative resources and capabilities

Innovative resources	Number of R&D employees (absolute/relative share in the total number of employees)
	Qualification level of R&D employees
	R&D investments/R&D intensity
	Royalty expenses
	Structure of innovation process
Innovative capabilities	Tooling development and tooling manufacturing
	Support of customers with engineering capabilities
	Simultaneous engineering competency
	Previous experiences with integration into product or process development projects of customers
	Innovation awards
	Certification according to ISO/TS 16949
	Number of registered patents

As discussed in the theoretical background section, Teece *et al* (1997) state that, in markets where competitive landscape is quickly shifting, the dynamic capabilities by which firm managers 'integrate, build and reconfigure internal and external competencies to address rapidly changing environments become the source of sustained competitive advantage. Eisenhardt and Martin (2000) on the other hand argue that since the functionality of the dynamic capabilities can be duplicated across firms, their value for competitive advantage lies in the resource configurations they create, not in the capabilities themselves. They further elaborate that, the potential for long-term competitive advantage lies in using dynamic capabilities sooner, more astutely, or more fortuitously than the competition to create resource configurations that have that advantage. To apply and understand the concept of dynamic capabilities and the corresponding competitive advantage created by them in the context of Indian auto component industry, let us consider the following scenario.

Based on the definition of RBV, let us conceptualize the domestic firms in the Indian auto component industry as bundles of resources (some of which are innovative resources, such as R&D investments and skill levels of engineers), and capabilities (such as tooling design and development, experience in the new product development), which are heterogeneously distributed across these firms during the study period 2003-2008. Each component firm typically has multiple customers, very likely across multiple product segments, such as two wheelers, passenger cars, commercial vehicles etc. Some of these customers are likely to be domestic OEMs and some could be foreign OEMs and/or foreign tier-1 suppliers. Depending upon the nature of the product a component supplier is specialized in (simple versus complex; standard versus proprietary etc.), in each of these segments, there are several possibilities for integration into the new product development projects of any given customer. The supplier is likely to have invested in internal R&D and/or recruited R&D staff, only if there is a possibility/requirement by at least one of the customers to participate in new product or process development. However, the supplier will be able to make use of these innovative resources only when he gets the opportunity to participate in a product or process development project and succeeds in it. The successful deployment then implies that the supplier has developed innovative capabilities, i.e., the ability to deploy innovative resources to achieve the desired goal.

However, it is not necessary that all the suppliers who possess innovative resources would be equally successful in achieving their desired goals, when market opportunities are presented to them. In order to succeed, firms need to carry out two types of integrations most effectively: (1) external integration, which requires the firm to have effective problem solving activities that span the boundary of its external environment (e.g. customers and/or suppliers) and explore responses to its evolution and

(2) internal integration, which involve problem solving activities that focus and manage internal assets to complete the selected responses (Iansiti and Clark, 1994). This essentially means, supplier firms should be firstly in a position to identify the appropriate solutions to customer's new product and process development requirements and convince customers about the supplier's own ability to respond effectively. Next, they should be able to internally tap into the available resources and capabilities to complete the required design and development jobs efficiently. It is possible that a given supplier may not have all the resources that are required to complete the job corresponding to a specific customer. Suppose a customer asks the supplier to develop required tooling for a newly designed part and then carryout production and supply that part. Even though this supplier has the general ability to develop tooling, it is possible that the technology/expertise required to develop this particular tool is not readily available with this supplier. Supplier then has the options of either expressing his inability and therefore forego the supply contract, or procuring the technology/expertise by licensing technology/hiring new manpower etc., or outsourcing the development of tooling alone to a capable and willing third party, such as a machine tool manufacturer. The supplier who manages to grab this market opportunity either going with the second option (if he sees future benefits in investing into these technologies/skills) or by convincing the customer to go with the third option, is likely to have integrated both external and internal resources and capabilities more effectively, and can be regarded as having dynamic capabilities compared to his counterparts who would forego this opportunity due to lack of a specific resource or problem solving skill.

It is likely that, the third option is more cost effective at a given point in time, as it may not require high investments into tooling development. However, the second option may prove to be a wise decision in the longer run, if the technology is progressing in that direction and more customers are likely to adopt this new technology and the supplier who develops these technical capabilities would enjoy the first mover advantages. Therefore, the choice between second and third options depends on many factors, such as vertical disintegration of the industry (Jacobides and Winter, 2005), technology clockspeed (Fine, 1998) of the particular part/tool in question, the suppliers past and present resource orientation (Eisenhardt & Martin, 2000), current and future market opportunities etc.

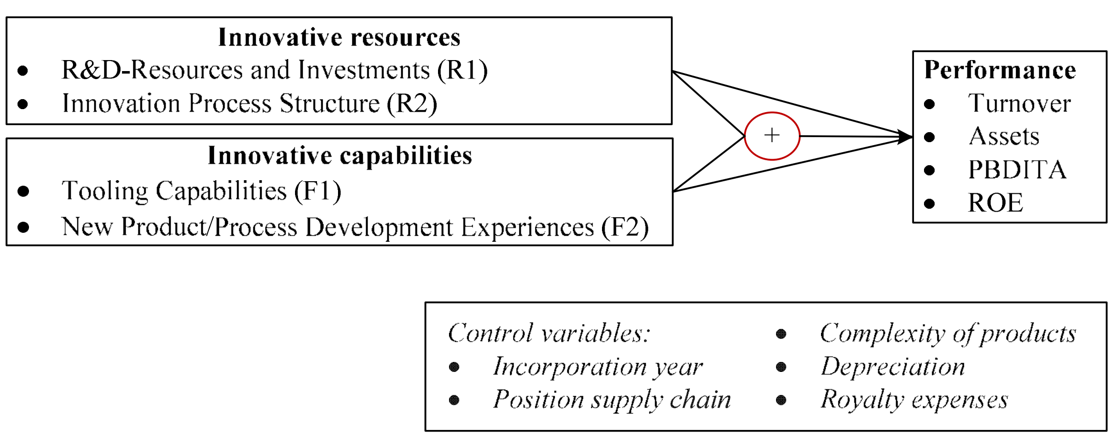
Thus, at any given point in time, the supplier who takes into account all these factors and comes up with a resource configuration that not just meets current requirements, but gives a competitive advantage in exploiting future market opportunities, is likely to show better performance than his competition. However, to begin with, it is necessary that (although not sufficient) the supplier has some amount of innovative resources and the ability to deploy them for effective use (i.e., also possesses innovative capabilities), to even come across the market opportunities and to exploit them by bridging the gap dynamically with the appropriate resource configuration. In fact, the higher the current base of innovative resources and capabilities that he possesses at an aggregate level, the more likely that he will be able to develop the dynamic capabilities and in turn improve his market and financial performance. Therefore, we use the interaction of innovative resources and capabilities as a proxy for dynamic capabilities in the current context.

Based on these considerations we assume that innovative resources and capabilities complement each other and their interaction has a reinforcing effect on a firm's level of dynamic capabilities and subsequently influences the firm's performance. Therefore we posit our third hypothesis as follows:

Hypothesis 3 (H_3): Innovative resources and innovative capabilities of domestic Indian auto component suppliers exhibit a significant reinforcing interaction effect on the performance.

Hypothesis H_1, H_2 and H_3 can be summarized using Figure 1.

Figure 1 Conceptual Framework



DESCRIPTION OF DATA, METHODS AND MODELS

Two groups of survey participants were created based on the ownership and the position in the supply chain of the companies (Table 2). The first group 'OEMs & international Tier 1 suppliers' is comprised of all OEMs and international Tier 1 suppliers (suppliers of an advanced, emerging or developing economy with production facilities in India) and Tier 1 suppliers which are a joint venture between a local (≤ 50 %) and foreign company (≥ 50 %). The second group 'Domestic Indian suppliers' includes all domestic Indian Tier 1 suppliers, Tier 1 suppliers which are a joint venture between a local (> 50 %) and a foreign company (< 50 %) and all Tier 2 suppliers.

