Journal of Business Research 85 (2018) 32–50

Contents lists available at ScienceDirect

Journal of Business Research

journal homepage: www.elsevier.com/locate/jbusres

Resource configurations, product development capability, and competitive advantage: An empirical analysis of their evolution

Haritha Saranga[a,*], Rejie George[a,*], Judith Beine[b], Ulli Arnold[c]

[a] Indian Institute of Management Bangalore, Bangalore, India
[b] Daimler, Stuttgart, Germany
[c] University of Stuttgart, Stuttgart, Germany

ARTICLE INFO

Keywords:
Resource based theory
Auto component industry competitive advantage
Emerging market
Product development capability

ABSTRACT

We draw on prior work in the strategy domain and provide empirical evidence of how interactions of resources (or resource configurations) underlying an important capability (i.e., product development capability) lead to differential levels of competitive advantage in a unique emerging economy setting. Our work provides a nuanced understanding of how the efficacy of a specific capability varies depending on changes in the product market environment, such that certain resource configurations facilitate competitive advantage during particular periods of time, while others do not. The study uses rich qualitative and quantitative data gathered through primary and secondary sources to test the conjectures. Our work also demonstrates that while interactions of resources matter significantly in providing competitive advantage, in isolation, these resources do not matter.

1. Introduction

According to Resource Based Theory (RBT), firms that possess valuable, rare, imperfectly imitable, and non-substitutable resources gain competitive advantage, owing to firm heterogeneity in the distribution of these resources and their imperfect mobility across firms (Barney, 1991). However, along with resources, firms also need to possess organizational capabilities to coordinate and exploit these resources and therefore Barney in his subsequent work stressed the importance of organizational capability to exploit the resources a firm possesses in order to attain and sustain competitive advantage (Barney, 1997). These resources and capabilities constitute bundles of tangible and intangible assets that include management skills, organizational processes, information and knowledge that the firm controls (Barney, 2001).

In addition to the emphasis on resources and capabilities, which represents an important element in understanding competitive advantage, there was an increasingly felt need to probe the evolution of capabilities and their underlying linkages closely. In line with this belief, some prior work (e.g. Black & Boal, 1994) has argued that the interactions (or linkages) between various tangible and intangible resources[1] enable firms to develop higher level routines leading to sustainable competitive advantage. Winter (2000) considers these higher level routines to be analogous to organizational capabilities.[2] Black and Boal (1994) argue that strategic resources that are part of a complex network can enhance, compensate, detract or substitute for each other, such that the combination of resources is important to gain competitive advantage that is sustainable in the long run. Therefore, understanding how the *interactions* of these resources take place and enable evolution of capabilities (or higher level routines), potentially provides an important perspective towards unpacking the drivers that lead to competitive advantage in firms.

Concurrent to the development of the theoretical building blocks pertaining to RBT, there have been several empirical studies that have focused on measuring the attributes of resources and capabilities and examining their implications on competitive advantage. (e.g., Barney, 2001; Henderson & Cockburn, 1994). In addition, studies have also engaged with issues pertaining to how capabilities change over time and the implications of these capability related changes on competitive advantage (e.g., Barney, 2001; Levinthal & Myatt, 1994). However, despite the importance of the phenomena, relatively scarce evidence exists of studies that empirically establish the linkages between resources and capabilities and their evolution. There are even fewer studies in the context of emerging markets where firms engage with each other based primarily on previous relations and trust, rather than presence of formal organizational processes, routines and structures (Kumaraswamy, Mudambi, Saranga, & Tripathy, 2012).

* Corresponding authors.
E-mail addresses: harithas@iimb.ernet.in (H. Saranga), rejieg@iimb.ernet.in (R. George), Judith.beine@web.de (J. Beine), ulli.arnold@bwi.uni-stuttgart.de (U. Arnold).

[1] Black and Boal (1994) use the term 'resource factor' whereas we stick to 'resource(s)' throughout the paper.

[2] Based on Winter (2000), we use higher level routines and capabilities interchangeably throughout the paper.

https://doi.org/10.1016/j.jbusres.2017.11.045
Received 21 February 2017; Received in revised form 27 November 2017; Accepted 29 November 2017

Therefore, in the current study, we first theorize on unique paths associated with the *interactions* of resources which lead to the development of a specific capability (i.e., product development capability), which eventually result in competitive advantage; and secondly empirically establish that specific resource configurations lead to differential levels of competitive advantage, represented by value-added performance. In addition, our empirical findings indicate that the efficacy of specific capabilities varies depending on the extent and nature of market dynamism (Eisenhardt & Martin, 2000), which results in certain resource configurations delivering a competitive advantage at specific periods of time.

We use the Indian auto component industry to investigate the linkages between resources and capabilities that were developed by the auto component firms in the context of product development, in an era that was characterized by substantially more market-based competition (Kumaraswamy et al., 2012). The automotive industry deals with integrated technologies and requires advanced technological and innovative skills from their component suppliers. This context enables us to examine how firm-level resources and capabilities emerge at a micro-level and their associated interlinkages, in a unique, natural laboratory setting where an emerging market is evolving from a protected and relation-based era to a market-based competitive setting (Kumaraswamy et al., 2012). Moreover, during this era, the Indian auto component firms had already matured through substantial upgrades of quality and technological capabilities (Iyer, Saranga, & Seshadri, 2013)[3] such that the resources and their interlinkages underlying the evolution of product development capability in creating competitive advantages are likely to be prominently discernable. Further note that, our setting includes an exogenous market shift due to global recession, which allows us to examine how the ideal resource configuration shifts because of external shocks.

To test our theoretical conjectures, we collected rich and unique primary data from practitioners in the field to (i) determine the measurement items that constitute the resources, (ii) identify the resources that underlie organizational capabilities and (iii) examine the interactions among resources and the paths to differential competitive advantage. Specifically, we examine the influence of the interactions of the constituent resources such as innovation process structure (IPS), R&D, past experience in product and process development (PEPPD), and tooling development and manufacturing (TDM) in creating firm level innovative capabilities and associated linkages to competitive advantage, as represented by value-added performance in the Indian auto component industry. The empirical results largely support our conjectures. We believe this study to be a pioneering attempt at unpacking the underlying resources and the constituent interactions leading to product development capability.

To summarize, our attempt in this paper has been to strive for a twofold contribution. Firstly, we draw on prior work in the strategy domain and in particular the Black and Boal (1994) framework owing to its analytical tractability to theorize how product development capability paths evolve through the interactions of the various resources (IPS, R&D, PEPPD and TDM) which eventually lead to differential levels of competitive advantage. In our work, we hypothesize that two of these product development capability paths lead to sustainable competitive advantage while the remaining two do not provide sustainable competitive advantages. In addition, we also draw on the dynamic capabilities literature [e.g., Teece, Pisano, & Shuen, 1997 and Eisenhardt & Martin, 2000] to link the evolution of these product development capability paths to changes in the external product market environment. Our attempt at building a bridge between the two approaches reflects a nuanced understanding of how the efficacy of a specific capability (i.e., product development capability) varies depending on changes in the product market environment, such that certain resource configurations facilitate competitive advantage during particular periods of time, while others do not. Our contention is that by overlaying the dynamic capabilities approach over the Black and Boal (1994) framework, we are able to provide a granular (or micro foundational) depiction of these resource factor interactions, product development capability paths and how their efficacy varies over time. The combination of being able to chart out the evolution of the resources and capabilities (exemplified in the resource factor interactions and the capability development paths) from a micro foundations level in the organization to changes in the product market environment, we believe, is where we are able to demonstrate the dynamic reconfiguration of resources in response to the external market. By doing so, our submission is that we provide a contribution beyond either Black and Boal (1994) or Eisenhardt and Martin (2000) taken in isolation and are able to build on their important contributions.

Secondly, our work is set in a unique context. The automotive industry in India has been evolving from a protected regulated environment to a more market based regime. This has significantly influenced the resource base possessed by a key supplier to this industry (i.e., the automotive component manufactures). This gives us a unique opportunity to examine, using rich qualitative and quantitative data gathered through primary and secondary sources, how product development capability paths evolve through the interactions of the various resources (IPS, R&D, PEPPD and TDM) eventually leading to differential levels of competitive advantage owing to the shift in market dynamism. There is a paucity of work which provides such a granular analysis across multiple levels and which ties it with shifts in the external market environment in an important emerging economy. The automotive component industry with its use of integrated technologies is particularly well suited to this investigation.

We therefore believe that the combination of the above two contributions make our work novel and further the literature in this domain. We also believe that our work is quite timely as it has practitioner utility with regard to informing managers about how the efficacy of a specific capability varies depending on changes in the product market environment and provides them with a perspective to assess and understand this. In the sections that follow, we develop the context, build the hypothesis, introduce the data, methods and analysis and finally conclude.

2. Context, theory and hypotheses development

In this study, we investigate the product development capabilities developed by the Indian auto component firms during an advanced phase of liberalized era (post 2002). During the early phase of liberalization (1991–2002), the technology licensing agreements and/or technology joint ventures (JVs) with foreign tier-1 suppliers provided the indigenous suppliers access to new products and technologies, while the vendor development activities by foreign automakers, such as Suzuki helped the indigenous suppliers to build quality and productivity-related competencies (Kumaraswamy et al., 2012). However, as the foreign suppliers saw growth opportunities and began entering the market (following further deregulation) by establishing production facilities in India, indigenous suppliers began to lose access to new products through the licensing and JV route. Firms had to therefore choose between either continuing as suppliers of low value-added components or invest in in-house R&D and develop new product development (NPD) capabilities to climb up the value chain.

By the time all the restrictions on imports and FDI investments were lifted and a "New Auto Policy"[4] was adopted in 2002 (Kumaraswamy

[3] These empirical studies demonstrated that unlike many Latin American and CIS economies, the slow pace of liberalization in India allowed the Indian auto component firms to survive the initial phases of liberalization by upgrading quality and technological capabilities.

[4] The government of India came up with the 'New auto policy' in 2002 to develop India as a global hub for small cars and an Asian hub for auto components. 100 percent MNC ownership was allowed and local content, export, minimum investment obligations were removed. As a result, MNC automakers and components firms increased their ownership stakes in JVs. http://www.siamindia.com/cpage.aspx?mpgid=16&pgid1=17&pgidtrail=79

et al., 2012), i.e., during the advanced phase of liberalization, the Indian automobile market began to experience significant competition with the entry of a large number of multinational (MNC) automakers, a wide variety of new product introductions, and the resulting price pressures (Okada, 2004). As the demand for automobiles in the developed markets of the U.S., Europe, and Japan stagnated and the markets in emerging economies exhibited significant growth potential, the focus of most global automakers shifted towards the emerging markets, especially China and India. The price-sensitive nature of customers in these markets coupled with the differences in emission norms encouraged auto assemblers to either develop completely new products for emerging markets or at least adapt existing products to local customer needs through significant modifications (Jonnalagedda & Saranga, 2017). Some MNC automakers and tier-1 suppliers began exploring the gradual involvement of local suppliers in NPD activities in order to bring the costs under control. Subsequently, these MNCs established their R&D centers in India (ACMA, 2014) and began to carry out co-design and co-development activities with the indigenous suppliers that exhibited potential for product adaptations and new product development. In addition to these opportunities, the incentives by the Indian government for the local production of small cars, tax concessions on R&D investments, and the provision of world-class facilities for automotive testing, certification, and homologation facilities etc. also encouraged the indigenous component firms to acquire NPD capabilities (Kumaraswamy et al., 2012).[5] Such investments into product development capabilities by indigenous auto component firms over time helped them climb up the value chain and participate in higher value-added activities. *(Please see the Appendix for additional details on the Indian automotive industry landscape)*.

2.1. Theoretical anchor

As alluded to earlier, in Barney (1991), there is no explicit consideration associated with regard to how the resources interact with each other and how these are embedded both in the local network within the firm as well as outside the firm. In other words, it *"…treats the evaluation of resources from a standalone viewpoint ignoring how resources are nested in and configured with one and another…"* (Black & Boal, 1994: 132). This represents a crucial lacunae as heterogeneous *'bundles of resources'* rather than a *'resource in isolation'* is considered to be key determinant in causing differential levels of firm competitive advantage (Dierickx & Cool, 1989; Grant, 1991). Black and Boal (1994) explicitly address this deficiency by examining (1) the inter-resource interactions, (2) the inherent resource characteristics along dimensions associated with tradability and acquisition process (i.e. stock or flow resources) and (3) whether the resources are linked to complex networks which possess attributes associated with substitutability of the resource, and their compensatory, enhancing and suppressing abilities. A compensatory relationship "exists when a change in the level of one resource is offset by a change in the level of another resource", an enhancing relationship "exists when the presence of one factor magnifies the impact of a different factor", and similarly, a suppressing relationship "exists when the presence of one factor diminishes the impact of the other".[6] Rather than individual resources, specific configurations of these resources are argued to yield several unique pathways to sustainable competitive advantage. Black and Boal (1994) thus provide an actionable framework which builds on the pioneering contributions of Barney (1991) which operationalizes the underlying tenets of resource based view (RBV). We therefore use Black and Boal (1994) as a conceptual anchor owing to its analytical tractability in our attempt at uncovering the microfoundations underlying interactions of resources, which lead to the development of capabilities.

Our focus on the underlying interactions mirrors the work of Winter (1995) and Teece et al. (1997). Winter (1995) conceptualizes routines as a *'web of coordinating relationships'* which enable the coordination and deployment of resources, thereby alluding to the interactions among them. Teece et al. (1997) conceptualize *'dynamic capability'* as *'the firm's ability to integrate, build and reconfigure internal and external competences to address rapidly changing environments'* (Teece et al., 1997: 516). These dynamic capabilities help us understand *'how combinations of competences and resources can be developed, deployed, and protected'* (Teece et al., 1997: 510). Once again the emphasis on interactions or linkages among resources that underlie particular resource combinations can be discerned. In addition, given our context, we aim to identify the type of resources that differentiate firms in an emerging economy from one another vis-à-vis firms in a developed economy context.

