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Measuring R&D Demographics to Assess the Potential for Technological Innovation of SMEs in India

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Abstract

Innovation is one of the best-known indicators of organizational competitive advantage. However, little is known about the innovation behavior of SMEs in developing countries. The capacity of SMEs to be lean, flexible and agile makes their potential for innovation, high. Their R&D demographics is a good indicator of whether they will be potentially innovative or not. It is with this aim that we studied the R&D characteristics of Indian SMEs. The survey methodology was used. The questionnaire method was used for data collection. A sample of 55 Indian SME organizations in the pharmaceuticals, information technology, machine tools and precision tools sectors were surveyed. The metrics used to measure R&D demographics included spread of R&D activities within the SMEs, R&D expenditure of the SMEs, education levels of the SMEs, collaborations of the SMEs for technology acquisition and clients of the SMEs between foreign and Indian markets. Implications and policy suggestions are also discussed.

Keywords: Indian SMEs R&D demographics, measuring R&D demographics.

INTRODUCTION

There is no doubt in the minds of Technology Management (TM) researchers and practitioners that R&D activity is essential for the manifestation of technological innovations and sustained organizational leadership. This is the difference between organizational innovations and technological innovations. Technological innovations need the unconditional support of R&D departments, unlike organizational innovations which need not have the support of R&D departments, to occur. Nevertheless, it is important for both organizational and technological innovations to co-exist and work in tandem for successful product performance in markets. Management of technological innovation is a poorly researched area in developing countries like India simply because R&D management itself is a missing topic of discussion. Organizations with active R&D tend to maintain their leadership in global markets. Such organizations focus on the term innovation as an outcome of R&D activity, which in turn brings them leadership in markets. It is thus obvious to say that the term innovation, when used by practicing managers of technology intensive sectors of industry, implies the existence of R&D activity either

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in-house in their organizations or outsourced to their organizations. It is in this context that the need to monitor the nature of R&D activity of organizations is essential. The monitoring of R&D is not in terms of technical content, as this is competitive intelligence and is not easily disclosed by organizations, but more from the perspective of how R&D is managed in organizations, or their R&D management practice.

The monitoring of R&D management practice is also essential as it is the route to develop outputs that are called technological innovations. Today the term innovation is described as the best-known indicator of organizational competitive advantage (Drazin and Schoonhoven, 1996, Christensen, 1997). 80 of the Fortune 500 companies that have focused on organic growth through innovations have "earned handsome rewards" for the shareholders, compared to companies with lower rates of organic growth (von Krogh and Raisch, 2009). It is argued that innovation is essential to organizations and the ability to innovate is "one of the most important strategic priorities" for them (Morris, 2006).

The term innovation is also a favorite topic of research for organizational theorists. The importance of innovation is reflected in the dramatic increase in literature that addresses the role, nature and measurement of innovation (Johannessen et al, 2001, Garcia and Calantone, 2002, Christensen and Raynor, 2003, Govindarajan & Trimble, 2005, Chandy et al. 2006, von Krogh and Raisch, 2009, Lafley & Charan, 2008). While it is clear that theoretically organizations of all sizes can engage in innovation, the myth that it is tough for small and medium enterprises (SME) appears to have been laid to rest. Many researchers have pursued studies with samples of SMEs and concluded that they have greater potential for innovative behavior compared to larger organizations. This paper focuses on certain R&D demographics that were measured in the context of Indian SMEs in four sectors namely, pharmaceutical, IT, machine tool and precision tool industries. The intent of measuring R&D demographics was to assess the potential for innovation in these Indian SMEs. This paper tries to address the lack of empirical data on these companies. It proposes the need to measure R&D demographics periodically in Indian SMEs to assess their potential to innovate. The study described here presents the results from a survey of 55 SMEs in India. We have confined this paper to results describing their R&D demographics.

THE R&D AGENDA IN INDIAN SMES

R&D is a much discussed function in organizations today. In earlier days Roussel et al (1991) defined R&D as a function "to develop new knowledge and apply scientific or engineering knowledge to connect the knowledge in one field to that in others". Twiss (1992) defined R&D as "the purposeful and systematic use of scientific knowledge to improve man's lot even though some of its manifestations do not meet with universal approval". The National Science Foundation in USA defines R&D as basic research, applied research and developmental research. These descriptions apply to any organizational size and to any country. In the case of developing countries, their over all R&D spend is less than that of developed countries.

With the saturation of developed markets, companies are increasingly focusing on emerging economies like India, China, Philippines and Indonesia for growth. As a reflection of this trend in business, academia has increased their focus on studying innovations in developing countries and how to successfully address them (Furtado et al., 1994, Coutinho and Ferraz, 1994, Katz, 1997, Anderson & Markides, 2007). They have found that internal efforts made by local manufacturing industries in technological activities are feeble, and mostly oriented towards incremental innovation. However, little is known about the major features of R&D demographics in technology intensive organizations of developing countries. The lack of empirical, comprehensive and aggregate data on innovation performance and activities of firms has been an obstacle to the better understanding of the nature of the innovations in developing countries. In this light, it seems important to evaluate the potential of SMEs in developing economies like India to innovate and accelerate technological progress.

Small and medium enterprises (SMEs) account for a considerable majority of industrial units and the highest proportion of employment in most developing as well as developed countries. They have the reputation of being boosters of employment, economic growth and economic dynamics. One of the most important means by which SMEs are able to make these contributions is their capability to realize innovations.

