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Working Paper 5

Working with Indian ICT Collaborative Capacity

By

Sudhanshu Rai and Mogens Kuhn Pedersen

4.1 Introduction

Our endeavor in this chapter is to discuss collaborative capacity by first discussing some theory linked to collaboration. This theory mainly is drawn from innovation generic innovation literature and at times, its conclusion may not fit the ICT innovation of which collaborative capacity is a part. To derive some insight on Indian ICT collaborative capacity we have endeavored to discuss the R&D data, the collaboration data we have gathered from the all India survey of ICT innovation. The data we present is not indicative of the whole country, nor should it be considered as representing ICT innovation in India. What this data consists of are firms that have gone through our different modules in our methodology, of which there were four, the survey being the second module in our methodology. Thus this data should be considered as a set of data we collected on ICT innovation. Therefore what we conjecture will refer to the data set only. However at times we will develop argument based conjectures, which could be interesting for further dialogue and consideration. In the section that follows 4.2, we create theoretical scaffolding for our ensuing analysis. In section 4.2.1 we discuss the idea of building collaborative capacity using cooperative networks, in section 4.2.2 we address collaborative R&D. In section 4.3 we provide summery and implication of the treatment given in previous sections, in Section 4.4 we engage with conclusion, discussion and implication.

4.2 Conceptualizing Collaborative capacity

Collaborative capacity in an ICT context is conceptualized by the ability of the firms to develop systems and structures for working with other firms aimed at leveraging each firm's competency. Three key enablers of collaborative capacity are worth discussing. Firm's ability to develop networks of alliances, second the size question. Third, what is the critical mass required for a firm to build collaborative capacity? What does it take to engage in knowledge co-creation? What is the level of critical knowledge essential for building collaborative capacity?

The technology and innovation literature also has a fair deal of operational proxies for indicating the level of innovation. However these proxies are often considered as a static indicator of innovation, a one point reference of innovation and not innovativeness which is in essence dynamic. The key difference is in the notion of performance; it is easier to study performance by studying innovation if conceptualized statically and relatively harder to study innovativeness if conceptualized dynamically. The subjective matter for our investigation is innovativeness, as the ICT sector is largely perceived as a dynamic. The use of static single basic measure of performance is found in much research related to technology and innovation. For example, in

computer disk drives, Christensen (1992a,b) uses megabytes of storage per square inch. Khanna (1995), in a study of the mainframe computer industry, employs computer operation cycle time. Foster (1986) specifies two characteristics of an appropriate performance parameter. The first is that it be of value to customers; the second is that it be easy to engage with, (Stock et al. 2002). In the case of the EU grants, the links with patents and accreditation are also close to significance. However, there is no doubt that the causality in this case runs in two directions. Indeed, respondents who had obtained finance from EU programs were invariably running well-managed, highly R&D intensive companies and had considerable experience in executing R&D projects and acquiring external finance for these projects. These are the sort of companies that would be good at collaborating in, and sometimes even co-coordinating, the international research consortia required for obtaining EU funds (Romijn and Albu 2001).

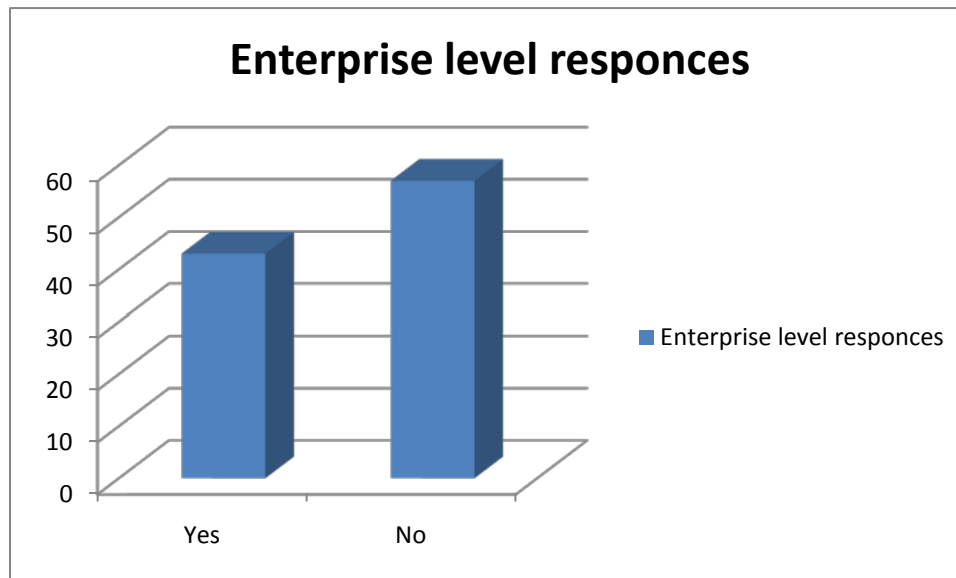
4.2.1 Building collaborative capacity using cooperative networks

In enabling the understanding of the problem domain for innovation, individuals within firms drive to engage with heterogeneous reference groups which are out of their immediate frame of reference; meaning, creating a common understanding of the problem area outside their immediate reference groups is as important as understanding what is to be done once heterogeneous groups are engaged. The key point is that networks build through firm initiatives or with the help of individuals are critical in building a collaborative ambiance that empowers the entire network. The question is what is required for the building of such a ambiance. In effect in developing a collaborative environment different kinds of knowledge is required, recall from chapter 3, the knowledge acquisition view, in effect the firms innovative potential is as important for initiating collaboration as is the support structure needed to facilitate it. Kanfer et al.(2000) discusses the distinction between embedded and mobile knowledge, proposing that the latter is not functioning unless there is a contextual built up, in other words one cannot rely solely on technologies in knowledge sharing across domains. Networks are one such mechanism that may affect the nature of innovation by allowing the relevant domain to become part of a shared understanding of the problem area, while allowing other aspects of knowledge to be located within the diverse groups. Powell et al. (1996) provide support for the hypothesis that in industries characterized by complex and rapidly expanding knowledge bases, the locus of innovation lies within a network of learning composed of incumbent firms, new entrants, and research institutions instead of within individual firms.

