

Innovation in India



सत्यमेव जयते

**National Knowledge Commission
2007**

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Executive Summary

Introduction

While literature on Innovation has been growing in recent times, the NKC survey on Innovation is perhaps the first detailed and in-depth quantitative and qualitative survey on Innovation in India (as defined more broadly than R&D) using firm level aggregate statistical data on a nationwide scale, with a sample that includes the top industry leaders as well as a large number of small and medium enterprises (SMEs), and across varied industrial profiles, ranging from manufacturing and services to diversified businesses. It is expected that the survey will provide feedback and information on current Innovation trends to firms as well as generate necessary catalyzing effects for business Innovation to take place in India on an even larger scale, thus ensuring sustained Innovation led economic growth in the coming years.

NKC defines Innovation in the following manner for the purposes of this survey:

‘Innovation is defined as a process by which varying degrees of **measurable value enhancement** is planned and achieved, in **any commercial activity**. This process may be breakthrough or incremental, and it may occur systematically in a company or sporadically; it may be achieved by:

- introducing *new or improved goods or services* and/or
- implementing *new or improved operational processes* and/or
- implementing *new or improved organizational/ managerial processes*

in order to improve market share, competitiveness and quality, while reducing costs.’

Innovation and competitiveness have a dynamic, mutual relationship. Innovation thrives in a competitive environment and in turn, plays a key role in the achievement of such an environment. Innovation generates economic value, new jobs in the economy and cultures of entrepreneurship. By virtue of its relationship with competitiveness, Innovation emerges as a factor in promoting economic growth.

Given the fact that the Indian economy is growing at 6-8% per year, while exports are growing at 30% Cumulative Annual Growth Rate (CAGR), and many Indian firms are successfully competing against international firms and brands, it can be concluded that this has been made possible by a combination of factors, including enabling environment, rising capital and labor productivity as well as improved quality of goods and services at lower costs.

Innovation and competitiveness have a dynamic, mutual relationship. Innovation thrives in a competitive environment and in turn, plays a key role in the achievement of such an environment. Innovation generates economic value, new jobs in the economy and cultures of entrepreneurship.

In the growth of the Indian economy, Innovation is emerging as a key driver, although this may neither be apparent nor readily visible. *In this respect, one of the aims of this study by NKC is to understand the role played by Innovation in India as a driver of such growth.*

Key Results

1. Increase in Growth and Innovation

- a. **‘Innovation Intensity’** (i.e. the percentage of revenue derived from products/ services which are less than 3 years old) has increased for large firms and SMEs, with SMEs registering a greater increase in Innovation Intensity than large firms. 42% of the large firms and 17% of the SMEs are also **‘Highly Innovative’** firms (i.e. firms who have introduced ‘new to world’ Innovations during the course of business in the last five years.)
- b. Nearly half of the large firms and SMEs attribute more than 25% of change in the following factors to Innovation: increase in competitiveness, increase in profitability, reduction in costs and increase in market share. For large firms Innovation has the most significant impact on competitiveness, while for SMEs, Innovation has the most significant impact on increase in market share.
- c. 17% of the large firms rank Innovation as the **top strategic priority** and 75% rank it among the top 3 priorities. All the large firms in our sample agree (of which 81% strongly agree) that Innovation has gained importance as being *critical to growth and competitiveness* since the start of economic liberalization in India. All the large firms agree (of which nearly half strongly agree) that they cannot survive and grow without *investment in Innovation*. An overwhelming 96% of large firms in our sample see *Innovation spending increasing* over the next 3-5 years.

‘Innovation Intensity’ (i.e. the percentage of revenue derived from products/ services which are less than 3 years old) has increased for large firms and SMEs, with SMEs registering a greater increase in Innovation Intensity than large firms.

2. Innovation Strategy

- a. **Area of business:** For large firms, Innovation is most highly concentrated in operations and sales and marketing.
- b. **Factors influencing Innovation:** More than half of the increase in market share, competitiveness, profitability and reduction in costs due to Innovation has occurred in SMEs due to three types of Innovation – new products, new processes and new services. At the same time, the customer is the primary external factor that leads more than half of the large firms to innovate.
- c. **Breakthrough and Incremental:** 37.3% of large firms have introduced breakthrough Innovation, while 76.4% have introduced incremental Innovation, which may be an indication that large firms in India are still in the mindset of incremental Innovation as compared with breakthrough Innovation.
- d. **Timeframe:** The average timeframe (from idea generation to market) of Innovation projects for half of the large firms is 1 – 3 years. Innovation projects in manufacturing firms have longer gestation period than in services.

3. Which firms are innovative?

- SMEs have greater Innovation Intensity than large firms.
- Innovation Intensity for privately and publicly owned firms is significantly higher than that of government owned firms.
- Firms with majority foreign ownership have greater Innovation Intensity than those with majority Indian ownership.
- Innovation Intensity for MNCs is significantly higher than for non-MNCs while there is little difference in the percentage of 'Highly Innovative' firms among MNCs and non-MNCs.
- Internal processes for Innovation such as maintaining a specific Innovation department, allocating funds, rewarding innovative employees, forecasting probabilities of success, formalizing processes and systematic attempts, maintaining physical locations for Innovation and constituting cross-functional teams all lead to firms being more innovative. Further, firms with greater R&D spending, Innovation spending and strategic prioritization for Innovation are also more likely to be more innovative.
- Firms with their primary market in India have higher Innovation Intensity than those with primary markets abroad. On the other hand, a greater proportion of firms with their primary market abroad are Highly Innovative (i.e. have introduced more 'new to world' Innovations) as compared with firms with their primary market in India.
- Firms in industries where Innovations are patented, with more patent filings and use of IPR consultants are more innovative.
- Firms partnering with government agencies, collaborating with universities and R&D labs also tend to be more innovative.

Internal processes for Innovation such as maintaining a specific Innovation department, allocating funds, rewarding innovative employees, forecasting probabilities of success, formalizing processes and systematic attempts, maintaining physical locations for Innovation and constituting cross-functional teams all lead to firms being more innovative.

4. Barriers

a. External:

- The most important external barrier to Innovation, as perceived by both large firms and SMEs, is skill shortage due to the lack of emphasis on industrial Innovation, problem-solving, design, experimentation, etc. in the education curricula
- Other prominent external barriers are lack of effective collaboration with research in universities and R&D institutions, excessive government regulation as well as insufficient pricing power to derive value from Innovations.

b. Internal:

- The most important internal barriers as perceived by large firms are lack of organizational focus on Innovation as a strategy for growth and competitiveness; inefficient knowledge management systems within the company; and poor understanding of customer needs and market dynamics.
- For SMEs, prominent internal barriers are skill shortages due to lack of effective in-house training programmes; inability to move beyond the first successful

Innovation and develop a sustainable model for continuous Innovation; as well as poor understanding of customer needs and market dynamics.

5. Manufacturing vs Services

While Innovation Intensity is higher for manufacturing than services (for large firms and SMEs), Innovation Intensity has grown faster from 2001-02 to 2005-06 for services than manufacturing. Further, services firms are more likely to be Highly Innovative, i.e. they have a greater propensity to introduce 'new to world' Innovations.

For all the firms in our sample (large firms and SMEs), Innovation has had roughly the same level impact for manufacturing and services firms, in respect of *increase in market share* and *increase in competitiveness*. However, Innovation has led to a greater *increase in profitability* for manufacturing firms and a greater *reduction in costs* for services firms.

Services firms are more likely to partner with government agencies with Innovation being the specific purpose. In large firms, the average R&D spend, as a percentage of annual revenue, is lower for the services sector as compared to the manufacturing sector, but Innovation spending is higher. For SMEs, both R&D and Innovation spend are higher in the case of services than manufacturing.

The NKC survey confirms the rising Innovation activity and awareness in India as well as the need to continuously and publicly encourage this trend as a key enabler in India's economic growth and competitiveness.

Conclusion

The NKC survey confirms the rising Innovation activity and awareness in India as well as the need to continuously and publicly encourage this trend as a key enabler in India's economic growth and competitiveness. However, there is need for further effort along a range of parameters in order to fully realize India's Innovation potential. Some of the important steps are:

- Systematic reform of the higher education system (including skill based marketable vocational education) in India, which would act as an enabler for developing the required intellectual capital as well as lay the foundation for effective collaboration between industry, educational institutions and the government. Therefore, the mandate of the NKC, which is to guide policy and direct reforms to allow India to effectively use and create knowledge capital, is critical and extremely relevant in furthering the cause of Innovation and entrepreneurship in the Indian economy.
- The synergistic use of cumulative energies of the industry, the government, the educational system, the R&D environment and the consumer. The Innovation ecosystem is a complex environment that requires the coordinated functioning of a number of diverse factors in order to function effectively.
- Innovation also needs to become as wide spread as possible, spreading across the entire economy, from the grassroots to the large firm level. It is felt that a comprehensive effort to address these issues would act as a critical enabling factor for India to be amongst the global leaders in Innovation.

1. Understanding Innovation in India

1.1 Defining Innovation

1.1.1 There is a widely held view that Innovation is primarily driven by high-end technology and R&D. However, high-end technology and R&D are only two of several sources of Innovation. The reach and impact of Innovation is seen across the value chain to also include other sources of Innovation such as various processes and services, marketing, branding, trade, entrepreneurship, market research, customer surveys, etc. The National Knowledge Commission (NKC) therefore defines Innovation in a more comprehensive sense, where along with products and services, processes and economic value enhancement are also paramount.

1.1.2 NKC defines Innovation in the following manner for the purposes of this countrywide survey:

‘Innovation is defined as a process by which varying degrees of measurable value enhancement is planned and achieved, in any commercial activity. This process may be breakthrough or incremental, and it may occur systematically in a company or sporadically; it may be achieved by:

- introducing *new or improved goods or services* and/or
- implementing *new or improved operational processes* and/ or
- implementing *new or improved organizational/ managerial processes*

in order to improve market share, competitiveness and quality, while reducing costs.’

1.1.3 Nearly 90% of the firms that were part of this survey have agreed with the aforesaid definition. Other illustrative definitions of Innovation, as provided by some of the firms surveyed, are as follows:

‘Innovation occurs at the intersection of invention and insight. It is about the application of invention - the fusion of new developments and new approaches to solve problems.’¹

‘Innovation is defined as a process by which varying degrees of measurable value enhancement is planned and achieved, in any commercial activity by the introduction of new or improved goods, services and processes’.

¹Definition proposed by IBM India Limited

‘Innovation is a creative idea focused on a customer touch point that (1) creates unique and compelling solutions valued by our customers, (2) create real and substantial competitive advantage and (3) creates extraordinary value for our company.’²

‘Innovation is not limited to commercial activity. It encompasses immeasurable value enhancement to customers, talent search and retention, employee satisfaction through opportunity to innovate and also value addition at industry level leading to brand enhancement.’³

‘Innovation lies at the interface between “invention” and “the customer” and results in enhanced value to the customer.’⁴

‘Innovation is about identifying and executing a) newer opportunities and b) newer geographies.’⁵

*“Innovation is the
‘necessary core competence’
to remain competitive in
this new landscape”.*

1.2 Innovation and global competitiveness

1.2.1 Innovation and competitiveness have a dynamic, mutual relationship. Innovation thrives in a competitive environment and in turn, plays a key role in the achievement of such an environment. Innovation generates economic value, new jobs in the economy and cultures of entrepreneurship. By virtue of its relationship with competitiveness, Innovation emerges as a factor in promoting economic growth.⁶ A recent World Bank study on Innovation notes that ‘Innovation can be a critical driver of increased productivity and competitiveness and ultimately poverty alleviation ... Innovation is not an end in itself but a means to productivity growth and higher living standards.’⁷

1.2.2 Globalization provides opportunities as well as challenges for nations to use Innovation as a strategic lever to generate knowledge flows. It provides unprecedented potential for Innovation to be used as a tool for revenue generation, so that nations with a strong knowledge base, can once and for all, escape ‘the stranglehold of poverty’.⁸ At the same time, globalization creates challenges for firms to either innovate or perish. ‘In the race to the top slot, the only way ahead for companies is to innovate...the only way to stay ahead is to innovate.’⁹ As such, Innovation is the ‘necessary core competence’ to remain competitive in the new landscape.’¹⁰

²Definition proposed by Whirlpool India Limited

³Definition proposed by Kotak Mahindra Private Limited

⁴Definition proposed by Phillips Electronics India Limited

⁵Definition proposed by Reliance Industries Limited

⁶ Some of the significant findings on Innovation and competitiveness from this survey are illustrated with greater detail in the pages to follow. See, for example sub-section 2.1.3 of this report for an understanding of how Innovation and firm behavior relate to competitiveness.

⁷Unleashing India’s Innovation: Towards Sustainable and Inclusive Growth’, World Bank, 2007, pg 1, 12

⁸Joseph Schumpeter was one of the first economists to link Innovation with economic growth. See, Bowonder, Kelkar, NG Satish, J K Racheria, ‘Innovation in India: Recent Trends’, TTMC Research paper dated March 31, 2006.

⁹Prof Vijay Govindarajan, Outlook Business, May 5, 2007, pg. 86.

¹⁰G Hamel, CK Prahalad, ‘The Core competence of the Corporation’, Harvard Business Review Vol. 68, No. 3, pg 79-91, 1990; also see Bowonder et al, supra note 9 as above; See also, Prof Rishikesha Krishnan, Economic Times, July 19, 2004 ‘In the global economy, firms have to derive competence through Innovation...nations and organizations need to innovate to survive.’

1.2.3 In understanding the significance of Innovation, the possibilities offered by complex and interconnected global networks become relevant. The ability to ‘adapt to changing market conditions and anticipate future technologies and economic trends’¹¹ and leverage Innovation across a large number of markets provides ‘opportunities for exploiting economies of scale as well as scope.’¹² Innovation is therefore also emerging as a global activity ‘dependent on international networks of knowledge sharing....requiring the combination of various disciplines.’¹³ In short, in this globalized landscape, comparative knowledge advantage and the availability of cutting edge Innovation at lower costs are becoming critical factors in the race to achieve economic competitiveness.