Small enterprises are defined based on a number of criteria such as: employment, turnover, assets, managerial processes, and other criteria (sometimes based on ownership or independence) (Atkins and Lowe, 1996). The definition of a small enterprise varies enormously between industrial sectors and between countries (Nanjundan, 1994). Looking at publications within India, the only known source of published definitions are available in the "Report of the study group on development of small scale enterprises", submitted by the S.P Gupta Committee of the Planning Commission (March, 2001). The committee focused on plant and machinery investment and defined such organizations in the following manner:

I) Tiny unit: up to Rs 25 lakh investment in plant and machinery

II) SSI unit: Above Rs 25 lakh, up to Rs 100 lakh investment in plant and machinery

II B) SSI units with technology and export intensity: up to Rs 500 lakh investment in plant and machinery

III) Medium unit: from Rs 1 crore to Rs 10 crore investments in plant and machinery

The case of Small and Medium Enterprises (SMEs) requires deep understanding as they do not have the rigidities of large established firms. Their capacity to be small, lean and agile makes them well prepared for innovations to happen. It has been argued that countries that have more number of new ventures grow faster than others (Schmitz 1989). The smaller companies help to accelerate the pace of technological change (Sorescu et al, 2003). Stock et al (2002) found a negative relationship between firm size and dynamic innovation. Smaller firms showed a significantly higher rate of change in product performance, on an average, than did larger firms. Their results therefore provided evidence for the argument that smaller firms are more technologically innovative, at least in a dynamic sense.

Most studies on R&D have focused on R&D outputs rather than R&D inputs. Figure 1 describes this process. Certain R&D demographics are needed as pre-requisites if R&D outputs must happen, be productive and lead to innovation. Most output studies take indicators to be number of commercialized patents (Rivette and Kline, 2000), or number of products and processes (Gopalakrishnan and Damanpour, 1994, Xu et al. 1999, 2000).

Figure 1: Showing the input - output perspective of R&D

Another approach of studying innovation outputs is in classifying innovation itself. The classification of innovation in terms of radical and incremental outcomes of innovations is also a much addressed area (Rosenberg and Steinmueller, 1988). From the standardization of measurement perspective the Oslo Manual, 1993, serves as a good guide for how to measure innovation. It is also true that SME's are also measured on the same outcomes of R&D.

On the other hand the input variables of R&D are a less studied area. When studying the inputs of R&D most researchers consider R&D investments and ratios of investment and outcomes, manpower and educational qualifications, tacit and explicit knowledge in the group. It is true that these aspects are less studied as gathering data of this nature is tedious unless researchers persist and organizations cooperate in giving their data.

From the inputs of R&D perspective, the emphasis given to R&D by the top management is also seen in terms of the way they design R&D into the organizational structure (Mathew and Chattopadyay, 2001). R&D can be an outsourced activity (not existing in – house) or it can be an in-house activity with a full fledged department. For SMEs, maintaining a full fledged R&D department may be a costly over head, hence SMEs may have to look for various other organizational designs to own R&D activity in order for technological innovation to happen.

Another perspective from the input side which is gaining popularity as an input variable is that of the importance of R&D networks. This area is also referred to as R&D collaborations, strategic alliances, and university-industry relations. The concept of network structures for R&D is mentioned over and over again in literature (Osborn and Hagedoorn 1997, Katz and Martin, 1997, Ganguly, 1999 p 120, Chesbourgh 2003, Mathew and Madhavan, 2007). R&D activity is considered to be conducted by various actors in the industry (Nelson, 1993), and these actors must network with each other (amongst and within) for productive R&D to happen, in other words for innovation to happen.

The above characteristic of networks is of great importance in the case of SMEs. SMEs being small in size are also short of finances for good part of their operations. Hence their investments in R&D are last priority unless R&D is given its right importance by the top management. This being the case, SMEs are not capable of investing in R&D on their own and often capital investments are high for sophisticated R&D laboratories. It is not uncommon for SMEs with an R&D priority to cluster together and conduct their R&D operations in a team. This implies that a group of SMEs join together to form a cluster. This network of SMEs, collaborate to bring out innovations and have a sharing contract for patents and commercialization.

Small sized organizations are said to be more innovative as they are “more flexible, have greater ability to adapt, improve and demonstrate less difficulty in accepting and implementing change” (Damanpour, 2001). This statement indicates that SMEs may have organizational designs that are flexible, and capable of networking and collaborating for better R&D access.

METHODOLOGY

This paper presents results from a part of a larger study on R&D and innovation in Indian SMEs. The method described here pertains to R&D demographics, a sub part of the main study.

(i) *Measurement design:* Keeping in mind the introductory discussion on SMEs and R&D demographics, we embarked on a questionnaire based survey to assess patterns of R&D demographics in Indian SMEs. A conceptual model useful for our measurement design was developed based on literature review, the experience of researchers and discussions with experts.