We also draw on Eisenhardt and Martin (2000) to illustrate the impact of *'market dynamism'* in influencing the efficacy of specific higher level organizational capabilities. Our overlaying of Teece et al. (1997) and Eisenhardt and Martin (2000)'s work on Black and Boal (1994) incorporates a temporal element to the impact of capabilities on competitive advantage. Finally, as advocated by Lee (1991), we adopt an integrated framework that combines both *'positivist and interpretive approaches'* in developing our theoretical conceptualization as described below.

2.2. Identification of resources underlying capabilities

To illustrate the evolution of capabilities in an organization, we focus on the evolution of product development capability, which has received attention in prior strategic management literature (Eisenhardt & Martin, 2000; Kusunoki, Nonaka, & Nagata, 1998; Winter, 2000). By drawing on Black and Boal (1994) and Dierickx and Cool (1989), we define 'resources' as tradable/non-tradable asset flows/stocks. We define 'measurement items' as the underlying set of variables that constitute a specific resource. In order to identify the measurement items and resources underlying product development capability of firms in the indigenous Indian auto component industry, we followed a multi-tiered process drawing on suggestions indicated in Armstrong and Shimizu (2007) regarding the use of survey methodologies for the purpose of obtaining first hand and more appropriate assessments of individual resources than would be possible through relying solely on secondary sources. In the first phase, we engaged in in-depth interviews with senior industry practitioners aimed at determining the various measurement items that underpin the resources. Concurrently, we searched the available literature to identify constituents of microfoundations underlying the product development capabilities and mapped these with the inputs from the industry experts. Our interviewees identified two main types of resources that they felt were critical to the development of product development capability in the Indian context. The first type was related to the R&D investments, organizational processes and product development structure related aspects, while the second was to do with the organizational learning and past experience of participating in new product and process related activities. Cumulatively, this exercise generated a list of measurement

[5] For example, Advik Hi-Tech, a supplier of tensioners to two-wheeler manufacturers decided to set up an R&D facility in Pune and began to develop in-house design and development competencies. Advik developed some crucial engine parts for Honda Motors and Scooters India Ltd. and also got an order for oil pump assemblies from other MNCs such as Yamaha, Piaggio, and Lombardini. In order to improve their product development competencies and with the intention of foraying into the four-wheeler oil pump segment, Advik entered into a technical tie-up with FMO Technologies of Germany in 2009. This technological collaboration led to the development of oil pumps for passenger cars and commercial vehicles. As a result of these efforts, Advik received an order of about €1 million to supply transmission oil pumps to ZF Friedrichshafen of Germany for its 9-speed transmission systems in 2012. http://www.autocarpro.in/ap/features/3361/2012-western-india-special-advik-hi-tech-bags-zf-oil-pumps (last accessed on 19th March 2015)

[6] Please refer to pages 138 and 139 of Black and Boal (1994) for details on compensating, enhancing and suppressing relationships.

Table 1
Description of measurement items underlying resources.

Acronym	Variable	Description of the survey question and measurement of the variable
IP-1	IP Stage Gate	Is the structure of innovation process **Stage Gate**? The variable is measured on a five-point interval scale:1, 'never heard'; 2, 'do not intend to implement'; 3, 'not yet begun'; 4, 'standard implementation'; 5, 'advanced implementation'.
IP-2	IP parallel Development	Is the structure of innovation process **Parallel Development**? The variable is measured on a five-point interval scale:1, 'never heard'; 2, 'do not intend to implement'; 3, 'not yet begun'; 4, 'standard implementation'; 5, 'advanced implementation'.
IP-3	IP Integrated Development	Is the structure of innovation process **Integrated Development**? The variable is measured on a five-point interval scale:1, 'never heard'; 2, 'do not intend to implement'; 3, 'not yet begun'; 4, 'standard implementation'; 5, 'advanced implementation'.
PrDPF	Process development project frequency	How often was the supplier integrated by his customers into process development projects during the past 5 years? The variable is measured on a five-point interval scale:1, never; 2, 'seldom'; 3, 'sometimes'; 4, 'often'; 5, 'most often'.
PDPF	Product development project frequency	How often was the supplier integrated by his customers into product development projects during the past 5 years? The variable is measured on a five-point interval scale:1, never; 2, 'seldom'; 3, 'sometimes'; 4, 'often'; 5, 'most often'.
IPMM	IP major modification[a]	What was the share of product or process development projects into which the supplier was integrated by his customers, focusing on 'major modifications' during the past 5 years?
IPND	IP new design[a]	What was the share of product or process development projects into which the suppliers were integrated by customers, focusing on 'new design'/'new process' during the past 5 years?
IPRND	IP radical new design[a]	What was the share of product or process development projects into which the supplier was integrated by his customers, focusing on 'radical new design'/'technologically new process' during the past 5 years?
TM	Tooling manufacturing[a]	What was the share of tools manufactured by the supplier as a percentage of all tools used during the past 5 years?
TD	Tooling development[a]	What was the share of tools developed by the supplier as a percentage of all tools used during the past 5 years?
RDE	R&D employees[a]	What was the number of employees working in the supplier's R&D department as a percentage of total number of employees?
RDI	R&D intensity[b]	What were the supplier's average R&D investments during the past 5 years, as a percentage of total turnovers?

[a] The variable is measured in percentages, on a 0–100 scale.
[b] Data for this variable was obtained from the *Prowess* database.

items that yielded the necessary inputs for the creation of our initial survey instrument. Sample questions from the questionnaire corresponding to each of the two categories are provided in the Appendix, Fig. A1. The survey instrument was then extensively pretested on senior executives from the Indian automotive industry and modified to ensure its understandability, completeness, accuracy, and length (Bailey, 2008). Armstrong and Shimizu (2007) note that an approach based on in-depth interviews with focal firms and industry experts in developing survey instruments help in mitigating "the construct measurement problems in RBV research". The key measures from the questionnaire survey that were used in the study are reported in Table 1. Since our primary objective was to assess product development competencies developed by the emerging market firms, the questionnaire survey focused only on indigenous Indian auto component suppliers.[7]

During the second phase, using the cutoff sampling method (Knaub, 2007), we created a sample of a common set of companies using the Center for Monitoring Indian Economy's (CMIE) Prowess and the Automotive Component Manufacturers Association's (ACMA) databases. The ownership information provided in these databases enabled us to identify a total of 216 indigenous Indian suppliers for the questionnaire survey.[8]

Subsequently, we contacted these 216 firms by phone or through emails to determine their interest in participating in the questionnaire survey.[9] The interviewers visited the firms that responded positively to our requests for conducting face-to-face interviews. A team of five interviewers, coordinated by the study's first and second authors, was formed to conduct various face-to-face-interviews all over India. All the members of the interview team possessed several years of experience in conducting interviews in the Indian industry and the necessary background knowledge. To ensure uniformity and consistency across all the interviews, a field manual including explanations and remarks regarding questions, response options, terms, abbreviations, survey objectives, and general rules of neutral interviewer behavior was created.

Generally, two to three senior executives from the purchasing, vendor development, R&D, and product development departments had to be interviewed to cover all the sections of the questionnaire. It took between four to five hours and multiple visits per company to complete one questionnaire. Approximately 350 h were spent in total in interviewing various industry executives to collect the primary data for our questionnaire survey.[10] We gathered data on 74 indigenous Indian suppliers, which entailed a response rate of 34.26%, which is reasonable given the detailed nature of the questionnaire. A non-response analysis (Kalton, 1983) was carried out. No noticeable problems could be identified with regard to the companies that did not participate in the survey.

During the third phase, we carried out an exploratory factor analysis (EFA). The purpose of EFA was two-fold: (i) to identify the most important constructs and (ii) to reduce the number of independent variables for our second stage analysis. EFA is an appropriate technique in this context as it allows us to consolidate highly-correlated variables into groups and separate them from less-correlated groups with minimal loss of information (Gorsuch, 1997). These groups that combine multiple variables are termed as 'factors' (Hair, Black, Babin, Anderson, & Tatham, 2010), which can be used in the subsequent empirical investigations instead of the original data (Gorsuch, 1997). Besides structuring variables, the EFA can be used for data reduction through determination of factor values (Gorsuch, 1997). Note that these 'factors' correspond to the 'resource factors' as indicated in Black and Boal (1994), which we refer as 'resources' in our study.

In the current study, the EFA is carried out using principal component analysis as the extraction method and Varimax rotation with Kaiser Normalization as a rotation method. Note that the EFA was carried out separately for each of the two categories of resources identified by our industry experts, in order to retain the distinction made by them and to obtain separate factors under each category. A total number of 20 measurement items from the questionnaire survey yielded four resource factors. The resulting factors and the corresponding variable groups are listed in Table 2.

[7] The indigenous Indian auto component suppliers segment includes indigenous Indian suppliers (both tier-1 as well as tier-2 suppliers) and suppliers that are a joint venture between a local (> 50%) and a foreign company (< 50%), with at least 51% control residing with the Indian partner.

[8] The Indian auto component industry in 2007 comprised 597 companies from the organized sector that were mainly distributed across three clusters located in the Northern (the national capital region in and around Delhi), Western (Pune and Mumbai regions), and Southern (Chennai and Bangalore regions) parts of India.

[9] In order to encourage participation, we promised to share the overall findings from the study that would enable the individual participating companies to benchmark their efforts vis-à-vis others.

[10] The participants were assured that the gathered data and information would be used only for academic purposes and would be processed anonymously.

Table 2
Exploratory factor analysis results for zero-order routines and resource factors (Rotated Component Matrix).

		Component	
		1	2
Innovation process structure (IPS)	IP stage gate	**0.793**	0.040
	IP parallelization	**0.786**	− 0.029
	IP Integration	**0.722**	0.165
R&D	R&D Employees	0.139	**0.812**
	R&D expenses	− 0.017	**0.843**
Past experience in product and process development (PEPPD)	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 design and manufacturing (TDM)	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. Based on the type of variables that constitute each of the factors, we named the factors as follows: 'Innovation process structure (IPS)', 'R&D', 'Product and process development experience (PEPPD)' 'Tooling Development and Manufacturing (TDM)'.

In order to verify and gain better understanding of the resultant constructs from EFA, we went back to the industry experts and carried out further interviews with an entire gamut of industry practitioners, which included multinational customers (automakers, tier-1 suppliers), indigenous customers (automakers, tier-1 suppliers), and indigenous suppliers. This approach is in line with Lee (1991), who suggests the researcher to refer back to the subjective understanding of the observed human subjects, during the second level of analysis, in order to test the validity of the resulting interpretive understanding of the researcher. These interviews (which together with phase-1 interviews yielded 45 h of information and rich insights) helped us gain better understanding of the four critical factors from the EFA analyses and name them appropriately: (i) Innovation Process Structure (IPS), (ii) Research and Development (R&D), (iii) Past Experience in Product and Process Development (PEPPD) and (iv) Tooling Design and Manufacturing (TDM) ability (see Illustration 0 in the Appendix), as well as discern how the interactions among these resource factors contribute towards development of product development capability. Below we provide a brief description of each of the four resources and their role in development of product development capability.

2.2.1. Innovation process structure (IPS)

Our initial interviews during phase-1 revealed that the automakers and Tier-1 customers in the Indian automotive industry (especially the multinational (MNC) customers) look for established NPD processes and structures, while evaluating a supplier on innovative capabilities. We learnt that, existence of a standard innovation structure enables effective collaboration and coordination between the suppliers and customers as they go back and forth, NPD being an iterative process. A detailed search of the literature indicated that such a structuring of innovation processes can be supported by a *stage-gate* process, or a process to *parallelize development* activities, or an *integrated product development* process (Flynn, Flynn, Amundson, & Schroeder, 2000). The stage-gate approach for example, divides the product development process into smaller and more manageable stages and divides the responsibilities and resources among various members. Gates essentially involve a set of criteria that the product must pass before moving to the next stage. Parallel development (also called concurrent engineering) involves cross-functional teams that plan product and process activities simultaneously in order to compress development time. Note that development activities can overlap, and stages and gates also can overlap in this approach. The integrated development approach includes cross-functional teams along with suppliers and customers in on-going contact/interactions with an objective to enhance their participation in product development efforts/decision making. We therefore incorporated in the survey instrument, a set of questions that are intended to measure the level of maturity of these product development processes, as well as any other firm specific *process (please see Question 2.1 in* Illustration 0 *in the Appendix*).

Subsequently, during the EFA, all three measurement items, viz., stage gate, parallel and integrated development loaded onto a single resource. A consultation with our interviewees revealed that, indigenous suppliers who were engaged in NPD activities were readily adopting any product development process that the specific customer is accustomed to, giving rise to presence of all three development processes. This could be the reason why all three measurement items were loading onto a single resource factor. Since this resource essentially captures the structure of a firm's innovation processes, we named this resource, Innovation Process Structure (IPS).

2.2.2. Research and development (R&D)

Our interviewees, the executives belonging to both the supplier as well as customer firms, especially the indigenous customers, believed that in-house R&D is necessary to develop product development capability. R&D investments were also encouraged by the Indian government through tax incentives and were considered necessary to internalize the knowledge acquired through the licensed technologies. The literature survey also revealed that investments into research and development activities along with the personnel involved in these activities are critical for carrying out innovative activities (McDermott & Corredoira, 2009; Nag & Gioia, 2012; Petroni & Panciroli, 2002). In our survey instrument we therefore included questions pertaining to the firm's investments into R&D during the past five years, as well as the number of R&D employees. Our subsequent EFA analysis loaded both R&D personnel and R&D investments onto a single factor, which we named as 'R&D' resource. According to the industry practitioners, the various elements associated with the personnel involved in R&D such as an employee's knowledge, experiences, and skills are intangible in nature and therefore are heterogeneous across firms. However, many industry experts that we interviewed also opined that most R&D investments in the Indian context were focused on manufacturing process improvement rather than product development related activities.