1.3 Innovation and India

1.3.1 Given the fact that the Indian economy is growing at 6-8% per year, while exports are growing at 30% CAGR¹⁴, and many Indian firms are successfully competing against international firms and brands, it can be concluded that this has been made possible by a combination of factors, including enabling environment, rising capital and labor productivity as well as improved quality of goods and services at lower costs. The efforts of Indian companies to improve performance are also being supplemented by foreign investments in areas ranging from R&D to manufacture of consumer durables, electronics, automobiles, textiles, services, etc.¹⁵ In the post liberalization scenario, with the introduction of ‘economic policies aimed at eliminating industrial licensing, reducing protection for internal products, allowing foreign direct investment and minimizing government controls and unleashing competition’¹⁶, Indian firms have been exposed to market forces where Innovation will increasingly play a key role in ensuring economic survival and achievement. In the growth of the Indian economy, Innovation is emerging as a key driver, although this may neither be apparent nor readily visible. **In this respect, one of the aims of this study by NKC is to understand the role played by Innovation in India as a driver of such growth.**

In the growth of the Indian economy, Innovation is emerging as a key driver, although this may neither be apparent nor readily visible.

¹¹ See Bowonder et al, supra note 8 as above; also I. Haque, ‘Trade, Development and International Competitiveness’, World Bank, 1995.

¹² See Bowonder et al, supra note 8 as above, pg 2.

¹³ See Kirsten Bound, ‘India: The Uneven Innovator: The Atlas of Ideas: Mapping the New Geography of Science’, Demos, 2007, pg 8.

¹⁴ Cumulative Annual Growth Rate

¹⁵ See for example, the recent World Bank study on Innovation (as noted in supra note 7 as above) that states that ‘more than 8% a year growth has been driven by a jump in export oriented, skill-intensive manufacturing (pharma, petrochemicals, auto parts and assembly) and services (IT, business services, finance)...these have been accompanied by a jump in innovative activities....higher productivity and economic growth have raised living standards and reduced the number of poor people’ at pgs 1-2. The World Bank quotes Planning Commission of India statistics that the consumption poverty head count ratio has fallen from 36% in 1993-94 to 27.8% in 2004-05. It notes that ‘while there is no established causal link between Innovation and poverty alleviation, it is plausible to presume that Innovation can have a longer-term impact on poverty by increasing growth as well as a more direct impact through pro-poor Innovation efforts.’ Also see, the recent Goldman Sachs study quoted in Bound (supra note 13 as above) which states that ‘India has the potential to grow faster than China in the long term...in just a few years India has been transformed from an aid recipient to a global competitor.’

¹⁶ See Bowonder et al (as noted in supra note 8 as above), pg 2

In this increasingly skill driven knowledge economy, necessary investments in education, including enterprise based vocational education and training and market based knowledge and skills in higher education, are going to be crucial to maintain India's Innovation driven growth and its cutting edge in knowledge based industries.

- 1.3.2 Statistics are already emerging on the increasing significance of Innovation and scale and scope of such Innovation occurring among the country's firms today. This NKC study reveals that **42% of large firms¹⁷ and 17% of SMEs** have introduced '**new to the world**' Innovations during the course of their business. 17% of the large firms rank Innovation as the **top strategic priority** and 75% rank it among the **top 3 priorities**. All the large firms in our sample agree (of which 81% strongly agree) that Innovation has gained importance as being *critical to growth and competitiveness* since the start of economic liberalization in India. Further, according to a recent study on 'Innovation and Manufacturing in India', a staggering 89% of the respondents said that the importance of Innovation has increased significantly over the last 10 years and 39% felt that Innovation has become 'critical to their operations.'¹⁸
- 1.3.3 India is emerging as a global hub of Innovation-low cost as well as high value products and services.¹⁹ Recent acquisitions by Indian companies in the global market also signify an increasing trend by Indian companies to leverage the various possibilities of Innovation that the global market offers. In addition, there has been recent commentary on India's 'inherent reasons' for innovative activity such as the existence of an open society, a technology base, democracy, diversity, an environment that allows experimentation, a vibrant capital market, availability of young populations necessary as human capital to fully reap the demographic dividend, full and free competition in the private sector, opportunities for technological leapfrogging as well as the availability of necessary infrastructure.²⁰
- 1.3.4 In this increasingly skill driven knowledge economy, necessary investments in education, including enterprise based vocational education and training and market based knowledge and skills in higher education, are going to be crucial to maintain India's Innovation driven growth and its cutting edge in knowledge based industries.²¹ India has to develop ways and means to translate its immense Innovation potential into high value commercial products and services.

¹⁷ Large enterprises are those having annual turnover of more than Rs. 100 crore, Medium enterprises have annual turnover between Rs. 10 and Rs. 100 crore, and Small enterprises have annual turnover less than Rs. 10 crore.

¹⁸CII-BCG Executive Survey, 'Innovation in Indian Manufacturing', 2007, pg 8.

¹⁹See for example, Bowonder et al in page 133-134 (as noted in supra note 8 as above), which states that global firms have used three options for sourcing Innovations from India, namely, locating centers of Innovations in India through fully owned subsidiaries; outsourcing Innovations to Indian firms or research centers and acquiring innovative entrepreneurial firms or start-ups. Bowonder et al also refers to 'a recent workshop at Harvard Business School' where 'India was ranked as the most preferred destination for locating Innovation centers.' Bowonder et al further note that this is an indication of India soon become a global Innovation hub. Further, Bowonder et al note that 'Emerging markets like India, China, Philippines, Thailand etc are becoming the testing grounds for innovative products. Also, as these are likely to experience faster growth Innovations targeted towards the bottom of the pyramid are likely to be the order of the day. Indian innovators face the challenge of identifying such windows of opportunity and also realizing them in a sustainable manner.' See also, World Bank study on Innovation (as noted in supra note 7 as above), which states that 'India is increasingly becoming a top global innovator for high tech products and services' at pg i; See also Michael Candon-Brookes, IBM-India, in Mint, May 8, 2007 stating that 'India is the hub for high value global Innovation'.

²⁰See Prof Vijay Govindarajan (as noted in supra note 9 as above).

²¹See for example, chapter V of the World Bank study on Innovation (as noted in supra note 7 as above).

1.4 Innovation and the National Knowledge Commission

- 1.4.1 Innovation forms part of NKC's objective of recommending ways and means to promote the use of knowledge in order to advance India's economic growth and competitiveness. Apart from a host of areas related to knowledge at all levels, NKC is also currently engaged in consultations on issues directly related to Innovation such as Entrepreneurship and Intellectual Property Rights. It has already made recommendations on other related areas such as higher education, vocational education and on enacting a uniform legal framework for public funded research.²²
- 1.4.2 While literature on Innovation has been growing in recent times, this survey is perhaps the first detailed and in-depth quantitative and qualitative survey on Innovation in India (as defined more broadly than R&D) using firm level aggregate statistical data on a nationwide scale, with a sample that includes the top industry leaders as well as a large number of Small and Medium enterprises, and across varied industrial profiles, ranging from manufacturing and services to diversified businesses.²³ It is expected that the survey will provide feedback and information on current Innovation trends to firms as well as generate necessary catalyzing effects for business Innovation to take place in India on an even larger scale, thus ensuring sustained Innovation led economic growth in the coming years.
- 1.4.3 Chapter I highlights the relevance of Innovation in today's globalized and interdependent market space, and its role as a driver for growth and competitiveness. It studies the unique opportunities and challenges that India is faced with in its effort to fully realize its Innovation potential, and become a global Innovation hub.

Chapter II analyses macro-economic trends in Innovation observed by the firms in our sample. The emerging trends indicate that Innovation Intensity is increasing, firms are introducing Innovations that are new to local as well as global markets, and Innovation is driving growth in the economy to a significant extent. We see that firms increasingly realize the importance of Innovation as being critical to growth and competitiveness. Innovation seems to have surpassed its status as being merely a buzzword, and is now firmly established as an integral part of firms' business practices.

In Chapter III, we study strategic issues pertaining to Innovation. We observe the departure from the conventional notion that Innovation is a measure of R&D through the high concentration of Innovation activities in firm operations. The manner in which Innovation takes place in SMEs is

Firms increasingly realize the importance of Innovation as being critical to growth and competitiveness. Innovation seems to have surpassed its status as being merely a buzzword, and is now firmly established as an integral part of firms' business practices.

²²See National Knowledge Commission, 'Report to the Nation, 2006' for recommendations already submitted for the year 2006 and www.knowledgecommission.gov.in for recommendations submitted after January 12, 2007 and for information on other consultative processes as well as NKC's work generally.

²³See for example, the World Bank study (as noted in supra note 7 as above) that focuses on macro level policies of Innovation; see also Bowonder et al (as noted in supra note 8 as above) that lays particular emphasis on R&D and case studies; see also the CII-BCG survey (as noted in supra note 18 as above) on manufacturing and the Demos Report (as noted in supra note 13 as above) that stresses on science and Innovation.

analyzed in detail, as well as the average timeframe of Innovation projects. Lastly, we explore four conceptual types of Innovation as experienced by firms, i.e. Systematic, Sporadic, Incremental and Breakthrough.

In Chapter IV, we examine the factors that lead some firms to be more innovative than others. The firms' structure, internal and external processes are all analyzed in detail – along with their impact on Innovation in a firm. Firm structure includes aspects of firm ownership, size and operation; internal processes include setting up special departments or officers for Innovation, specifically allocating funds for Innovation projects in annual budgets, setting up physical centres for Innovation, etc; and external processes include collaboration with government agencies set up specifically for the purpose of Innovation, collaboration with universities and R&D labs, using the services of IPR consultants, etc.

Chapter V outlines the internal as well as external barriers to Innovation faced by firms, i.e. the factors that hold back firms from reaching their Innovation potential.

Chapter VI compares the experiences of firms in the manufacturing and services sectors with Innovation. Since the growth of the services sector is a critical driver in India's economic growth, we expect Innovation to play an increasingly significant role.

Chapter VII concludes and sums up the NKC findings.

Highlights of the NKC study on Innovation

- The first detailed and in-depth quantitative and qualitative survey on Innovation in India (as defined more broadly than R&D) at this scale.
- 137 firms interviewed, out of which 58 are large firms and 79 are SMEs.
- Firms represent a wide range of sectors from manufacturing and services – including mining, automotives, home appliances, paper, steel, energy, pharmaceuticals, textiles, IT/ITeS, banking and financial, healthcare, aviation, retail, shipping, biotechnology, media, diversified etc. See Annexure 1 for a list of the firms that participated in the NKC survey, along with a sectoral breakdown.
- The first platform that has brought together industry leaders in various sectors – including the CEOs of Reliance, Infosys, Tata Group, IBM, ICICI Bank, CRISIL, Biocon, Kotak Mahindra Bank, ONGC, SAIL, BSNL, Nuclear Power Corporation of India, etc.; as well as industry chambers CII (Confederation of Indian Industry), PHDCCI (Punjab, Haryana and Delhi Chambers of Commerce and Industry), MCCIA (Maratha Chambers of Commerce, Industry and Agriculture); and academics from the Indian Institutes of Management, Bangalore, Lucknow and Ahmedabad.
- Methodology: Separate questionnaires on Innovation for large firms and SMEs.
- Reports to Prime Minister on the topic and seeks to generate and facilitate policies that would accelerate Innovation led economic growth in India
- Provides feedback to firms so that they can use this information to improve processes.
- Expected outcome: Add to Innovation literature and generate catalytic impact on a large scale to embed the spirit of Innovation.

Results from NKC Survey

General Trends in Innovation

2.1 Measure of Innovation in the economy and impact on economic growth

This section highlights the prevalence of Innovation in the economy and studies its impact on economic growth. **The NKC hypothesis is that Innovation is increasing, driving growth and increasing competitiveness in various sectors of the Indian economy.** This section presents evidence from the NKC Survey database to support the NKC hypothesis.

We use ‘**Innovation Intensity**’ to measure the prevalence of Innovation in a firm – where Innovation Intensity is defined to be “*the percentage of revenue derived from products/ services which are less than 3 years old*”, consistent with the NKC definition of Innovation as already stated in Chapter I. Sub-section 2.1.1 presents results regarding Innovation Intensity for large firms and SMEs.

Innovation Intensity measures the percentage of revenue derived from products/ services that are *new to the firm*. However, focusing only on Innovation Intensity is not comprehensive enough, especially when the question is whether a particular product, process or service is truly ‘innovative’, i.e. whether such an Innovation is new to the market itself (i.e. local, national or global). As such, there could be a situation where a firm is constantly introducing imitation products, which leads to a high value of Innovation Intensity, but is not necessarily ‘innovative’ enough to introduce a new product/ service to the market. Therefore, for the sake of clarity in this study, Innovation Intensity is not considered in isolation, but in conjunction with the introduction of Innovations that are ‘new to the industry’, ‘new to the Indian market’ or ‘new to the global market’. In this context, we also use the term ‘**Highly Innovative**’ to refer to firms that have introduced a ‘new to world’ Innovation during the course of their business in the last five years. Sub-section 2.1.2 of this chapter presents further details on these aspects.

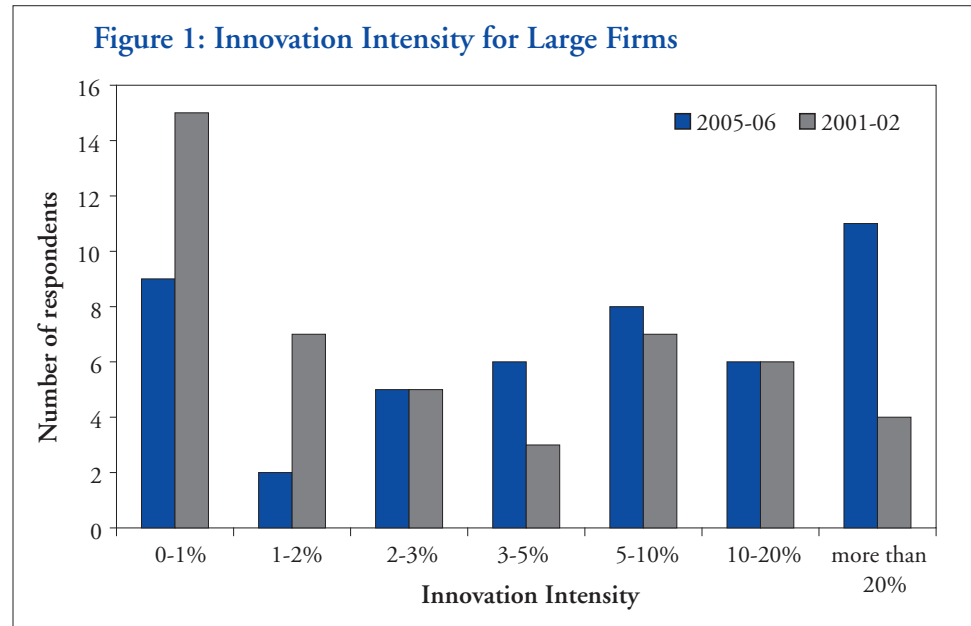
Since our sample consists of the largest firms in the Indian economy as well as a large base of SMEs²⁴, firm-level growth indicators are used as a proxy for overall growth in economy. Sub-section 2.1.3 studies the improvement in these indicators over the last 5 years, and measures the impact attributable to Innovation.