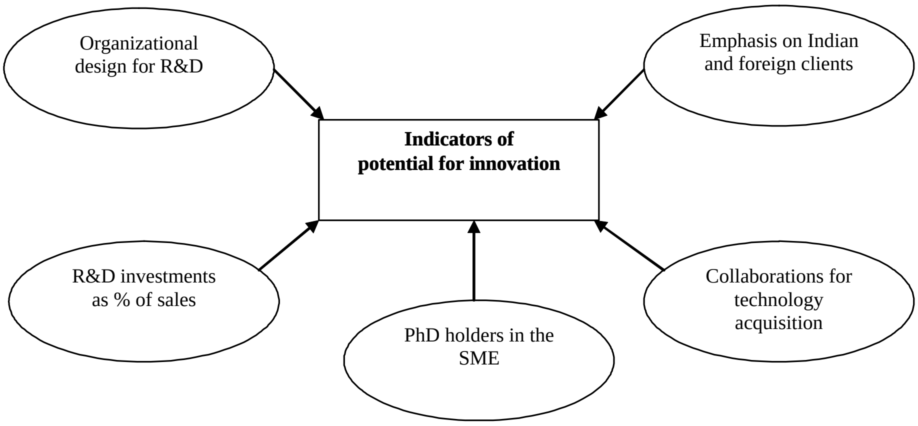

Figure 2: Measurement model showing R&D demographics to be monitored periodically

First, the CEOs of SMEs were asked to choose the activity that they felt was the most appropriate area of their work. They chose from the following: Manufacturing and R&D, IT and R&D, R&D only, Manufacturing only, IT services only, Sales and marketing, and Maintenance. An SME can engage itself in more than one activity at the same time.

Subsequently they answered queries on various factors describing the nature of R&D management in their organizations. Figure 2 shows the factors of R&D demographics our study measured. These factors were self explanatory. They were operationally defined as shown in Table 1. This model measures the SME on:

(a) activities of the SMEs (Business activities)
(b) number of doctorate degree holders in the SMEs (Education level)
(c) spread of R&D activities (Organization design of R&D structure)

(d) financial investment towards R&D (Investment practice)
(e) details of foreign and Indian clients (Foreign market orientation)
(f) collaborations for technology acquisition (Network behavior)

Based on the conceptual model shown in Figure 2, a questionnaire was developed. This was done to understand the R&D and thus level of technological innovation potential of the SMEs. A copy of the questionnaire used for this paper is shown in Appendix 1. Table 2 describes this questionnaire further. The table gives the list of the questions that were put across, the number of items under each question and their measurement scale. A few questions asked were on a nominal scale (0/1), some were open-ended and the remaining was assessed on a rating scale.

Table 1: Operational definition of factors in the measurement model for indicators of possible innovation

Factors	Operational definitions
Ph.D. holders in the SME	The number of full time employees and the number of Ph.D. holders amongst them.
Organizational design for R&D	This refers to the organizational design for R&D, classified as: • Entire organization • An R&D department within the organization • Special R&D teams in the organization • Outsourcing • Cluster/community R&D
R&D investment in the SME	This is the comparison of R&D expenditure for the past 5 years and the present year.
Collaborations for technology acquisition	SMEs collaborations for technology acquisition can be with: • Indian universities • Foreign universities • Foreign technology organizations • Indian technology organizations • None, indigenously developed in-house
Clients of the organizations	The clients (both foreign and Indian markets) of the SME to whom sale of technology, goods, and services can be made

Table 2: Structure of the questionnaire

	Number of items	Scale	Question numbers
Activities that describe the SME	1	Nominal (0/1)	3
Employee details of the SME	1	Open-ended	4
Organizational design for R&D	1	Nominal (0/1)	5
Financial investment towards R&D	1	Open-ended	6
Collaborations for technology acquisition	1	Nominal (0/1)	7
Clients for sale of technology, goods, and services	1	Nominal (0/1)	8
Foreign and Indian clients (%)	1	Open-ended	8

(ii) Sampling design: The sample in the survey was limited to SMEs from four sectors: Pharmaceutical, information technology (IT), machine tools (MT) and precision tools (PT). These were considered technology intensive.

The challenge of identifying who these Indian SMEs were was a gigantic task. For the purpose of identifying the samples, organizations such as the Federation of Karnataka Chamber of Commerce and Industry (FKCCI), Confederation of Indian Industry (CII), Karnataka Small Scale Industrial Association (KASSIA), Karnataka Udyog Mitra and Karnataka Council for Technological Upgradation (KCTU) were contacted and information to identify SME members of these associations was sought. Further, information was acquired from associations such as Chemicals, Pharmaceuticals and Cosmetics Export Promotion Council (CHEMEXCIL), Karnataka Drugs and Pharmaceutical Manufacturers Association (KDPMA) and All India Small-Scale Pharmaceutical Manufacturers Association (AISSPMA) exclusively for the pharmaceutical sector, Engineering Export Promotion Council (EEPC) for all sectors, as well as from the databases of National Association of Software and Service Companies (NASSCOM) and Manufacturers Association of Information Technology (MAIT) for the IT sector. For the tooling sectors, Indian Machine Tool Manufacturer's Association (IMTMA), Indian Machine Tool Consortium (IMTC) and the Peenya Industrial Association (PIA) were contacted. A summary of the associations contacted for each of the chosen technologies is shown in the Table 3. Lack of adequate responses, is a common problem in survey methods and this was encountered in this survey as well.