Firms also establish a network of alliances to better share domain knowledge with intent to developing process, products or services, (Gulati 1998). Alliances have become commonplace as firms try to absorb or learn capabilities and knowledge from other firms (Badaracco 1991, Ahuja 2000, Hagedoorn 1993, Powell et al. 1996, Rothaermel 2001). Research in the bio-technology industries indicate that networks are particularly successful in developing new technologies, in bringing about increased patent registrations for new products, (Rothaermel and Hess 2007) and in the semiconductor industry predict increased innovation rates as a consequence of networked alliances, (Stuart 2000) and Ahuja (2000) studying established firms in the chemical industry finds that direct network connection is positively correlated to innovative output, (Rothaermel and Hess 2007).

To explore what the data is telling us within the framework of the theory, we have chosen to use the enterprise level data to indicate collaborative capacity encapsulated in the ideas discussed above.

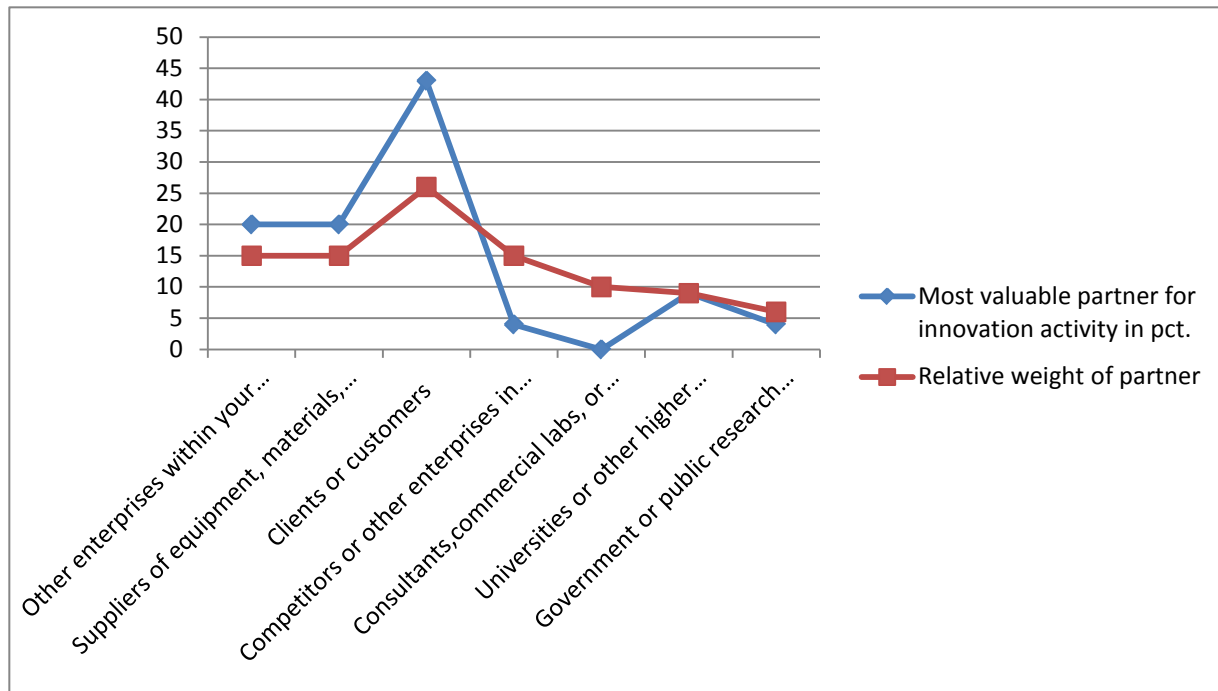
Figure 1, Did you co-operate with other enterprises or institutions?



Source, Euro-India ICT survey

From figure 1, at an enterprise level the response appears to be in the negative when asked about collaboration, implicitly this would mean that enterprises collaborate less but looking at figure 2 and 3, the picture is a bit more granulated. Consider figure 2, the responses indicate two key ideas; first ICT firms largely prefer to co-operate with clients or customers both in terms of frequency mentioned in the sample but also in terms of the value attributed to the collaboration. Second, ICT companies are largely service oriented in the meaning that they are mostly sub-suppliers or industrial product providers rather than consumer product providers, thus they prefer to collaborate with their clients. Limited collaboration takes place with suppliers and manufacturers of equipment, materials and components. Though collaborating with competitors or other enterprises in the same sector do take place it is valued very low.

Figure 2 Partners that the enterprises co-operate with



Source, Euro-India ICT survey

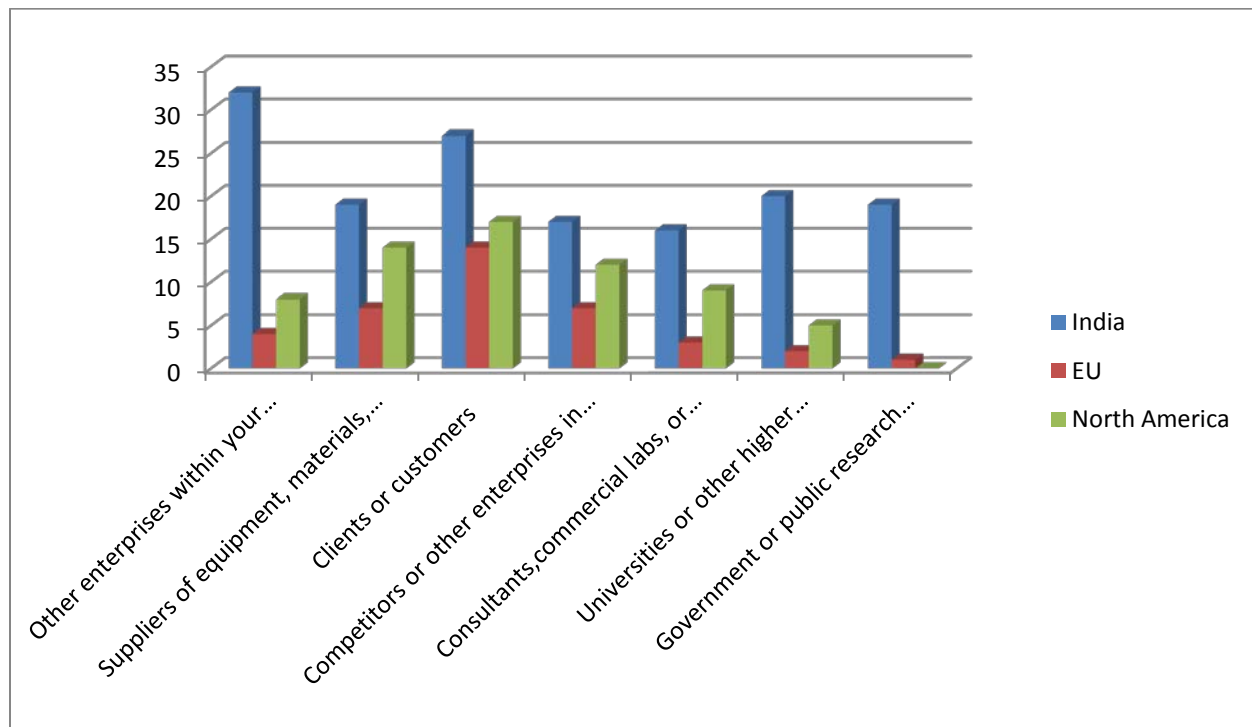
What insights can we carry forward for collaborative capacity from the three observations we have made above? From a network perspective, the question is do Indian ICT firms create networks that enhance their collaborative capacity? To answer this question we should have conducted a network analysis, since we have not, what we can indicate from the data is that some kind of relationship building takes place between the client and the firms. Whether this is based on conventional networks is hard to say. We suppose this kind of relationship is a hybrid, part of it based on networks and part of it based on formal client service practices