We also use the term ‘Highly Innovative’ to refer to firms that have introduced a ‘new to world’ Innovation during the course of their business in the last five years.

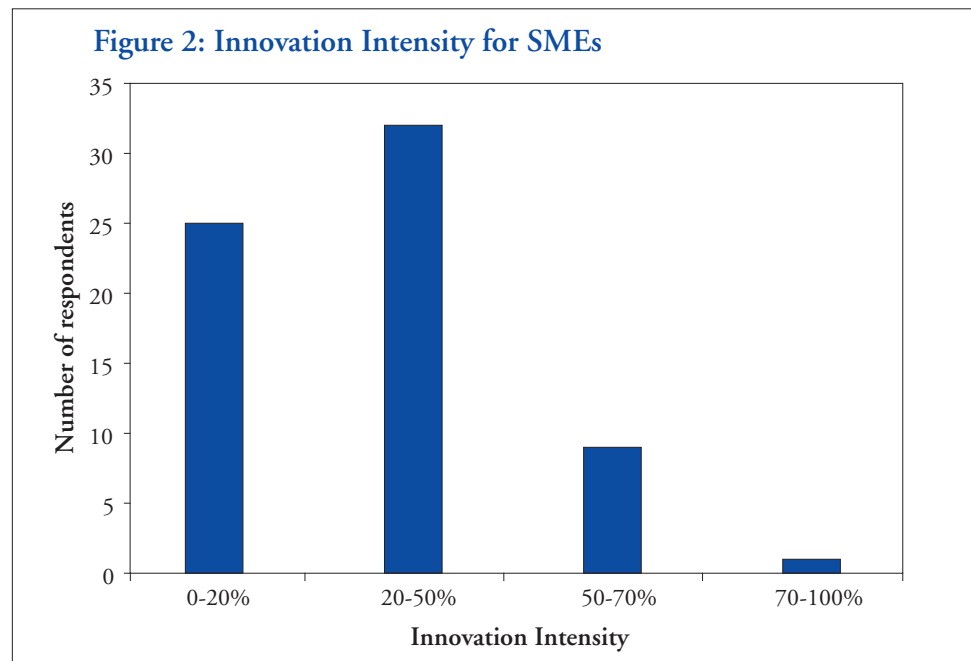
²⁴See Annexure 1 for the list of firms that participated in the NKC survey.

2.1.1 Innovation Intensity has increased: It can be seen from Figure 1 below that Innovation Intensity has significantly increased for large firms in our sample from 2001-02 to 2005-06. The average value of Innovation Intensity has increased from 6.49% in 2001-02 to 11.15% in 2005-06, and the median value increased from 2.27% in 2001-02 to 5.88% in 2005-06²⁵.

More than 60% of the SMEs in our sample have Innovation Intensity greater than 20%, as compared to less than 25% of the large firms in our sample.



Innovation Intensity values are expected to be higher for SMEs, and this is seen from Figure 2 on the following page. More than 60% of the SMEs in our sample have Innovation Intensity greater than 20%, as compared to less



²⁵The average and the median have a difference in their values when the distribution is skewed, which is the case for the distribution of Innovation Intensity. The average represents the expected value of Innovation Intensity, and is more sensitive to extreme values. The median represents the value that splits the distribution into half, and is less affected by extreme values. For the purposes of this report, we quote both the average and the median, since they capture different aspects of the Innovation Intensity distribution.

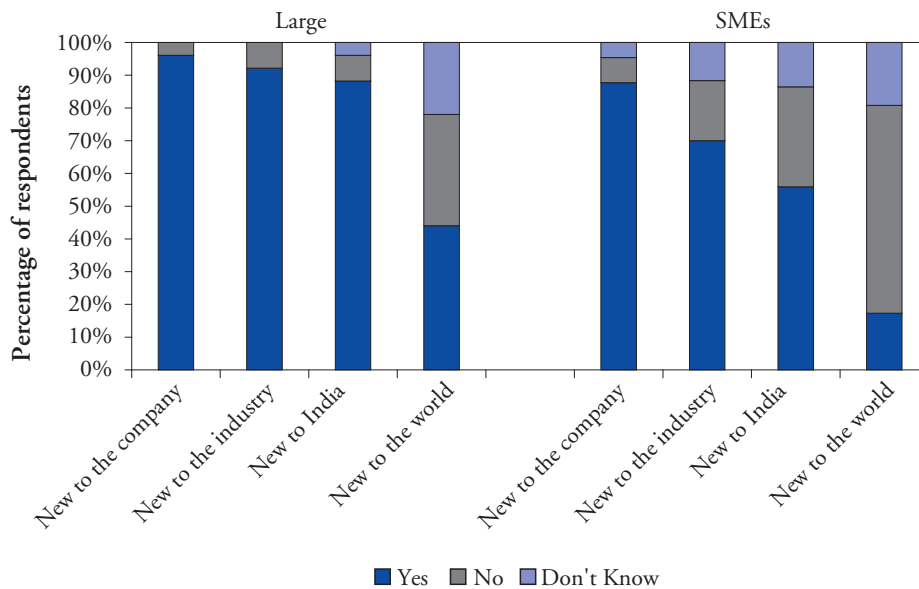
than 25% of the large firms in our sample. This could perhaps be due to a number of reasons, including the fact that small enterprises can pioneer revolutionary technologies and are relatively free from the inertia that can act as a restraint on larger firms²⁶. In addition, large firms are also likely to have a larger portfolio of established products and services, and therefore the revenue derived from new products/ services would account for a lower proportion in the overall revenue figures than in the case of SMEs.

2.1.2 Innovation Intensity measures the revenue derived from products/ processes/ services that are new to the firm. However, over the course of the last 5 years, a large number of firms in our sample have introduced Innovations that are not only *new to the company*, but also *new to the industry*, *new to the Indian market* and *new to the global market*.

Figure 3 on the following page shows the proportion of large firms and SMEs in our sample that has succeeded in pushing forward the Innovation frontier. **More than 90%** of the large firms in our sample have introduced Innovations that are new to the company, industry and the Indian market and 42% have introduced Innovations that are new to the global market as well, i.e. 42% of large firms are ‘Highly Innovative’ as defined by NKC for the purposes of this survey. This indicates a high level of international competitiveness in India’s Innovation activities.

More than 90% of the large firms in our sample have introduced Innovations that are new to the company, industry and the Indian market and 42% have introduced Innovations that are new to the global market as well.

Figure 3: In the last 5 years, have you introduced innovations that are:



In comparison, 70%, 56% and 17% of SMEs have introduced Innovation that is new to the industry; new to India and new to world, respectively. Therefore, 17% of the SMEs are ‘Highly Innovative’, as defined by NKC for the purposes of this survey. This indicates that SMEs are not as successful as large firms in pushing forward the Innovation frontier through the introduction

²⁶‘Opportunities for Innovation: The business opportunities for SMEs in tackling the causes of climate change’, October 2006, Shell Springboard and Vivid Economics.

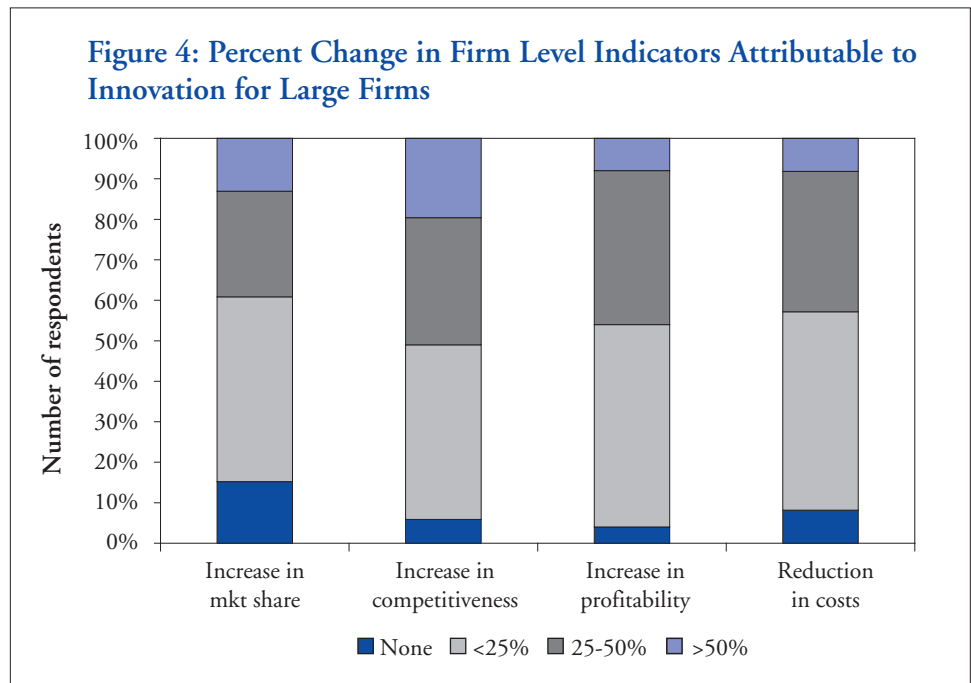
of new Innovations that are novel to national and global markets. This could be due to a lower awareness of SMEs of the uniqueness of their products, a reporting bias on the part of large firms, or it could genuinely imply that while SMEs are able to capture advantages or meet unmet demand in local markets, they are less able to do the same at a national or international level.

2.1.3 Firms in various sectors in the Indian economy are driving growth and competitiveness, as can be seen from the NKC Survey database. Over the last 5 years, of the large firms in our sample;

- (a) 77% have experienced an increase in market share;
- (b) 94% have experienced an increase in competitiveness;
- (c) 92% have experienced an increase in profitability; and
- (d) 84% have experienced a reduction in costs.

17% of large firms claim that Innovation has led to greater than 50% increase in competitiveness.

Figure 4: Percent Change in Firm Level Indicators Attributable to Innovation for Large Firms



Similarly, over the last 5 years, of the SMEs in our sample;

- (a) 76% have experienced an increase in market share;
- (b) 84% have experienced an increase in competitiveness;
- (c) 69% have experienced an increase in profitability; and
- (d) 55% have experienced a reduction in costs.

Figure 4 shows the degree of impact that Innovation has had on each of these indicators in the case of large firms. To illustrate, 17% of large firms claim that Innovation has led to greater than 50% increase in competitiveness; 31% claim it has led to 25-50% increase in competitiveness; 43% claim it has led to 0-25% increase in competitiveness and the remaining 6% claim it has had no impact.

It can be observed from Figure 4 that:

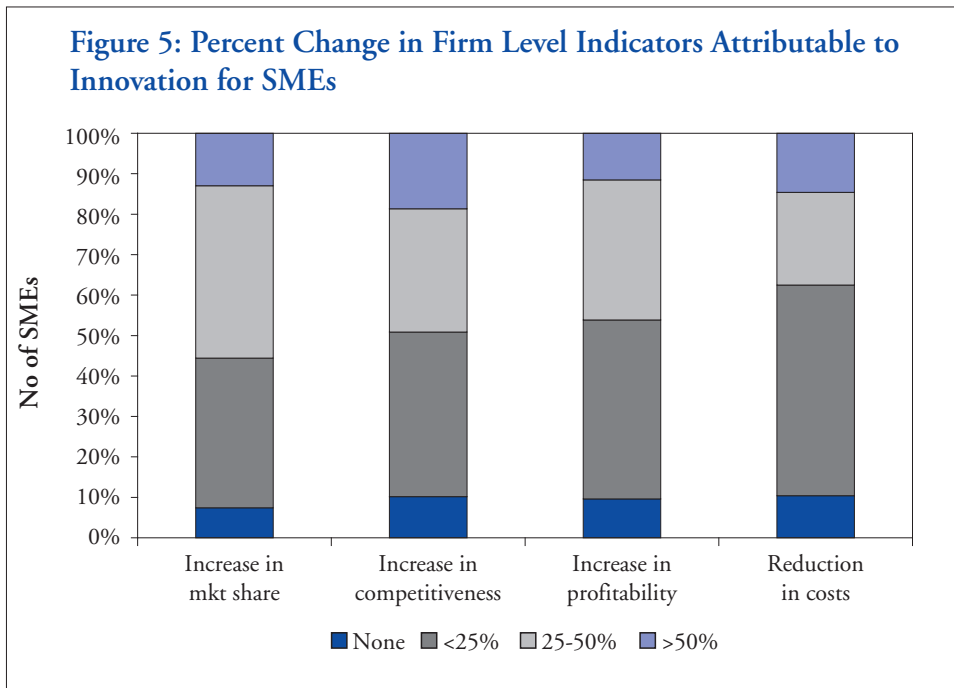
- the proportion of firms that attribute no change to Innovation is extremely low (less than 20%) in each case, and
- nearly half of the firms attribute more than 25% of the change in each indicator to Innovation

This implies that Innovation has a significant impact on these indicators of firm growth.

Also, the proportion of firms that attribute 25-50% and >50% of the change in an indicator to Innovation is the **highest in the case of competitiveness**. It can be inferred that for large firms *Innovation has the most significant impact on competitiveness*. Similarly, the remaining indicators are, in decreasing order of impact of Innovation: increase in profitability, reduction in costs and increase in market share.

The previous results of large firms can be compared with the experience of SMEs, as seen from **Figure 5** below:

For large firms Innovation has the most significant impact on competitiveness.



To illustrate, 19% of SMEs claim that Innovation has led to greater than 50% increase in competitiveness; 30% claim it has led to 25-50% increase in competitiveness; 41% claim it has led to 0-25% increase in competitiveness and the remaining 10% claim it has had no impact.

Further, it can be observed from **Figure 5** as above that:

- the proportion of firms that attribute no change to Innovation is extremely low (less than 10%) in each case, and
- nearly half of the firms attribute more than 25% of the change in each indicator to Innovation

This implies that Innovation has a significant impact on these indicators of firm growth in the case of SMEs as well.