Table 3: List of associations contacted for sample identification

Industry	No. of associations contacted	No. of associations that responded	Types of lists obtained	Approx. no. of SME population in India
Pharamaceutical	3	3	CHEMEXCIL, AISSPMA, KDPMA	651
Information technology	5	3	MAIT, NASSCOM,Electronics and Computer Software Export Promotion Council (ESC)	1500
Precision tools	3	3	Indian Machine tool Manufacturer's Association (IMTMA), Indian Machine Tool Consortium (IMTC) and the Peenya Industrial Association (PIA).	188
Machine tools	3	3		250

Having obtained a list of SMEs it was clear to us that all SMEs in the population need not be contacted as they may not have R&D activity. The total population of SMEs obtained from the above sources was subjected to a process of screening for elimination since it was assumed that many from the population would not have R&D activity, and it was practical to reduce the time spent and cost of the survey via a screening stage. It was decided to identify at least 30 potentially innovative organizations of the population in each of the four sectors of the study respectively after a discussion with experts. The criteria identified to screen and eliminate samples were evolved based on interactions with experts from industry and academia. The criteria aimed at finding those SMEs that had R&D activity. The following criteria were used to screen the sample.

Awardee list: SMEs who won awards are expected to have a higher innovation potential than those that do not. Lists of awardees were obtained from various institutes such as the Engineering Export Promotion Council (EEPC), National Research Development Corporation (NRDC), Small Industry Development Organization (SIDO) in order to obtain the names of firms that have won awards, and hence potentially innovative.

Exporter's list: SMEs that have a high export base are expected to be more innovative than those that do not. Organizations such as EEPC, ESC and CHEMEXCIL were approached to acquire the lists of SME exporters to determine the SMEs that have large exports and thus are potentially innovative.

Exhibitors list: Lists of exhibitors in various expositions such as NMIT, IMTEX were obtained, with the assumption that SMEs that market themselves and have technologies to showcase thus must be potentially innovative.

The list of companies obtained after the elimination process detailed above was presented to industry experts for verification. Changes were made in accordance to the feedback received from the experts consulted.

At the end of the screening process only 119 SMEs qualified for the survey. Out of 119 short listed SMEs, 102 SMEs were finally contacted. Some of the SMEs could not be traced because of a change in their phone numbers and web addresses. Questionnaires were delivered to these 102 SMEs by courier or through e-mail as specified by them. The concerned CEO of each SME answered the questionnaire. The interest shown by the SMEs towards the questionnaire helped us obtain filled questionnaires within a reasonably period of time. Out of 102 SMEs contacted 55 responded positively and with complete data worthy of analysis. Figure 3 gives the sector-wise break up of the respondents. The response rate from the machine tool sector appears highest, although we anticipated it should have been more from the pharma organizations. During data collection we also faced a lack of co-operation from some SMEs as they refused to answer some questions and showed some concern over revealing their data for the purpose of this questionnaire.

Since the data in this part of the study was measured using a nominal scale with some open ended questions, this paper presents descriptive analysis of demographics in R&D practice of these 55 Indian SMEs.

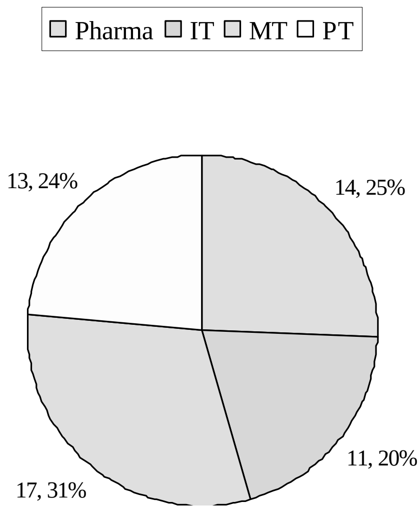

Figure 3: Sector wise break up to respondents (n=55)

RESULTS

The results in this section are discussed following the measurement design described in the methodology section. Hence, first the business activities of these SMEs are described. This is followed by a description of each factor described in our conceptual model in Figure 2.

(i) Activities of the SMEs (Business activities)

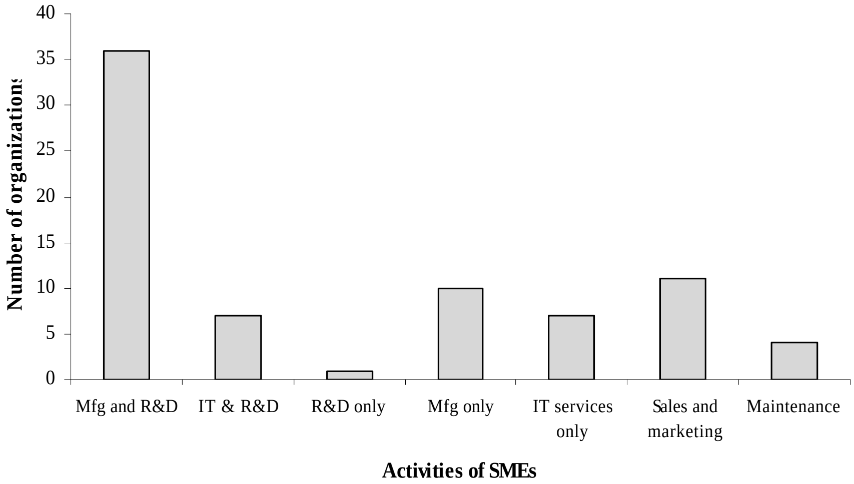

Figure 4: Activities of the SMEs (n=5)