The next question, are alliance sufficiently evident from the data? From figure 2, the alliance component of the data is vague. We cannot tell for certain whether the co-operation between clients and customers is based on alliance or pure market interests, nor whether within enterprise interaction is established as an alliance or an obligation institutionalized by the corporate enterprise. For certain, companies are able to leverage a component of both co-operation and alliances for surmising their customers. For this to happen, their level of internal knowledge needs to be as recognized by the external entity as their ability to acknowledge what knowledge and skill is needed to service their customers. Looking at the data, firms appear to work with complementary alliances, meaning they use a combination of collaborating approaches dedicated to the demands of the situation. The ability to gauge and spot potential for developing dedicated networks and alliances and making them work can be conjectured to indicate a firm's collaborative capacity.

Collaborative capacity is then all about understanding how to capture the knowledge from an alliance or network and remit it to the reference group within the innovating company.

Figure 3 adds a further clarifying set of statistics indicating the ICT firms in India are able to collaborate across geographical regions. But there are two problems with this data. It does not tell us how they collaborate nor does this tell us the success of collaboration. What we can induce therefore from figure 3 is that ICT Indian firms work with other firms in other geographical regions but the nature of that work is yet to be determined. From the collaborative capacity perspective, we can conjecture little but to indicate that by working with firms from other geographical regions firms seem to indicate their ability to work with others, this may indicate a latency, a talent or a skill inherent in these ICT firms which enables the activity to occur but precisely which are these activities figure 3 is ambiguous. Figure 4 however takes the debate of collaborative capacity a step further in informing our understanding of Indian collaborative capacity.

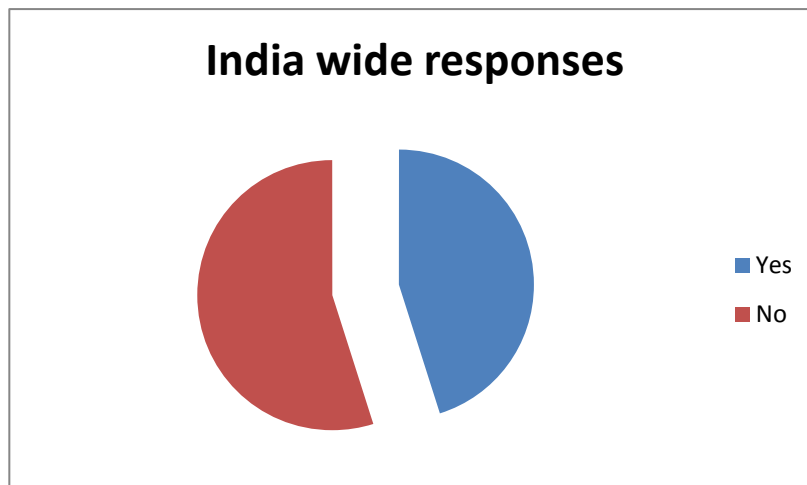
Figure 3 Location of partners with whom innovation activity occurs



Source, Euro-India ICT survey

Figure 4, provides a specific instance of an example of collaboration in the ICT sector. From the nature of the responses it is clear that the ICT industry is so intertwined in terms of the pervasiveness of technology that it becomes imperative upon firms to take advantage of others innovation as a stepping stone to their own innovation. Licenses also reflect the general terms of acquiring software whereas royalties reflect the use of patents.

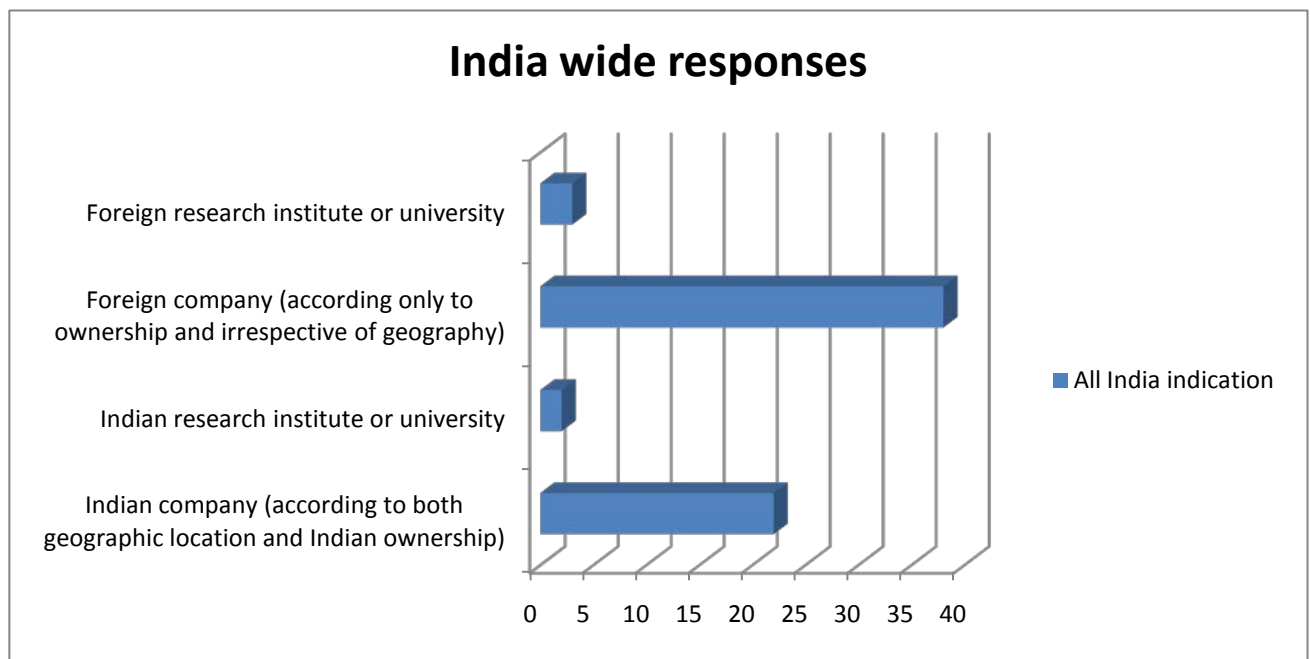
Figure 4 Does your enterprise currently have one or more licensing contract(s) for technology that is required for your product or service innovation?