Table 2 Definition of automotive company groups participating in the survey

OEMs & international Tier 1 supplier	Domestic Indian suppliers
All OEMs	All domestic Indian Tier 1 suppliers
International Tier 1 suppliers; that means suppliers of an advanced economy with production facilities in India and suppliers of an emerging or developing economy with production facilities in India	Tier 1 suppliers which are a joint venture between a local (> 50 %) and foreign company (< 50 %)
Tier 1 suppliers which are a joint venture between a local (≤ 50 %) and foreign company (≥ 50 %)	All Tier 2 suppliers

The domestic Indian supplier sample was selected using the cutoff sampling method (Knaub, 2008). The sample was created based on two databases Prowess and ACMA. *Prowess* is a database provided by independent Centre for Monitoring Indian Economy (CMIE)[10], which is headquartered in Mumbai, India. The *Prowess* database contains detailed information on over 23,000 large and medium Indian firms. These comprise all companies traded on India's major stock exchanges and several others including the central public sector enterprises. The companies covered in Prowess account for 75 per cent of all corporate taxes[11] and over 95 per cent of excise duty[12] collected by the Government of India. The normalised database includes 1,500 financials data items and ratios per company and in

[10] http://www.cmie.com/
[11] http://business.gov.in/taxation/corporate.php
[12] http://business.gov.in/taxation/excise_duty.php

addition it provides quantitative information on production, sales, consumption of raw material and energy. Totally, the number of indicators per company is close to two thousand available for a period of over ten years.[13] The annual database of the *Automotive Component Manufacturers Association of In*dia (ACMA)[14] for the year 2008 contains information on 597 Indian automotive component manufacturers (574 ACMA members and 23 non-members). The ACMA database contains additional information on products, quality standards, foreign collaborations, local and international customers of each listed company. The companies covered in the ACMA database account for 80 per cent of automotive component sales in India.[15]

We identified all automotive suppliers which are listed in both Prowess database and ACMA database and created a common list of suppliers to include in our questionnaire survey. The secondary data on all variables of our interest was available for this common list of suppliers. As a result, our empirical study could be based on primary data gathered through the questionnaire survey and secondary data collected by using both databases. In particular the secondary data was essential to analyze financial performance of sample firms[16]. Using the information (ownership and position in supply chain) given in these databases, the suppliers were divided into the groups 'domestic Indian suppliers' and 'international Tier-1 suppliers'. In this way, a total of 216 domestic Indian suppliers could be identified for the questionnaire survey.

A standardized questionnaire[17] was prepared for the purpose of this study after an extensive literature survey, and was divided into five sections focusing on general information, innovativeness, technology and production, human resources, supplying, supplier development and financial information about the company. The questionnaire was extensively pretested on various experts of the

[13] http://www.cmie.com/database/?service=database-products/firm-level-data-services/prowess-corporate-database.htm; Prowess database is also used in following relevant articles: Kumaraswamy, Mudambi, Saranga, & Tripathy, 2011; Saranga, 2009.
[14] http://www.acmainfo.com/
[15] http://acmainfo.com/docmgr/Status_of_Auto_Industry/Status_Indian_Auto_Industry.pdf
[16] Sales, PBDITA and ROA were gathered through Prowess; ROE was collected through the questionnaire survey because it was not included in Prowess data base.
[17] Survey questionnaire is available upon request from the authors

Indian automotive industry (e.g. Bailey, 1994) to ensure its understandability, completeness, accuracy and length.

Between February 2009 and September 2009 face-to-face-interviews (e.g. McGivern, 2009) were carried out to complete the questionnaire survey[18]. Interviews with scientists and industry experts showed the need to conduct face-to-face-interviews. The willingness to participate in a survey decreases dramatically in the Indian automotive industry if a personal contact between interviewer and interviewee cannot be established. A team of five interviewers was built to facilitate the conduction of numerous face-to-face-interviews all over India. All members of the interviewer team possessed several years of experience in conducting interviews in the Indian industry and the necessary background knowledge. Five-hour long training sessions were held to prepare the team members (Bailey, 1994). To supplement, a field manual including explanations and remarks regarding questions, response options, terms, abbreviations, survey objectives and general rules of neutral interviewer behaviour was provided. The latter should in particular prevent possible distortions of the interviewee answers by the interviewer.

Potential survey participants were firstly contacted by phone or through emails. Interested companies were visited by the interviewers at their sites and executive interviews (Kumar, Aaker & Day, 2002) were conducted. Generally, two to three executives from the purchasing and R&D department had to be interviewed to cover all sections of the questionnaire. It took between 4 to 5 hours per company to answer one questionnaire. The participants were assured that the gathered data and information is used only for academic purposes and it is processed anonymously (Groves, 2009). Data of 74 domestic Indian suppliers could be gathered which means a rate of return of 34.26%. A non-response analysis (Kalton, 1983) was carried out. No noticeable problems could be identified with regard to the companies which did not participate in the survey.

[18] For advantages and disadvantages of interview studies see Bailey, 1994: 174-176

The missing values[19] were imputed by using the widely accepted **EM-algorithm** (Expectation Maximization; Ibrahim, Chen, Lipsitz & Herring, 2005; Schafer & Graham, 2002), which goes back to the work of Dempster, Laird and Rubin (Dempster, Laird & Rubin, 1977).[20] According to the LITTLE´S MCAR test (Little, 1988), the data are missing completely at random (MCAR; Rubin, 1976) and the algorithm can be applied (Schafer & Graham, 2002). We provide descriptive statistics of our data in Table 3 and Table 4

Table 3 Distribution of sample by structural position in value chain and by individual vs. group companies (n=74)

		Frequency	Percent
structural position in value chain	Tier 1	56	75.7
	Tier 2	18	24.3
	Total	*74*	*100*
individual vs. group companies	individual company	41	55.4
	group company	33	44.6
	Total	*74*	*100*

Table 4 Distribution of sample by number of employees, incorporation year and turnover (n=74)

	Mean	Std. Deviation
Employees 2008	906.96	1205.73
Incorporation year	1978.95	16.22
Turnover 2008 (Mio. Rs)	4860.59	8068.13

The following analyses are based on the primary data collected through the questionnaire survey and the secondary data gathered using the two public databases.

Innovative Resources

The indicators identified in Table 2 measure the innovativeness of suppliers and are used as independent variables to describe the innovative resources and capabilities of suppliers. Subsequently the innovative resources (RE) are operationalized as number of R&D employees (RE_1), qualification

[19] 5.72 % of the domestic Indian supplier data were missing.

[20] For simulations studies regarding the efficiency of the EM-algorithm see for example Bernaards, Farmer, Qi, Dulai, Ganz & Kahn, 2003

level of employees (RE_2), R&D investments (RE_3), royalty expenses (RE_4) and structure of innovation process (RE_5-RE_7).

The first resource (RE_1) is measured as the percentile share of number of R&D employees to the total number of employees. Regarding the qualification level of the employees (RE_2), the share of the company's engineers and scientists who possess a high educational degree is considered (e.g. Leiponen, 2000; McDermott & Corredoira, 2010). In India these include diploma and college degrees (e.g. Bachelor of Technology, Bachelor of Engineering, Bachelor of Science) as well as the post graduate degrees (Okada, 1998). The annual investments in R&D (RE_3) and annual royalty expenses (RE_4) are measured as the average R&D intensity (R&D as a % of turnover) and average royalty intensity (royalty as a % of turnover) during the time period 2003-2008. To measure the structure of the innovation process (RE_5-RE_7), the stage gate process, the process to parallelize development activities and the integrated product development process are measured using a five-point interval scale from 1 (= never heard about it) to 5 (= highly advanced implementation) (Ray, Barney & Muhanna, 2004). These measurement details are tabulated in Table 5 below.

Table 5 Description of innovative resources

Item Number	Variable	Variable type	Description
RE_1	R&D Employees	Bounded (0-100)	Number of employees working in R&D-department as a percentage of total number of employees in 2007 [%]
RE_2	ME Education	Bounded (0-100)	Number of engineers and managers holding a diploma, college or post graduate degree as a percentage of total number of engineers and managers [%]
RE_3	R&D intesity*	Bounded (0-100)	Average R&D expenses/investments in last 5 years (2003-2007) [% of turnover]
RE_4	Royalty Expenses*	Bounded (0-100)	Average royalty expenses in last 5 years (2003-2007) [% of turnover]
RE_5	IP Stage Gate	Five-point interval scale (1 = never heard about it, 2 = don't intend to implement, 3 = not yet begun, 4 = standard/common implementation, 5 = highly advanced implementation)	Structure of innovation process: Stage Gate
RE_6	IP Parallelization		Structure of innovation process: Parallelization
RE_7	IP Integration		Structure of innovation process: Integration

*Data for these variables is obtained from Prowess Database. Data for all remaining variables is obtained from the Questionnaire survey results

Innovative Capabilities

The innovative capabilities (CA) are operationalized as tooling development and tooling manufacturing (CA_1, CA_2), the capability to support customers with engineering capabilities (CA_3), simultaneous engineering competency (CA_4) as well as previous experiences in integration into product or process development projects of customers (CA_5-CA_9), innovation awards (CA_{10}), certification ISO/TS 16949 (CA_{11}) and the number of registered patents (CA_{12}).