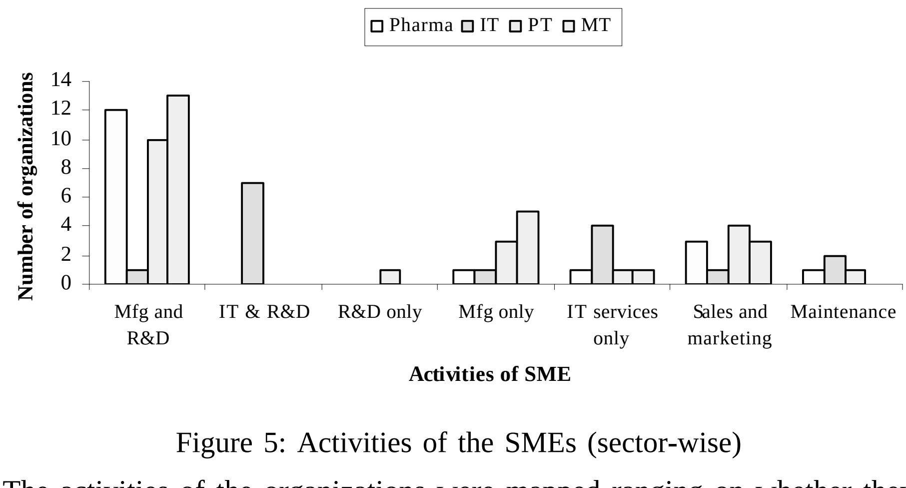

Figure 5: Activities of the SMEs (sector-wise)

The activities of the organizations were mapped ranging on whether they engaged in manufacturing and R&D, IT and R&D, only R&D, only manufacturing, sales & manufacturing or maintenance only. Organizations were allowed to choose more than one option. Most of the organizations (36) engaged in manufacturing and R&D activities while only one organization (in the precision tools sector) engaged in core R&D activity. The high density of manufacturing and R&D organizations were in the pharmaceuticals, PT and MT sectors. Ten organizations claimed to be involved in only manufacturing. One organization each in the pharmaceutical, PT and MT space engaged in IT services space for the particular sector while eleven organizations claimed to be involved in sales and marketing. Only four organizations claimed to be involved in maintenance related activities. None of the organizations amongst the 55 sampled in the study were involved in only sales & marketing or only maintenance activities. The fact that only one SME engaged in R&D fully is interesting as this is a challenging task for an SME. R&D can be considered a cost centre with slow returns hence it is not easy for an SME to survive in a competitive market with a business focus as only R&D, it will need other revenue generating activity like services and manufacturing. Although the sample size is small these figures are descriptive of the way SME CEOs describe their business.

(ii) Education level (number of doctorate degree holders in the SMEs)

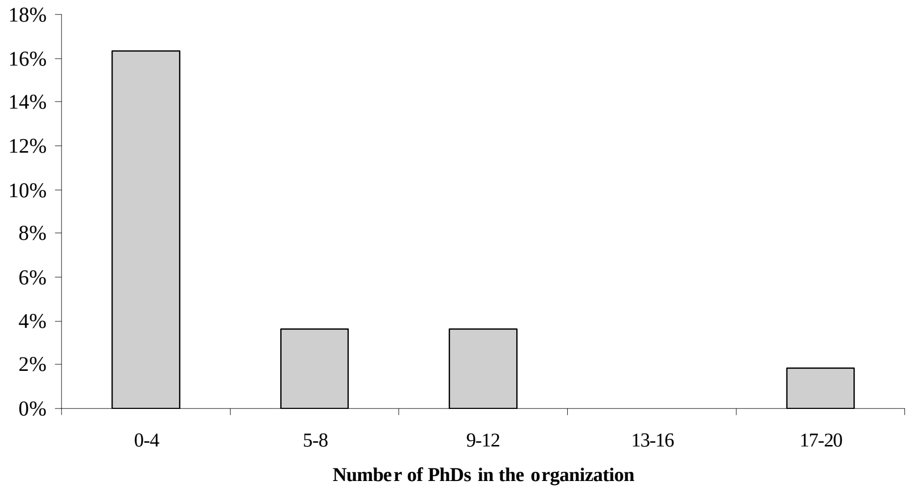

Figure 6: Education level (n=14)

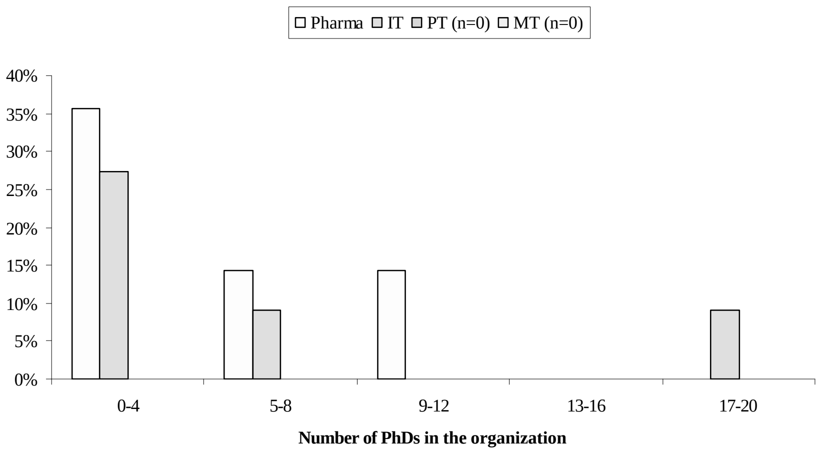

Figure 7: Education level (sector-wise)

Out of the entire sample, only 14 organizations hired doctorates. All these organizations were from the pharmaceutical & information technology sectors. 64% of the pharmaceutical organizations and 45% of the information technology organizations hired PhD. Majority of them have about 0-4 such employees. Only one organization in the IT sector employs 17-20 doctorate degree holders. None of the machine tools & precision tools organizations hired doctorate degree holders. This shows a difference between the sectors of pharmaceuticals and IT and machine/precision tools. It is clear that in the Indian market, machine and precision tool sectors are low on R&D activity.