2.2.3. Past experience in product and process development (PEPPD)

Indigenous auto component firms that participated frequently in product and process development activities involving major modifications as well as new and radically new designs seem to accumulate significant learning and experience in innovative activities, based on our interactions with industry experts as well as extant literature (Pisano, 1994Yelle, 1979). While past experience of participating in product and process development activities was in general perceived to be valuable by the automakers and Tier-1 customers, there were differences in these valuations based on the type of product/process, level of development (incremental versus radical, for example) and nature of experience (generic versus domain-specific) etc. Firms that had acquired valuable experience in development activities nevertheless were more likely to embody inter-project transfer of knowledge, which would enhance the shared experience among the people involved in the product development activities (Nag & Gioia, 2012; Schilling, Vidal, Ployhart, & Marangoni, 2003; Teece, 2007). Therefore in our survey instrument, we had designed a set of questions to capture the level of participation of indigenous supplier firms in a variety of product and process development activities of their customers. During the EFA, all the measurement items that represented the frequency of participation, as well as the percentage of product and process development projects involving major modification, new design and radically new design, loaded onto a single factor. After due consultations with industry practitioners, we named this resource PEPPD, as it represented the cumulative experience of participating in product and process development activities.

2.2.4. Tooling development and manufacturing (TDM)

The senior executives from automakers and tier-1 customers during the development of our survey mentioned that one of the important criteria they look for is to what extent a supplier is self-sufficient in developing the tools, dies, and fixtures needed to produce the new products. Most industry experts from supplier firms also identified in-house tooling design and manufacturing expertise to be a valuable addition, as it significantly reduces the product development lead times as well as the prototype development costs. According to them, the iterative nature of NPD activities constantly require tooling related expertise during the prototype building and testing phase. If this expertise is not available in-house, they have to coordinate with separate machine tool suppliers, which results in constant delays and cost overruns. We therefore incorporated questions to measure the percentage of tools designed in-house and the percentage of tools manufactured in-house by the sample firms. As both of these variables loaded onto the same factor during the EFA, we named this resource TDM. Given the importance that customers placed on the tooling-related resourcefulness of supplier firms, which became more pronounced during the advanced phase of liberalization (due to cost and time-to-market pressures), TDM was found to be a critical resource.

2.3. Conceptual framework

As indicated above, the detailed practitioner interviews and the rich primary data allowed us to empirically estimate the four resources as well as validate them qualitatively. In addition, our qualitative analysis revealed that, all four resources can be considered as ‘asset stocks’ as they cannot be adjusted immediately and need to be built up over time from asset flows (Dierickx & Cool, 1989). However, IPS and R&D, the two factors belonging to the first category may be considered as ‘tradable’ in the market for the following reasons – for example, an organization that is deficient in IPS can possibly ally with or acquire another organization that has an established IPS. Another scenario, although rare, is enrollment of an entire team of product development engineers that were working for an established company in a similar field, with a successful innovation structure in place. This might enable the recruiting firm to replicate the formal innovation process structure, with the knowledge acquired from its members. The R&D resources can also be acquired in a similar fashion. For example, a supplier of rubber parts in the automotive cluster based in Western India acquired a product development team and R&D scientists (along with some machinery and equipment that was used by the engineers and scientists) in the early 1990's, when a competing firm was folding up its operations (as it was foraying into other businesses). Therefore, although they are not commonly traded in the markets, one may consider IPS and R&D to be ‘tradable’ factors, if one were to take more conservative view.

On the other hand, the next two factors PEPPD and TDM, which are categorized under organizational learning and experience related variables by the practitioners, are ‘non-tradable’ in nature, as they are not readily available in factor markets. While the enlisted members of the product development and R&D teams may bring their own past experience into the new organization (as in the above example), major part of this experience is typically context dependent and relevant to the customers and suppliers in the previous organization. Similarly, the ability to design and manufacture tooling equipment for a new product not only requires appropriate skills and knowledge, it also needs close collaboration with the customers and suppliers that are involved in the co-development of the product. Therefore, as PEPPD and TDM are highly context dependent and embedded within the organizations, and are semi permanently tied to the firm (Barney, 1991), we consider them to be non-tradable.

While our interviews and information gathered through literature survey asserted that all the four factors play an important role in developing the product development capability, our interpretation of various examples given by the industry practitioners and our observations from case studies of supplier firms led us to believe that, they may not result in sustainable competitive advantage in isolation. In line with Black and Boal's arguments, we believe in our context too, it is the interactions between strategic resources that contribute towards firm level competitive advantage.

Therefore, following the intuition for categorization of resources into two separate buckets by the industry practitioners and for the reasons outlined above, we focus our investigation on the two strategic resources, namely, IPS and R&D and their inter-resource relationships with PEPPD and TDM. Using our results from factor analysis, further insights from the interview data, and drawing from Black and Boal (1994) we theorize and develop a conceptual framework that establishes appropriate linkages between the underlying microfoundations to resources, and various paths that connect resources to the firm level competitive advantage through capabilities (or higher level routines). Since the core of microfoundations takes time to develop and to lead to competitive advantage, following Eisenhardt and Martin (2000) we incorporate the time element as well in our conceptual framework, which is depicted in Fig. 1 below (various levels ($n - 2$ to $n + 1$) and time dimension ($t - 5$ to $t + 4$) related details of the conceptual framework are discussed in more detail in Data and Methods section).

While IPS and R&D are critical inputs to attain firm level competitive advantage, their characteristic traits, such as value, rareness, inimitability and organizational orientation will yield results only when these resources are interacted with other critical resources that have cogency relationships, such as of compensating and/or enhancing nature. These interactions we believe would result in development of capabilities over a period of time, further leading to firm level competitive advantage, as shown in Fig. 1. We investigate these inter-resource relationships and the conditions leading to competitive advantage in more detail below for each of the two strategic resources, IPS and R&D and present detailed arguments to support the subsequent hypotheses.

2.4. Hypotheses development

The American Productivity and Quality Center study on performance and best practices in new product development (NPD) found that putting a formal innovation process structure (IPS) in place is one of the critical best practices followed by the U.S. manufacturing firms (Cooper, Edgett, & Kleinschmidt, 2004). However, based on Black and Boal (1994), a resource like IPS, which is a tradable asset stock, will yield firm level competitive advantage only when it satisfies certain criterion and is part of a resource configuration with appropriate cogency relationships. For example, any tradable asset stock should (i) be part of a complex network, (ii) not have a substitute, (iii) not be in a compensatory relationship with another tradable network factor, (iv) be in a compensatory relationship with a non-tradable network factor, or (v) be in an enhancing relationship with another network factor, and (vi) not be in a suppressing relationship with another network factor. If this was not the case, it is highly unlikely that, any resource, however critical it may be, will yield sustainable competitive advantage on its own.

In order to assess if and how IPS meets the criterion discussed above, we take a closer look at the network configuration that IPS is embedded in. IPS is clearly not a self-contained network but is an integral part of a value chain in a larger structural network. IPS in any organization involves linkages with other resources within its local network as well as factors external to its network. The local network for

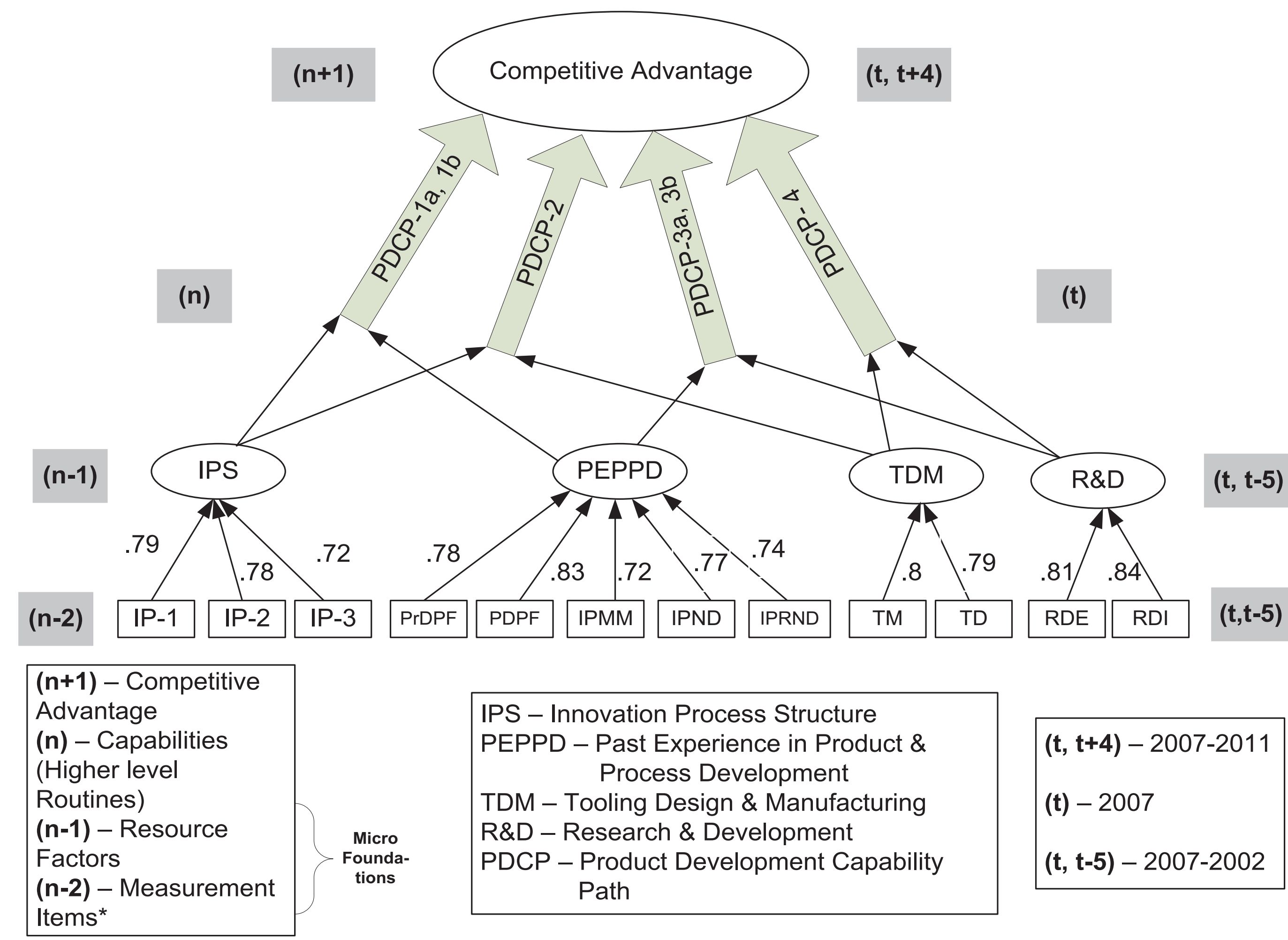

Fig. 1. Conceptual Diagram Explaining the Linkages from Resources to Capabilities/Higher Level Routines and Competitive Advantage
*Note that Measurement Items are defined in Table 1
** While the interactions between various resource factors (IPS, PEPPD, TEM and R&D) leading to capabilities and subsequently to competitive advantage is adopted from Black and Boal (1994), the time element 't', which captures changes in market dynamism is adopted from Eisenhardt and Martin (2000).

IPS for example would involve employees from design, development, product engineering, marketing, and production functions interacting with one another. The structural network on the other hand would involve suppliers, customers, and other channel partners within the value chain. The structural network members will be able to *sense* the technological synergies among the various value chain partners as and when their engineers engage with each other during the product development projects (Teece, 2007). In the automotive industry, the product development engineers and the artifacts such as designs and drawings emanating from the IPS of a tier-1 company would have to interact with an automaker (who is the customer), a tier-2 company (which develops/supplies components), and a machine tool company (which supplies tooling equipment), and possibly a supplier of raw material. Consequently, IPS is part of a **complex network** involving interactions at multiple levels. These interactions, when effective, enable the integration of specialized and co-specialized assets resulting in innovative products that meet market requirements, enabling the firms to *seize* the market opportunities (Teece, 2007).

As defined before, structured innovation involves processes such as *stage-gate*, *parallel development* activities, and/or *integrated product development* (Flynn et al., 2000). While substitution of these processes with one another is feasible, the cumulative substitution of the entire innovation process structure with another factor is extremely unlikely. Therefore, we argue that IPS has no readily available **substitutes**.

Further, because structured innovation processes are deeply embedded in organizational capabilities and are tightly coupled with customer requirements (e.g., customer product development norms), we expect IPS to not readily have a compensatory relationship with another tradable network factor. However, we do anticipate the potential for a **compensatory relationship** with a non-tradable network factor such as past experience in product and process development (PEPPD), since it is found to be a significant determinant of product innovation in industries such as automobiles (Kusunoki et al., 1998; Lewin, Massini, & Peeters, 2011). On the other hand, PEPPD will be able to compensate only if it is domain-specific, as participants typically respond to the outcomes of their prior experiences of product development relating to that domain, and hence, will contribute towards continuous change (Feldman, 2000). If this is the case, then IPS in conjunction with domain-specific PEPPD could potentially lead to a highly sustainable competitive advantage for the firm that possesses these two factors, as the first four conditions mentioned above ((i) to (iv)), that are necessary to attain sustainable competitive advantage, are met. This is owing to the fact that a compensatory relationship of IPS with a non-tradable network factor such as domain-specific PEPPD magnifies the path effects due to the complex network elements and the offsetting abilities that are tied to firm-specific or very rare factors [Fig. 2, Product Development Capability Paths (PDCP)-1a]. Note that we describe the PDCPs in our study, drawing on Decision Trees, in particular, Fig. 5 of Black and Boal (1994).