The tooling capabilities (CA_1, CA_2) are measured as the share of developed and manufactured tools respectively as a % of all the tools used by the supplier. The next capability (CA_3) is measured as the % share of customers, which are supported through the engineering capabilities of the firm.[21] Following Petersen, Handfield, & Ragatz (2005) the SE-competency (CA_4) is measured using a three-point interval scale (0 = low, 1 = medium, 2 = high). The supplier`s experience of integration into the product or process development projects of customers (CA_5, CA_6) is determined by the frequency of how often they were integrated by their customers, using a five-point interval scale from 1 (= never) to (5 = most often). Furthermore the % share of product and process development projects with a high degree of innovation (CA_7-CA_9) into which the supplier is integrated during 2003-2007 is captured as follows. A high degree of innovation exists if the project focused on a (radical) new layout or a major modification of the product or process.[22] The number of innovation awards (CA_{10}) and ISO/TS 16949 (CA_{11}) are described by dummy-variables (with "1" indicating the existence of award/certification). Additionally, the total number of product and process patents registered by the suppliers (CA_{12}) during 2003-2008 is considered. (see Table 6 below).

[21] This indicator is based on a question including three specifications of the suppliers' customers. First of all the suppliers should mention, how many customers with whom they share their engineering capabilities (in %), secondly how many customers they support with engineering capabilities (in %) and thirdly with how many customers they do not have such supporting or sharing relationships (in %). The sum of these percentages corresponds to 100 %.

[22] According to Takeishi (2001) the innovation degree of product development projects is characterized along five possible forms: 1. *Minor modifications* (changes were less than 20%) of product design, 2. Medium modification (20–50%) of product design, 3. *Major modification* (50–80%) of product design, 4. *Completely new design* (more than 80%), but its design was based on a technology that had been demonstrated in another project and 5. *Technologically new* to your company and a completely new design. The innovation degree of process development projects is characterized along following five possible forms: 1. *Minor modifications* of existing process layout and equipment, 2. *Medium modification* of existing process layout and equipment, 3. *Major modification* of existing process layout and equipment, 4. *New process layout* and equipment, but based on established process engineering, in your company and 5. *Technologically new process* to your company and completely new process layout and equipment (Takeishi, 2001: 428).

Table 6 Description of identified innovative capabilities (independent variables)

Item Number	Variable	Variable type	Description
CA_1	Tooling Development	Bounded (0-100)	Amount of developed tools by supplier as a percentage of all used tools [%]
CA_2	Tooling Manufacturing	Bounded (0-100)	Amount of manufactured tools by supplier as a percentage of all used tools [%]
CA_3	Customer Support	Bounded (0-100)	Share of all customers, which are supported through the engineering capabilities of the domestic Indian suppliers [%]
CA_4	SE Competency	Three-point interval scale (0 = low, 1 = medium, 2 = high)	Degree of SE-competency
CA_5	Process Development Project (PrDP) Frequency	Five-point interval scale (1 = never; 2 = seldom; 3 = sometimes; 4 = often; 5 = most often)	Frequency how often supplier were integrated by customers into process development projects
CA_6	Product Development Project (PDP) Frequency		Frequency how often supplier were integrated by customers into product development projects
CA_7	IP Major Modification	Bounded (0-100)	Share of product or process development projects, into which the supplier were integrated by customers, focusing on 'major modifications' (2003-2008) [%]*
CA_8	IP New Design	Bounded (0-100)	Share of product or process development projects, into which the supplier were integrated by customers, focusing on 'new design'/'new process' (2003-2008) [%]*
CA_9	IP Radical New Design	Bounded (0-100)	Share of product or process development projects, into which the supplier were integrated by customers, focusing on 'radical new design'/ 'technologically new process' (2003-2008) [%]*
CA_{10}	Innovation Award	Count	Number of received innovation awards
CA_{11}	ISO TS 16949	Dichotomous (0 = not certified according to 'ISO TS 16949', 1 = certified according to ISO TS 16949)	Certification according to ISO TS 16949
CA_{12}	Patents	Count	Number of registered product and process patents (2003-2008)

* see footnote 22

Performance and control variables

In order to assess the impact of innovative resources and capabilities on the suppliers' performance, we use performance measures such as 'annual turnover per employee', which measures labour productivity of the firm (Leiponen, 2000; Newbert, Gopalakrishnan & Kirchhoff, 2008), as well as financial measures such as 'profit before depreciation, interest, tax and amortization (PBDITA) per employee' (Hooley et al 1996; Carr & Pearson, 2002), and 'return on assets (ROA)' and 'return on equity (ROE)' (Venkatraman & Ramanujam, 1986; Cho & Pucik, 2005) are considered as dependent variables. All dependent variables refer to the financial year 2007-08 (see Table 7), since our objective is to test the impact of the built up innovative resources and capabilities (e.g. effected investments in R&D) during the study period (2003-2008) on the current performance of the suppliers.

Table 7 Description of performance variables

Variable	Variable type	Description
Turnover per employee	Count	Turnover in 2007-08 [Mio Rs] / employees in 2007-08
PBDITA per employee	Count	Profit before depreciation, interest, tax and amortization in 2007-08 [Mio Rs] / employees in 2007-08
ROA	Count	Return on asset in 2007-08
ROE	Count	Return on equity in 2007-08

Data for all performance variables is obtained from the Prowess Database.

In Addition, several control variables are included in the analysis to control their impact on the corresponding dependent variable. The control variables include the company age (CV_1), the position in the supply chain (CV_2), the product complexity (CV_3), the annual depreciation (CV_4), the annual royalty expenses (CV_5), size of the company (CV_6) and the company leverage (CV_7) (see Table 8).

The company age (CV_1) represents the difference between the year 2008 and the incorporation year of the company in years. The position in the supply chain (CV_2) is represented by a 'tier dummy' variable, which indicates if the considered company acts primarily as a tier 1 (= 1) or tier 2 supplier (= 0) in the automotive supply chain (Kotabe et al 2003). The product complexity (CV_3) is specified based on a five-point interval scale from 1 (=extremely simple parts) to 5 (= extremely complex parts) (Handfield et al 1999; Veloso & Kumar 2002). The two control variables, position in the supply chain (CV_2) and the product complexity (CV_3) are perceived to be differentiating factors in our qualitative pre-study, and hence included as control variables. Furthermore the average annual depreciation (CV_4) and the average annual royalty and licensing expenses (CV_5) as % shares of the annual turnover between 2003 and 2008 are included as control variables. These two variables represent the impact of capital intensity and technological expenditures. To control for the size of the company, we use ln(total assets) (CV_6) and to control for the leverage, we use the financial leverage ratio, (total assets/equity), also called 'DuPont multiplier' (Anthony, Hawkins and Merchant, 2006).

Table 8 Description of control variables

Item Number	Variable	Variable type	Description
CV_1	Company Age *	Count	Company age, calculated as the difference between the year 2008 and the year of incorporation
CV_2	Position SC	Dichotomous (1 = Tier 1, 0 = Tier 2)	Position in supply chain
CV_3	Complexity	Five-point interval scale (1 =extremely simple parts; 5 = extremely complex parts)	Complexity of supplied products in terms of design, manufacturability and coordination (no. of sub-suppliers) in 2007-08
CV_4	Depreciation*	Bounded (0-100)	Average annual depreciation (2003-2008) [as a % of turnover]
CV_5	Royalty Expenses*	Bounded (0-100)	Average annual royalty expenses (2003-2008) [as a % of turnover]; *Item Number R3 in EFA*
CV_6	Company Size*	Bounded (0-100)	Company size, calculated as the ln(total assets)
CV_7	Company Leverage*	Bounded (0-100)	The financial leverage ratio, (total assets/equity)

*Data for these variables is obtained from Prowess Database. Data for all remaining variables is obtained from the Questionnaire survey results

Methods

We first carry out an **exploratory factor analysis (EFA)** as a structure-revealing analysis to reduce and consolidate the number of variables, whose data is collected through questionnaire survey and from prowess database. With minimal loss of information, highly correlated variables can be consolidated into groups and can be separated from less correlated groups using EFA (Gorsuch, 1983). These groups which combine multiple variables are termed 'factors' (Hair, 2006). Besides structuring variables, the EFA can be used for data reduction by determining factor values for the identified factors. The factor values can be used in the subsequent empirical investigations instead of the original data (Gorsuch, 2003).