(iii) Spread of R&D activities (Organization design of R&D structure)

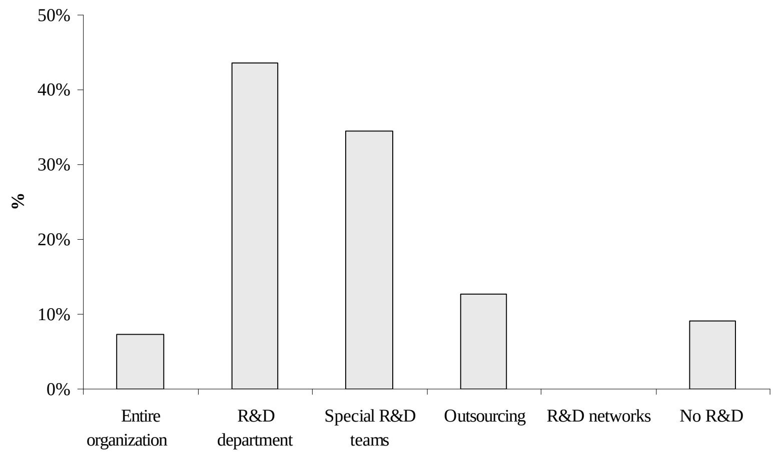

Figure 8: Organizational design for R&D (n=55)

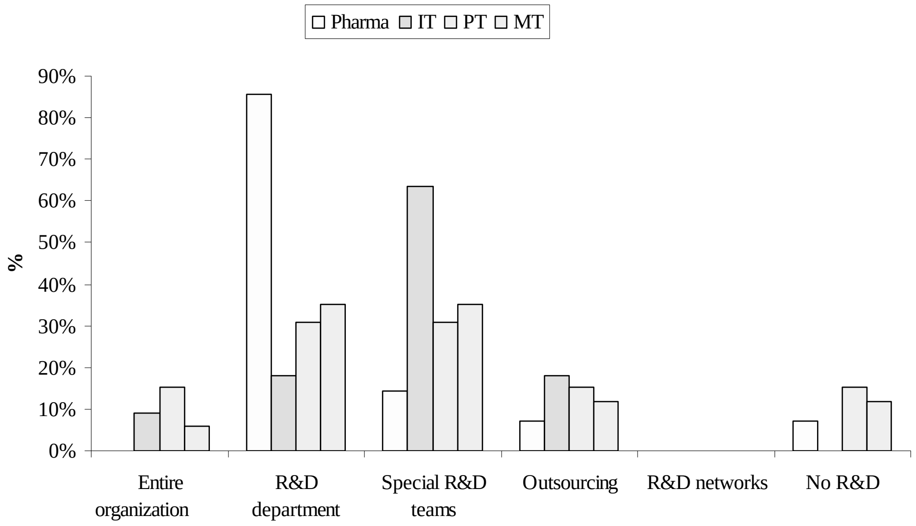

Figure 9: Organizational design for R&D (sector-wise)

We measured the spread of the R&D activities within the sample by looking at their organizational design for R&D. Organizations were allowed to choose more than one option. 79% of the organizations claimed that they have an exclusive R&D department or had special R&D teams. 86% of the pharmaceutical SMEs had an R&D department. Only 13% of the organizations outsourced their R&D and 9% had no R&D activities. This shows that the SMEs recognize the importance of R&D. Figure 9 that shows that sectors must be interpreted with care as the sample sizes are small. However shows that although few SMEs from the machine and precision tool claim to be R&D as a whole, they do not have Ph.Ds in these organizations. Thus the perception of a CEO can be that he or she engages fully in R&D but the verification of an external expert about this claim can conclude otherwise. This implies that there may be a need for greater awareness and clarification workshops to communicate to Indian SMEs about R&D and its nature.

However, none of the organizations were involved in R&D networks. In spite of the tremendous advantage of R&D networks and open innovation processes, SMEs in the study showed a marked preference to keeping their R&D activities closed. This finding is in contrast to practices in Taiwan and other south east Asian locations where R&D clusters are common. They do this to share R&D overheads so that SMEs can jointly enjoy the power of R&D activity. Networking of this sort is not mentioned by Indian

SMEs in this sample. This is something the Government can look into and encourage. While special economic zones and hi tech parks are encouraged by the Government these apparently have become real estate ventures suitable for services activities, rather than serious R&D. Thematic R&D clusters in these economic zones can be encouraged.