To illustrate this phenomenon, we present the example of an

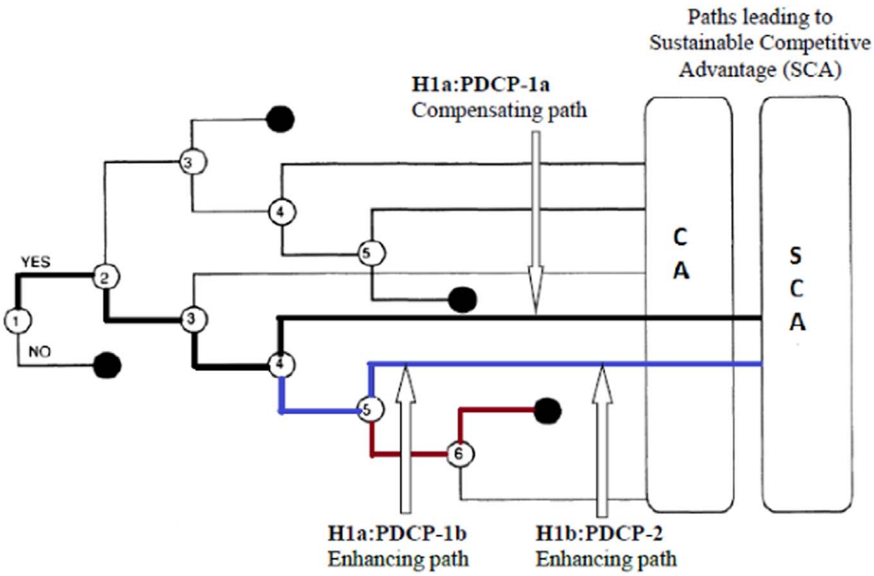

Fig. 2. Product Development Capability Paths (PDCP) Leading to Sustainable Competitive Advantage*
* Adapted from Fig. 5 on Tradable Asset Stocks in Black and Boal (1994, p. 144)
Note 1: Paths leading from 3, 4, 5, and 6 refer to the possible interactions between IPS and other network factors.
Note 2: PDCP-1 and PDCP-2 refer to the product development capability paths depicted in Fig. 1.
Note 3: The questions leading to various paths in Figs. 2 & 3 are described below in Fig. 3.

indigenous automotive firm, Super Auto Forge, as we had the opportunity to closely study their product development-related activities.

> Super Auto Forge,[11] an indigenous automotive company in India is a supplier of machined parts to automakers and tier-1 automotive companies in India. Sensing the market opportunities in the product development space, Super Auto Forge had just put a formal innovation process structure (IPS) in place, when it was approached by a MNC car manufacturer for the design and development of a critical suspension system for one of their newer models. When the automaker provided the broad specifications to Super Auto Forge's design team, fortunately, there were members in the team that had already participated in the design of similar products for other automakers. Using their previous experience (PEPPD) and after due consultation with other functional areas, the design team came up with slightly modified specifications for this particular customer, which would result in a standardized design that would be common across customers and hence would result in significant savings in development and manufacturing costs. The MNC customer appreciated the modified design and was delighted with the additional savings realized by the supplier. According to the company officials, without prior experience in design and development of critical components/systems for four-wheelers, such benefits are difficult to realize.

While the existence of IPS helped this supplier in attracting the MNC customer in the first place, it is the interaction between the IPS and past experience of product development team that enabled the modified design, giving them the necessary edge against competing suppliers in clinching the supply contract. This example clearly demonstrates how the interaction between IPS and PEPPD magnified the product development capability of this firm and enabled it to *seize* market opportunities, leading to sustainable competitive advantage, through superior value-added product development contracts.

If a firm does not possess domain-specific product and process development experience, it will not have a compensatory relationship with IPS. However, product and process development experience within the industry in general has a high likelihood of being in an **enhancing relationship** with IPS, since alternative solutions developed as part of the product development process often prove useful later on in the current project or for other future projects (Lewin et al., 2011). Therefore this path also leads to highly sustainable competitive advantage for a firm that possesses these two attributes (see Fig. 2, PDCP-1b).

Similar to PEPPD, tooling development and manufacturing (TDM) would also have the potential for an **enhancing relationship** with IPS, because it is less domain-specific and more generic in nature. We again use our learnings from Super Auto Forge to illustrate this:

> Over a period of time, Super Auto Forge had developed process development competencies (such as cold forging technology and warm forging technology) and associated product development competencies. They got an opportunity to supply CV joint parts (for front-wheel transmission of cars) to an MNC tier-1 company (GKN). At this point in time, while Super Auto Forge had already put IPS in place, it did not have the tooling equipment needed to obtain the close tolerances required for the final product, and hence had to be content with making rough-cut components, which were then sent to another indigenous tier-1 company for final finishing. The MNC customer was ready to provide the contract for the entire part to Super Auto Forge, if the latter procured the necessary technology and tooling equipment (which were not only very expensive to import, but also required royalty payments). Subsequently, with the help of their in-house tooling design and development abilities (TDM), Super Auto Forge developed the tooling equipment that was necessary to make the finished component and became a preferred supplier to both indigenous and MNC customers. Due to the in-house development of tools, they became very competitive on price compared to other CV joint manufactures in India, who had to pay royalties on imported technologies. Today, Super Auto Forge produces 90% of the CV joints that are assembled in the passenger vehicles manufactured in India and also exports them to tier-1 companies in Europe and the U.S in high volumes. Harnessing these competencies, Super Auto Forge has now become one of the top four global players in this segment.

Thus, the interaction between IPS and TDM (Fig. 2, PDCP-2) enabled this supplier to not only *sense* and *seize* market opportunities, but also create additional value by combining these two factors, and subsequently appropriate this superior value. The product development capability paths (PDCPs) can also be understood in the context of the *ostensive* and *performative* aspects of higher level routines (or capabilities). Feldman and Pentland (2003) termed the *ostensive* aspect of routine as 'structure', while the *performative* aspect—which embodies the actual performance of the routine by specific people at a specific

[11] For the background information, refer to http://www.superautoforge.net/ (Last accessed on 25 March 2015).

time in specific places—is termed as 'agency'. In our study, *IPS* embodies more of the *ostensive* aspects (structural) of the routine and *PEPPD* and *TDM* bring out the *performative* (agency) and the know-how elements, respectively. As argued by Feldman and Pentland (2003), each part is necessary, but neither part on its own is fully sufficient. Firms need to combine both aspects to harness the potential of organizational resources as a source of change. Therefore, cumulatively, these arguments and anecdotes lead us to posit the following hypotheses:

H1a. *Innovation process structure in conjunction with past experience in product and process development creates a product development capability path (PDCP-1a & 1b in* Fig. 2*), which leads to sustained competitive advantage as represented by superior value-added performance in the Indian auto component industry.*

H1b. *Innovation process structure in conjunction with tooling development and manufacturing creates a product development capability path (PDCP-2 in* Fig. 2*), which leads to sustained competitive advantage as represented by superior value-added performance in the Indian auto component industry.*

We next investigate the characteristic traits of R&D resource and its inter-resource relationships with other resources within its network configuration. Similar to IPS, R&D is integral part of the value chain in a larger structural network and is not a self-contained activity (Lewin et al., 2011). R&D function in any organization involves linkages with other resources within its local network as well as resources external to its network. For example, the local network for R&D would include interactions between R&D scientists, product design and development engineers, prototype builders, tooling department and production employees. The structural network of R&D would include research institutions, universities,[12] industry conclaves/conferences, machine tool manufacturers, and raw material suppliers. In the case of the automotive industry for example, the employees in the R&D department keep abreast of current advances in the technology domain by participating in national and international conferences, reading technical journals, and interacting with academia (Lewin et al., 2011). Consequently, R&D is part of a **complex network** involving interactions at multiple levels. These interactions allow the R&D employees to integrate knowledge outside as well as within the organization and consequently discover the progression of technological trajectories and associated market opportunities (Teece, 2007).

However, we expect R&D to have **substitutes**, especially in an environment laden with technological voids, wherein the norm is to seek advanced technologies from firms in developed countries. Typically, this transfer of technology takes place via licensing and/or technology joint ventures, with the caveat that the host country's regulatory norms offer adequate safeguards and assuming the technology provider is willing to transfer the technology.[13] While we do not expect R&D to have a compensatory relationship with a tradable network factor (Arora, Fosfuri, & Gambardella, 2001, p. 148 & p. 245), we do anticipate the potential for a **compensatory relationship** with a non-tradable network factor such as PEPPD. However, as argued earlier in the case of IPS, PEPPD will be able to compensate only if it is domain-specific. If this is the case, then R&D in conjunction with domain-specific product and process development experience could lead to competitive advantage for a firm that possesses these attributes. To illustrate this, we present the example of LG Balachandran & Brothers Ltd. (LGB), a tier-2 company that manufactures transmission chains for the two-wheeler and four-wheeler industries.[14]

> LGB has been participating in new product development projects of indigenous and multinational customers for more than a decade and most of their innovation in terms of product development has been incremental in nature. An MNC customer once approached LGB to adapt a bush (an important component in transmission chains) for the Indian market. The customer provided LGB with the sample and asked them to "benchmark with this sample and give equivalent or better performance product". The sample bush was rolled out of sheet metal; as a result, the geometry of the part was not perfect and affected the transmission chain's life. Drawing on their past experience in processes associated with similar products (PEPPD), LGB's R&D team felt that it would be better to use a different technology to make this particular product. After much deliberation, they came up with the idea of drawing the bush from solid metal instead of using sheet metal. This resulted in better geometry of the part, which in turn improved the transmission chain's life.

Therefore, the difficulties involved in radical product development – which requires substantive R&D competencies – at LGB were being compensated successfully by past domain-specific experience in the development of process technologies. As this example illustrates, the interaction between a tradable asset stock (R&D) and a non-tradable network resource (PEPPD) magnify their individual effects due to the complex nature of the network and compensatory relationships, leading to a higher level product development capability that ultimately results in competitive advantage at the firm level by providing opportunities for higher value-addition (Fig. 3, PDCP-3a).

A firm that does not possess domain-specific product and process development experience will not have a compensatory relationship with R&D. However, any product and process development experience within the industry has a high likelihood of being in an **enhancing relationship** with R&D.

> For example, the R&D team members of an indigenous supplier we interviewed gained expertise in simultaneous engineering (SE) while developing products for two-wheeler automakers (PEPPD). In due course, the supplier also ventured into the four-wheeler segment. This was an era characterized by enhanced competition among the four-wheeler automakers, requiring compressed vehicle development cycles. The supplier capitalized on this opportunity by leveraging the SE competency of R&D team, which enabled the concurrent development of components while the vehicle was being developed by the automaker, offsetting any developmental lags. For example, the scientists from R&D team used CAD/CAM to create 3D models of the component being developed. These 3D models enabled simultaneous product development between the supplier and customer in an iterative manner, eliminating the need for the development of multiple physical prototypes. The 3D models also enabled finite element analysis during the testing phase and could be uploaded seamlessly into the CNC machines during the production phase. All of this cumulatively reduced time as well as cost of development, testing, and manufacturing of the components for the supplier as well as the customer.[15]

This path, which represents the interaction between R&D and non-domain-specific PEPPD, also therefore leads to competitive advantage for a firm, due to the complex network and the enhancing relationship between these two resources (Fig. 3, PDCP-3b).

Similar to PEPPD, tooling development and manufacturing (TDM) would also have the potential for an **enhancing relationship** with

[12] For example, many indigenous automakers such as Tata Motors, Mahindra & Mahindra Ltd., and Ashok Leyland, and auto component suppliers such as India Pistons Ltd. collaborate on a regular basis with research institutes such as the Indian Institute of Science (IISc) on product and process development projects.

[13] Note that unlike IPS, wherein we do not expect a credible substitute, in the case of R&D, because substitutes potentially exist, the path to competitive advantage differs in our adaptation of Black and Boal's (1994) model. In addition, the availability of substitutes for R&D, we believe is context dependent. In general, we don't anticipate fungibility between in-house R&D and technology licensing in developed markets to the same extent as emerging markets.

[14] Based on an interview with LGB, conducted by the authors.

[15] To maintain confidentiality as per the request of the company we interviewed, we refrain from disclosing their identity here.

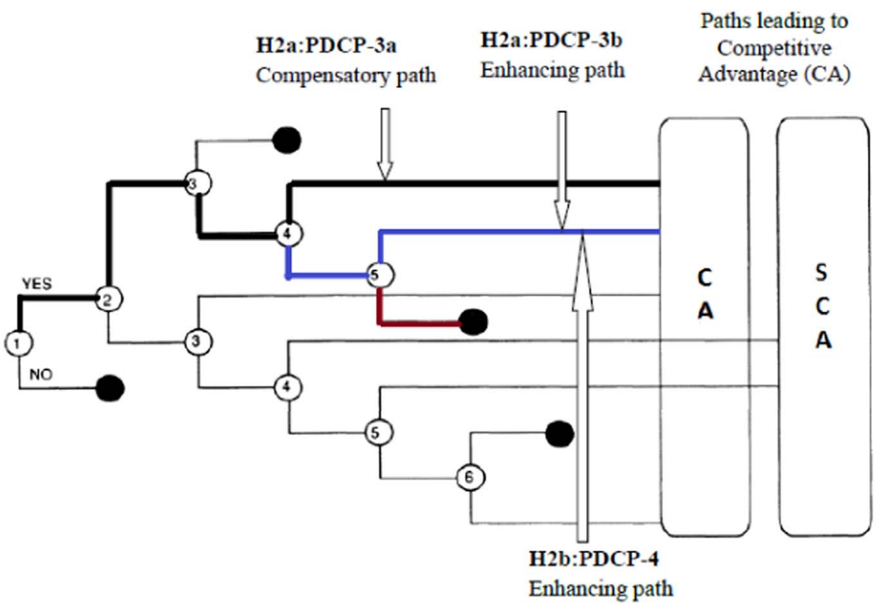

Fig. 3. Product Development Capability Paths (PDCP) Leading to Competitive Advantage*
* Adapted from Fig. 5 on Tradable Asset Stocks in Black and Boal (1994, p. 144)
Note 1: Paths leading from 3, 4, and 5 refer to the possible interactions between R&D and other network factors.
Note 2: PDCP-3 and PDCP-4 refer to the product development capability paths depicted in Fig. 1.
Note 3: The following questions relate to both Figs. 2 and 3. While the reference to IPS pertains to Fig. 2, the reference to R&D pertains to Fig. 3.
Note 4: The questions below are drawn from Black and Boal (1994, p.144)
1. Is this resource (IPS/R&D) a member of a complex network?
2. Do substitutes exist for IPS/R&D?
3. Is IPS/R&D in a compensatory relationship with a tradable network factor?
4. Is IPS/R&D in a compensatory relationship with a non-tradable network factor?
5. Is IPS/R&D in an enhancing relationship with another network factor?
6. Is IPS/R&D in a suppressing relationship with another network factor?
● Leads to either competitive parity or competitive disadvantage.