Source, Euro-India ICT survey

Now combine the information from figure 4, with figure 5, and what do we learn about collaborative capacity in India?

Figure 5 If yes then does licensing derive from:

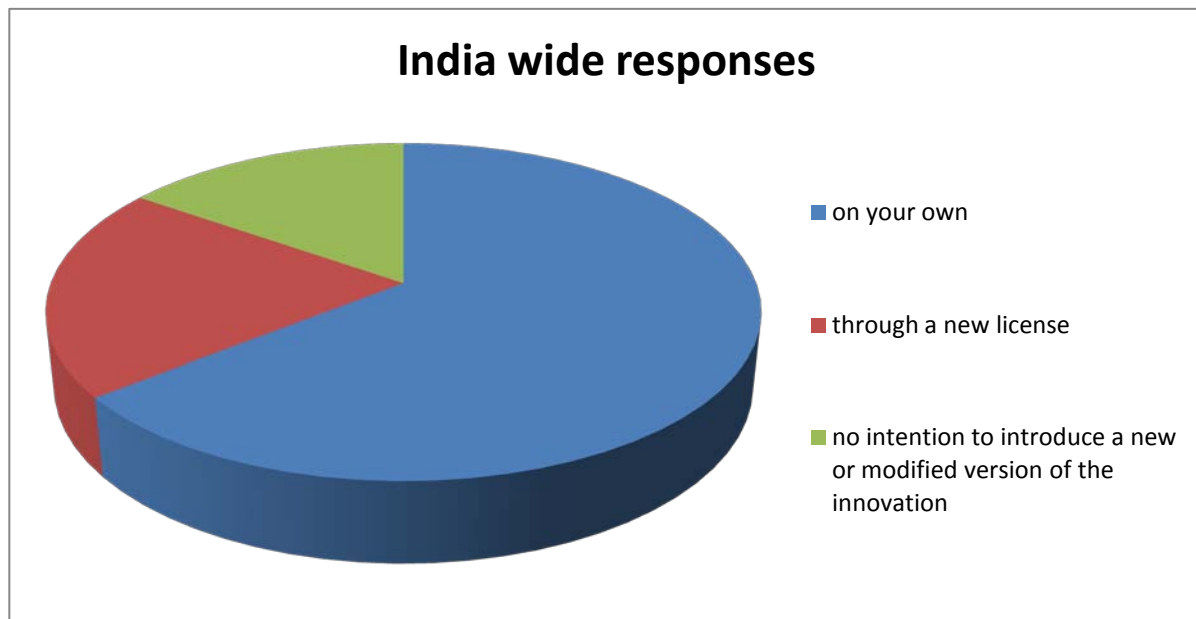


Source, Euro-India ICT survey

If licensing is an instance of co-operation, it appears that Indian companies licence a large number of technologies for their innovations from foreign companies. This can lead to two

further insights, first, Indian companies do not develop their own technology from base but innovate on technology developed by others, and second, for them to succeed in their usage of the licence and be innovative, they must develop some skills to engage with the licensed product in order to understand its technology and thus to apply it for their own purpose.

Figure 6 If you intend to develop new or modified versions of the innovative product or service for which you apply that license(s) will you do so:



Source, Euro-India ICT survey

Figure 6, does tell us that firms want to move beyond the licensed technology to gain independency if they continue to innovate. With mastery of a technology they develop their potentials for innovation having acquired a capacity for their own innovation process. On the contrary, if their own innovation is ineffective this may reveal that they are not able to understand the potential of the technology they license. Gaining proficiency in a technology requires constant engagement with the licensing firm in a knowledge sharing and transfer mode the more the technology develop as a platform for new innovations. Knowledge sharing and transfer are critical components of collaborative capacity building as they indicate level of internal capacity to deal with external collaboration. The degree to which this is acquired we cannot see here.

Table 1, provides a more indicative understanding of types of collaboration. This directly addresses the alliance issue and from this table we can safely deduce that from among the companies sampled there is a fair spread in types of alliances, and some companies report more than just a single type is in used. This leads us to develop two conjectures on collaborative capacity of Indian ICT companies, those that took part in the survey. First, that Indian ICT

companies are in habit of collaboration, although they collaborate along a narrow span of their value chain, meaning largely within their (major) customers (35%). Second, there are still some 35% reporting irrelevance of or having no formal outside contacts. Reasons may be as diverse as being a subsidiary of a major corporation; alliances are only a matter for corporate management. Or being a very small company asking for formal alliances makes little impression on any another, large company. And you do not have formal alliances with other very small companies!

Table 1 Does you innovation activities take place in alliances, joint venture or in collaboration with customers?

| Collaboration type | Responses | Relative frequency |
|---|-----------|--------------------|
| Alliance with major customers | 28 | 18 |
| Alliance with major (technology) suppliers | 34 | 22 |
| Joint venture | 14 | 9 |
| Collaboration with the customer | 27 | 17 |
| No formal contacts outside company/organization | 28 | 18 |
| Not relevant | 27 | 17 |
| Total responses | 158 | 101 pct. |

Source, Euro-India ICT survey

In summary: What can we say about the firm's collaborative capacity using three key theoretical guiding principles? Let's take the idea of network and alliance building capability that theoretically is implicit of a firm having collaborative capacity. The data presented above indicates that Indian ICT firms are more preoccupied with developing collaboration with their own customers than within their own domain. This does not mean that they do not have collaborative capacity all that it means that their collaborative capacity is targeted closely to their market.