The final EFA was carried out by choosing principal component analysis as the extraction method and the Varimax rotation with Kaiser Normalization as a rotation method. After excluding some of the variables because of their MSA-value, explained communality or cross-loading (details can be found in the appendix), a final MSA-value of 0.604 for all remaining capabilities and a MSA-value of 0.752 for all remaining resources could be obtained. The results of the factor analyses can be seen in Table 9. Corresponding correlation matrixes can be found in the appendix.

Table 9 EFA results for indentified resources and capabilities (Rotated Component Matrix)

			Component	
			1	2
Resources	**Innovation process structure (Factor R_1)**	IP stage gate	**0.793**	0.040
		IP parallelization	**0.786**	-0.029
		IP Integration	**0.722**	0.165
	R&D resources (Factor R_2)	R&D Employees	0.139	**0.812**
		R&D expenses	-0.017	**0.843**
Capabilities	**Product and process development experience (Factor C_1)**	PrDP Frequency	**0.775**	0.400
		PDP Frequency	**0.833**	0.012
		IP Major Modification	**0.719**	0.111
		IP New Design	**0.768**	-0.072
		IP Radical New Design	**0.737**	-0.271
	Tooling capabilities (Factor C_2)	Tooling Manufacturing	-0.209	**0.800**
		Tooling Development	0.207	**0.791**

The extracted factors result from the variables which are most significantly related to the corresponding factor (Gorsuch, 1983). According to Backhaus and Fahrmeir (2008), factor loadings over 0.5 are considered as 'high'. As one may note from Table 9, the groups of variables neatly cluster together into different factors. Based on the type of variables that constitute each of the factors, we named the factors as follows: factor R_1 is called '**Innovation process structure**', factor R_2 '**R&D resources**', factor C_1 '**Product and process development experience**' and factor C_2 '**Tooling capabilities**'. Following the methodology used by Zhu & Kraemer (2002), we estimate the aggregate resources (R_{agg}) and aggregate capabilities (C_{agg}), by taking the sum of R_1 and R_2 to compute R_{agg}, taking the sum of C_1 and C_2 to compute C_{agg}.

The reliability of the results of the EFA were tested through the widely accepted quality criterion Cronbachs-Alpha, which measures the internal consistency of all items of a construct (Cronbach, 1951). All Cronbachs-Alpha values lie above the critical level of 0.5, which can be used, if less than four indicators are analyzed at the same time, as is the case in our example. Construct validity was also confirmed considering both convergence validity and discriminate validity

After identifying the factors through EFA, we use **multiple regression analyses** to investigate the impact of innovative resources and capabilities of domestic Indian suppliers on their performance.

We use the variables listed in Table 7 to measure the market and financial performance of the firm. Please note that these variables correspond to the financial year 2007-08, as our objective is to measure the impact of capabilities and resources built over a period of time (such as investments and R&D efforts in the last 5 years) on a firm's current performance. We also control for other firm level factors in our regression analysis and these control variables are listed in Table 8.

EMPIRICAL ANALYSIS AND RESULTS

We use the following linear regression equation to test the impact of innovative resources, innovative capabilities and their interaction effect (dynamic capabilities) on firm performance (Hypotheses $\mathbf{H_1}$ – $\mathbf{H_3}$), after controlling for other firm level factors.

$$Y_P = \beta_0 + \sum \beta_i R_i + \sum \beta_i C_i + \beta_5 R_{agg} * C_{agg} + \sum \beta_i X_i + e \qquad (1)$$

$$Y_P = \beta_0 + \beta_1 R_{agg} + \beta_2 C_{agg} + \beta_3 R_{agg} * C_{agg} + \sum \beta_i X_i + e \qquad (2)$$

Where, Y_P represents the 4 variables described in Table 7 corresponding to firm performance; R_i (i=1, 2) and C_i (i=1, 2) in equation (1) represent the two factors (R_1 & R_2) corresponding to innovative resources and the two factors (C_1 & C_2) corresponding to innovative capabilities listed in Table 9 respectively; R_{agg} and C_{agg} in equation (2) represent aggregate resources and aggregate capabilities, which correspond to the sum of the two factors R1 and R2 (R_{agg}) and the sum of the factors C1 and C2 (C_{agg}) in equation (1) and (2). $R_{agg} * C_{agg}$ represent the interaction term which is calculated as a product of aggregate resources (R_{agg}) and aggregate capabilities (C_{agg}) (Jaccard & Turrisi, 2003); finally X_i represent the control variables described in Table 8. The results of the regression analyses are shown in Table 10. Model 1, 3, 5 and 7 include all four factors to test their influence on firm performance separately (hypotheses H_1 & H_2). The calculations for model 2, 4, 6 and 8 are based on the aggregate factors to analyse the significance of the aggregate factors (hypotheses H_3) and significance of the interaction effect.

Robustness checks

Based on the graphical examination of residual scatter plots, normality, linearity and homoscedasticity of residuals can be assumed (Tabachnick, 2006; Draper, 1998). To test for multicollinearity, the correlation matrixes[23] were examined, regression analyses of each independent variable[24] were carried out and the Variance Inflation Factor (VIF) and tolerances[25] were appraised. Multicollinearity could not be identified. All Cook's distances lie below the critical F-value, therefore no outliers were found (Chatterjee & Hadi, 1986; Rousseeuw & Leroy, 1987; Reinard, 2006).

---

[23] According to Hair correlations above 0.9 are an indication of substantial collinearity (Hair, 2006: 227). Examination of the correlation matrixes showed that all correlation coefficients lie below 0.9. The highest correlation exists between the variables 'Interaction Resources and Capabilities" and 'R&D resources' (-0.567) when all factors are considered. Looking at the models including the aggregated factors, the highest correlation exists between the variable 'Interaction Resources and Capabilities' and 'Aggregated Factors Resources' (= -0.378).

[24] e.g. Tabachnick & Fidell 2006; R^2 values lie between 0.133 (dependent variable 'Royalty Expenses) and 0.371 (dependent variable 'Interaction Resources and Capabilities') when the calculation is based on all four factors. Considering the aggregated factors, R^2 values lie between 0.085 (dependent variable 'Royalty Expenses') and 0.292 (dependent variable 'Aggregated Factors Resources').

Table 10 Linear regression model with Turnover per employee, PBDITA per employee, ROA and ROE as dependent variable

Dependent Variable	Turnover per employee		PBDITA per employee		ROA-4 (PAT)		ROE (Prowess data)	
Parameter	***Model 1***	***Model 2***	***Model 3***	***Model 4***	***Model 5***	***Model 6***	***Model 7***	***Model 8***
Resources:								
Aggregated Factors Resources		0.311 **		0.156		0.063		0.439 ***
Innovation process structure	0.074		0.197		-0.195		0.140	
R&D investments	0.365 ***		0.027		0.242 **		0.454 ***	
Capabilities:								
Aggregated Factors Capabilities		0.000		0.005		-0.039		-0.044
Past experience in PDP & PrDP	-0.057		0.017		0.231 **		0.124	
Tooling Design and Development	0.103		-0.039		-0.183 *		-0.116	
Interaction Effect:								
Interaction Resources and Capabilities	0.250 **	0.324 ***	0.458 ***	0.415 ***	-0.203 *	-0.090	-0.440 ***	-0.359 ***
Company Age	-0.132	-0.091	0.002	-0.023	0.058	0.121	-0.044	0.001
Position SC	-0.080	-0.132	-0.366 ***	-0.342 ***	-0.232 **	-0.206 *	0.014	0.024
Complexity	-0.181 *	-0.237 **	-0.196 *	-0.171 *	-0.151	-0.095	-0.306 ***	-0.279 ***
Depreciation	0.006	-0.087	0.047	0.096	-0.068	-0.115	0.026	-0.016
Royalty Expenses	0.031	0.000	0.030	0.042	-0.037	0.020	0.037	0.068
Size_ln_Assets	0.369 **	0.481 ***	0.444 **	0.386 **	0.383 **	0.427 **	0.154	0.196
Leverage	0.047	0.098	-0.035	-0.065	-0.552 ***	-0.468 ***	-0.415 ***	-0.355 ***
Overall Model								
R^2	0.513	0.469	0.496	0.484	0.508	0.410	0.662	0.621
R^2 adjusted	0.417	0.385	0.397	0.402	0.411	0.317	0.595	0.560
Significance	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Number of observations	74	74	74	74	74	74	74	74