(iv) Financial investment towards R&D

Table 4: R&D expenditure of SMEs as % of sales turnover

	< 10% expenditure	> 10% expenditure
All sectors	31	7
Pharmaceuticals	11	2
IT	3	2
PT	9	0
MT	8	3

The organizations in our sample were asked to provide inputs on the percentage of total turnover that they utilized towards R&D activities. (Some organizations with negligible turnover percentage invested in R&D activities did not respond to this question). 31 organizations invest less than 10% of their total turnover on R&D activities. In pharmaceuticals, 12 organizations fall in the investment range 0-10 %, only 2 organizations have been investing in the range 11-20 %. Although IT companies claimed to have either R&D departments or special R&D teams, only 5 organizations responded. 3 of them have an investment of less than 10% (in the range of 4 – 5%) and two greater than 10%. None of the organizations in the precision tool sector invest more than 10% on R&D. Three machine tools organizations invested more than 10% of their sales on R&D activities. Of the entire sample only 7 SMEs claim to have a high R&D investment.

Other studies have shown that R&D investments in SMEs are actually as low, as 1% and about 0.79-0.99% in tiny and non-tiny sectors (Bala Subrahmanya et al., 2001). Organizations showing very large investments in R&D are special cases and require further investigation.

(v) Details of foreign and Indian clients (Foreign market orientation)

Table 5: SMEs having foreign and Indian clients

Class interval (% indicating type of clients: foreign & Indian)	All sectors		Pharma		IT		PT		MT	
	Foreign (count)	Indian (count)	Foreign (count)	Indian (count)	Foreign (count)	Indian (count)	Foreign (count)	Indian (count)	Foreign (count)	Indian (count)
0 - 10										
11 - 20	6	2	1	1	3	1	0	0	2	0
21 - 30	6	5	1	2	0	2	1	1	4	0
31 - 40	4	1	2	1	0	0	1	0	1	0
> 40	16	35	7	5	6	4	3	10	0	16

About 17 organizations have less than 10% of foreign clients. Most of the organizations have more clients from Indian markets than from foreign markets (>50%). It is also seen that one organization from the IT sector has clients only from foreign market and 5 organizations have only Indian clients (100%). Two organizations have only 10% of Indian clients and the remaining 90% are foreign clients. Pharmaceutical and information technology companies had more foreign clients where as machine tool and precision tool organizations have fewer foreign clients. This data indicates that the pharmaceutical and IT organizations are more globally oriented than the other two sectors. This supports a view that the innovation potential for Indian pharmaceutical and IT SME organizations is likely to be more than in machine tool and precision tool organizations.

(vi) Collaborations for technology acquisition (Network behavior)

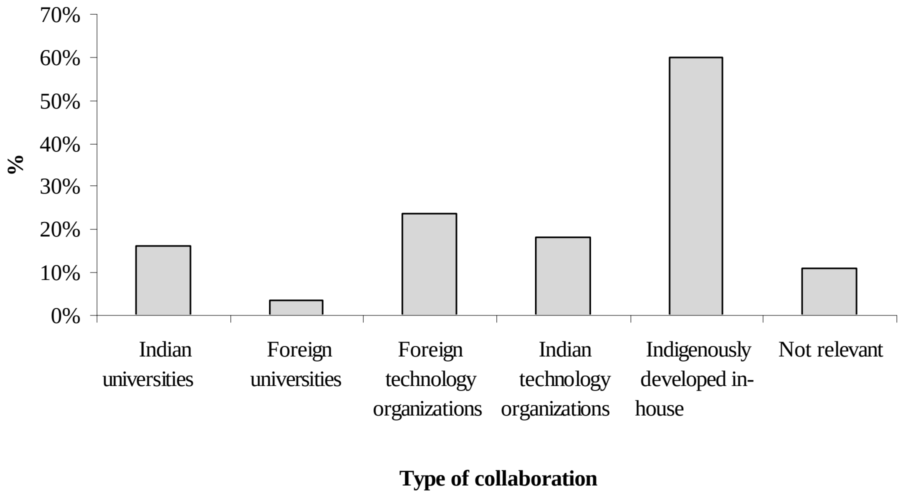

Figure 10: Collaboration for technology acquisition (n=55)

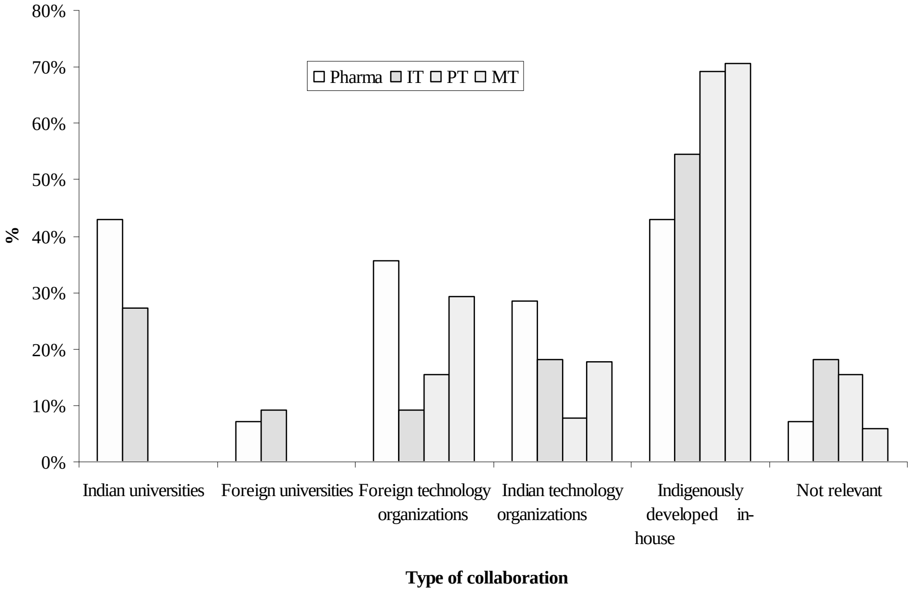

Figure 11: Collaborations for technology acquisition (sector-wise)