Companies are more hesitant to build collaboration based on licenses; here they indicate that they focus on innovation on their own if they extend their innovation.

With who do the Indian companies collaborate? It is evident from the data that United States is the key foreign recipient of Indian ICT firm's collaborative endeavors. The EU is present as the second most frequently mentioned foreign partner to Indian ICT innovative companies.

In retrospect we can safely indicate that Indian ICT firm's collaborative capacity can be stated in three perspectives;

- External customer-close enterprise focus in collaboration
- Limited knowledge sharing and transfer in regard to licensing technology
- Innovation is largely an in-house phenomenon.

4.2.2 Collaborative R&D

In chapter 4, we discussed firm size in terms of innovative potential, particularly from the standpoint of Schumpeterian first hypothesis. In this chapter we discuss his second hypothesis and firm productivity. We will then couch it by thinking about collaborative capacity within R&D. We will then ask the question does ICT R&D among the firms we surveyed provide any indication about their collaborative capacity?

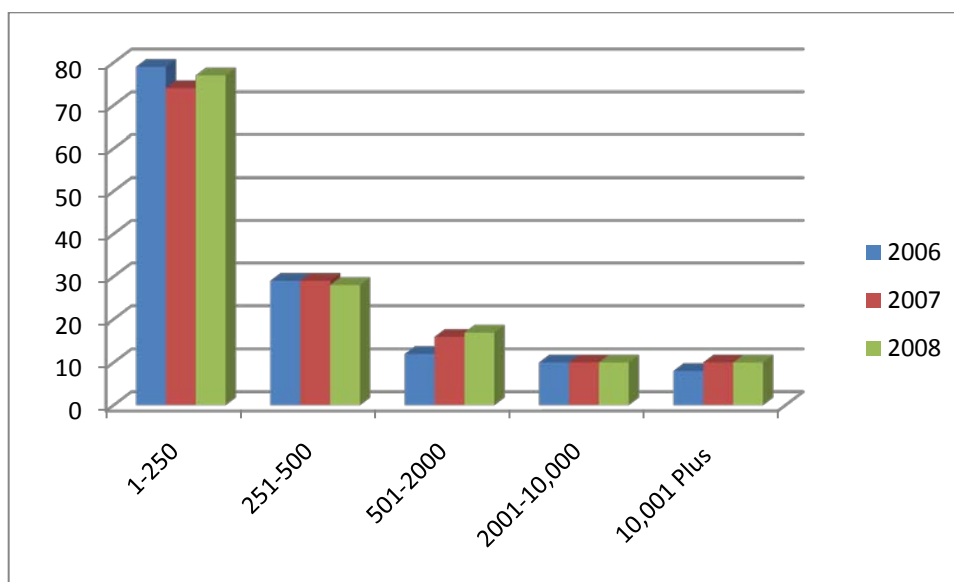
Ever since Schumpeterian ideas relating to firm productivity, economies of scale and firm size gained currency. The second Schumpeterian hypothesis predicts a positive relationship between innovation and monopoly power. It states that large firms will be more than proportionately innovative than small firms Schumpeter (1942). The predictive nature of this hypothesis depends on how economies of scale are brought to bear on the allocation of research resources for innovation. The conjecture forwarded within this argument supports the view that larger firms will have a greater ability to direct research resources on their R&D thus spurring innovation by managing economies of scale and productivity of the R&D process implying a direct correlation between firm size and resource allocation leading to innovation, as in larger the size of the firm the more resources it can allocate to R&D, (Stock et al. 2002). Consequently, larger size will allow a firm to accumulate a larger store of technological knowledge and capabilities (Damanpour, 1992). Another way to think of this point is that a larger firm will have the resources to tolerate an occasional unsuccessful R&D project (Stock et al. 2002). A large multiproduct firm will have more opportunities for diversification of R&D projects, and will therefore be able to realize a higher yield from the resources devoted to R&D (Kamien and Schwartz, 1982). Additionally, there is research showing that larger firms have an advantage in innovation, at least in some cases (Henderson and Cockburn, 1996; Lichtenberg and Siegel, 1991; Mansfield, 1980; Harrison, 1994; Cohen and Klepper, 1996).

Moreover, diversification strategies which may be better pursued by large organizations rather than SMEs (Caputo et al. 2002) clearly show a positive correlation rate among enterprise size and innovation ability. The profile that emerges for the adoption of radical innovations is one of large organizations that can afford large numbers of engineers to experiment with and absorb innovations containing a substantial new knowledge component (Dewar and Dutton 1986). Finally, the effects of size on the adoption of more radical innovations cannot be denied. Increased size leads to more engineers and, most likely, to more research equipment, larger labs, and more slack to permit failures (March 1981). As more experiments and trials are made, the number of failures increases, but so does the number of successes (Peters and Waterman 1982).

Larger size permits more risk-taking, a necessary condition for the consideration and adoption of more radical innovations (Dewar and Dutton 1986). Thus the monopoly and the economies of scale thesis of the size question clearly links size to sustainability over time for R&D commitment.

Let's consider the empirical evidence gathered through the survey on R&D among innovative Indian ICT companies. The arguments above indicate three key insights why large firms are said to be better at R&D than small firms. First, in resource allocation in terms of finance, second in human capital resources (large number of engineers), third in risk taking and sustainability; let's address the resource allocation issue. The resource allocation issue can be stated with the help of a few tables and figures. From figure 7, it is evident that a large number of companies taking the survey and part of our sample are small and medium size companies, which is further enforced by figure 8, which highlights the value of the sales of the firm as being in the middle range.