*p<0.10; **p<0.05; ***p<0.01
Model 1, 3, 5, 7: calculations with all four factors
Model 2, 4, 6, 8: calculations with aggregated factors

Results and Implications

Our regression results corroborate the conjecture that as emerging economies evolve; a firm's resources begin to play a critical role in determining the market and financial performance of the firm (Hoskisson et al, 2000). The results are reported in Table 11 and support our hypotheses H_1 and H_3, which conjecture that firms with higher innovative resources and dynamic capabilities are associated with better performance. However, we do not find support to our hypothesis H_2 in majority of the cases, which posits that firms with innovative capabilities achieve better performance. Only in one case, that too only one innovative capability – past experience in product and process development – is found to be positively associated with performance with respect to return on assets (ROA). In fact, the second innovative capability – tooling development and manufacturing – is found to have negative association with ROA (at 10% level). We further elaborate this discussion in the following paragraphs and analyze the underlying dynamics in the industry that to some extent explain these results.

The results from Models 1 & 2 show that, the innovative resources of domestic firms in the Indian auto component industry are indeed positively associated with higher productivity. Especially firms that have invested highly in R&D resources seem to be enjoying higher turnover per employee (at 1% significance level), compared to firms with lower levels of R&D resources, as per model 1. This could be because they are able to obtain supply contracts for more sophisticated products that require higher levels of technical interventions and R&D expertice, which is likely to result in higher value addition. This result is in line with earlier studies on the Indian auto component industry (Kumaraswami et al 2011), which conjecture that after the liberalization came into full effect (i.e. post 2002), the auto component firms began to invest significantly in R&D and these investments coupled with the earlier quality and technological upgrades are likely to determine their performance during this period. At the aggregate level too, it is the innovative resources that are positively and significantly associated with productivity of the firm as per model 2 (at 10% level), while the capabilities (both at individual as well as aggregate level) do not seem to have any association with productivity. The interaction of resources and capabilities, which we use as a proxy for 'dynamic capabilities' on the other hand turns out be highly significant with regard to productivity, both at the individual level (model 1) as well as aggregate level (model 2). This suggests that the impact of R&D

on firm productivity gets further magnified for firms that possess higher tooling development and tooling manufacturing capabilities. Since in-house tooling development and manufacturing capabilities allow a firm with higher R&D investments to carry out product and process development activities at a faster pace and at the same time significantly reduce required coordination efforts with third party vendors (as the tooling would otherwise have to be outsourced to a third party), the labor productivity of the firm seems to be improving significantly.

Neither the innovative resources nor the innovative capabilities seem to have an impact on the PBDITA of the firm at an individual or at an aggregate level as per models 3 and 4. This fact, in conjunction with earlier results suggests that, although R&D is associated with higher labor productivity, it comes at a cost, and hence does not contribute directly to PBDITA. Innovative capabilities too do not have any impact on PBDITA at an individual or at an aggregate level. However, the interaction between innovative resources and capabilities is positively and significantly associated with PBDITA at 1% level. These results suggest that, even though the innovative resources such as *R&D investments* and *Innovation process structure* may not influence higher profitability on their own; and the past experience of participating in *product and process development activities* do not directly help much; the combination of having both the resources and the ability to employ these resources at the right time to create appropriate resource configurations i.e., possession of the dynamic capabilities has a highly significant impact on PBDITA in the Indian auto component industry. Note that, the ability to develop and manufacture tools in-house however has a negative association, although not significant, on PBDITA. These results suggest that, firms that have invested in R&D and have a innovative process structure in place as well as have a history of participating in earlier product/process development projects are able to attract supply contracts with higher value addition and/or able to reduce their costs vis-à-vis other suppliers who are acquiring similar projects through technology sourcing. Whereas, firms with similar resources and capabilities, but have additionally invested in in-house tool development may be finding the costs too prohibitive, compared to firms that are able to manage without in-house tooling capabilities. (can we test this out by interacting tooling with aggregate resources???)

The results corresponding to ROA partially support our hypotheses H_1 and H_2. As one may note from the results listed under Model 5 in Table 11, the innovative resource *R&D investments* again has a positive and significant association with ROA (at 5% level), whereas the second resource *Innovation process structure* again fails to show significant association with ROA (although the sign of the coefficient becomes negative). The innovative capabilities on the other hand exhibit more interesting results in this case, with past experience in *product and process development* having positive association with ROA (at 5% significance level) and tooling capabilities having negative association with ROA (at 10% significance level). Given these contrasting results amongst the resources and capabilities, the significance vanishes at the aggregate level (see results corresponding to Model 6). However, the most interesting result of all is the interaction term, which exhibits a negative and significant (albeit at 10% level) association with ROA. Although these results are quite contradictory at the first sight and reject our hypothesis H_3 at the outset, the reasons behind such results provide significant insights into the dynamics of capabilities that are valuable in the context of an emerging economy like India.

Before we elaborate further, one needs to note two things, firstly the earlier set of analyses considered a measure like PBDITA (profit before depreciation, interest, tax and amortization) to represent firm profitability, which does not include the costs of capital investments (depreciation), capital raised through debts (interest) or amortization. Whereas, in the current case, we deliberately use PAT (profit after tax) as the profitability measure to compute ROA, which takes into account all the above costs. Secondly one needs to consider all the results under models 5 and 6 together along with the discussion of results from earlier models (1 to 4), to understand the nuanced evidence we have and to interpret these results. Considering this backdrop, the results suggest that, even though the *R&D investments* amongst the resources and past experience in *product and process development* amongst the capabilities have a positive impact on ROA, the investments into *Innovation process structure* (to some extent) and into *tooling development* (to a significant extent) are costing the firms dearly and are eating into their returns. As a result, firms that are investing in all resources and capabilities (high interaction effect) have lesser returns, compared to firms that are more selective in their investments, choosing to invest their scarce capital only in R&D and outsourcing tooling related activities to a third party machine tool manufacturer. The interaction term in the earlier models (1 to 4) turned out to be highly positive and significant, primarily because, the costs of investments were not accounted for in those models. This argument is further supported by the fact that, the control variable 'leverage' which remained insignificant in earlier models, becomes highly significant (at 1% level) in models 5 and 6, and has a negative association with ROA. Leverage essentially represents the firm's assets to equity ratio, and in our context shows that returns of component firms that are using mainly debt to finance their innovative resource and capability development are being affected significantly. However, firms with past experience in product and process development activities are definitely enjoying better returns, indicating that customers do value this experience irrespective of suppliers' investments in R&D and/or tooling. Also, the size variable turns out to be positive and significant, further supporting our argument that large firms with sufficient funds for investments have an upper hand over smaller firms, who may have to barrow heavily to finance their investments into innovative resource and capability development.

The results corresponding to ROE (our last two models 7 and 8) are more or less similar to those of ROA, with R&D investments, both at individual level and aggregate level exhibiting positive and significant association (at 1% level) with returns. However, unlike ROA results, neither of the innovative capabilities seems to be contributing to ROE, with both coefficients although maintaining similar directional impact as that of ROA, turning out to be insignificant in this case. The interaction term becomes much more prominent and highly significant in case of ROE (negative association), implying that returns on shareholder equity are getting more affected than the returns on assets. This result also corroborates our conjectures above, since assets are procured using capital raised through both equity and debt. Therefore, ROE is getting affected more than ROA implies that, parts of the earnings are spent towards interest payments, which is reducing the returns that shareholders receive on their equity. Again, the control variable, leverage, becomes highly significant with a negative sign, indicating the losses incurred by highly leveraged firms, due to high cost of capital in India.