Today there is an increasing focus on developing innovation networks and having open innovation initiatives amongst organizations. Collaborating with external partners can be helpful in leveraging the competencies available outside the organization but within the network. We tried to measure the openness to innovation in the previous factor (Figures 8 and 9) of spread of R&D activities to see if the SMEs engaged in cluster R&D. In these figures however, we measured the networks for technology acquisition.

Organizations may have indigenously developed in-house facilities, they can also collaborate with one or more organizations or universities to acquire the latest technology. The SMEs were asked to state their collaborations for technology acquisition from one of more of the following:

- Indian universities
- Foreign universities
- Foreign technology organizations
- Indian technology organizations
- Indigenously developed in-house facility

It was seen that 33 of the organizations had no collaborations outside and had indigenously developed their technologies through in house facilities. 13 SMEs said that they collaborated with foreign technology organizations while 10 SMEs collaborated with Indian technology organizations. Only 11 organizations networked with universities, 9 with Indian universities and two with foreign. The pharmaceutical sector was particularly strong in collaborating with external partners for technology acquisition. This could primarily be because of high cost of technology development in this sector. The other sectors showed a marked preference for in house technology development. Six organizations out of eleven in the IT sector said that they have in-house facilities. Similarly nine out of thirteen in the PT sector and twelve out of seventeen in the machine tool sector had in-house facilities to develop indigenous technology. From the above analysis, we see that more organizations in each sector have in-house facilities for indigenous technology development and technology acquisition. Though a few organizations collaborate with other universities/organizations for technology acquisition, such collaborations appear less predominant.

CONCLUSIONS

Our attempt in this paper was to communicate the R&D demographics in Indian SMEs of the pharmaceutical, information technology, machine tool and precision tool sectors. The choice of these sectors was done partly in discussion with the funding agency of this project. Our conclusions are two fold; first we address our learning from the perspective of R&D demographics and nature of R&D management. Second, we raise some methodological issues in gathering data of this nature which can be addressed at the policy level where the Indian Government is concerned.

It is clear that sectors differ in their R&D orientation in India. This is also a pattern in SMEs. Pharmaceutical and information technology SMEs in India show more R&D management behavior than do those in machine tool and precision tool sectors. This is being judged from the descriptive data collected to understand the nature of R&D management in these SMEs. While there are a host of SME organizations in India, not many of them can be categorized as doing true R&D activity. The ones that are categorized as doing R&D in this sample also have manufacturing, services and maintenance related activities under their business so as to maintain a steady revenue flow. There do not appear to be SMEs who claim to be only R&D organizations, focused solely on R&D activity and nothing else. This balanced pattern of both revenue based business activity coupled with R&D activity appears to be the best way to manage R&D. Unfortunately the pattern of cluster based R&D and collaboration amongst Indian SMEs for R&D does not appear to be a trend. This is something that needs policy attention from the government. Mechanisms and methods to bring SMEs together to form groups and thematic clusters in multi-disciplinary technology areas is something that is critical to develop R&D activity to progress in India. It is also the route to obtain technological innovations in such organizations. Another R&D management activity that the government can encourage is that of the SME networking with universities and other technology organizations for technology exchanges. The challenge of inducting doctorates and masters employees into SMEs is a tough one. Indian SMEs may not pay salaries as much as that of foreign MNCs having R&D departments. Hence, PhDs and MTechs will tend to find employment in these large organizations and not in the SME who of course pay much less. This is again another issue that the government can look at in the case of manpower planning in SMEs who have an R&D focus. Attractive plans from the side of the government can be created to benefit from win win situations where Indian SMEs with an R&D focus will be motivated to hire, and in turn PhD candidates will be motivated to work for such SMEs.

From the perspective of methodological challenges, a few points are raised with pointers for policy makers. The challenge faced in this study was to first identify SMEs who will qualify for such a study. First, whilst the lists of SMEs in India are not available at a one stop location, it was possible to cull out a list of the population from many association databases. Second, whilst such lists are obtainable not all in the list can participate in such a study as many SMEs have a wide range of business activities not related to R&D at all. Hence, finding those SMEs in these sectors that claim to have an R&D orientation is a big challenge for Technology Management researchers. This was finally accomplished after a series of discussions with experts facilitated by the funding agency. Third, the sample elimination criteria were useful and it helped reduce the population to the actually surveyed sample. The entire sample was then sent the questionnaire however as expected the response rate was only 50%. This lack of data poses a problem for Technology Management researchers. Hence, we suggest that a secure portal for SMEs to provide on going information regarding their R&D demographics is the need of the hour. Attractive benefits can be planned to condition this behavior of data deposition in R&D focused SMEs. Creating such data, suitable for research and analysis is a time bound activity and needs long term planning.

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