R&D, because it is less domain-specific and more generic in nature.

> For example, fine blanking in the Indian automotive industry was considered to be an expensive technology, with each fine blanking press costing approximately 1 million Euros, making it economically unviable for most suppliers in India to procure it. Realizing the market opportunities in India, one indigenous supplier whom we interviewed entered into a technology transfer agreement with an MNC and also invested in internal R&D to develop process competencies in fine blanking technology. These efforts helped them build their own in-house fine blanking presses over a period of time. Fine blanking works through total precise process control and requires coordinated action between the fine blanking press and a specially designed fine blanking tool. Therefore, in order to cater to multiple customers with different product needs, the supplier simultaneously worked on tooling development and manufacturing capabilities (TDM) along with the fine blanking process technology. As the in-house fine blanking and tooling capabilities grew, with the help of increased scale and scope economies, they were able to cater to global customers and more heterogeneous customers within India and abroad.

Thus, TDM led to an enhancement of the utilization and productivity of R&D efforts into fine blanking process technology of this supplier. As this example clearly demonstrates, the interaction between R&D and TDM resulted in an enhanced effect, which is difficult for competitors to duplicate due to the time constraints and the ambiguity created by the complex nature of the network, enabling better utilization of their high value-added R&D resources ultimately leading to competitive advantage (Fig. 3, PDCP-4). Therefore, cumulatively, these arguments and anecdotes lead us to posit the following hypotheses:

H2a. *R&D in conjunction with past experience in product and process development creates a product development capability path (PDCP-3a & 3b, in* Fig. 3*), which leads to competitive advantage as represented by value-added performance in the Indian auto component industry.*

H2b. *R&D in conjunction with tooling development and manufacturing creates a product development capability path (PDCP-4, in* Fig. 3*), which leads to competitive advantage as represented by value-added performance in the Indian auto component industry.*

3. Data and methods

We collated the information from phases 1, 2, and 3 described in previous section with the additional information drawn from secondary sources on the companies for the period 2007–2011 in order to obtain information on financial performance measures and various control variables for our analysis. Finally, we cross-checked the data collected from various primary and secondary sources to ensure the accuracy and integrity of the data. Cumulatively, the information and data gathered through all three phases formed our master database, which allowed us to carry out various empirical tests (including the EFA discussed in the previous section) for examining our hypotheses and to interpret the results.

3.1. Research design, measures, and methods

We drew inspiration from Salvato and Rerup (2011) to bridge the micro- and macro-linkages between the development of resources, capabilities and competitive advantages at multiple levels. Our research design essentially involved three levels. The first two levels constituted the microfoundations of the capabilities (or higher level routines). At the most basic level [$(n-2)^{th}$ level], we had the measurement items (as described in Table 1), which formed the core of the microfoundations. At the next level [$(n-1)^{th}$ level], clusters of interrelated measurement items formed specific *resources*. Finally, at the n^{th} level, the interactions among these resources yielded capabilities which ultimately led to competitive advantage for the firm [$(n+1)^{th}$ level]. The creation of these capabilities through these measurement items and resources is a time-consuming process; therefore, we measured their development over a 5-year period. The interactions among various resources were measured at time t and their subsequent effect on firm-level competitive advantage was evaluated over the next five years. Our research design is deliberately structured to capture the progressive impact of the stock of resources developed over a period of five years on firm level competitive advantage in the subsequent five year period. As Barney (2001) and Armstrong and Shimizu (2007) indicate, such approaches are desirable for the purpose of appropriately determining the sustainability of focal resources and capabilities. Note that the entire conceptual diagram with all these elements was depicted in Fig. 1.

As discussed earlier, we used EFA to identify the constructs representing the resources IPS, R&D, PEPPD, and TDM, from the primary data collected through our questionnaire survey.

Table 3
Description of Dependent and Control Variables used in the Regression analysis.

Acronym	Variable	Description and Measurement
DV	PBDITA per employee	"Profit before depreciation, interest, tax, and amortization" divided by "employees" for a given year.
CV_1	Company age	"Company age" measured as the difference between the "year *t*" and the "year of incorporation", where t ranges from 2007 to 2011
CV_2	Tier-1 supplier	"Position in supply chain" measured as a dichotomous variable with 1, representing Tier 1; and 0, representing Tier 2.
CV_3	Complexity	"Complexity of supplied products in terms of design, manufacturability, and coordination (no. of sub-suppliers)" measured by five-point interval scale ranging from 1, "extremely simple parts" to 5, "extremely complex parts".
CV_4	Depreciation	Measured using "Annual depreciation"
CV_5	Royalty expenses	Measured using "Annual royalty expenses"
CV_6	Firm Size	Measured by "ln(Total Assets)"
CV_7	Leverage	"The financial leverage ratio" is measured as the ratio between "Total Assets" to "Equity"

We next used multiple regression analyses to investigate the impact of the interactions among these resources (that were built up over the previous five years (2002–2007)) on firm-level competitive advantage during the next five years (2007–2011).

3.2. Dependent and control variables

Note that, the primary objective of this study is to discern whether the investments into product development capabilities by indigenous auto component firms have helped them climb up the value chain, in a sustainable manner. In the automotive industry, labor intensive manufacturing activities get relegated to lower tiers and larger value is appropriated by suppliers that collaborate with automakers and foreign tier-1 suppliers in design and development activities. Earnings per employee (which is also used as a measure for labor productivity in economics literature) is expected to increase as value appropriated by firm increases. We therefore used earnings per employee as the dependent variable (DV), which was measured by 'earnings before depreciation, interest, tax, and amortization (EBDITA) per employee'. This measure has also been used as a performance indicator in prior literature (Campbell, Ganco, Franco, & Agarwal, 2012; Datta, Guthrie, & Wright, 2005; Huselid, 1995).

In addition, several control variables were included in the analysis to control for their impact on the performance variables (see Table 3). Since age can have an impact on the performance of the firm, we include the firm's age (CV_1), which represents the difference between the regression year and the incorporation year of the firm. Similarly, how upstream in the supply chain the firm is located, can have an impact on its value appropriation (Kumaraswamy et al., 2012) and therefore we include the firm's position in the supply chain as a control variable. The position in the supply chain (CV_2) is represented by a 'tier dummy' variable, which indicates whether the considered company acts primarily as a tier-1 (= 1) or tier-2 supplier (= 0) in the automotive supply chain (Kotabe, Martin, & Domoto, 2003). The product complexity (CV_3) is specified based on a 5-point interval scale from 1 (= extremely simple parts) to 5 (= extremely complex parts) (Handfield, Ragatz, Peterson, & Monczka, 1999; Veloso & Kumar, 2002). The two control variables—position in the supply chain (CV_2) and product complexity (CV_3)—were perceived to be differentiating factors in our qualitative pre-study, and hence are included as control variables. Further, the average annual depreciation (CV_4) and the average annual royalty and licensing expenses (CV_5) as percentage shares of the annual turnover 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 leverage, we use the financial leverage ratio (total assets/equity), also called 'DuPont multiplier' (Anthony, Hawkins, & Merchant, 2006). Most of the last set of control variables were also used in earlier empirical studies on Indian auto component industry and are relevant in the context of our study (Iyer et al., 2013; Kumaraswamy et al., 2012). Please note that data to determine whether a supplier belongs to Tier-1 or Tier-2 was obtained from the ACMA database. Data for all the other control variables as well as R&D expenses was obtained from the Prowess database.

3.3. Regression models

In order to test the impact of the interactions between *resources* on the current performance, we used the following basic regression model:

$$Y_{i,t} = \beta_{0,t} + \beta_{1,t} IPS_i + \beta_{2,t} R\&D_i + \beta_{3,t} PEPPD_i + \beta_{4,t} TDM_i + \sum_{j=5}^{11} \beta_{j,t} \mathbf{X}_{j,i,t} + \beta_{12,t} IPS_i{}^{*}PEPPD_i + \beta_{13,t} IPS_i{}^{*}TDM_i + \beta_{14,t} R\&D_i{}^{*}PEPPD_i + \beta_{15,t} R\&D_i{}^{*}TDM_i + e_{i,t} \quad (1)$$

where $Y_{i,t}$ represents the performance variable Profit Before Depreciation, Interest, Tax and Amortization (*PBDITA*) per employee for firm *i* and year *t*, (i.e., 2007). *IPS*, *R&D*, *PEPPD*, and *TDM* represent individual resources and $X_{j,i,t}$ represents the control variables. Coefficients β_{12} to β_{15} represent the effects of the interactions of the resources on the performance variable $Y_{i,t}$.

In addition, a panel data regression for the period 2008–2011 to assess future performance was employed. Since our key explanatory variables (*IPS*, *R&D*, *PEPPD*, and *TDM*) are time invariant, we used the random effects model as depicted below:

$$Y_{i,t} = \beta_0 + \beta_1 IPS_i + \beta_2 R\&D_i + \beta_3 PEPPD_i + \beta_4 TDM_i + \sum_{j=5}^{j=11} \beta_j \mathbf{X}_{j,i,t} + \beta_{12} IPS_i{}^{*}PEPPD_i + \beta_{13} IPS_i{}^{*}TDM_i + \beta_{14} R\&D_i{}^{*}PEPPD_i + \beta_{15} R\&D_i{}^{*}TDM_i + e_{i,t} \quad \forall\, i, t \quad (2)$$

4. Results

The descriptive statistics and the correlations of the variables of the final dataset that was used to test the hypotheses through the regression analysis are reported in Table 4. Note that all the four resources were standardized with mean 0 and standard deviation 1.

To test hypotheses H1a, H1b, H2a, and H2b, we ran the regression using specification (1) for 2007 (i.e., year 't', see Fig. 1). As discussed earlier, this was the year in which the survey was administered and the respondents were asked about the development of resources during the five year period from 2002 to 2007. Specification (2) was employed for determining the impact of these resources and their interactions during the subsequent 4 year period (i.e., from 2008 to 2011 using a random

Table 4
Descriptive statistics and Pearson correlation matrix for independent, control, and dependent variables ($n = 74$).

No	Variable	Mean[a]	Std. Deviation	1	2	3	4	5	6	7	8	9	10	11	12
1	Innovation process structure (IPS)	0.000	1.000	1											
2	R&D	0.000	1.000	0.000	1										
3	Past experience in product and process development (PEPPD)	0.000	1.000	0.435	0.020	1									
4	Tooling design and manufacturing (TDM)	0.000	1.000	0.110	0.185	0.000	1								
5	Company age	29.054	16.216	−0.215	0.075	−0.108	−0.171	1							
6	Supply chain position	0.757	0.432	0.222	0.039	0.297	0.012	0.025	1						
7	Complexity	4.095	0.706	0.178	0.008	0.232	−0.222	−0.079	0.077	1					
8	Depreciation	64.903	84.561	0.214	−0.014	0.163	−0.019	0.131	0.122	0.215	1				
9	Royalty expenses	0.240	0.549	0.040	−0.031	0.211	−0.183	0.142	0.223	0.092	0.139	1			
10	Firm size	7.125	1.130	0.200	0.150	0.186	0.057	0.000	0.431	0.260	0.722	0.182	1		
11	Leverage	3.404	1.721	−0.419	−0.035	0.019	−0.027	0.035	−0.175	0.127	−0.108	−0.001	−0.210	1	
12	PBDITA per employee	0.997	2.666	0.158	0.327	0.053	0.107	−0.013	−0.178	−0.117	0.273	−0.008	0.300	−0.103	1

[a] The values of IPS, R&D, and PEPPD & TDM are standardized with mean zero and standard deviation of one.

Table 5
Linear regression results with PBDITA per employee as dependent variable.

Parameter	2007	2008–11	2008–11
	(1)	(2)	(3)
Intercept	−2.484	8.322**	5.119
Innovation process structure (IPS)	0.542*	−1.626***	−0.601
R&D investments (R&D)	−0.560*	0.042	0.086
Past experience (PEPPD)	0.015	−1.065***	−0.765*
Tooling design & manufacturing (TDM)	−0.513	−1.325***	−0.492
Company age	0.001	−0.015	−0.07
Tier-1 supplier	−2.700***	−2.713*	−1.160
Product complexity	−0.788**	−1.330***	−1.589***
Depreciation	−0.001	0.004***	0.004***
Royalty expenses	−0.133	−0.011***	−0.013***
Size	1.259***	0.140	0.549
Leverage	−0.533	1.181	0.116
IPS X PEPPD – (H1a)	−0.340	1.443***	
IPS X TDM – (H1b)	0.223	1.478**	
R&D X PEPPD – (H2a)	0.854***	−0.237	
R&D X TDM – (H2b)	0.805**	0.468	
Adjusted R^2	0.521		
Overall R^2		0.687	0.540
F-statistic	6.28***		
Wald chi2		93.13***	79.49***
Number of observations	74		
Firm-year observations		112	112

Note: The results reported in the last two columns are from a Random Effects GLS regression for a panel spanning 2008–2011. The number of observations therefore corresponds to firm-year observations.
* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.

effects regression model and using the panel data for the period 2008–2011.[16]

The results of the multiple regression and panel data analyses are presented in Table 5. Hypothesis H1a which predicts that Innovation process structure in conjunction with past experience in product and process development creates a product development capability path which leads to sustained competitive advantage was tested by examining the impact of the interaction between *IPS* and *PEPPD*. Model 2 depicts strong support for this hypothesis in the period 2008–2011 wherein the coefficient of the interaction is positive and is highly significant ($p < 0.01$). However, for 2007 (model 1 in Table 5), the coefficients of this interaction term was not significant.