Also, in the case of SMEs, the proportion of firms that attribute 25-50% and >50% of the change in an indicator to Innovation is the **highest in the case of increase in market share**. It can be inferred that for SMEs, *Innovation has the most significant impact on increase in market share*. Similarly, the remaining indicators can be listed as follows, in decreasing order of impact of Innovation: increase in competitiveness, increase in profitability and reduction in costs.

It could be inferred from the observations stated above that in the case of SMEs, Innovation by and large leads to greater increase in market share, competitiveness and profitability rather than reduction in costs. Unlike large firms where nearly half of the large firms have attributed significantly positive results on each of the four indicators due to Innovation, in the case of SMEs, only 35% of the SMEs attribute a significant reduction of costs due to Innovation. Scaling up of large scale Innovation efforts in the case of SMEs therefore may not find sufficient traction unless top leadership within SMEs perceive cost reduction as a necessary corollary to Innovation efforts.

2.2 Approach to Innovation

The increased understanding of the role of Innovation in driving growth and improving competitiveness in the Indian economy has led to greater interest and visibility of Innovation in the Indian media and public attention²⁷. This section attempts to quantify how firms view Innovation and the strategic importance placed on Innovation.

2.2.1 Strategic approach

The growing strategic importance placed by firms on Innovation is evident from the following points:

- All the large firms in our sample rank Innovation as being amongst the top 10 *strategic priorities*, with 17% ranking it as the **top strategic priority** and 75% ranking it as being amongst the **top 3 priorities**²⁸.
- All the firms in our sample – large firms and SMEs – agree (of which more than 70% strongly agree) that *Innovation is good for business*, even if it does not always result in higher market share or better competitiveness.
- All the large firms agree (of which nearly half strongly agree) that they cannot survive and grow without *investment in Innovation*.
- 65% of large firms (and 59% of SMEs) disagree that Innovation is a *high-risk activity*.

2.2.2 Operational approach

In addition to recognizing the strategic importance of Innovation, firms are taking concrete steps to incorporate Innovation as a business practice that is essential for the firm's survival and success. This is evident from the increasing Innovation spending and the increasing attempt by firms to encourage Innovation across the board – by not restricting it to top and middle management.

- Innovation has taken place largely in response to specific problems or challenges thrown up by the market or competitors, as observed by 65% of large firms and 83% of SMEs in our sample.

²⁷For instance, several conferences have been organized by industry chambers specifically on Innovation in the last 2 years, there has recently been a dramatic increase in the number of studies on Innovation in India and the number of cover stories in business magazines, Innovation awards have been instituted by government, private and media agencies, a successful Innovation consultancy has existed in India for the past 7 years, etc.

²⁸This observation could be subject to respondent bias, where applicable. See also, the CII-BCG report 'Innovation in Indian Manufacturing, 2007' also concludes that Innovation is a top priority for Indian companies, with 91% of firms naming Innovation as a Top 3 priority.

The increased understanding of the role of Innovation in driving growth and improving competitiveness in the Indian economy has led to greater interest and visibility of Innovation in the Indian media and public attention.

- Almost 70% of large firms are *satisfied with their returns* on investment in Innovation.
- An overwhelming 96% of large firms in our sample see *Innovation spending increasing* over the next 3-5 years.
- Half the large firms claim that the *motivation to innovate* is driven by the entire firm, whereas less than half claim that it is primarily driven by top and middle management. In fact, all the large firms in our sample *reward employees* for successfully demonstrating their capabilities as innovators.
- The reverse is true in the case of SMEs – less than 30% of the SMEs in our sample claim that the motivation to innovate is driven by the entire firm, whereas more than 60% claim that it is primarily driven by top and middle management.
- Although Innovation may be driven primarily by top management in the case of SMEs, there is an effort to mainstream Innovation as a business process – more than 70% of SMEs discuss Innovation at their annual board meetings, and more than half discuss it at their shareholder meetings.

2.2.3 Change since liberalization

It is evident that the economic liberalization of 1991 led to a significant increase in competitiveness in the Indian economy, and therefore, to an increase in the importance of Innovation. This is supported by the experience of firms in our sample:

- As expected, all the large firms in our sample agree (of which 81% strongly agree) that Innovation has gained importance as being critical to growth and competitiveness since the start of economic liberalization in India.
- However, prior to the 1990s, 77% of large firms in our sample had introduced new or improved products/ services/ processes based on Innovation.

2.2.4 Chapter Summary

‘**Innovation Intensity**’ (i.e. the percentage of revenue derived from products/ services which are less than 3 years old) has increased for large firms and SMEs, with SMEs registering a greater increase in Innovation Intensity than large firms. 42% of the large firms and 17% of the SMEs are also ‘**Highly Innovative**’ firms (i.e. firms who have introduced ‘new to world’ Innovations during the course of business in the last five years.) Nearly half of the large firms and SMEs attribute more than 25% of change in the following factors to Innovation: increase in competitiveness, increase in profitability, reduction in costs and increase in market share. For large firms Innovation has the most significant impact on competitiveness, while for SMEs, Innovation has the most significant impact on increase in market share. 17% of the large firms rank Innovation as the **top strategic priority** and 75% rank it among the top 3 priorities. All the large firms in our sample agree (of which 81% strongly agree) that Innovation has gained importance as being *critical to growth and competitiveness* since the start of economic liberalization in India. All the large firms agree (of which nearly half strongly agree) that they cannot survive and grow without *investment in Innovation*. An overwhelming 96% of large firms in our sample see *Innovation spending increasing* over the next 3-5 years.

Although Innovation may be driven primarily by top management in the case of SMEs, there is an effort to mainstream Innovation as a business process – more than 70% of SMEs discuss Innovation at their annual board meetings, and more than half discuss it at their shareholder meetings.

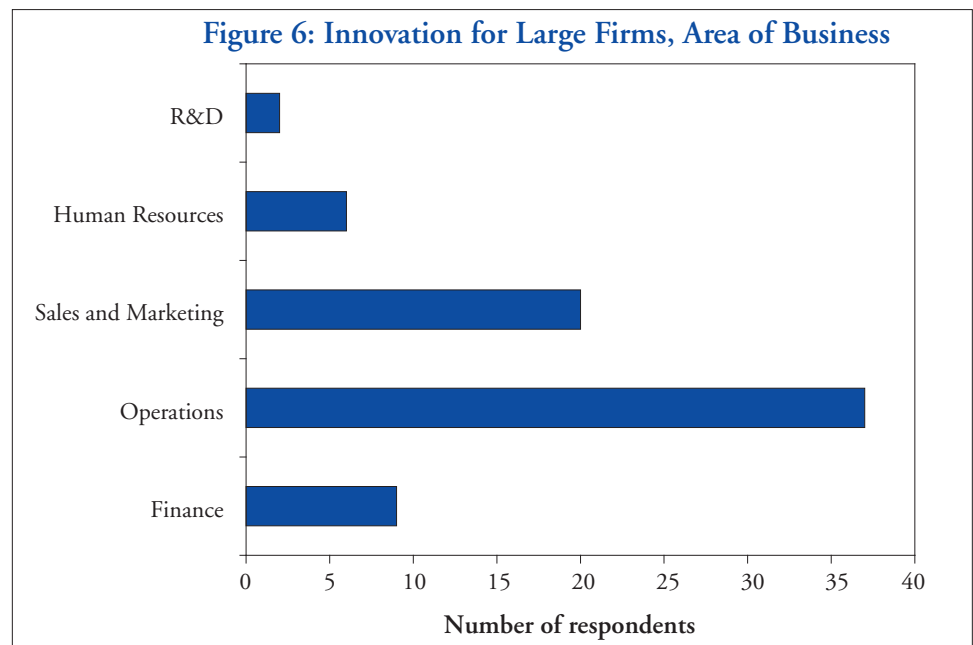
Innovation Strategy

The activity where Innovation is most highly concentrated continues to be operations, with sales and marketing being the next most important.

This chapter analyzes key strategic issues pertaining to Innovation, particularly in respect of firm operations, factors influencing Innovation, general conceptual types of Innovation and the average time frames of Innovation projects from idea generation to the market.

3.1 Area of business

Large firms in our sample were asked to pick the area of business where Innovation is most highly concentrated. The results are shown in **Figure 6** below. It is clear that the activity where Innovation is most highly concentrated continues to be **operations**²⁹, with **sales and marketing** being the next most important. Interestingly, the only firms that named R&D as the most important area of focus were pharmaceuticals firms. **This emphasis on process is a sharp departure from traditional R&D and manufacture centric notions of Innovation.**

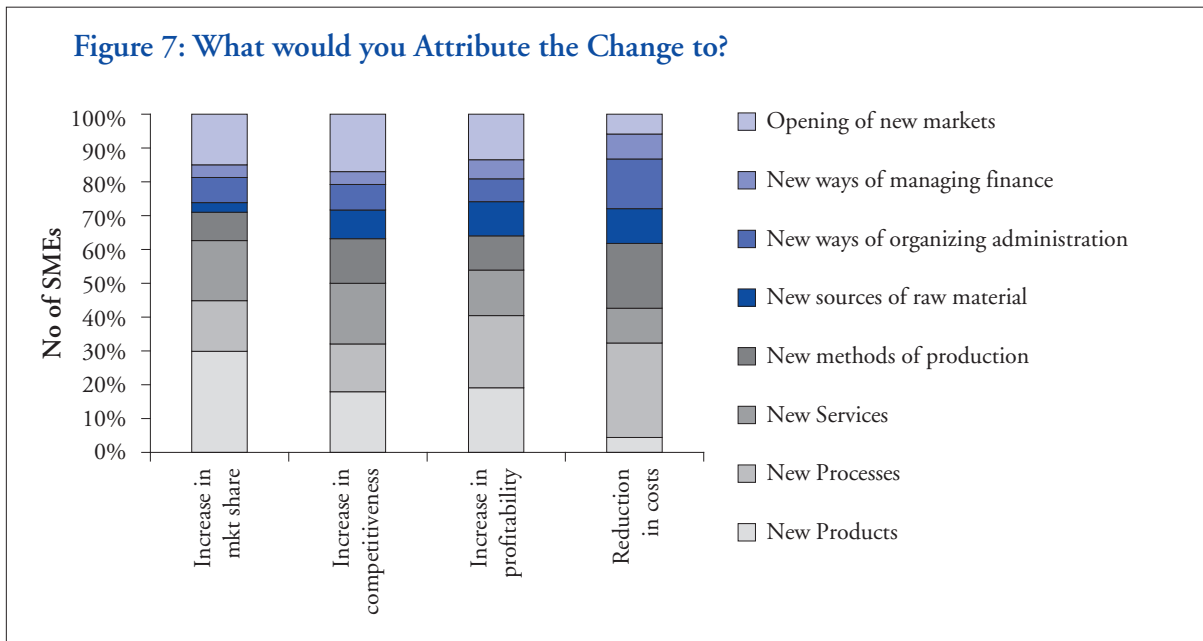


²⁹This finding is in direct contrast with that of the CII-BCG report on Innovation in Indian Manufacturing, where respondents stated that Innovation covered all the stated areas of business. Our findings could be different because unlike the BCG-CII report, respondents in this survey were forced to prioritize between the above focus areas.

3.2 Factors influencing Innovation in SMEs

We have seen in Section 2.1.3 that Innovation has had a significant impact on firm-level indicators of growth. This section studies how that impact has come about – i.e., through new products, new processes, new services, new methods of production, new sources of raw materials, new ways of organizing administration, new ways of managing finance or opening up of new markets. The SMEs in our sample were asked to report which of the above measures resulted in an increase in market share, increase in competitiveness, increase in profitability and reduction in costs.

It can be seen from **Figure 7** below that more than half of the increase in market share, competitiveness, profitability and reduction in costs due to Innovation has occurred due to only three types of Innovation – new products, new processes and new services. Other types of Innovation such as new methods of production and new ways of organizing administration have had a significant impact on cost reduction. Opening up of new markets has had an impact on the increase in competitiveness.



3.3 Conceptual Types of Innovation

Figure 8 below demonstrates the manner in which Innovation takes place in large firms – systematic vs. sporadic, incremental vs. breakthrough. The numbers in each quadrant represent the proportion of large firms, for instance, 27.5% of firms have experienced systematic breakthrough Innovation, whereas 5% have experienced sporadic breakthrough Innovation. Therefore, 32.5% of the large firms in our sample have experienced breakthrough Innovation.

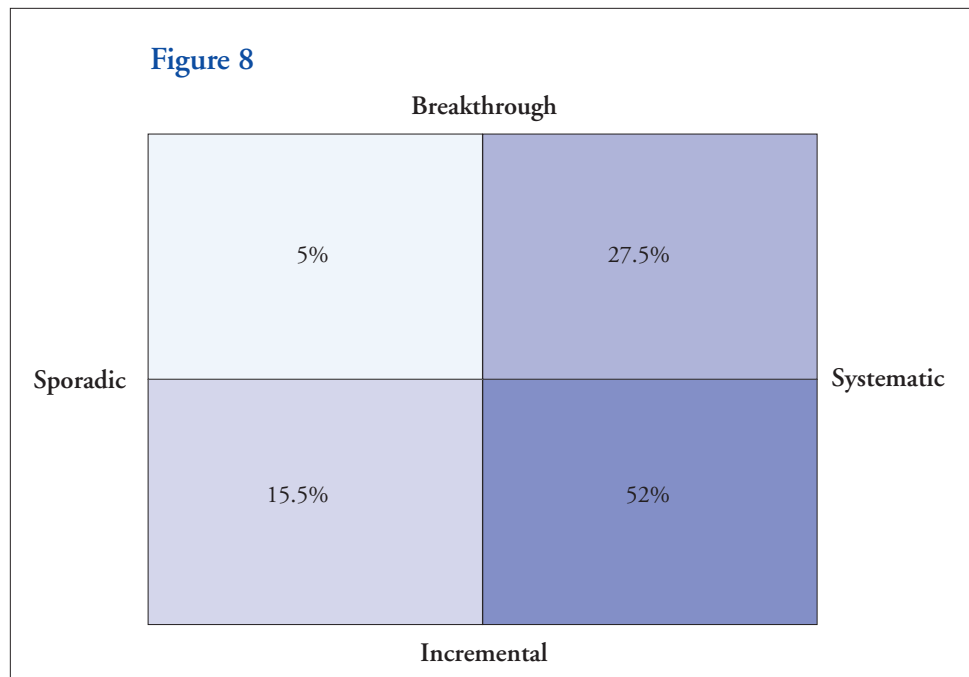


Figure 8 above shows that all the four conceptual types of Innovation – systematic, sporadic, breakthrough and incremental – are occurring simultaneously at varying degrees in India’s economy today. The largest proportion (more than half) of large firms lies in the systematic incremental quadrant, as can be seen from **Figure 8**, which may be an indication that large firms in India are still in the mindset of incremental Innovation as compared with breakthrough Innovation. This finding is reinforced by **Figure 9** below, which shows the proportion of firms that have introduced breakthrough or incremental Innovation.