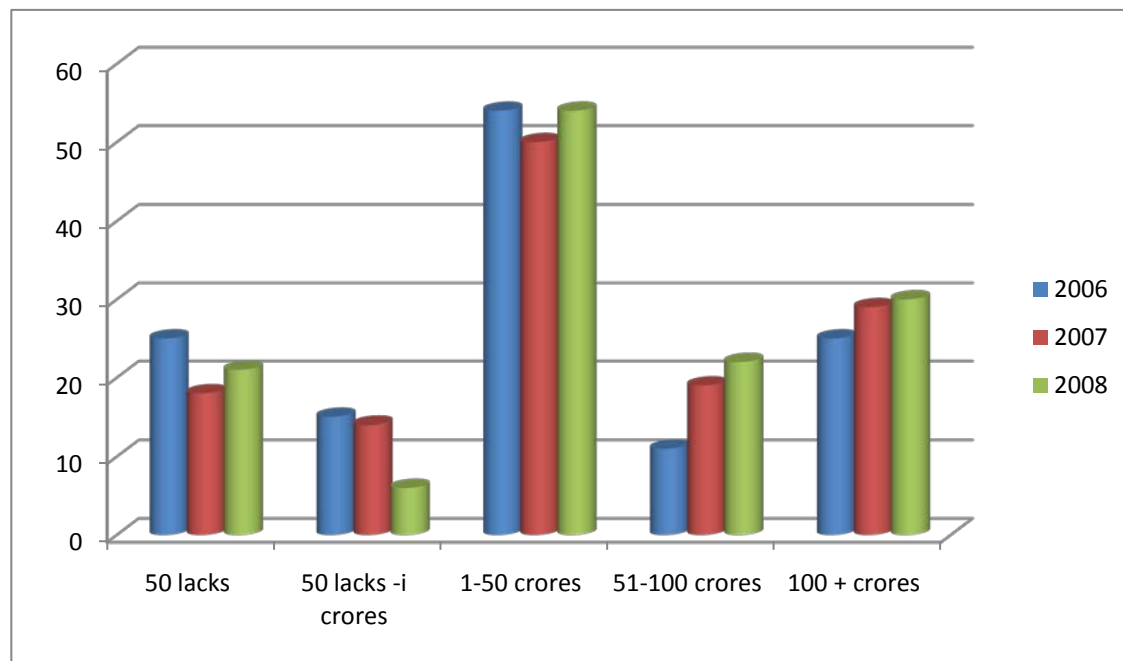
Figure 7 Number of employees of a firm



Source Euro-India ICT survey

Add to this figure 9, which indicates the value of exports, completes our picture of the nature of the Indian ICT companies that we surveyed. They are largely small and medium scale companies, having established that we then take the next set of arguments about their collaborative capacity reflected by R&D.

Figure 8 Values of Sales

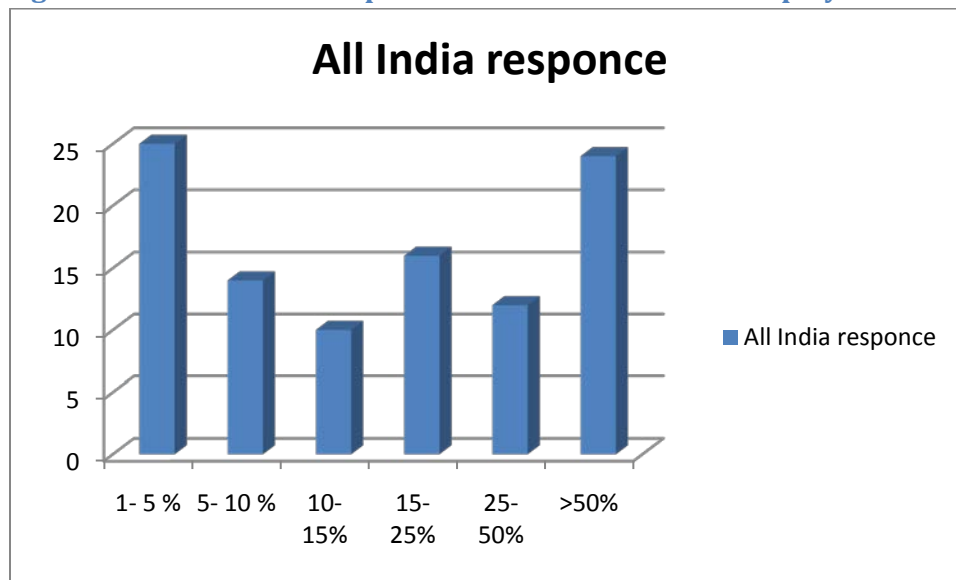


Source Euro-India ICT survey

If firm size was directly linked to collaborative R&D and firm innovativeness then figure 9, would be quite different, considering that most of our companies in our sample are small and medium scale firms. We have established that above. In which case we should be able to see little or no percentage of employees allocated to R&D or at least a very limited figure. Instead figure 9 indicates that ICT companies need far less resources to create an innovative environment around them. Further right across the firms there is some expenditure on R&D despite the size being small. But the most critical insight is that the firm with the largest ratio of R&D among the sample is also in the larger scheme of things a medium firm.

The emerging picture then can provide an alternative conjecture that in the ICT companies perhaps firm size does not matter as much as it did in other industries. The critical point to note about the ICT industry and our sample size in particular in figure 9, is there appears to be another ratio between research and development and manpower allocation for engaging in collaborative capacity than what is found in other industries. We find small companies devoting a sizable share of their human resources on R&D not the least because there are little investment requirements beyond their own labor to conduct much of the development in software building. The degree of formalization of R&D may be low since the company size does not allow for a strict functional division of labor and nor does that spur innovativeness.

Figure 9 The share of R&D personal in total workforce employed



Source Euro-India ICT survey

From our sample then the hypothesis that large firms are better at resource allocation may not be such a cut and dry case. The sample that we engaged with indicates that ICT companies though small or medium show signs of engaging with R&D.

What can we say about collaborative capacity? Before we engage with that subject let's consider what theory has to say about the converse articulation linking small size to collaborative R&D.