Hypothesis H1b which predicts that Innovation process structure in conjunction with tooling development and manufacturing creates a product development capability path which leads to sustained competitive advantage was tested by examining the impact of the interaction between *IPS* and *TDM*. Similar to the case of H1a, Model 2 shows support for this hypothesis during the period 2008–2011 wherein the coefficient of the interaction was positive and significant ($p < 0.05$). However, for 2007 (model 1 in Table 5), the coefficients of this interaction term were not significant.

Hypothesis H2a which predicts that R&D in conjunction with past experience in product and process development creates a product development capability path which leads to competitive advantage was tested by examining the impact of the interaction between *R&D* and *PEPPD*. We found strong support for this hypothesis only for the year 2007 (model 1 in Table 5), wherein the coefficient of the interaction was positive and highly significant ($p < 0.01$). For the period 2008–2011, Model 2 of Table 5) shows that the interaction term is not significant.

Hypothesis which predicts that R&D in conjunction with tooling development and manufacturing creates a product development capability path which leads to competitive advantage was tested by examining the impact of the interaction between *R&D* and *TDM*. Again, we found strong support for this hypothesis only for the year 2007 (model 1 in Table 5), wherein the coefficient of the interaction was positive and significant ($p < 0.05$). Similar to the case of H2a, for the period 2008–2011, model 2 of Table 5, shows that this interaction term is not significant.

Cumulatively, the results for H1a, H1b, H2a, and H2b suggest that the interactions between *IPS* and *PEPPD* and between *IPS* and *TDM* provide more sustainable competitive advantage than the interactions between *R&D* and *PEPPD* and between *R&D* and *TDM*, as conjectured in our hypotheses and depicted in Figs. 2 and 3. This is evidenced by the longer duration of the competitive advantage for the interactions between *IPS* and *PEPPD* and between *IPS* and *TDM* for the panel data analysis from 2008 to 2011. These findings are in line with those of Lewin et al. (2011), who indicated that differences in complementarities between internal and external *metaroutines* result in differential performance.

[16] The difference in the sample sizes from 2007 and the panel data from 2008 to 2012 is essentially due to the fact that several survey related items were unavailable for the sample firms from public sources in subsequent years. Therefore, instead of 74*4 = 296 firm-year observations, we are left with 112 firm year observations (i.e., from 28*4 = 112 firm year-observations). However, we do not find any systematic bias on account of this reduction in sample size. In addition, as indicated earlier, we were required to rely on random effect models as fixed effect models could not be employed due to the time invariant nature of the various resource factors (i.e., IPS, R&D, PEPPD and TDM). These were calculated for 2007 and remain unchanged from 2008 to 2011.

Model 3 of Table 5 represents the baseline model without the interaction terms. The baseline model helps us examine the individual effects of the four factors (*IPS*, *R&D*, *PEPPD*, and *TDM*) on firm performance without the interaction effects. As can be seen from the coefficients, except for *PEPPD*, none of the factors were found to be significant. In fact, *PEPPD* was also negative and significant. This is in sharp contrast to the interaction effect coefficients that were discussed earlier. This reinforces our assumptions on the benefits of examining the interactions among various resources rather than looking at them in isolation. This also counters the emphasis which is all too often placed on the positive impact of resources. At times, they can retard sustainability when they become 'rigidities' (Leonard-Barton, 1992) and, therefore, there is a need to combine or re-combine resources for the sustenance of competitive advantage. Finally, we undertook variance inflation factor tests which were found to be within tolerable limits.[17]

As far as the control variables are concerned, the company's age and leverage did not have any significant impact on performance. The royalty expense was also not found to be significant in the year-by-year regression models; in fact, it was found to be negative and significant in the panel models. It is interesting to note that this is in contrast to the findings of prior studies, where royalty and know-how expenses were found to be highly positive and significant in earlier periods (Kumaraswamy et al., 2012). This possibly shows that the Indian auto component industry has progressively evolved from the technology licensing era to an era of in-house R&D and IPS-based innovative capabilities. Another interesting result pertains to the control variable 'tier-1 supplier', which was found to have a negative and significant impact on firm profitability in all our models. This result essentially suggests that the profitability of tier-1 firms (which are closest to the automakers) is lower than the profitability of tier-2 firms. Once again, this finding is in contrast to the findings of studies from earlier periods, where relational ties (which are supposed to be strongest between tier-1 firms and automakers) contributed positively to firm performance. This evidence also points to the transition of the Indian auto component industry from a relationship-based, personalized transaction structure that rewarded network-based capabilities until 2002 (Kumaraswamy et al., 2012) to a more rule-based structure that rewards market-based innovative capabilities during our study period. Finally, we were puzzled to find that the size of the firm had a positive and significant impact on the profitability of firms only during the year 2007. However, our subsequent discussions with industry experts indicated the possibility that post 2008, the smaller firms (being more flexible) were able to diversify and adapt to the more difficult external environment compared to the larger firms (Teece, 2007). We believe that this nullified (to an extent) the size advantage in subsequent years.

4.1. Robustness tests

To test the robustness of our results, we also ran regressions with firm size as an alternative dependent/outcome variable, in order to capture impact of the resource interactions on firm size (and associated growth of the firm during 2008–11) as a measure of competitive advantage.[18] While we fully acknowledge the limitations of this as a proxy variable, we wanted to assess the stability of our results using an alternative dependent variable at the firm level. These results are reported in Table A3 of the Appendix. As Model (1) in Table A3 depicts, our results for the 2008 to 2011 period remain consistent with the results depicted in Model (2) of Table 5. The interactions between IPS and PEPPD and IPS and TDM are positive and significant as hypothesized in H1a and H1b. In addition, as depicted in Model (2) of Table 5, the interactions between R&D and PEPPD and R&D and TDM are not significant. These are also in line with Hypothesis H2a and H2b which predict on a competitive advantage and not a sustainable competitive advantage of the resource interactions over time (i.e., for 2008–11). Model (2) in Table A3 is the baseline model without the interaction variables.

Models (2) and (3) in Table 5 assume that the statistical effects on their dependent variable for years 2008–2011 are uniquely attributable to IPS, R&D, PEPPD and TDM accumulated during 2002–2007. In order to address to some extent issues pertaining to an omitted variable bias, we re-ran the regressions on Table 5, with a control variable. Ideally, we should have included comparable measures of IPS, R&D, PEPPD and TDM during the years 2008–2011 as control variables. However, we do not have access to these measures post 2007, as they were obtained from a survey conducted in 2007. However, we could obtain secondary data on R&D expenses for 2008–2011, and incorporated it as the control variable in our regression models.[19] Due to lack of comprehensive data availability on R&D expenses from publicly available sources, the sample size on which these new regressions were carried out reduced from 112 firm-year observations to 64 observations. The drop in observations owing to non-disclosure of R&D expenses is a widely recognized issue in India and including the variable truncates the sample considerably. This makes us cautious in relying on these results. Nevertheless, these results are presented in Table A4 of Appendix.

For Models (1) to (5) in Table A4, the dependent variable is PBDIT/Employees. Model (1) is the baseline model without the interactions of the key resources (i.e., IPS*PEPPD; IPS*TDM; R&D*PEPPD; R&D*TDM). Model (2) introduces the IPS interactions (i.e., IPS*PEPPD; IPS*TDM). Both IPS*PEPPD and IPS*TDM are positive and significant as hypothesized (H1a and H1b) and consistent with the results in Model (2) of Table 5. The R&D*PEPPD and R&D*TDM interactions are introduced in Models (3) and (4) respectively. The R&D*PEPPD and R&D*TDM interactions were hypothesized (H2a and H2b) to not provide a sustainable competitive advantage. The R&D*PEPPD and R&D*TDM interactions depict that the interactions are not significant. Model (5) is the model wherein all the interactions are introduced simultaneously in the model. Unfortunately, we do not get results consistent with Model (2) of Table 5. The IPS*PEPPD and IPS*TDM interactions lose significance. Possibly, the significant reduction in sample size from 112 to 64 firm year observations has impacted the power of the test. In addition, we are also cautious with regard to inferences based on these results, since in Models (1) and (2), the Wald Chi2 statistic is not significant.

Finally, as a further robustness test, we also ran the regressions with firm size as an alternative dependent/outcome variable in order to capture implications of our resource combinations on firm size as a measure of competitive advantage. Model (6) and Model (7) in Table A4 provide these results. Firm Size as measured by the log of firm assets, is the dependent variable. Model (6) is the baseline model and Model (7) introduces the key resource interaction variables (i.e., IPS*PEPPD; IPS*TDM; R&D*PEPPD; R&D*TDM). Once again, the IPS*PEPPD; IPS*TDM interactions are strongly positive and significant. This is consistent with models (2), (3) and (4) of Table A4 and also Model (2) of Table 5. They are therefore consistent with Hypotheses 1a and 1b. The interactions of R&D*PEPPD and R&D*TDM are negative and significant. However, the expectation was that these would not be significant (owing to the competitive advantage not being sustainable as per H2a and H2b) during 2008–2011 period (as we find in Models 2

[17] We also carried out regressions by clubbing both the 2007 and 2008–11 periods together and using a dummy variable to interact with all four interactions (i.e., IPS*PEPPD; IPS*TDM; R&D*PEPPD; R&D*TDM) to capture a pre-2008 and post 2008 effect. However, this increased the number of interactions in the regression models from 4 to 8. Due to smaller sample size, the increase in the number of interactions impacted the reliability of our results and the consequent inferences that can be drawn. Given these constraints, we have decided to report only the sub-sample results for 2007 and 2008–11, as depicted in Table 5.

[18] We thank an anonymous reviewer for this suggestion.

[19] We thank an anonymous reviewer for sensitizing us to this issue and also proving a solution to attempt to address this issue.

to 4) and in Model 2 of Table 4. We are quite frankly at a loss to explain a negative and significant interaction between R&D*PEPPD and R&D*TDM. This possibly needs more investigation, and as before, due to reduced sample size, we are cautious with the interpretation of these results.

5. Theoretical and managerial implications

The empirical evidence presented above supports our theoretical conjectures that the interactions of resources constituting tradable asset stocks such as IPS and R&D with non-tradable network factors such as PEPPD and TDM, give rise to product development capability paths, leading to differential levels of competitive advantage.

The Indian auto component industry context provided an ideal setting to test our theoretical conjectures and to tease out the nuanced differential impact of capabilities on competitive advantage. As liberalization in India matured, the auto component industry entered the knowledge creation phase post 2002 (Kumaraswamy et al., 2012). This phase is characterized by a greater need for investing in innovative resources (such as in-house R&D) and creating formal structures for NPD processes in order to cope with higher competitive pressures in an increasingly market-based economy. In conjunction with this phenomenon, the economic recession in 2008 resulted in several automakers facing severe cost pressures globally. This was accentuated further by falling demand in their home markets and the need for more cost-effective and fuel-efficient products across the globe. Post-2008 in particular, these two contrary forces meant that new product development needed to be undertaken by the automakers, but it had to be achieved cost-effectively, given the prevailing economic environment. This evolution in the global automotive industry opened up opportunities for component firms in low-cost countries such as India.[20] Therefore, the year 2008 represents a key inflexion point in the market evolution requiring strategic changes (Teece, 2007).

Our theory and empirical findings suggest that the R&D activity of Indian auto component firms in combination with PEPPD and TDM enabled them to sense customer needs and capitalize on market opportunities prior to 2008. This is in line with Teece (2007) who argues that R&D was seen as one way that the enterprise could promote learning about the environment and new technological capabilities. However, the in-house R&D of indigenous firms was largely associated with process oriented rather than product oriented development activities, which is idiosyncratic to the Indian context. As it was mainly the indigenous automakers who involved the local suppliers in product development activities during this era, the in-house R&D investments sufficiently distinguished suppliers, even if they were related to process improvement activities. However, post 2008, when the global automakers and MNC tier-1 suppliers began scouting for local suppliers with adequate product development capabilities, the process related R&D failed to send credible signals to these prospective customers. We believe that this is why the positive and significant effects associated with the interaction of *R&D* with *PEPPD* and *TDM* could not be sustained from 2008 onwards.

On the other hand, IPS which comprises product development processes (therefore product oriented in nature), in combination with PEPPD and TDM resulted in the development of capabilities, which were manifested by the compensating and enhancing organizational practices (PDCPs), and enabled the supplier firms to sense, seize and reconfigure based on market opportunities (Teece, 2007). For instance, these firms were able to sense the market opportunities through their cross-functional collaborations within and outside the organization using IPS, as well as seize them by sending out appropriate signals about their product development capabilities, as IPS is a well-recognized resource across the globe (Eisenhardt & Martin, 2000). Subsequent to the shortlisting by the customers (which was enabled by IPS), the past experience in product development and tooling design and manufacturing skills helped these suppliers gain competitive advantage. This, we believe, is why the positive impact of the interactions between *IPS* and *PEPPD* and between *IPS* and *TDM* showed up in the regression analysis post 2008 wherein the environment was more munificent for new product development.