In addition, only 2 (out of 22) Highly Innovative firms in our sample lie in the sporadic half of our sample, with the remaining 20 lying in the systematic half. This may indicate that a significant bulk of ‘new to world’ Innovation is very much a planned and systematic activity, and only occurs as a result of concrete steps taken by firms to innovate.

From **Figure 9** below, we see that 37.3% of firms have introduced breakthrough Innovation, while 76.4% have introduced incremental Innovation. Of the firms that have introduced breakthrough Innovation, 63% is ‘new to world’; and of the firms that have introduced incremental Innovation, 39.5% is ‘new to world’.

The proportion of firms that have introduced Breakthrough, Incremental or both types of Innovation

At the same time, from our survey database, we can infer that Highly Innovative firms have introduced ‘new to world’ Innovations that are not just breakthrough, but also incremental in nature. **Figure 10** below shows the proportion of Highly Innovative firms that have introduced breakthrough or incremental Innovation.

The largest proportion of large firms lies in the systematic incremental quadrant, which may be an indication that large firms in India are still in the mindset of incremental Innovation as compared with breakthrough Innovation.

Figure 9: The Proportion of Firms that have introduced Breakthrough, Incremental or Both Types of Innovation

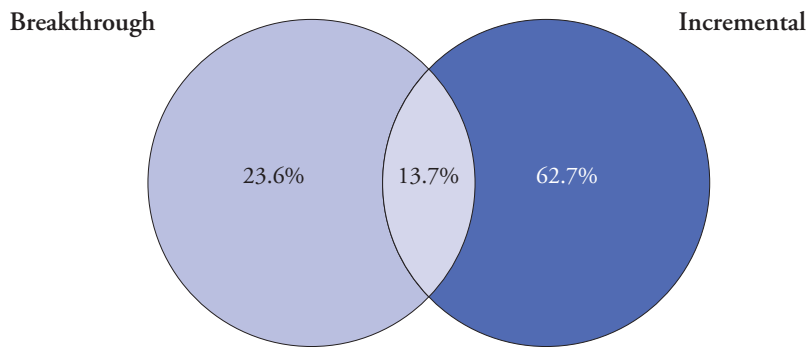
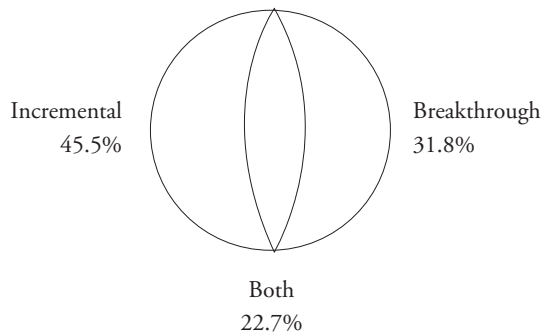


Figure 10: Highly Innovative Firms

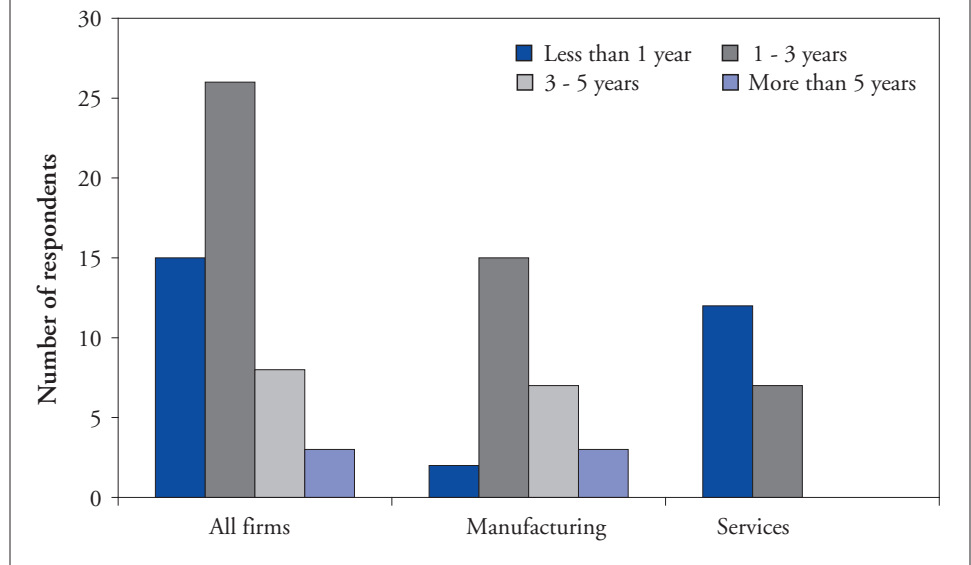


This shows that more than half of the ‘new to world’ Innovation introduced by large firms has been incremental in nature.

3.4 Timeframe for Innovation projects.

The average timeframe (from idea generation to market) of Innovation projects for the large firms in our sample is displayed in **Figure 11** below. For half the large firms in our sample, the average timeframe of Innovation projects is 1 – 3 years. It is also evident from the figure below that Innovation projects in manufacturing firms have longer gestation period than in services. Interestingly, we also observe that not a single services sector firm undertakes Innovation projects that take more than 3 years from idea generation to market, on average.

Figure 11: Average Timeframe of Innovation Projects for Large Firms



3.5 Chapter Summary

For large firms, Innovation is most highly concentrated in operations and sales and marketing. More than half of the increase in market share, competitiveness, profitability and reduction in costs due to Innovation has occurred in SMEs due to three types of Innovation – new products, new processes and new services.

37.3% of large firms have introduced breakthrough Innovation, while 76.4% have introduced incremental Innovation, which may be an indication that large firms in India are still in the mindset of incremental Innovation as compared with breakthrough Innovation. The average timeframe (from idea generation to market) of Innovation projects for half of the large firms is 1-3 years. Innovation projects in manufacturing firms have longer gestation period than in services.

Firm Structure and Processes

4.1 Impact of firm structure on innovativeness

This sub-section studies the impact of factors such as firm ownership and structure on innovativeness³⁰. Table 1 correlates Innovation Intensity with factors such as size of firm, age of firm, etc for large firms.

4.1.1 *Size of firm*: Table 1 indicates that Innovation Intensity has an inverse relationship with the size of the firm – as measured both by the number of employees and the annual revenue. Consistent with this inverse relationship within large firms, we have also observed that SMEs have higher Innovation Intensity than large firms (sub-section 2.1.1).

Innovation Intensity has an inverse relationship with the size of the firm – as measured both by the number of employees and the annual revenue.

Table 1: Relationship between Firm Structure and Innovation Intensity for Large Firms³¹

Factor	Correlation with Innovation Intensity
Age of firm	- 0.081
Size of firm (no. of employees)*	- 0.311*
Size of firm (annual revenue)*	- 0.268*
Profits	0.046
R&D spending*	0.298*
Spending on other Innovation*	0.353*
Ranking of Innovation as a strategic priority*	0.280*

* These correlations are significant at the 5% level.

³⁰ As explained in Chapter II, Section 1, innovativeness is measured by Innovation Intensity as well as by new to world Innovation. We define firms that have introduced Innovation that is new to the world in the last 5 years as 'Highly Innovative' firms. For a detailed explanation of the methodology followed in this section, refer to Appendix 2.

³¹ In this test, the null hypothesis states that no relationship exists between Innovation Intensity and each of the above factors. Based on the size of our sample, we can reject the null hypothesis in the rows that are marked with a *. In other words, a relationship does exist between Innovation Intensity and the factors marked with a *.

Table 2: Relationship between Firm Structure and Innovativeness

Indicator	Indicator Value	Number of firms	Average Innovation Intensity	Median Innovation Intensity	Number of Highly Innovative firms
Entire sample		52	11.15%	5.88%	22
Majority Stakeholder	Public	27	12.78%	8.13%	15
	Private	13	13.36%	8.89%	3
	Government	10	2.61%	1.55%	4
Majority Stakeholder	Indian	39	10.92%	5.88%	17
	Foreign	10	14.94%	10%	5
Are you an MNC?	Yes	21	14%	10%	9
	No	31	9.38%	3.62%	13

4.1.2 *Majority stakeholder (public/private/government)*. Innovation Intensity for privately and publicly owned firms is significantly higher than that of government owned firms (refer to Table 2).

Comparing private and public ownership, it is interesting to note that Innovation Intensity is higher in the case of privately owned firms.

However, more than half of the publicly owned firms are Highly Innovative (as defined by NKC for the purposes of this survey) whereas less than a quarter of the privately owned firms are Highly Innovative.

4.1.3 *Majority stakeholder (Indian/foreign)*. Firms with majority foreign ownership have greater Innovation Intensity than those with majority Indian ownership (refer to Table 2). In addition, 50% of the former and 43.5% of the latter are Highly Innovative.

This suggests that although average Innovation Intensity is significantly different (10.9% for Indian owned firms as compared with 14.9% for foreign owned firms), there is a high degree of ‘new to world’ type innovativeness in both categories. In other words, foreign owned firms generate greater revenue through the introduction of new products/services – this may be due to the introduction of existing global product lines to the Indian market, bringing global best practices to conducting business in India, and other similar factors. However, foreign ownership does not lead to a significantly higher propensity to be Highly Innovative, i.e. in respect of introduction of ‘new to world’ Innovations. This indicates that Indian firms have the potential to compete globally in their Innovation efforts.

4.1.4 *MNC (yes/no)*. Innovation Intensity for MNCs is significantly higher than for non-MNCs (average Innovation Intensity is 14% for MNCs, as compared to 9.38% for non-MNCs, refer to Table 2). However, 42% of non-MNCs are Highly Innovative, and 43% of MNCs are Highly Innovative. This is similar to the conclusions arrived at for Indian owned/foreign owned firms.

Foreign ownership does not lead to a significantly higher propensity to be Highly Innovative, i.e. in respect of introduction of ‘new to world’ Innovations. This indicates that Indian firms have the potential to compete globally in their Innovation efforts.

4.2 Impact of internal firm processes on innovativeness

This section establishes the impact of deliberate efforts made by firms, such as allocating funds and other resources specifically for Innovation, systematizing and formalizing processes related to Innovation, etc. on innovativeness, as seen from Table 3 below.

Table 3³²: Relationship between Internal Processes and Innovativeness

Indicator	Indicator Value	No. of firms	Average Innovation Intensity	Median Innovation Intensity	Number of Highly Innovative firms
Entire sample		52	11.15%	5.88%	22
Do you have a special department/ officer for Innovation?	Yes ³³	34	10.16%	4.38% ³⁴	16
	No	18	13.27%	9.25%	6
Do you allocate funds specifically for Innovation?	Yes	36	10.68%	5.67% ³⁵	16
	No	16	12.25%	6.67%	6
Do you formally forecast the probability of success for Innovation projects?	Yes	37	12.71%	7.22%	16
	No	14	7.73%	2.85%	5
Do you reward employees who are successful innovators?	Yes	50	10.74%	5.59%	21
	No ³⁶	1	-	-	-
Do you have formal processes to analyze the causes of success/ failure of Innovation projects?	Yes	32	12.18%	10%	15
	No	19	9.33%	6.36%	6
Do you make systematic attempts to track Innovations that are taking place in your industry or related areas?	Yes	46	11.61%	5.56%	19
	No	5	8.1%	7.5%	2
How many, if any, physical locations for Innovation does your company have?	None	7	8.9%	4%	0
	1 – 5	26	11.26%	4.88%	10
	5 – 10	6	7.8%	0.83%	5
	More than 10	12	11.73%	6.39%	7
Do you constitute cross-functional teams to tackle and deliver mega Innovation projects?	Yes	42	12.72%	7.5%	20
	No	8	4.56%	2.48%	1
How many patents have you filed in the last 5 years?	0 – 10	26	9.44%	4.6%	13
	10 – 20	0	-	-	-
	More than 20	16	13.34%	10%	9

³² The results from Table 3 could be subject to respondent bias, where applicable.

³³ The firms who have a special department/ officer for Innovation that are 'highly innovative' include Biocon, CRISIL, Infosys, etc.

³⁴ All PSUs in our sample lie in this category. Removing PSUs, the average Innovation Intensity for firms having a dedicated department or officer for Innovation rises to 13.1%, and the median rises to 7.7%.

³⁵ As before, nearly all PSUs lie in this category. Removing PSUs, the average Innovation Intensity for firms allocating funds specifically for Innovation rises to 13.04% and the median rises to 9%.

³⁶ The only firm responding 'No' is Shoppers' Stop.

4.2.1 Table 1 indicates that firms with higher a) R&D spending; b) Innovation spending; and c) greater strategic priority placed on Innovation; all have higher values of Innovation Intensity³⁷.

4.2.2 A significant observation that arises from Table 3 is the *increasing awareness* of the need to establish processes for Innovation. This can be seen by the fact that in each case, 60% or more of the large firms in our sample are already institutionalizing systems to manage Innovation.

4.2.3 *Special department or officer dedicated to Innovation.* Unexpectedly, we find that Innovation Intensity is lower for firms which have a special department or officer dedicated to Innovation. We also find that all the PSUs in our sample³⁸ have a special department or officer dedicated to Innovation. When we remove the PSUs from the sample, the average Innovation Intensity for firms having a dedicated department or officer for Innovation rises to 13.1%, and the median rises to 7.7% (compared with the values 10.16% and 4.38% in Table 3, which have been calculated for all firms having a dedicated department or officer for Innovation).

These figures imply that though PSUs have created dedicated departments for Innovation, they have not been effective in increasing Innovation Intensity.

However, at the same time, we find that for firms other than PSUs, having a special department or officer for Innovation has led to an increase in Innovation Intensity. This is further supported by the fact that firms having a special department or officer for Innovation are also more likely to be Highly Innovative (see Table 3).