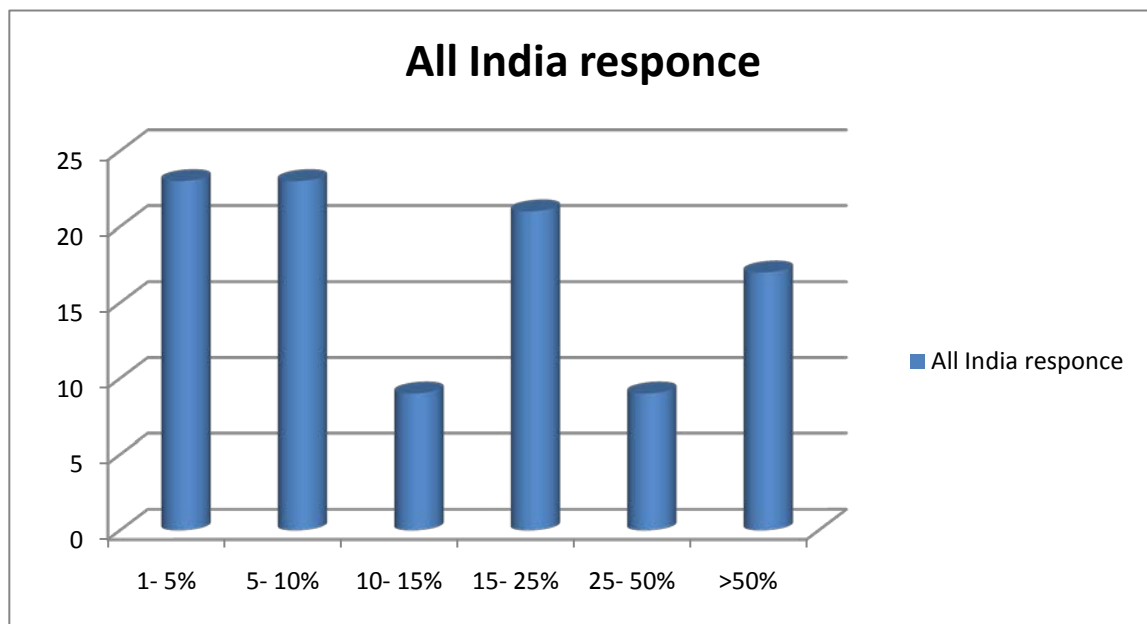
In their literature review, Kamien and Schwartz (1975, p. 15) characterize the objective of this stream of research in the following manner: "A statistical relationship between firm size and innovative activity is most frequently sought with exploration of the impact of firm size on both the amount of innovational effort and innovation success." Kamien and Schwartz (1982, p. 84) find that "beyond some magnitude, size does not appear to be especially conducive to either innovational effort or output." (Stock et al. 2002).

Another consideration is that engineers and scientists in a smaller firm may be more highly motivated than in a large firm. In a small firm, the compensation of an individual may be more tightly linked to performance than in a large firm, particularly in those entrepreneurial firms where a scientist or engineer receives stock or stock options as part of a compensation package (Kamien and Schwartz, 1982). A number of studies have shown that patent counts increase at a rate that is less than proportional to firm size (Bound et al., 1984; Schwalbach and Zimmerman, 1991; Chakrabarti and Halperin, 1991). Other studies using the number of innovations (Acs and Audretsch 1987, 1988; Audretsch and Acs, 1991), the number of new drugs brought to market (Graves and Langowitz, 1993), and scientific publications (Halperin and Chakrabarti, 1987) have yielded similar findings (Stock et al. 2002). Smaller firms showed a significantly higher rate of change in product performance, on average, than did larger firms. Our results therefore provide evidence for the argument that smaller firms are more technologically innovative, at least in a dynamic sense (Stock et al. 2002). Therefore, it may not be size, per se, that is responsible for the difference in innovation performance; it may be that organizational characteristics often found in

small firms are the determining factor. In other words, can a large firm “act small” in the innovation process? One way to address this question would be to study dynamic innovation in entrepreneurial divisions or joint ventures of large firms. (Stock et al. 2002).

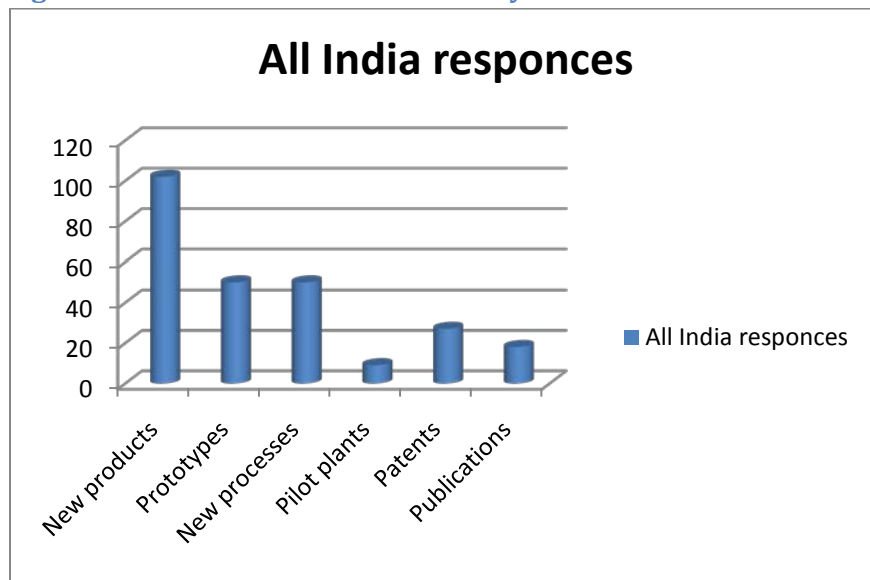
From figure 10 three interesting insights can be acquired, first that the amount of resources allocated to R&D as a percentage of the firms turnover indicates that all firms have a steady stream of investment in R&D, despite their size. Second, resource allocation in the ICT sector may not have the same gravity in terms of resource burn-rate as it could in traditional industries and third the R&D in the ICT sector is more akin to innovation than basic R&D.

Figure 10 What was the average per year R&D expenditures in 2006-2008 to total turnover (include all taxes except VAT)?