Since the nature of product development in our study context was adaptation and incremental modifications of existing products, we find that IPS, a structured process of product development was more appropriate than in-house R&D investments. While the latter is focused on generating new knowledge, the former was more of exploiting the existing knowledge. Research has shown that, in emerging markets, which are far away from the technology frontier, exploitation of existing knowledge is more beneficial than re-inventing the technologies that have been developed and put to use by advanced economies long before. For example, an empirical study by Kumaraswamy et al. (2012) in the same context, which documents the catch-up strategies of Indian auto component firms during the period 1992–2002 has shown that, while the technology licensing and relationship building with customers have been found to be beneficial, in-house R&D investments did not have a significant impact on profitability of firms. They go on to conjecture that, post 2002, in-house R&D should begin to impact profitability of firms, since the industry would by then have matured and reached an advanced stage of liberalization. While our study does supply some empirical evidence to support this conjecture, we too find that this advantage is short lived and it is the interactions of IPS with non-tradable resources that provide sustainable competitive advantage rather than in-house R&D, at least in the Indian automotive industry context.

In addition, our qualitative observations as well as quantitative results indicate that, the compensatory and enhancing nature of non-tradable resources, such as past experience and tooling design and development capabilities play a critical role in determining the sustainability of competitive advantage in our emerging market context. This is because, unlike developed economies, emerging markets like India typically suffer from lack of advanced institutional infrastructure for product development as well as significant investments into advanced technologies at the industry level. Since new products are mostly developed in advanced economies and only minor adaptations and modifications are carried out in emerging markets, investments are typically not made in NPD technology and infrastructure. However, as emerging markets become more critical for the survival of MNCs, as was the case in the current study, NPD capabilities do become important and the compensating and enhancing resources would then come into play, rewarding the indigenous firms that had the foresight to make such investments.

From a theoretical angle, our work highlights the need for asset specific investments by emerging market suppliers, to enter into MNC value chains. While the transaction cost literature on outsourcing considers only the moral hazard problem, our findings suggest that, post the global recession, investments into resource factors such as IPS, which reflected MNC practices in their home country and therefore were customer-specific, became more important. Whereas, pre-recession, when automakers were mostly Indian, a supplier's R&D contribution was more important and, because asset specificity was less important, it was conducted at arms-length.[21] In the automobile industry, where, 60% to 80% of the total value add is typically sourced from suppliers, this is an important factor to consider, both from a managerial point of view, as well as a theoretical lens for future research on outsourcing.

[20] http://www.automotiveproductsfinder.com/APFCONTENT/coverstory/suppliers-initiate-new-strategies-to-combat-rising-cost-pressures.php.

[21] We are grateful to the anonymous referee, who pointed out to us this theoretical contribution based on our research.

From a MNC perspective, evidence from recent studies (Jonnalagedda & Saranga, 2017; Mudambi, Saranga, & Schotter, 2017) indicates that, success in emerging markets like India depends on not only introducing the latest products in their portfolio, but also adapting these products to local customer needs, especially in the mid to lower income segments. Further, it has been demonstrated that, products that succeed in the Indian market can be successfully exported to other emerging markets in Asia, Africa and Latin America. Our study findings, which determine the underlying micro foundations of product development and adaptation capabilities in the Indian automotive industry context, therefore are quite timely and relevant, and contribute significantly to the managerial practice in an emerging economy context.

The differential interaction effects during pre and post 2008 alludes to how capabilities, as manifested by different product development capability paths associated with various resource configurations, led to differing levels of sustainability of competitive advantage, owing to the churn in the external environment. This has interesting parallels with the work of Dixon, Meyer, and Day (2014) where they depict a dynamic capabilities lifecycle wherein sustainability of competitive advantage depends on the sequencing of adaptation and innovative capabilities and their linkages to changes in the external environment. While in this study we provide evidence for a particular combination of resources which result in competitive advantage, understanding why the positive impact of these resource combinations do not sustain, we believe, aligns with the call made by Armstrong and Shimizu (2007), that identifying those contexts in which valuable, rare and inimitable resources fail to provide sustainable competitive advantages can greatly extend RBT research.

Acknowledgements

This research was funded by Research Seed Grant No. 22048 from Indian Institute of Management Bangalore.

Appendix A. Evolution of the Indian auto component industry

Liberalization brought about significant institutional transformation in emerging economies and changed the rules of the game in both a formal as well as an informal sense for organizations in these countries. 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. (2012), three phases of evolution can be distinguished in the post-liberalization period: 1992–1997, 1998–2002, and post-2002. Building on this, we study the period 2002–2011 in the current paper and refer to it as the advanced phase of liberalization.

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 companies, especially Japanese companies such as 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). 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 indigenous Indian suppliers) owing to the local content requirements enforced by the Indian government and the appreciated Yen (Okada, 2004). These JVs and technology collaborations with MNE firms helped indigenous suppliers realize improvements with regard to quality, technology, and productivity (Tewari, 2001). The production volumes of the indigenous Indian automobile industry increased significantly since the mid-1980s (D'Costa, 1995; Okada, 2004).

Extensive reforms between 1991 and 1992 led to further economic liberalization of the Indian industry. Local content restrictions were completely lifted between 1991 and 1994 (Singh, 2004). Between 1992 and 1997, several automakers and their direct suppliers—the so-called tier-1 suppliers—entered the market through the acquisition of majority stakes in JVs or by the approved foundation of production facilities on a case-by-case basis (Kumaraswamy et al., 2012).

In 1997, regulatory norms were changed again, forcing the MNE entrants to build local production facilities and mandating a local content requirement of 50–70% within the first five years after market entry (Tewari, 2001). These regulatory changes provided further impetus to supplier development activities because most indigenous component suppliers still lagged in quality, productivity, and technology requirements of foreign companies (Okada, 2004). Simultaneously, the product complexity and the competitive pressure within the Indian automobile industry increased significantly (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., 2012). In addition, the exports of the Indian automobile industry rose continuously due to increased foreign demand. Thus, the Indian automobile industry could realize an average annual growth of 21% between 1990 and 1999. This industry growth resulted in the formation of a tier-structured automobile industry. By the end of the 1990s, the Indian automobile industry included 400 mid-sized and large auto component suppliers, which supplied to at least one automaker. These companies of the so-called organized sector generated 75–80% of the production volume of the Indian industry in total (Okada, 2004). Three primary clusters of the automobile industry were formed in North India around Delhi and Gurgaon, in West India around Mumbai and Pune, and in South India around Bangalore and Chennai (Kumaraswamy et al., 2012).

In 2002, the Indian automobile industry experienced further deregulation; local content and import restrictions on completely knocked down (CKD) kits, as well as local production requirements, were effectively lifted. The Government of India envisaged the establishment of an internationally competitive automobile industry in India, which could act as an Asiatic export hub for small cars and automobile components through its Automotive Mission Plan (AMP).[22] AMP identified the automotive sector with its backward and forward linkages as a sector with high potential to increase the share of manufacturing in GDP, exports, and employment. It emphasized the need for long-term competitiveness in this sector through the upgrading of new product design and development capabilities, rather than depending on cheap labor and favorable exchange rates. To achieve these objectives, incentives for local production of small cars, investments into R&D, new product development, world-class facilities for automotive testing, and certification and homologation facilities were created (Ministry of Heavy Industries and Public Enterprises 2006[23]). In 2004, India signed a free trade agreement (FTA) with Thailand, which is seen as a significant contribution to the opening up of the Indian automobile industry (Singh, 2004). Additional free trade agreements with the South Asian Association for Regional Cooperation and ASEAN states were signed in the following years (ASEAN Secretariat, 2011).

Because of many of these initiatives, car production in India increased by 14% per annum and the volume of the auto component industry rose by 18.7% per annum between 2000 and 2010.[24] The global economic crisis in the recent years merely led to limited growth losses in the Indian

[22] http://www.dhi.nic.in/draft_automotive_mission_plan.pdf (Last accessed on 1st February 2017).
[23] http://dhi.nic.in/dhi0506eng.pdf (Last accessed on 29th April 2014).
[24] www.acmainfo.com (Last accessed on 18th July 2017).

automobile industry due to the strong indigenous demand and India's independence from trade with Western industrial states (Marr & Reynard, 2010). The high growth potential of the indigenous market and the favorable regulatory environment have encouraged many foreign automakers such as Suzuki, Hyundai, Ford, Nissan–Renault, Toyota, General Motors (GM), Honda, and Volkswagen to make significant investments in India in a bid to make it the base for compact car production.[25] Many of these automakers (Suzuki, GM, Ford, Honda, Hyundai, and Mercedes-Benz) and their global tier-1 suppliers (Bosch, Delphi, Valeo, Magna, Caterpillar, Cummins, and so on) slowly began to establish their design and research centers in India, because it made sense to develop these small cars in India itself, owing to the low cost and availability of skilled engineers and also since the final component and sub-system suppliers could be integrated into product development activities from the very beginning. This gave rise to plenty of opportunities for the indigenous Indian suppliers who possessed product development capabilities to participate in the new product development activities of foreign automakers and garner supply contracts for newer models.

As one can see from Table A1, there was a drastic increase in the number of models introduced in the Indian market from 2007 onwards by foreign automakers. This clearly points towards an increased interest in the Indian market and the corresponding increase in new product development activities necessitated by increased market dynamism in the Indian automotive sector. The Indian auto component manufacturers are suppliers to Indian and foreign automakers and as mentioned above they have had to adapt to the new product development (NPD) needs of the automakers. Important elements of addressing these NPD needs of automakers relate to resource factors such as, innovation process structure (IPS), R&D, past experience in product and process development (PEPPD) and tooling design and manufacturing (TDM), at the suppliers' end.

Further, we have collected data on the extent of local content in some of the most popular vehicle models in the Indian auto industry and their corresponding sales figures. This information is presented in Table A2. As one may note, the percentage of local content is significantly higher for some of the top selling models in each of the market segments, substantiating the anecdotal references by our interviewees that, it is important to localize the products to succeed in the Indian market. This, in addition to the data in Table A1 also reinforces our claims that new product development and adaptation capabilities began to assume more prominence in the Indian auto component industry during our study period, especially post 2008.

Illustration A1. Sample questions from the survey instrument

Question 2.10: Do you follow a standardized innovation processes within your company?
Please circle the appropriate options.

1 = never heard about it
2 = don't intend to implement
3 = not yet begun
4 = standard/common implementation
5 = highly advanced implementation

Process based on division of labour *Every department is responsible for a specific task which is conducted by specialists; after task fulfillment the next department is responsible*	1	2	3	4	5
Stage Gate process *Innovation process is divided into several "stages" and "gates". Every stage comprises best practice activities which are conducted by an interdisciplinary team (e.g. R&D, marketing, production) simultaneously. Every stage is followed by a gate where according to go/kill criteria the continuation or the stopping of the project is decided*	1	2	3	4	5
Process to parallelize development activities *Advancement of stage gate process. Development activities can overlap, stages and gates can overlap. Parallelizing of development activities (e.g. simultaneous engineering); intensive coordination between all participating departments; standardizing for describing innovation process related aspects (e.g. process organization)*	1	2	3	4	5
Integrated product development process *Integration of all product life cycle related information in current innovation projects (e.g. experiences of technical customer service); Parallelizing of product and process development, every department participate in every development step; guidelines are not fixed and are continuously improved during the project*	1	2	3	4	5
Company specific standardized process	1	2	3	4	5

☐ No standardized process

Note 1 Examples for Category 1 'measurement items' - Captures Organizational Processes and Structure related aspects.

Note 2 To construct the measurement items that were used in the EFA (which finally loaded onto IPS), from the above question we took the scores obtained against each of the items as they are.

[25] http://acma.in/pdf/Status_Indian_Auto_Industry.pdf (Last accessed on 1st February 2017).

Question 2.12: In the last five years, in how many product development projects have you been integrated by following customers? Please provide the share in % of the certain customer group in all of your product development projects. Additionally, please provide the types of projects in which you were integrated for each customer group.

Customer groups in percentage	Customer groups	Percentage of projects with...					
		minor modification	medium modification	major modification	new design	radical new design	
	Domestic Indian customer (incl. joint ventures)						∑ 100 %
	Customer of advanced economies with production facilities in India						∑ 100 %
	Customer of advanced economies without production facilities in India						∑ 100 %
	Customer of other emerging and developing economies						∑ 100 %
∑ 100 %							

Explanations:
Minor: *Minor modifications (changes were less than 20%) of component design*
Medium *Medium modification (20–50%) of component design*
Major: *Major modification (50–80%) of component design*
New Design: *Completely new design (more than 80%), but its design was based on a technology that had been demonstrated in another project*
Radical new Design: *Technologically new to your company and a completely new design*

Note 1 Examples for Category 2 ‘measurement items’ - Captures Past Experience of participating in product development activities.

Note 2 To construct the measurement items that were used in the EFA (which finally loaded onto PEPPD), from the above question we took the weighted sum of percentage values in first column (customer groups in percentage) with percentage values in respective columns. For example, to get the measurement item value for ‘IP Major Modification’, we took the weighted sum of values in first column with values in column five (major modification).

Table A1
Total number of new and upgraded models introduced in the Indian market during the study period (2002 – 2011).

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Indian automakers	2	0	0	0	0	1	2	6*	4	4
Foreign automakers	1	6	9	8	7	12	13	9	19	16
Joint ventures	2	4	2	2	4	3	3	4	3	2
Total number of models introduced	5	10	11	10	11	16	18	19	26	22

Source: Authors' compilation from multiple sources.
* Tata Motors, an Indian company that acquired Jaguar and Land Rover from Ford, introduced 5 new models into the Indian market this year, including Land Rover Freelander 2 and Range Rover, resulting in 6 new models by Indian companies.

Table A2
Local content details of car models in various price categories in India.

Model Name	Maruti Suzuki Alto 800	Hyundai Eon	Hyundai Grande i10	VW Polo	Maruti Swift Dezire	Honda City	Skoda Rapid	Ford EcoSport	Renault Duster	Mahindra XUV500
Price category[a]	$4600–$6400		$7600–$12,750			$10,125–$17,850			$12,450–$30,000	
% of localization	> **85%**	70%	**90%**	70%	> **95%**	**92%**	60% to 65%	80%	70%–80%	**90%**
No. of units sold[b,c]	**160,976**	68,575	**93,109**	28,078	**191,145**	**71,308**	10,130	39,344	25,676	**32,264**

Models with high local content and the corresponding sales figures are highlighted in bold.
Note.
[a] Price conversion: 1 USD = 66.66 Rupees.
[b] Based on Aug 2014–June 2015 sales data.
[c] http://autoportal.com/ (last accessed on 23rd April 2016).