4.2.4 *Allocate funds specifically for Innovation in annual budgets.* Similar to the previous case, we observe a counter-intuitive decrease in Innovation Intensity for firms that allocate funds specifically for Innovation in annual budgets. Again, all the PSUs in our sample³⁹ claim that they allocate funds specifically for Innovation in annual budgets. However, when we remove the PSUs from this sample, we find that the average Innovation Intensity for firms allocating funds specifically for Innovation rises to 13.04% and the median rises to 9% (compared with the values 10.68% and 5.67% in Table 3). This implies that in the case of PSUs, allocation of funds specifically for Innovation in annual budgets has not perhaps been effective in increasing Innovation Intensity.

At the same time, firms (other than PSUs) that allocate funds specifically to Innovation have higher Innovation Intensity. They are also more likely to be Highly Innovative (refer to Table 3).

4.2.5 *Impact of Other Processes:* In all the other cases, both Innovation Intensity and the proportion of Highly Innovative firms is higher for firms who undertake particular processes, such as the following: *formally forecasting probability of success; rewarding employees who have successfully demonstrated their capabilities*

³⁷ This can be seen by the positive and significant value of correlation in each of these cases.

³⁸ With the exclusion of Rural Electrification Corporation.

³⁹ With the exception of Punjab National Bank, Central Bank of India and Rural Electrification Corporation

In the case of PSUs, allocation of funds specifically for Innovation in annual budgets has not perhaps been effective in increasing Innovation Intensity. At the same time, firms (other than PSUs) that allocate funds specifically to Innovation have higher Innovation Intensity. They are also more likely to be Highly Innovative.

as innovators; formal processes to analyze the causes of success/ failure of Innovation projects; systematic attempts to track Innovations in industry or related areas, setting up physical locations for Innovation; and constituting cross-functional teams to deliver mega Innovation projects (refer to Table 3).

4.2.6 From the data sample, we are unable to analyze the impact of firm structure and internal processes on Innovation in the case of SMEs because of insignificant results.⁴⁰

4.2.7 *Patenting behavior and Innovation:* There appears to be a segment within large firms (i.e. 40% of large firms) who have filed greater than 20 patents and have achieved much higher degrees of Innovation Intensity and Highly Innovative percentages. At the same time, there is still a substantial segment of large firms (i.e. 60%) who have filed only between 0–10 patents in the last 5 years. Further, there are no firms in our sample that have filed between 10 and 20 patents in the last 5 years.

Firms that have filed for more than 20 patents have higher Innovation Intensity and are more Highly Innovative than firms which have filed 0-10 patents in the last five years. (Refer to Table 3, which indicates that average Innovation Intensity for firms that have filed for more than 20 patents in the last 5 years is 13.34%, compared with 9.44% for firms that filed for less than 10 patents in the last 5 years. Also, 57% of the former are Highly Innovative, while 50% of the latter are Highly Innovative.) Certain large firms therefore are becoming increasingly aware of IP as a means of increasing innovativeness and are assuming positions of leadership in this regard⁴¹. At the same time, it appears that there is need for large firms to enter, at least the intermediate bracket, i.e. 10-20 patent filings in order to be competitive with the leaders, who would, with experience of success, try for further Innovation in the coming years.

Firms that have filed for more than 20 patents have higher Innovation Intensity and are more Highly Innovative than firms which have filed 0-10 patents in the last five years.

Further, the relationship between Innovation and IP protection in the perception of large firms is evident from our sample. When asked how firms perceive the value of IP, nearly 80% respond that they view it as a valuable corporate asset per se, 17% view it as a measure of R&D and only 4% view it as an employee reward mechanism.

This means that within large firms, there is significant agreement on the role of IP in revenue generation, while we notice a disparity between such perception and actual translation into results in terms of patent filings.

The situation is quite different for the SMEs in our sample – only 3% of SMEs have filed more than 5 patents in the last 5 years, and therefore we do not have enough evidence to study the impact on Innovation for SMEs.

⁴⁰ In case of firm structure, this is because the number of firms that have foreign ownership, public ownership or primary markets abroad is too low to give significant results. All the correlations are also insignificant. In the case of internal processes, we find that discussing Innovation at annual board meetings and holding annual audits to study the success/ failure of Innovation projects has an insignificant impact on Innovation Intensity. The number of SMEs that have shareholder meetings is too low to give significant results. This might be due to the fact that SMEs are unable to properly implement these processes, or there could be flaws in our data.

⁴¹ Note that 74% of the large firms in our sample have access to a patenting process.

4.3 Impact of external processes on innovativeness

This section analyzes efforts made by firms for external collaboration, seeking external information, using consultants, etc. and establishes the impact of these efforts on innovativeness.

Table 4: Relationship between External Processes and Innovativeness

Indicator	Value	No of firms	Average Innovation Intensity	Median Innovation Intensity	Number of highly innovative firms
Entire sample		52	11.15%	5.88%	22
Primary market	India	38	11.66%	7%	14
	Abroad	14	9.81%	4.65%	8
Do you partner with government agencies for the purpose of Innovation?	Yes	17	14.14%	8.33%	10
	No	33	9.88%	4.83%	12
Do you collaborate with universities?	Yes	33	12.05%	6.79%	17
	No	16	8.6%	4.7%	6
Do you collaborate with R&D labs?	Yes	35	12.02%	5.77%	17
	No	14	9.71%	6.21%	5
Are Innovations patented in your industry?	Yes	30	12.2%	7.73%	16
	No	22	9.73%	5%	6
Do you use IPR consultants in India?	Yes	27	11.75%	3%	12
	No	24	10.52%	6.35%	10
Do you use IPR consultants abroad?	Yes	19	16.28%	14.61%	11
	No	26	7.7%	4.75%	10

It is extremely interesting to observe that firms with their primary market in India have higher Innovation Intensity than those with primary markets abroad.

4.3.1 *Primary market (India/Abroad).* It is extremely interesting to observe that firms with their primary market in India have higher Innovation Intensity than those with primary markets abroad (refer to Table 4). It was expected that firms with their primary market abroad would be more innovative because of exposure to global competition. However, it could be the case that Indian firms with their primary market abroad are more focused on catching up with the local competition.

On the other hand, a greater proportion of firms with their primary market abroad are Highly Innovative as compared with firms with their primary market in India. *This implies that exposure to global competition may not lead to an increase in Innovation Intensity (i.e. in proportion of revenue earned from Innovation in the last 3 years) but does lead to an increase in the likelihood of becoming Highly Innovative (i.e. in the propensity of firms to introduce 'new to world' Innovations).*

4.3.2 *Partnerships with government agencies.* Several government programs have been established with the explicit purpose of driving Innovation in the Indian economy – notable amongst these are the NMITLI (New Millennium India Technology Leadership Initiative), TePP (Techno-Entrepreneurs Promotion Program), the National Innovation Foundation, TDB (Technology Development Board), HGT (Home Grown Technology Program), etc.

We find a small proportion of firms (roughly 30% of large firms and 10% of SMEs) in our sample partnering with government agencies for the purpose of Innovation. These firms have a significantly higher Innovation Intensity (refer to **Table 4** – the average Innovation Intensity is 14.14% for large firms⁴² that partner with government agencies, as compared with 9.88% for firms that do not) as well as a significantly higher likelihood to be Highly Innovative (refer to **Table 4**, which indicates that 59% of these firms are Highly Innovative, whereas only 36% of firms that do not partner with government agencies are Highly Innovative).

From the above, we can conclude that further investigation is required into the strengths and weaknesses of these government support programs for Innovation. There may be a case for extending and scaling up these programs. There has also been discussion in recent times on setting up of a National Innovation Program, under the aegis of the Government. In order to develop norms conducive to collaboration between industry and R&D labs or universities, such a plan could help facilitate the following: enable researchers to set up commercial entities while in professional employment with their research organizations; enable research organizations to invest knowledge including inventions and Innovations as equity in the new enterprises; as well as facilitate mobility of researchers and encourage setting up incubation centers.⁴³ Public Private Partnerships (PPP) have also emerged as a tool for effecting Innovation and it is expected that this trend will continue in future.

4.3.3 *Collaboration with universities and R&D labs.* There is a clear indication that collaboration with universities and R&D labs enhances firm innovativeness. **Table 4** indicates that Innovation Intensity is higher for firms that collaborate, and that the proportion of Highly Innovative firms is also higher. In fact, more than half of the large firms and SMEs in our sample claim that the lack of co-operation with universities and R&D labs is an important barrier to Innovation (see **Chapter V** on Barriers below). It could be argued here that the Indian Industry-R&D relationship has yet to achieve critical mass. In the case of Indian industries, this could be a powerful competitive tool, which could also perhaps require some facilitating institutional mechanisms.

4.3.4 *IP Regime.* Of the large firms in our sample, 57% claim that Innovations are patented in their industry⁴⁴. Of these firms, more than half are Highly

Innovation Intensity is higher for firms that collaborate, and that the proportion of Highly Innovative firms is also higher. In fact, more than half of the large firms and SMEs in our sample claim that the lack of co-operation with universities and R&D labs is an important barrier to Innovation.

⁴² The number of SMEs who engage in partnerships with government agencies is too low to get significant results on the impact on Innovation Intensity.

⁴³ See also for example, the draft 'Proposal from CSIR entitled 'Encouraging Development and Commercialization of Inventions and Innovations: A new Impetus' dated April 10, 2007.

⁴⁴ Interestingly, of the firms who claim that Innovations are not patented in their industry, more than half foresee patentable Innovations in the next ten years. This is reflective of the evolving IPR regime in India.

External Collaboration

While partnering with government agencies and collaborating with universities and R&D labs both lead to greater Innovation, it can be seen from Table 4 that the former has a greater impact. This might be due to the fact that the government schemes are specifically targeted, which in turn could lead to higher levels of Innovation for a firm.

Innovative, whereas of the firms that claim that Innovations are not patented, roughly one quarter are Highly Innovative. Innovation Intensity is also higher in the case of firms that have protection for their intellectual property (refer to Table 4, which indicates that the average Innovation Intensity increases from 9.73% to 12.2% in the case of firms that claim Innovations are patented in their industry).

Comparing this with the experience of SMEs, only 33% claim that Innovations are patented in their industry. This could perhaps explain the very low percentage of patent filings by SMEs as seen in subsection 4.2.7. At the same time, we find that SMEs have higher Innovation Intensity and a higher proportion of Highly Innovative firms if Innovations are patented in their industry (the average Innovation Intensity for SMEs if Innovations are patented in their industry is 36%, as compared with 26% for SMEs if Innovations are not patented in their industry. The proportion of Highly Innovative firms is 12.5% for the former, as compared with 10% for the latter.)

It also appears therefore that there is still scope for enhanced patentability within industrial sectors and such opportunities have not yet been fully exploited.

4.3.5 *Royalties from IP.* In terms of royalties earned and costs incurred from IP licensing, both revenue earned from IP royalties and costs incurred are in the 0-5% bracket for 95% of large firms in our sample. This indicates that revenue generation from IP licenses as well as IP licensing for Innovation generally may still be at a somewhat nascent stage in India today. In an interdependent globalized space, where science is complex, the scope for licensing of IP at various stages of the manufacturing process, may increasingly become pertinent, for reasons of cost as well as comparative advantage.

4.3.6 *Use IPR consultants.* More than half the large firms in our sample use the services of IPR consultants in India, and 36% use the services of IPR consultants abroad. Innovation Intensity is slightly higher for firms using the services of IPR consultants in India, but it is significantly higher for firms using IPR consultants abroad (refer to Table 4, which indicates that average Innovation Intensity for firms using IPR consultants in India is 11.75%, as compared with 10.52% for firms that don't; whereas it is 16.28% for firms that use IPR consultants abroad, as compared with 7.7% for firms that don't). The proportion of Highly Innovative firms is also the highest for firms using IPR consultants abroad (Table 4 indicates that 44% of firms using IPR consultants in India are Highly Innovative, as compared with 42% of firms that do not use IPR consultants in India; while the corresponding figures are 58% and 38% respectively for firms

At the same time, we find that SMEs have higher Innovation Intensity and a higher proportion of Highly Innovative firms if Innovations are patented in their industry.

Intellectual Property Rights and Innovation

From sub-sections 4.2.7, 4.3.4 and 4.3.6, it is evident that Innovation is positively impacted by protection for firms' intellectual property in the case of large firms, and to some extent, also in the case of SMEs.

This can be seen by the fact that

1. Firms in industries where Innovations are patented have higher Innovation Intensity and are more likely to be Highly Innovative (sub-section 4.3.4).
2. Firms that have filed more than 20 patents have higher Innovation Intensity than those with less than 10 filings and are more likely to be Highly Innovative (sub-section 4.2.7).
3. Firms that use IPR consultants have higher Innovation Intensity and are more likely to be Highly Innovative (sub-section 4.3.6).

that use the services of IPR consultants abroad). This also signifies the necessity for extensive IPR capacity building within the country.

4.3.7 *Seek information from customer, suppliers and distributors.* All the large firms in our sample seek information from customers, suppliers and distributors and use this information to improve their products and services.

4.3.8 *Source of funding for Innovation activities.* Nearly all the firms in our sample use internal funds to fund their Innovation activities, rather than venture capital, bank loans or government grants. A small proportion (roughly 10%) of SMEs uses bank loans as an additional source of funding for Innovation.

4.3.9 *Primary external factor to innovate.* The customer is the primary external factor that leads firms to innovate, according to more than half of the large firms in our sample. The market is the next most important external factor, and the industry and the economy are relatively less important.

4.3.10 *Chapter Summary:* SMEs have greater Innovation Intensity than large firms. Innovation Intensity for privately and publicly owned firms is significantly higher than that of government owned firms. Firms with majority foreign ownership have greater Innovation Intensity than those with majority Indian ownership. Innovation Intensity for MNCs is significantly higher than for non-MNCs while there is little difference in the percentage of 'Highly Innovative' firms among MNCs and non-MNCs.

Internal processes for Innovation such as maintaining a specific Innovation department, allocating funds, rewarding innovative employees, forecasting probabilities of success, formalizing processes and systematic attempts, maintaining physical locations for Innovation and constituting cross-functional teams all lead to firms being more innovative. Further, firms with greater R&D spending, Innovation spending and strategic prioritization for Innovation are also more likely to be more innovative.