We next look at other control variables and their impact on firm performance. The company age, depreciation and royalty expenses do not have any significant impact on performance. Especially the insignificant impact of royalty & know how expenses, which is found to be highly significant in earlier periods (Kumaraswami et al, 2011), in conjunction with significant association between R&D and all measures of firm performance supports our arguments pertaining to the progressive evolution of Indian auto component industry and the increase in innovative capabilities of domestic firms. Another interesting result pertains to the control variable 'position in supply chain', which has a negative and significant impact on firm profitability, in case of both PBDITA and ROA (models 3 to 6). This result essentially is indicating that, the profitability of tier-1 firms, which are closest to the OEMs, is lower than the profitability of tier-2 firms, which again is in contrast to the earlier findings pertaining to the earlier periods, where relational ties, which are supposed to be strongest between tier-1s and OEMs, contribute positively (Kumaraswami et al, 2011) towards firm performance. This evidence also points towards the transition of the Indian auto component industry from a relationship based personalized transaction structure that rewarded network based capabilities till 2002 (Kumaraswami et al, 2011), to a more rule based structure that rewards market based dynamic capabilities post 2002, as per Peng's (2003) two-phase model. Finally, while size of the firm is found to have a positive and significant impact on productivity, profitability (PBDITA) and ROA, it does not show any significant impact on ROE, suggesting that there is no statistically significant difference between the returns enjoyed by shareholders of small and large firms on their equity investments.

DISCUSSION AND CONCLUSIONS

Our data analysis through descriptive statistics and results from regression analysis, as well as qualitative inputs from the expert interviews reveal that the Indian auto component industry is moving towards a market based competition and domestic auto component firms are developing innovative resources and capabilities that are helping them to integrate into the product and process development activities of domestic and to some extent multinational customers. However, not all innovative resources and innovative capabilities seem to be contributing towards better firm performance during the study period 2003-2008, which only partially supports our original hypotheses, however provides many more insights than we have bargained for, into the current functioning of the Indian auto component industry, and consequently into other emerging markets that posses similar characteristics, subjected to similar type of regulatory reforms and are going through similar stages of evolution.

Firstly, our study shows that, given appropriate incentives and sufficient time and scope for development, domestic firms will invest in R&D and also reap benefits in terms of higher productivity and financial performance. Secondly, the past experience of firms, of participating in process and product development activities, does open up new opportunities to integrate into higher value added projects, which subsequently results in higher returns. Therefore, the efforts by the domestic firms towards upgrading of technological capabilities through licensing and joint venture agreements during the earlier periods (Saranga, 2009; Iyer et al, 2011, Kumaraswami et al, 2011) have become stepping stones towards present and very likely future capability development, which is in line with the path dependency argument put forth by the literature on RBV and dynamic capabilities. Thirdly, we find that certain capabilities such as, in-house tooling development and manufacturing, which used to be highly valued capabilities until recently, are not necessary to be integrated into product/process development activities by the customers, and in fact turning out to be a burden on the domestic firms that have to depend on barrowed funds to make investments into such capabilities.

Since the economic liberalization in the early 90's, along with auto component industry, Indian machine tool industry has also evolved into a competitive sector, mainly catering to the tier-1 and tier-2 firms in the auto industry[26]. Many low cost machine tool manufacturers have emerged out of the domestic sector, through collaboration and joint development of various machine tools required by the auto component suppliers. Given that Most of the product and process development projects where the domestic suppliers are integrated (see tables ???) were focusing on minor and medium level modifications, that too at a low frequency, the tooling capabilities of auto component suppliers are scarcely utilized as against the high utilization rates of machine tool manufacturers. Therefore component suppliers who have developed close collaborations with machine tool suppliers are benefitting, since they can make use of the capabilities of mache tool suppliers as and when required. Although outsourcing tooling development to a third party is not as effective as having in-house capabilities, with appropriate coordination and co-development, this arrangement seems to be working quite well in many cases. Also, since tool manufacturing is their core business, machine tool manufacturers have greater manufacturing expertise and can afford higher investments into latest

[26] Almost 50% of the output from Indian machine tool industry is supplied to the Indian auto industry.

technological capabilities, while smaller size domestic auto part suppliers, whose cost of capital is quite high, cannot afford similar investments. Therefore, this co-evolution of machine tool manufacturers and superior coordination capabilities of some of the domestic firms enables outsourcing of tooling with reduced transaction costs and allows these firms to focus their valuable capital resources elsewhere, consistent with Madhok's (2002) triangular alignment argument in firm's boundary decision. This also supports the notion that the regulatory reforms and policy interventions by the Indian government at various stages of liberalization have created sufficient levels of heterogeneity in the distribution of productive capabilities (Jacobides and Winter 2005) that, narrow specializations like tool development and manufacturing have been relegated to the machine tool manufacturers, allowing component firms to focus on core activities like product/process development and pursue manufacturing excellence.

Another important finding is related to the usefulness of *innovative process structure* for domestic suppliers in the current stage of evolution. Since domestic component firms were mainly integrated in minor or medium level modifications, that too, mostly involving processes rather than products, the new product development processes like the stage gate, parallel or integrated development do not seem to be of great relevance or contribute towards better financial performance. Our interviews with the industry experts instead reveal that, the low cost automation expertise developed by the Indian auto component firms has been very effective in improving process efficiency, manufacturing flexibility and productivity. These process improvement activities however are carried out by cross functional teams, constituting regular employees who along with their regular jobs, carry out improvement activities as and when they identify a process requiring intervention or modification, rather than dedicated process development personnel. This phenomenon is identical to the *ad hoc problem solving* approach proposed by Winter (2003) as an alternative to the dynamic capability approach, to meet the market requirements, but at a lower cost, since the existing resources are utilized whenever necessity arose, rather than investing in dedicated resources that may not be utilized optimally. Given the current market uncertainties posed by the recessionary environment across the globe and the presence of MNE suppliers with higher order capabilities, the domestic firms in the emerging economies may be better off with *ad hoc problem solving* approaches rather than investing in expensive resources that are only rarely utilized. Our results in fact indicate that in Indian auto component industry domestic firms are indeed following this route, given the high cost of capital in India, and it seems to be contributing to better performance than the tooling capabilities and innovative process structure. The highly significant negative impact of leverage on returns also supports this conjecture.

We therefore suggest the need for future empirical research in this direction, by identifying *ad hoc problem solving* approaches that are being used in emerging countries as alternatives to the more standard resources and capabilities and by collecting and using primary data on these approaches. There is also a need to develop focused management concepts that explain the theories behind successful adaptation by emergin firms, despite the adversary market conditions and test them using data from various industries belonging to emerging economies.

Appendix

Correlation Matrix[a] Innovative resources

		PrDP Frequency	PDP Frequency	IP Major Modification	IP New Design	IP Radical New Design	Tooling Manufacturing	Tooling Development
Correlation	PrDP Frequency	1.000	0.598	0.518	0.466	0.481	0.146	0.377
	PDP Frequency	0.598	1.000	0.570	0.514	0.491	-0.159	0.150
	IP Major Modification	0.518	0.570	1.000	0.426	0.295	-0.103	0.174
	IP New Design	0.466	0.514	0.426	1.000	0.549	-0.135	0.112
	IP Radical New Design	0.481	0.491	0.295	0.549	1.000	-0.248	-0.037
	Tooling Manufacturing	0.146	-0.159	-0.103	-0.135	-0.248	1.000	0.330
	Tooling Development	0.377	0.150	0.174	0.112	-0.037	0.330	1.000
Sig. (1-tailed)	PrDP Frequency		0.000	0.000	0.000	0.000	0.108	0.000
	PDP Frequency	0.000		0.000	0.000	0.000	0.087	0.100
	IP Major Modification	0.000	0.000		0.000	0.005	0.192	0.069
	IP New Design	0.000	0.000	0.000		0.000	0.126	0.171
	IP Radical New Design	0.000	0.000	0.005	0.000		0.016	0.378
	Tooling Manufacturing	0.108	0.087	0.192	0.126	0.016		0.002
	Tooling Development	0.000	0.100	0.069	0.171	0.378	0.002	

a. Determinant = ,099

Correlation Matrix[a] Innovative capabilities

		R&D Employees	R&D expenses	IP stage gate	IP parallelization	IP integration
Correlation	R&D Employees	1.000	0.387	0.082	0.132	0.181
	R&D expenses	0.387	1.000	0.092	-0.018	0.092
	IP stage gate	0.082	0.092	1.000	0.434	0.393
	IP parallelization	0.132	-0.018	0.434	1.000	0.346
	IP integration	0.181	0.092	0.393	0.346	1.000
Sig. (1-tailed)	R&D Employees		0.000	0.245	0.131	0.061
	R&D expenses	0.000		0.219	0.438	0.219
	IP stage gate	0.245	0.219		0.000	0.000
	IP parallelization	0.131	0.438	0.000		0.001
	IP integration	0.061	0.219	0.000	0.001	

a. Determinant = 0.527

Excluded variables (Resources)*

				Bartlett-Test		
Iteration	Included items in analysis	Recommended elimination of item	MSA	Chi	df	sig
1	All	**ME Education** (MSA)	0,570	55,807	21	0,000
2	All except ‚ME Education‘	**Royalty Expenses** (MSA)	0,586	48,550	15	0,000
3	All except ‚Royalty Expenses‘		0,604	45,224	10	0,000