Table A3
Panel random effects regression results with firm size as dependent variable.

Parameter	2008–11	2008–11
	(1)	(2)
Intercept	9.532***	9.671***
Innovation process structure (IPS)	−0.174	0.248
R&D investments (R&D)	0.277	0.203*
Past experience (PEPPD)	−0.577***	−0.333**
Tooling design & manufacturing (TDM)	−0.424***	−0.328*
Company age	−0.007	−0.003
Tier-1 supplier	−2.075***	−1.765***
Product complexity	0.418	−0.893
Depreciation	0.001***	0.001***
Royalty expenses	0.001	0.001
Leverage	0.984***	0.920***
IPS X PEPPD – (H1a)	0.527**	
IPS X TDM – (H1b)	0.615**	
R&D X PEPPD – (H2a)	−0.040	
R&D X TDM – (H2b)	−0.060	
Overall R^2	0.565	0.456
Wald chi2	242.27***	228.63***
Number of observations		
Firm-year observations	112	112

* Represents 10% significance.
** Represents 5% significance.
*** Represents 1% significance.

Table A4
Panel random effects regression results with PBDIT/Employees and firm size as dependent variable (with R&D as a control variable for 2008 to 2011).

Parameter	PBDIT/E	PBDIT/E	PBDIT/E	PBDIT/E	PBDIT/E	Firm Size	Firm Size
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Intercept	3.197***	4.801***	1.390	1.383	−2.655	7.493***	12.075***
Innovation process structure (IPS)	−0.733	−1.012	−0.556***	−0.557***	−0.570	0.503*	−1.253***
R&D investments (R&D)	0.130	0.120	−0.184	−0.106	−0.560	0.174	1.434***
Past experience (PEPPD)	−0.319	−0.502	−0.312***	−0.306***	−0.295	−0.067*	−0.087
Tooling design & manufacturing (TDM)	−0.460*	−0.880**	−0.390**	−0.378***	−0.142	−0.443	−1.253***
Company age	−0.008	−0.008	0.001	−0.017	0.007	−0.004	−0.028***
Tier-1 supplier	−0.759***	−1.952	−0.141	−0.140	0.424	−1.299	−3.320***
Product complexity	−0.483**	−0.518	0.069	0.179	0.179	0.286***	−0.290***
Depreciation	−0.001	−0.001	−0.001**	−0.001**	−0.002**	0.001***	0.004***
Royalty expenses	−0.003	−0.018	−0.004**	−0.005***	−0.004**	0.001***	−0.003
Size	0.181	0.056	0.098	0.100	0.1556		
Leverage	−0.828	0.157	−1.840***	−2.099***	−2.057***	0.895***	1.486***
R&D	−0.002	0.003	0.006	0.008*	0.008*	−0.001	−0.003
IPS X PEPPD – (H1a)		1.000*	0.515**	0.567***	0.316		1.618***
IPS X TDM – (H1b)		0.891*	0.299*	0.274*	0.173		0.939***
R&D X PEPPD – (H2a)			0.260		0.398		−0.843***
R&D X TDM – (H2b)				0.274	0.137		−0.259**
Overall R^2	0.31	0.37	0.66	0.67	0.68	0.59	0.87
Wald chi2	15.39	14.14	89.25***	90.16***	94.11***	229.15***	307.53***
Firm-year observations	64	64	64	64	64	64	64

* Represents 10% significance.
** Represents 5% significance.
*** Represents 1% significance.

References

ACMA (2014). Auto component industry in India: Growing capabilities & strengths. *Automotive component manufacturers association of india*http://www.acma.in/pdf/Status_Indian_Auto_Industry.pdf, Accessed date: 22 January 2014.

Anthony, R., Hawkins, D. F., & Merchant, K. (2006). *Accounting: Text, problems and cases.* (Singapore).

Armstrong, C. E., & Shimizu, K. (2007). A review of approaches to empirical research on the resource-based view of the firm. *Journal of Management, 33*(6), 959–986.

Arora, A., Fosfuri, A., & Gambardella, A. (2001). *Markets for technology: The economics of innovation and corporate strategy.* Cambridge, USA: The MIT Press.

Bailey, K. (2008). *Methods of social research.* Simon and Schuster.

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

Barney, J. B. (1997). *Gaining and sustaining competitive advantage.* Reading, MA: Addison-Wesley.

Barney, J. B. (2001). Resource-based theories of competitive advantage: A ten-year retrospective on the resource-based view. *Journal of Management, 27*(6), 643–650.

Black, J. A., & Boal, K. B. (1994). Strategic resources: Traits, configurations and paths to sustainable competitive advantage. *Strategic Management Journal, 15*(S2), 131–148.

Campbell, B. A., Ganco, M., Franco, A. M., & Agarwal, R. (2012). Who leaves, where to and why worry? Employee mobility, entrepreneurship and effects on source firm performance. *Strategic Management Journal, 33*(1), 65–87.

Cooper, R. G., Edgett, S. J., & Kleinschmidt, E. J. (2004). Benchmarking best NPD practices-III. *Research-Technology Management, 47*(6), 43–55.

Datta, D. K., Guthrie, J. P., & Wright, P. M. (2005). Human resource management and labor productivity: Does industry matter? *Academy of Management Journal, 48*(1), 135–145.

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

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

Dixon, S., Meyer, K., & Day, M. (2014). Building dynamic capabilities of adaptation and innovation: A study of micro-foundations in a transition economy. *Long Range Planning, 47*(4), 186–205.

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

Feldman, M. S. (2000). Organizational routines as a source of continuous change. *Organization Science, 11*(6), 611–629.

Feldman, M. S., & Pentland, B. T. (2003). Reconceptualizing organizational routines as a source of flexibility and change. *Administrative Science Quarterly, 48*(1), 94–118.

Flynn, B. B., Flynn, E. J., Amundson, S. D., & Schroeder, R. G. (2000). Team characteristics as enablers of fast product development speed. *Advances in Interdisciplinary Studies of Work Teams, 5*, 133–169.

Gorsuch, R. L. (1997). Exploratory factor analysis: Its role in item analysis. *Journal of Personality Assessment, 68*(3), 532–560.

Grant, R. M. (1991). The resource-based theory of competitive advantage: Implications for strategy formulation. *California Management Review, 33*(3), 114–135.

Hair, J., Black, W., Babin, B., Anderson, R., & Tatham, R. (2010). *Multivariate Data Analysis* (7th ed). Englewood Cliffs (NJ): Prentice Hall.

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

Henderson, R., & Cockburn, I. (1994). Measuring competence? Exploring firm effects in pharmaceutical research. *Strategic Management Journal, 15*(S1), 63–84.

Huselid, M. A. (1995). The impact of human resource management practices on turnover (7th productivity, and corporate financial performance). *Academy of Management Journal, 38*(3), 635–672.

Iyer, A. V., Saranga, H., & Seshadri, S. (2013). Effect of QMS and TQM on productivity before and after: Empirical evidence from the Indian auto component industry. *Production and Operations Management, 22*(2), 283–301.

Jonnalagedda, S., & Saranga, H. (2017). Commonality decisions when designing for multiple markets. *European Journal of Operational Research, 258*, 902–911.

Kalton, G. (1983). *Introduction to Survey Sampling. Vol. 7*. SAGE Publications.

Knaub, J. R., Jr. (2007). *Cutoff sampling and inference.* April: InterStat.

Kotabe, M., Martin, X., & Domoto, H. (2003). Gaining from vertical partnerships: Knowledge transfer, relationship duration, and supplier performance improvement in the US and Japanese automotive industries. *Strategic Management Journal, 24*(4), 293–316.

Kumaraswamy, A., Mudambi, R., Saranga, H., & Tripathy, A. (2012). Catch-up strategies in the Indian auto components industry: Domestic firms' responses to market liberalization. *Journal of International Business Studies, 43*(4), 368–395.

Kusunoki, K., Nonaka, I., & Nagata, A. (1998). Organizational capabilities in product development of Japanese firms: A conceptual framework and empirical findings. *Organization Science, 9*(6), 699–718.

Lee, S. A. (1991). Integrating positivist and interpretive approaches to organizational research. *Organization Science, 2*(4), 342–365.

Leonard-Barton, D. (1992). Core capabilities and core rigidities: A paradox in managing new product development. *Strategic Management Journal, 13*(S1), 111–125.

Levinthal, D., & Myatt, J. (1994). Co-evolution of capabilities and industry: The evolution of mutual fund processing. *Strategic Management Journal, 15*(S1), 45–62.

Lewin, A. Y., Massini, S., & Peeters, C. (2011). Microfoundations of internal and external absorptive capacity routines. *Organization Science, 22*(1), 81–98.

Marr, J., & Reynard, C. (2010). *Investing in emerging markets: The BRIC economies and beyond.* Wiley.

McDermott, G. A., & Corredoira, R. A. (2009). Network composition, collaborative ties, and upgrading in emerging-market firms: Lessons from the argentine auto parts sector. *Journal of International Business Studies, 41*(2), 308–329.

Mudambi, R., Saranga, H., & Schotter, A. (2017). Mastering the make-in-India challenge. *MIT Sloan Management Review, 58*(4), 59–66.

Nag, R., & Gioia, D. A. (2012). From common to uncommon knowledge: Foundations of firm-specific use of knowledge as a resource. *Academy of Management Journal, 55*(2), 421–457.

Okada, A. (2004). Skills development and interfirm learning linkages under globalization: Lessons from the Indian automobile industry. *World Development, 32*(7), 1265–1288.

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 & Supply Management, 8*(3), 135–149.

Pisano, G. P. (1994). Knowledge, integration, and the locus of learning: An empirical analysis of process development. *Strategic Management Journal, 15*, 85–100.

Salvato, C., & Rerup, C. (2011). Beyond collective entities: Multilevel research on organizational routines and capabilities. *Journal of Management, 37*(2), 468–490.

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.

Schilling, M. A., Vidal, P., Ployhart, R. E., & Marangoni, A. (2003). Learning by doing something else: Variation, relatedness, and the learning curve. *Management Science, 49*(1), 39–56.

Secretariat, A. S. E. A. N. (2011). ASEAN – India free trade area. http://www.aseansec.org/22563.htm, Accessed date: 5 June 2011.

Singh, N. (2004). *Strategic approach to strengthening the international competitiveness in knowledge based industries: The case of Indian automotive industry.* (Research and Information System for the Non-aligned and Other Developing Countries).

Teece, D. J. (2007). Explicating dynamic capabilities: The nature and microfoundations of (sustainable) enterprise performance. *Strategic Management Journal, 28*(13), 1319–1350.

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. *Government of Tamil Nadu, India, by the center for international development, research and advisory project for the Tamil Nadu government. 22. Government of Tamil Nadu, India, by the center for international development, research and advisory project for the Tamil Nadu government* (pp. 40–50). Boston: Harvard University.

Veloso, F., & Kumar, R. (2002). *The automotive supply chain: Global trends and Asian perspectives. ERD Working Paper Series No. 3*Asian Development Bank: Manila.

Winter, S. G. (1995). Four Rs of profitability: Rents, resources, routines, and replication. In C. A. Montgomery (Ed.). *Resource-based and evolutionary theories of the firm: Towards a synthesis* (pp. 147–178). Boston: Kluwer Academic Publishers.

Winter, S. G. (2000). The satisficing principle in capability learning. *Strategic Management Journal, 21*(10/11), 981–996.

Yelle, L. E. (1979). The learning curve: Historical review and comprehensive survey. *Decision Sciences, 10*(2), 302–328.

Haritha Saranga (PhD, University of Exeter) is Professor at the Production and Operations Management Area at the Indian Institute of Management Bangalore, India. Her interests include Data Envelopment Analysis, Total Quality Management, Lean Manufacturing, Six Sigma, New Product and Process Development, Empirical Research on Indian manufacturing industries, in particular, automotive and pharmaceutical industries and healthcare sector. She is a Fellow of MIRCE Akademy, Exeter, UK, and a recipient of the T.E. Filbee Research Fellowship. She has published several articles in refereed international journals, such as *Production and Operations Management*, *European Journal of Operational Research*, *Journal of International Business Studies*, *MIT Sloan Management Review*, *Annals of Operations Research*, *Journal of Operational Research Society*. She also co-authored a book, titled *Reliability* and *Six Sigma*, published by Springer and has written many cases and book chapters. She can be reached at harithas@iimb.ac.in

Rejie George (PhD, Tilburg University) is a Professor in the Strategy Area at the Indian Institute of Management (IIM) Bangalore. He holds the IIMB Chair of Excellence and is the Chairperson of the Fellowship Program (FPM) as well as Chair of the Centre for Corporate Governance and Citizenship at IIM Bangalore. Rejie has published in journals such as the *Strategic Management Journal*, *Journal of Business Research*, *Journal of International Business Studies*, *Long Range Planning*, *Asia Pacific Journal of Management* and the *Rutgers Business Review*. His research interests are in the areas of Corporate Governance, Strategic Management and International Business. He can be reached at rejieg@iimb.ac.in.

Judith Beine (PhD, University of Stuttgart) gained her doctorate at the University of Stuttgart in the field of supply management. Her research focuses on the development and integration of innovative automotive suppliers in emerging countries with regard to product and process development. For her empirical work, she also conducted a research visit at the Indian Institute of Management Bangalore. She is currently working in strategic procurement at a German automobile manufacturer.

Ulli Arnold is Emeritus Professor, University of Stuttgart/Germany. His research focus is in the field of Purchasing and Supply Management. He has many publications and conference papers in this research domain. He has been for several years member of the Educational and Research Committee of NAPM (ISM in USA) and Chairman of several corportae boards. He has been awarded the Federal Cross of Merit/Knight's Cross of Germany.