The customer is the primary external factor that leads more than half of the large firms to innovate.

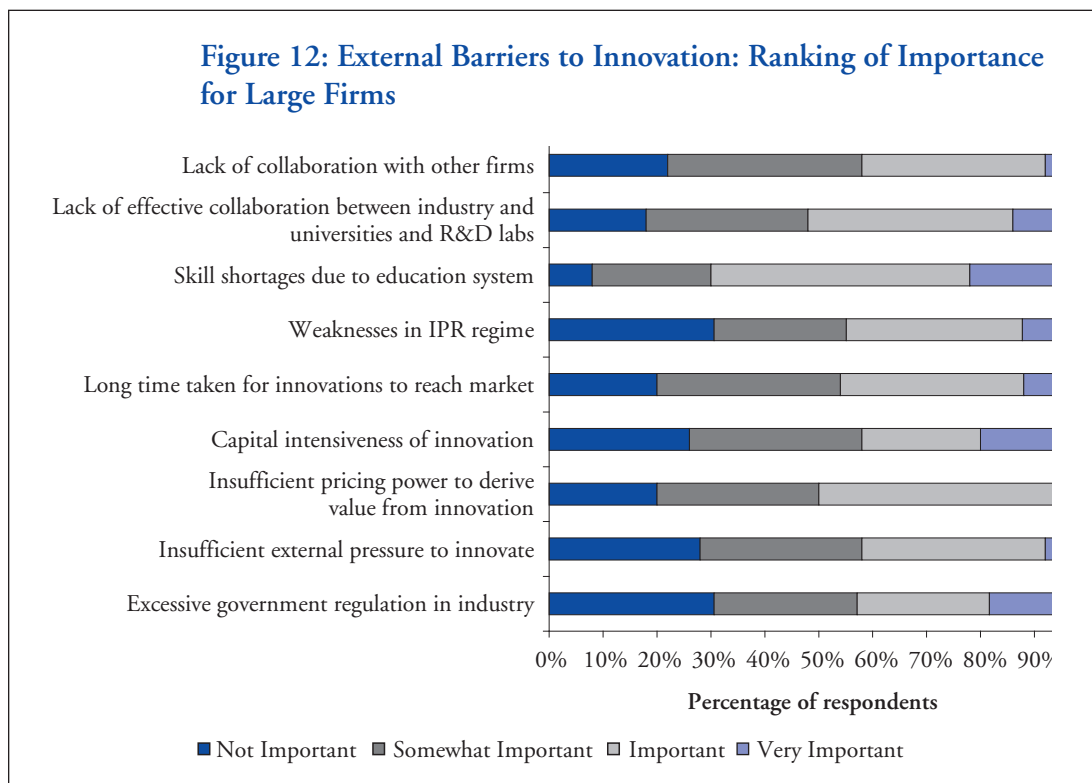
Firms with their primary market in India have higher Innovation Intensity than those with primary markets abroad. On the other hand, a greater proportion of firms with their primary market abroad are Highly Innovative (i.e. have introduced more 'new to world' Innovations) as compared with firms with their primary market in India. Firms in industries where Innovations are patented, with more patent filings and use of IPR consultants are more innovative. Firms partnering with government agencies, collaborating with universities and R&D labs also tend to be more innovative.

Barriers to Innovation

5.1 External and Internal Barriers

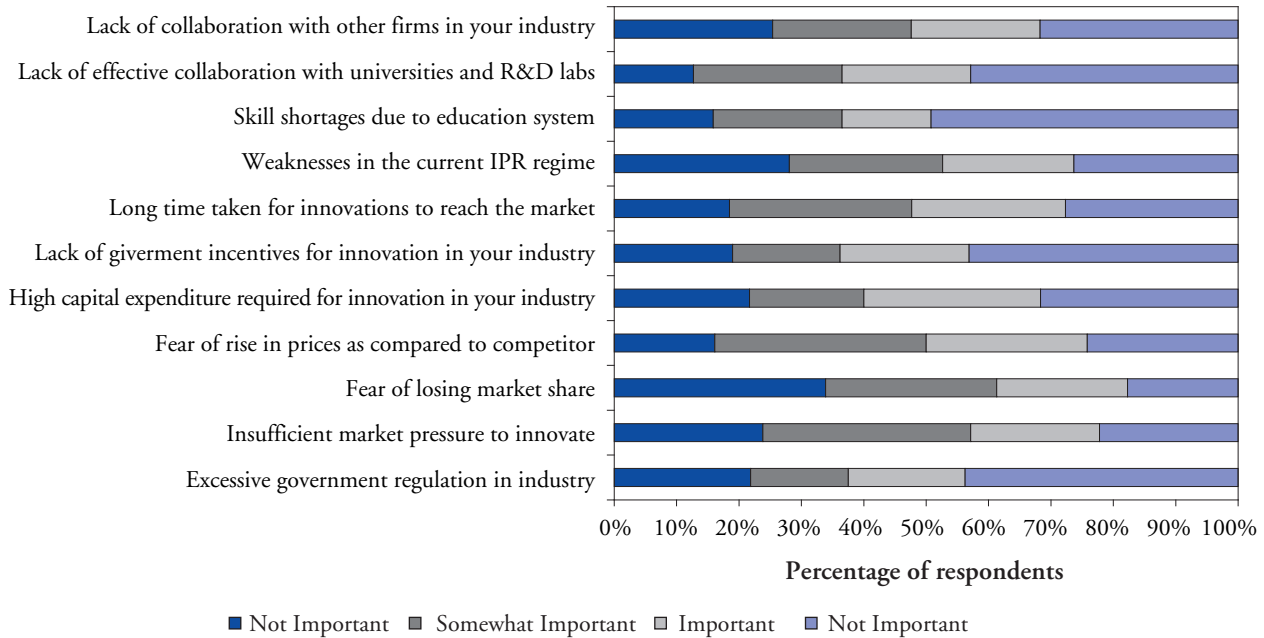
5.1.1 This section analyzes the barriers to Innovation perceived by large firms and SMEs. The barriers have been classified into (1) *external* – those that could arise due to the regulatory environment, the market, the Intellectual Property Rights (IPR) regime, etc., and (2) *internal* – those that could arise due to internal firm processes such as internal resistance to change, inefficient systems and processes to manage Innovation, etc. The figures below display firms' ranking of importance for barriers to Innovation.

It is interesting to note that in most cases, more firms considered a particular barrier to be 'Not Important' rather than 'Important'. This signifies a positive attitude towards Innovation at a general level. Also, on average, *firms perceive external barriers more important than internal barriers*.



5.1.2 *External barriers* – We observe that only 43% of large firms think that excessive government regulation in their industry is an important barrier to Innovation. In addition, only 42% of large firms perceive insufficient external pressure to innovate as an important barrier to Innovation. This could be a reflection of the existence of competitiveness as a spur to Innovation efforts in the current economy.

Figure 13: External Barriers to Innovation: Ranking of Importance for SMEs



The most important external barrier to Innovation, as perceived by both large firms and SMEs, is skill shortages due to the lack of emphasis on industrial Innovation, problem-solving, design, experimentation etc. in the education curricula. It is critical to focus on policy reform in the higher and vocational educational curricula in order for India to achieve its Innovation potential.

The next most important external barriers as perceived by large firms are, in decreasing order of importance as follows: the lack of effective collaboration between industry and research conducted in universities and R&D institutions; insufficient pricing power to derive value from Innovations.

For SMEs, the most important external barriers are: excessive government regulation; the lack of effective collaboration between industry and research conducted in universities and R&D institutions.

5.1.3 *Internal barriers*: The most important internal barriers as perceived by large firms, in decreasing order of importance are: lack of organizational focus on Innovation as a strategy for growth and competitiveness; inefficient knowledge management systems within the company; and poor understanding of customer needs and market dynamics.

Figure 14: Internal Barriers to Innovation: Ranking of Importance for Large Firms

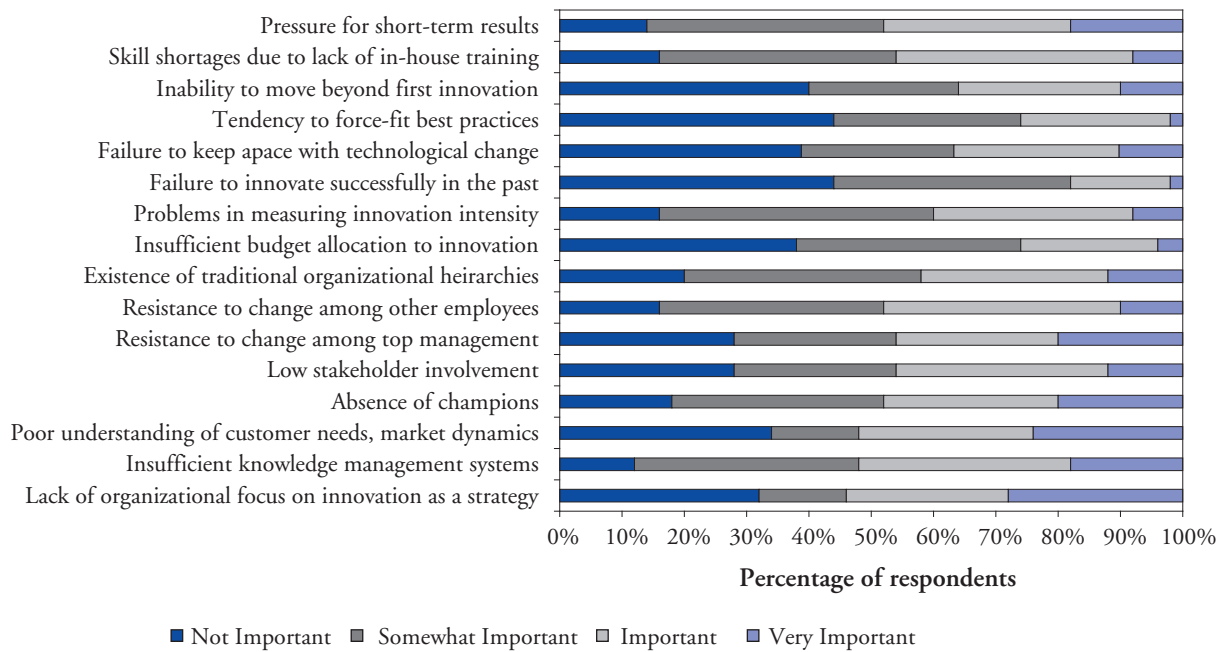
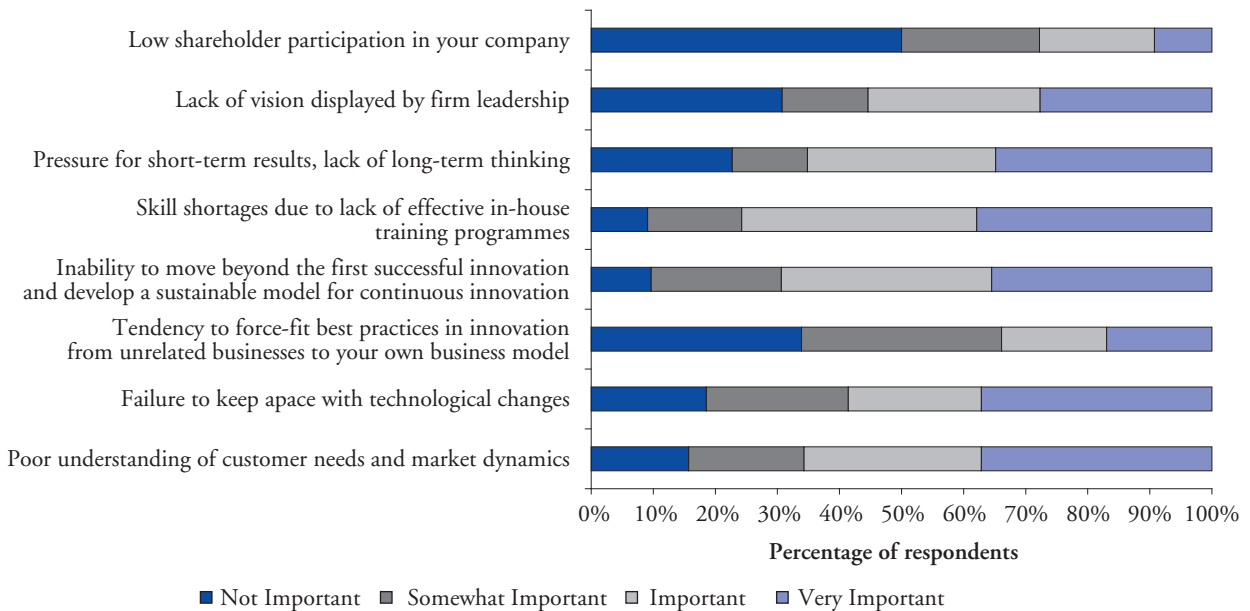


Figure 15: Internal Barriers to Innovation: Ranking of Importance for SMEs



The most important internal barriers as perceived by large firms are lack of organizational focus on Innovation as a strategy for growth and competitiveness; inefficient knowledge management systems within the company; and poor understanding of customer needs and market dynamics.

The most important internal barriers as perceived by SMEs, in decreasing order of importance are: skill shortages due to lack of effective in-house training programmes; inability to move beyond the first successful Innovation and develop a sustainable model for continuous Innovation; and poor understanding of customer needs and market dynamics.

Therefore, while SMEs are able to target small and emerging markets, are open to radical Innovation and can try new business models, they have issues in scaling up and gaining a deeper understanding of the market.

- 5.1.4 *Chapter Summary:* The most important external barrier to Innovation, as perceived by both large firms and SMEs, is skill shortages due to the lack of emphasis on industrial Innovation, problem-solving, design, experimentation, etc. in the education curricula. Other prominent external barriers are lack of effective collaboration with research in universities and R&D institutions, excessive government regulation as well as insufficient pricing power to derive value from Innovations.

The most important internal barriers as perceived by large firms are lack of organizational focus on Innovation as a strategy for growth and competitiveness; inefficient knowledge management systems within the company; and poor understanding of customer needs and market dynamics. For SMEs, prominent internal barriers are skill shortages due to lack of effective in-house training programmes; inability to move beyond the first successful Innovation and develop a sustainable model for continuous Innovation; as well as poor understanding of customer needs and market dynamics.