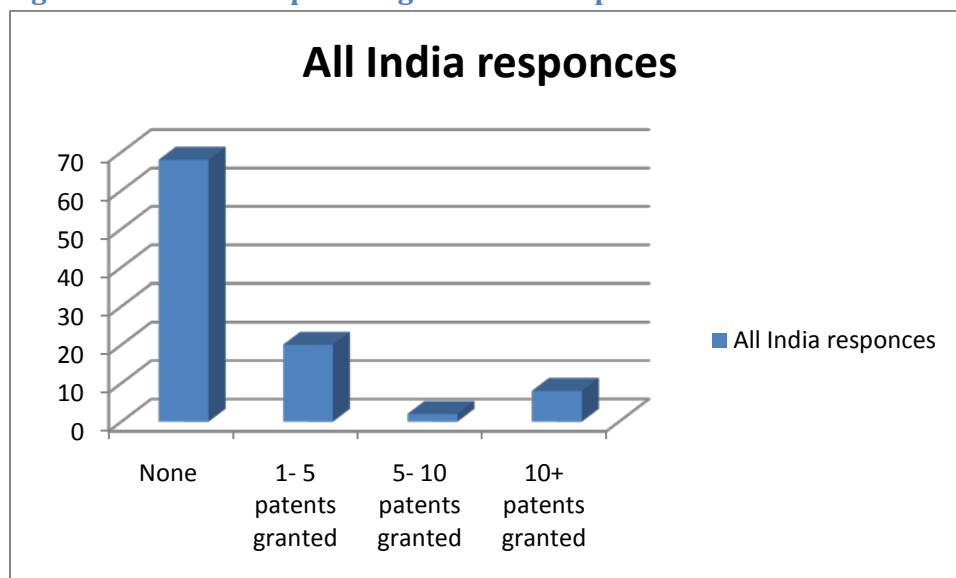
Source, Euro-India ICT survey

Figure 11 what has been the result of your R&D efforts in 2006- 2008?



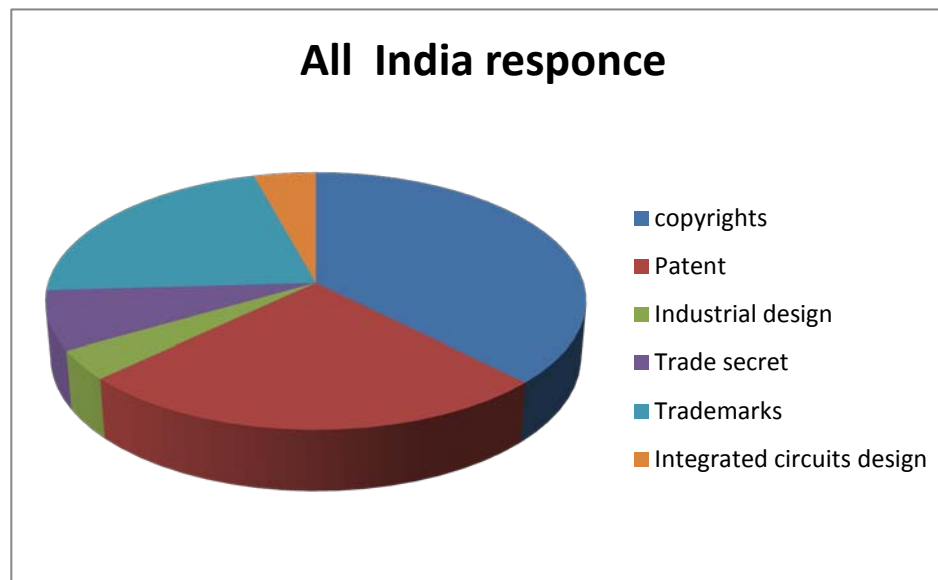
These are pointers based on the data set and not a prediction of the general ICT industry at large. It could be the case that large ICT companies in India do engage with fundamental research. However the data we present here does not seem to indicate that fundamental research is being conducted among the ICT companies we have surveyed. We can further substantiate this point by considering figures 11, which talks about the result of their R&D, figure 12 which tells us about the number of patents granted to Indian ICT companies and figure 13 that indicates how do companies safeguard their intellectual property rights.

Figure 12 Number of patents granted in the period 2006-2008



Source Euro-India ICT survey

Figure 13 How is your intellectual property rights protected?



Let's take all these figures and make a singular argument about fundamental research. Assuming if the companies were doing fundamental research then it would follow that they would have a greater spread in their portfolio of intellectual property right, as an important way to safeguard their investment by creating a revenue channel. Usually patenting is the key outcome of a “deep” R&D process (in some industries more than others) but on the output side in the survey the number of patents indicate a footprint less important than copyrights, which indicate an R&D effort that is less profound; because in figure 13, the major type of risk mitigating strategy adopted is not singularly patents. This also indicates that companies may not be market leaders in their product types but technology integrators.

Let's ask ourselves, if an ICT company is primarily a technology integrator, where it develops products using key technologies from other companies (mostly foreign) and it has a copyright IPR footprint, does this tell us about the nature of the innovative potential and capacities of the company? Maybe it indicates a focus on being aware of the changing technology, developing capacity for collaboration close to the market (customer dependent), but disregarding long term alliance building and maintenance of a technology platform with close cooperation with technology providers?

In combination these skills that are cultivated leads us in the direction of forming conjectures that indicates a high sense of reliance on *short term* collaborative capacity.

4.3 Summing up; Collaborative capacity among Indian ICT firms

We can develop four simple indicative insights on our treatment of the data within theory on innovation and R&D.

First, alliance building through sustaining technology platforms is *not* a relevant indication of collaborative capacity for the sample of ICT innovative companies in general,

Second, there are a high proportion of resources allocated to R&D *irrespective* of the size of the company. There does not seem to be any co-relation between size and resource allocation. Meaning all sizes of companies in our data set indicated that they allocated a non-negligible amount of resources towards R&D.

Third, there is a high focus on technology integration rather than building basic new technology.

Fourth, there is a low footprint in terms of IPR indicating limited research into fundamentals of technology. Which support a conjecture that Indian ICT companies are very seldom market leaders in products but are leaders in services provided to market leaders.

4.4 Conclusion, discussion and implication

We have discussed at length the data we have presented. The question, what are the implications of this data set for Indian ICT companies at large, to our mind we can see two broad implications from the treatment of the data set above:

First, Collaborative capacity is not necessarily predicated on R&D but will continue to play an important role if the Indian ICT companies move from technology integrators servicing immediate customers into providing product leadership.

A glimpse of this transition may be discerned from the indication from two groups of data sets. A) There is a large across the board investment in R&D. This will at some point materialize in products if not surrendered due to a lack of sufficient new revenues; B) the increasing focus on products should be complemented by efforts in new market creation efforts (marketing have been mentioned by most companies as one of their innovation activities).

ICT innovative companies are currently involved in innovation that combines or integrates technologies based on short-term collaboration.

Second, the ICT industry may slowly move towards a collaborative model away from an in-house innovation focus, this would imply that product development would take place less within enterprise and more across enterprises.