Excluded variables (Capabilities)*

				Bartlett-Test		
Iteration	Included items in analysis	Empfohlene Elimination von Item (Grund)	MSA	Chi	df	sig
1	Alle	**Customer Support** (MSA)	0,666	250,913	66	0,000
2	All except ‚Customer Support'	**Innovation Award** (MSA)	0,718	224,819	55	0,000
3	All except ‚Innovation Award'	**ISO TS 16949** (communality)	0,762	210,094	45	0,000
4	All except ‚ISO TS 16949'	**SE Competency** (communality)	0,757	198,165	36	0,000
5	All except ‚SE Competency'	**Patents** (cross-loading)	0,754	187,019	28	0,000
6	All except ‚Patents'		0,752	161,419	21	0,000

* According to the Measure-of-sampling-Adequacy (MSA) criteria, the variables RE4, RE3, CA1, CA6 are not suitable for the EFA, because their MSA-value is below the recommended value of 0.5 (Kaiser, 1970; Hair, 2006). Furthermore, the explained communality of the variables CA2 and CA3 lies below the threshold value of 0.5, thus they are excluded from the further analysis. X argues that the result could be distorted otherwise. The variable CA12 shows a cross-loading with both factors, therefore it is eliminated, following the guidelines of Hair (Hair, 2006). This leads to a final MSA-value of 0.604 for all remaining capabilities and to a MSA-value of 0.752 for all remaining resources.

References

Robert Anthony, David Hawkins, Kenneth Merchant. 2006. ACCOUNTING: Text & Cases, McGrawHill Education.

ASEAN Secretariat. 2011. ASEAN - India Free Trade Area. http://www.aseansec.org/22563.htm (Accessed 6 May 2011).

Bailey, K. D. 1994. *Methods of social research*. New York: Free Press.

Barney, J. B. 1991. Firm resources and sustained competitive advantage. *Journal of Management*, 17(1): 99–120.

Barreto, I. 2010. Dynamic capabilities. A review of past research and an agenda for the future. *Journal of Management*, 36(1): 256–280.

Bernaards, C. A., Farmer, M. M., Qi, K., Dulai, G. S., Ganz, P. A., & Kahn, K. L. 2003. Comparison of two multiple imputation procedures in a cancer screening survey. *Journal of Data Science*, 1(3): 293–312.

Carr, A. S., & Pearson, J. N. 2002. The impact of purchasing and supplier involvement on strategic purchasing and its impact on firm's performance. *International Journal of Operations and Production Management*, 22(9): 1032–1053.

Chatterjee, S., & Hadi, A. S. 1986. Influential observations, high leverage points, and outliers in linear regression. *Statistical Science*, 1(3): 379–393.

Cho, H.-J., & Pucik, V. 2005. Relationship between innovativeness, quality, growth, profitability, and market value. *Strategic Management Journal*, 26(6): 555–575.

Cronbach, L. J. 1951. Coefficient alpha and the internal structure of tests. *Psychometrika*, 16(3): 297–334.

Croom, S. R. 2001. The dyadic capabilities concept. Examining the processes of key supplier involvement in collaborative product development. *European Journal of Purchasing and Supply Management*, 7(1): 29–37.

D'Costa, A. P. 1995. The restructuring of the Indian automobile industry. Indian state and Japanese capital. *World Development*, 23(3): 485–502.

Dempster, A. P., Laird, N. M., & Rubin, D. B. 1977. Maximum likelihood from incomplete data via the EM algorithm. *Journal of the Royal Statistical Society. Series B (Methodological)*, 39(1): 1–38.

Dierickx, I., & Cool, K. 1989. Asset stock accumulation and sustainability of competitive advantage. *Management Science*, 35(12): 1504–1511.

Draper, N. R., & Smith, H. 1998. *Applied regression analysis*. New York: Wiley.

Easterby-Smith, M., Lyles, M. A., & Peteraf, M. A. 2009. Dynamic capabilities. Current debates and future directions. *British Journal of Management*, 20(1): 1–8.

Eisenhardt, K. M., & Martin, J. A. 2000. Dynamic capabilities. What are they? *Strategic Management Journal*, 21(10/11): 1105–1121.

Flynn, B. B., Flynn, E. J., Amundson, S. D., & Schroeder, R. G. 2000. Team characteristics as enablers of fast product development speed. In M. M. Beyerlein, D. A. Johnson & S. T. Beyerlein (Eds), *Advances in interdisciplinary studies of work teams: Product development teams*: 133–169. Stamford: JAI Press.

Galbreath, J. 2005. Which resources matter the most to firm success? An exploratory study of resource-based theory. *Technovation*, 25(9): 979–987.

Gorsuch, R. L. 1983. *Factor analysis*. Hillsdale: Erlbaum.

Gorsuch, R. L. 2003. Factor analysis. In J. A. Schinka, W. F. Velicer & I. B. Weiner (Eds), *Handbook of psychology. 2: Research methods in psychology*: 143–164. Hoboken: John Wiley & Sons.

Groves, R. M., Fowler, F. J., Couper, M. P., Lepkowski, J. M., Singer, E., & Tourangeau, R. 2009. *Survey methodology*. Hoboken: John Wiley & Sons.

Hair, J. F. 2006. *Multivariate data analysis*. Upper Saddle River: Pearson/Prentice Hall.

Handfield, R. B., Ragatz, G. L., Petersen, K. J., & Monczka, R. M. 1999. Involving suppliers in new product development. *California Management Review*, 42(1): 59–82.

Hoetker, G. 2005. How much you know versus how well I know you. Selecting a supplier for a technically innovative component. *Strategic Management Journal*, 26(1): 75–96.

Hooley, G., Cox, T., Shipley, D., Fahy, J., Beracs, J., & Kolos, K. 1996. Foreign direct investment in Hungary. Resource acquisition and domestic competitive advantage. *Journal of International Business Studies*, 27(4): 683–709.

Humphrey, J., & Memedovic, O. 2003. *The global automotive industry value chain. What prospects for upgrading by developing countries*. Wien.
Ibrahim, J. G., Chen, M.-H., Lipsitz, S. R., & Herring, A. H. 2005. Missing-data methods for generalized linear models. A comparative review. *Journal of the American Statistical Association*, 100(469): 332–346.
Jaccard, J., & Turrisi, R. 2003. *Interaction effects in multiple regression*. Thousand Oaks: SAGE.
Kaiser, H. F. 1970. A second generation little jiffy. *Psychometrika*, 35(4): 401–415.
Kalton, G. 1983. *Introduction to survey sampling*. Newbury Park: SAGE.
Knaub, J. R. 2008. Cutoff sampling. In P. J. Lavrakas (Ed), *Encyclopedia of survey research methods*. *1*: 175–176. Thousand Oaks: SAGE.
Kotabe, M., Martin, X., & Domoto, H. 2003. Gaining from vertical partnerships. Knowledge transfer, relationship duration, and supplier performance improvement in the U.S. and Japanese automotive industries. *Strategic Management Journal*, 24(4): 293–316.
Kumar, V., Aaker, D. A., & Day, G. S. 2002. *Essentials of marketing research*. New York: Wiley.
Kumaraswamy, A., Mudambi, R., Saranga, H., & Tripathy, A. 2008. *Strategic adaptation to deregulation in the Indian auto components industry*. Pittsburgh.
LaBahn, D. W., & Krapfel, R. E. 2000. Early supplier involvement in customer new product development. A contingency model of component supplier intentions. *Journal of Business Research*, 47(3): 173–190.
Lamberson, L. R., Diederich, D., & Wuori, J. 1976. Quantitative vendor evaluation. *Journal of Purchasing and Materials Management*, 12(1): 19–28.
Lee, H., & Kelley, D. 2008. Building dynamic capabilities for innovation. An exploratory study of key management practices. *R&D Management*, 38(2): 155–168.
Leiponen, A. 2000. Competencies, innovation and profitability of firms. *Economics of Innovation and New Technology*, 9(1): 1–24.
Little, R. J. A. 1988. A test of missing completely at random for multivariate data with missing values. *Journal of the American Statistical Association*, 83(404): 1198–1202.
Mahoney, J. T. 1995. The management of resources and the resource of management. *Journal of Business Research*, 33(2): 91–101.
Malik, O. R., & Kotabe, M. 2009. Dynamic capabilities, government policies, and performance in firms from emerging economies. Evidence from India and Pakistan. *Journal of Management Studies*, 46(3): 421–450.
Marr, J., & Reynard, C. 2010. *Investing in emerging markets*. *The BRIC economies and beyond*. Chichester: John Wiley & Sons.
McDermott, G. A., & Corredoira, R. A. 2010. Network composition, collaborative ties, and upgrading in emerging-market firms. Lessons from the Argentine autoparts sector. *Journal of International Business Studies*, 41(2): 308–329.
McGivern, Y. 2009. *The practice of market research*. *An introduction*. Harlow: Pearson Education.
Ministry of Heavy Industries and Public Enterprises of the Government of India. 2006. Automotive mission plan 2006-2016. A mission for development of Indian automotive industry. http://www.siamindia.com/upload/AMP.pdf.
Ministry of Heavy Industries and Public Enterprises of the Government of India. 2011. Annual report 2009-10. http://dhi.nic.in/HeavyIndustry_inside_eng_2009-2010.pdf (Accessed 29 March 2011).
National Informatics Centre of the Government of India. 2011. Trade agreements. http://business.gov.in/trade/trade_agreements.php (Accessed 6 May 2011).
Newbert, S. L. 2007. Empirical research on the resource-based view of the firm. An assessment and suggestions for future research. *Strategic Management Journal*, 28(2): 121–146.
Newbert, S. L., Gopalakrishnan, S., & Kirchhoff, B. A. 2008. Looking beyond resources. Exploring the importance of entrepreneurship to firm-level competitive advantage in technologically intensive industries. *Technovation*, 28(1/2): 6–19.
Okada, A. 1998. *Does globalization improve employment and the quality of jobs in India? A case from the automobile industry*. Cambridge.
Okada, A. 2004. Skills development and interfirm learning linkages under globalization. Lessons from the Indian automobile industry. *World Development*, 32(7): 1265–1288.
Penrose, E. T. 1959. *The theory of the growth of the firm*. Oxford: Basil Blackwell.

Petersen, K. J., Handfield, R. B., & Ragatz, G. L. 2005. Supplier integration into new product development. Coordinating product, process and supply chain design. *Journal of Operations Management*, 23(3/4): 371–388.
Petroni, A., & Panciroli, B. 2002. Innovation as a determinant of suppliers' roles and performances. An empirical study in the food machinery industry. *European Journal of Purchasing and Supply Management*, 8(3): 135–149.
Porter, M. E. 1980. *Competitive strategy. Techniques for analyzing industries and competitors*. New York: Free Press.
Ray, G., Barney, J. B., & Muhanna, W. A. 2004. Capabilities, business processes, and competitive advantage. Choosing the dependent variable in empirical tests of the resource-based view. *Strategic Management Journal*, 25(1): 23–37.
Reinard, J. C. 2006. *Communication research statistics*. Thousand Oaks: SAGE.
Rousseeuw, P. J., & Leroy, A. M. 1987. *Robust regression and outlier detection*. New York: Wiley.
Rubin, D. B. 1976. Inference and missing Data. *Biometrika*, 63(3): 581–592.
Sáez, L. 2006. India and the new international economic order. A focus on trade. In S. K. Mitra & B. Rill (Eds), *India's new dynamics in foreign policy*: 137–151. München: Hanns-Seidel-Stiftung.
Saranga, H. 2009. The Indian auto component industry. Estimation of operational efficiency and its determinants using DEA. *European Journal of Operational Research*, 196(2): 707–718.
Sarkis, J., & Talluri, S. 2002. A model for strategic supplier selection. *Journal of Supply Chain Management*, 38(1): 18–28.
Schafer, J. L., & Graham, J. W. 2002. Missing data. Our view of the state of the art. *Psychological Methods*, 7(2): 147–177.
Schiele, H. 2006. How to distinguish innovative suppliers? Identifying innovative suppliers as new task for purchasing. *Industrial Marketing Management*, 35(8): 925–935.
Singh, N. 2004. *Strategic approach to strengthening the international competitiveness in knowledge based industries. The case of Indian automotive industry*. New Delhi.
Singh, N. 2006. *Supply chain in Indian industries. A case of automobile sector*. Indore.
Soderquist, K. E., & Godener, A. 2004. Performance measurement in R&D and new product development. Setting the scene. *International Journal of Business Performance Management*, 6(2): 107–132.
Souitaris, V. 1999. Research on the determinants of technological innovation. A contingency approach. *International Journal of Innovation Management*, 3(3): 287–305.
Spekman, R. E. 1988. Strategic supplier selection. Understanding long-term buyer relationships. *Business Horizons*, 31(4): 75–81.
Sudhir Kumar, R., & Bala Subrahmanya, M. H. 2010. Influence of subcontracting on innovation and economic performance of SMEs in Indian automobile industry. *Technovation*, 30(11/12): 558–569.
Sutton, J. 2004. *The auto-component supply chain in China and India. A benchmarking study*. London.
Tabachnick, B. G., & Fidell, L. S. 2006. *Using multivariate statistics*. Boston: Pearson Education.
Takeishi, A. 2001. Bridging inter- and intra-firm boundaries. Management of supplier involvement in automobile product development. *Strategic Management Journal*, 22(5): 403–433.
Tatikonda, M. V., & Montoya-Weiss, M. M. 2001. Integrating operations and marketing perspectives of product innovation. The influence of organizational process factors and capabilities on development performance. *Management Science*, 47(1): 151–172.
Teece, D. J., & Pisano, G. 1994. The dynamic capabilities of firms. An introduction. *Industrial and Corporate Change*, 3(3): 537–556.
Teece, D. J., Pisano, G., & Shuen, A. 1997. Dynamic capabilities and strategic management. *Strategic Management Journal*, 18(7): 509–533.
Tewari, M. 2001. *Engaging the new global interlocutors. Foreign direct investment and the transformation of Tamil Nadu's automotive supply base*. Cambridge.
Veloso, F., & Kumar, R. 2002. *The automotive supply chain. Global trends and Asian perspectives*. Manila.
Venkatraman, N., & Ramanujam, V. 1986. Measurement of business performance in strategy research. A comparison of approaches. *Academy of Management Review*, 11(4): 801–814.
Wad, P. 2004. *International linkages and the automobile component industry in developing countries. A comparative study of Indian, South African and Malaysian auto supplier firms*. Aalborg.

Wang, C. L., & Ahmed, P. K. 2004. The development and validation of the organisational innovativeness construct using confirmatory factor analysis. *European Journal of Innovation Management*, 7(4): 303–313.
Wang, C. L., & Ahmed, P. K. 2007. Dynamic capabilities. A review and research agenda. *International Journal of Management Reviews*, 9(1): 31–51.
Wasti, S. N., & Liker, J. K. 1997. Risky business or competitive power? Supplier involvement in Japanese product design. *Journal of Product Innovation Management*, 14(5): 337–355.
Zhu, K., & Kraemer, K. L. 2002. e-Commerce metrics for net-enhanced organizations. Assessing the value of e-commerce to firm performance in the manufacturing sector. *Information Systems Research*, 13(3): 275–295.