Innovation in Manufacturing and Services Firms

The literature on Innovation in India has largely been silent on the specific experiences of the services sector with Innovation. With the changing composition of Indian economic growth to be increasingly services led, NKC sees Innovation playing a crucial role in this growth. Services contributed as much as **68.6%** of the overall average growth in GDP in the last five years between 2002-03 and 2006-07⁴⁵.

6.1 Innovation Intensity

From the results of our survey, we observe that Innovation Intensity is higher for manufacturing than for services (for both large firms and SMEs, refer to Table 5 below). However, we do see that Innovation Intensity has grown faster from 2001-02 to 2005-06 for services than for manufacturing (the rate of growth over this four-year period was **62.8%** for manufacturing and **80.5%** for services). This finding reflects the overall trend in the economy as well – that the services sector is smaller, but growing more rapidly than the manufacturing sector.

The services sector is smaller, but growing more rapidly than the manufacturing sector.

6.2 Highly Innovative Firms

Although services sector firms have lower Innovation Intensity, they are more likely to be Highly Innovative (both in the case of large firms and SMEs – while **37%** and **7%** of large and SME firms in the manufacturing sector are Highly Innovative respectively, **42%** and **17%** of large and SME firms in the services sector are Highly Innovative respectively, refer to Table 5).

The above findings as highlighted in 6.1 and 6.2 could indicate that firms in the services sector do not innovate as consistently as manufacturing firms, and therefore have a smaller percentage of revenue from new products or services. It could also be possible that the Innovations in the services sector may themselves be of lower revenue value than the ones in the manufacturing sector. However, services firms have experienced a higher degree of success as measured by ‘new to world’ Innovation, which could also perhaps be a reflection of increasing services led efforts leading to economic growth in recent times.

⁴⁵ Source: India Economic Survey, 2006-07. See <http://indiabudget.nic.in>.

Table 5

	Manufacturing		Services	
	Large firms	SMEs	Large firms	SMEs
Average Innovation Intensity, 2005-06	12%	33%	9%	27%
Average Innovation Intensity, 2001-02	7.4%	-	5%	-
Proportion of Highly Innovative firms	37%	7%	42%	17%
Average R&D expenditure, as a % of revenue	2.04%	5%	1.06%	7%
Average Innovation expenditure, as a % of revenue	1.25%	4%	1.91%	7%
Percentage of firms that collaborate with government agencies for the purpose of Innovation	22%	9%	31.5%	12%
Percentage of firms that collaborate with universities	67%	26.5%	52.5%	44%
Percentage of firms that collaborate with R&D labs	78%	30%	42%	21%

6.3 Impact of Innovation on firm growth

For all the firms in our sample (large firms and SMEs), Innovation has had roughly the same level impact for manufacturing and services firms, in respect of *increase in market share and increase in competitiveness*. However, Innovation has led to a greater *increase in profitability* for manufacturing firms and a greater *reduction in costs* for services firms. Cost reduction in the global services market could be a significant aim for the services firms' competitiveness. This can be seen from **Figure 16**, by observing the proportion of firms that attribute more than 25% of the change in any indicator to Innovation.

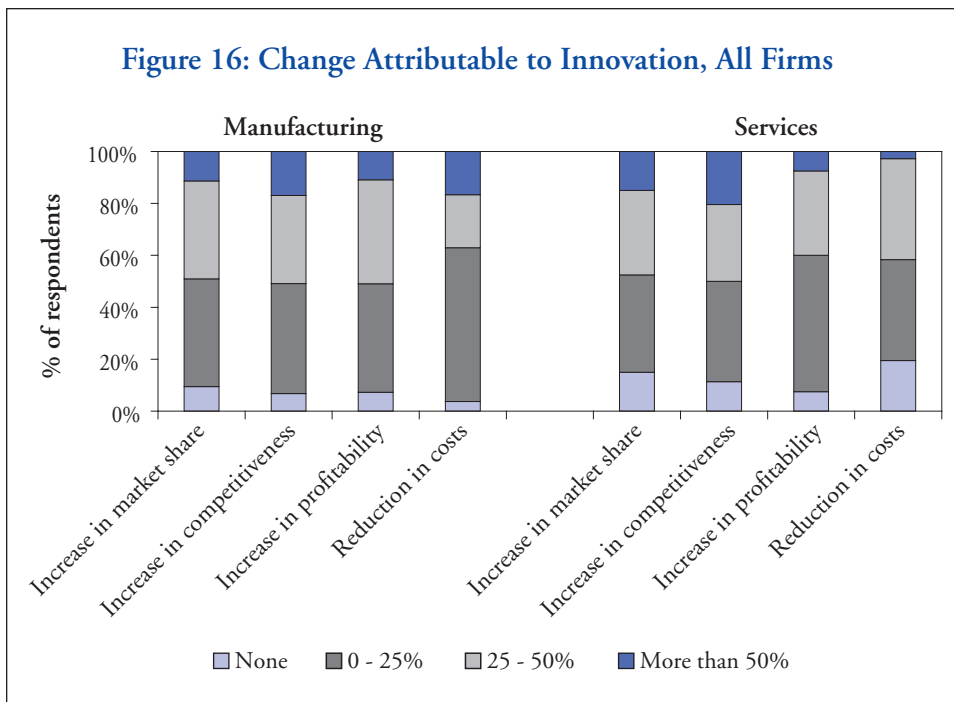
It can also be seen from **Figure 16** that the proportion of firms that attribute no change to Innovation is slightly higher in the case of services sector firms. This indicates that Innovation has had a greater degree of impact on growth in the manufacturing sector so far. It would be interesting to note how this aspect changes in India's transition to becoming an increasingly services based economy.

6.4 Partnerships with government agencies

We find that 22% and 8% of large and SME manufacturing sector firms respectively partner with government agencies, as compared with 31.5% and 12% respectively for services sector firms. Therefore, services firms are more likely to partner with government agencies with Innovation being the specific purpose.

Innovation has led to a greater increase in profitability for manufacturing firms and a greater reduction in costs for services firms

Figure 16: Change Attributable to Innovation, All Firms



6.5 Collaboration with universities and R&D labs

- **Large firms:** More firms in the manufacturing sector collaborate with universities and R&D labs, as compared with the services sector;
- **SMEs:** More firms in the services sector collaborate with universities than in the manufacturing sector, and the reverse is true for collaboration with R&D labs.

6.6 Spending on R&D and Innovation

- **Large firms:** The average R&D spend, as a percentage of annual revenue, is lower for the services sector as compared to the manufacturing sector, but *Innovation spending is higher.*
- **SMEs:** Both R&D and Innovation spend are higher in the case of services than manufacturing.

6.7 Further remarks

From the above, it seems that large firms in the services sector are more specifically focused towards Innovation generally, as is clear from a higher spend on Innovation and collaboration with government agencies/ schemes specifically for the purpose of Innovation; and lower R&D spend and lower collaboration with universities and R&D labs. As we have seen in Chapter IV, collaboration with government schemes has a higher impact on Innovation than collaboration with universities and R&D labs.

Services firms are more likely to partner with government agencies with Innovation being the specific purpose. In large firms, the average R&D spend, as a percentage of annual revenue, is lower for the services sector as compared to the manufacturing sector, but Innovation spending is higher.

Similarly, SMEs in the services sector spend more on Innovation and R&D as well as collaborate with government agencies/ schemes for the purpose of Innovation. They also have higher collaboration with universities, but lower collaboration with R&D labs.

6.8 Chapter Summary

While Innovation Intensity is higher for manufacturing than services (for large firms and SMEs), Innovation Intensity has grown faster from 2001-02 to 2005-06 for services than manufacturing. Further, services firms are more likely to be Highly Innovative, i.e. they have a greater propensity to introduce 'new to world' Innovations. For all the firms in our sample (large firms and SMEs), Innovation has had roughly the same level impact for manufacturing and services firms, in respect of *increase in market share and increase in competitiveness*. However, Innovation has led to a greater *increase in profitability* for manufacturing firms and a greater *reduction in costs* for services firms.

Services firms are more likely to partner with government agencies with Innovation being the specific purpose. In large firms, the average R&D spend, as a percentage of annual revenue, is lower for the services sector as compared to the manufacturing sector, but Innovation spending is higher. For SMEs, Both R&D and Innovation spend are higher in the case of services than manufacturing.

Concluding Observations

The NKC survey confirms the rising Innovation activity and awareness in India as well as the need to continuously and publicly encourage this trend as a key enabler in India's economic growth and competitiveness. It reinforces the fact that Innovation is growing in the Indian economy significantly. However, there is need for further effort along a range of parameters in order to fully realize India's Innovation potential. The spread and impact of Innovation depends on several factors which must relate to each other in order to achieve optimal results.

7.1 Innovation Impact

We have seen from the previous chapters that Innovation Intensity has increased for large firms as well as SMEs. SMEs have experienced faster rates of increase as compared to large firms whereas large firms have a greater percentage of 'new to world' Innovations, i.e. they are more 'Highly Innovative' than SMEs. We also find that more than 80% of both large firms and SMEs have achieved greater competitiveness, profitability, market share and reduction of costs due to Innovation. Nearly half of the large firms and SMEs attribute a change of greater than 25% in each of those four factors to Innovation. Increase in competitiveness and increase in market share are the most significant changes due to Innovation in large firms and SMEs respectively. 81% of the large firms strongly agree that Innovation has gained importance as being *critical to growth and competitiveness* since the start of economic liberalization in India. Further, 37.3% of firms have introduced breakthrough Innovation, while 76.4% have introduced incremental Innovation. Of the firms that have introduced breakthrough Innovation, 63% is 'new to world'; and of the firms that have introduced incremental Innovation, 39.5% is 'new to world'. This indicates a significant rise in Innovation led efforts for economic growth in the country.

Innovation is most highly concentrated in operations, with sales and marketing being the next most important. This emphasis on process is a departure from traditional R&D and manufacture centric notions of Innovation.

7.2 Processes and Services

Innovation is occurring in process (i.e. not just in product development) as well as in the services sector. (i.e. not just manufacturing) Although services sector firms have lower Innovation Intensity, they are more likely to be Highly Innovative. Innovation is most highly concentrated in operations, with sales and marketing being the next most important. This emphasis on process is a departure from traditional R&D and manufacture centric notions of Innovation. Interestingly, we also observe that in our

sample not a single services sector firm undertakes Innovation projects that take more than 3 years from idea generation to market, on average. Firm processes (internal and external) are observed to have a positive impact on Innovation. There is increasing awareness of the need to establish processes for Innovation. This can be seen by the fact that in each case, 60% or more of the large firms in our sample are already institutionalizing systems to manage Innovation.

7.3 Intellectual Property

Firms in industries where Innovations are patented have higher Innovation Intensity and are also more likely to be Highly Innovative. Firms that have filed more than 20 patents in the last five years have higher Innovation Intensity than those with less than 10 filings and are also more likely to be Highly Innovative. Further, firms that use IPR consultants have higher Innovation Intensity and are more likely to be Highly Innovative. At the same time, there is potential for increased scope of patentability, use of licensing as well as a greater translation of IP awareness into concrete revenue generation and asset creation.

7.4 Education

The most important external barrier to Innovation, as perceived by both large firms and SMEs is skill shortage, due to the lack of emphasis on creativity, problem-solving, design, experimentation, etc. in the education curricula. In order to unleash India's Innovation potential, an essential step is systematic reform of the higher education system in India, which would act as an enabler for developing the required intellectual capital as well as in laying the foundation for effective collaboration between industry and educational institutions. It could be argued that Innovation, Education (including Vocational Education) and Entrepreneurship are three ends of a triangle, each of which is related to the other. NKC has already made recommendations to the Prime Minister for reform in the higher education system, focusing on expansion, excellence and inclusion. In addition, NKC has also made recommendations to overhaul the system of Vocational Education and Training (VET), with a focus on increasing industry participation in VET, which would correct the imbalance of supply and demand in VET and act as a more effective tool to address the skill shortages faced by industry. Through VET, emphasis is to be laid on skill development and inculcating a culture of entrepreneurship. Public Private Partnerships (PPP) between industry-government-academia also need to be explored. To incentivize R&D, NKC has also recommended the enactment of uniform legislation for public funded research, which is discussed under subsection 7.5 below. Educational reforms are crucial in enabling Innovation led economic growth in the country.

7.5 R&D Collaboration

The second most important external barrier as perceived by large firms is the lack of effective collaboration between industry with research conducted in universities and R&D institutions. In fact, more than half of the large firms and SMEs claim that the lack of co-operation with universities and R&D labs is an important barrier to

The most important external barrier to Innovation, as perceived by both large firms and SMEs is skill shortage, due to the lack of emphasis on creativity, problem-solving, design, experimentation, etc. in the education curricula.

Innovation. Conversely, there is a clear indication that collaboration with universities and R&D labs does enhance firm innovativeness. Innovation Intensity is higher for firms that collaborate, and the proportion of Highly Innovative firms is also higher. In order to create more incentives for R&D, NKC has recommended the enactment of legislation for government funded research in the country, that would enable the following: give universities and research institutions ownership and patent rights over inventions arising out of government funded research; create an enabling environment for universities and research institutions to commercialize such inventions through licensing arrangements/partnerships where inventors would also be allowed to receive a share of the royalty; and also thereby generally facilitate more collaborative efforts with industry.⁴⁶ There are precedents for such legislation such as the American enactment entitled the Patent and Trademark Law Amendments Act, enacted in 1980 and commonly known as the Bayh-Dole Act. Introduction of legislation generally along the lines of the Bayh-Dole Act, while keeping in mind India's specific interests, is necessary to help scientific research develop far reaching Innovations, generate employment and function as a vehicle of significant economic growth.

7.6 Government Partnerships

The study finds a small proportion of firms (roughly 30% of large firms and 10% of SMEs) partnering with government agencies for the purpose of Innovation. These firms have a significantly higher Innovation Intensity as well as a significantly higher likelihood to be Highly Innovative. Several government programs have been established with the explicit purpose of driving Innovation in the Indian economy – notable amongst these are the NMITLI (New Millennium India Technology Leadership Initiative), TePP (Techno-Entrepreneurs Promotion Program), the National Innovation Foundation, TDB (Technology Development Board), HGT (Home Grown Technology Program), etc. There has also been discussion in recent times on setting up of a National Innovation Program, under the aegis of the Government. Public Private Partnerships (PPP) have emerged as a tool for effecting Innovation and it is expected that this trend will continue in future.

7.7 Other Barriers to Overcome

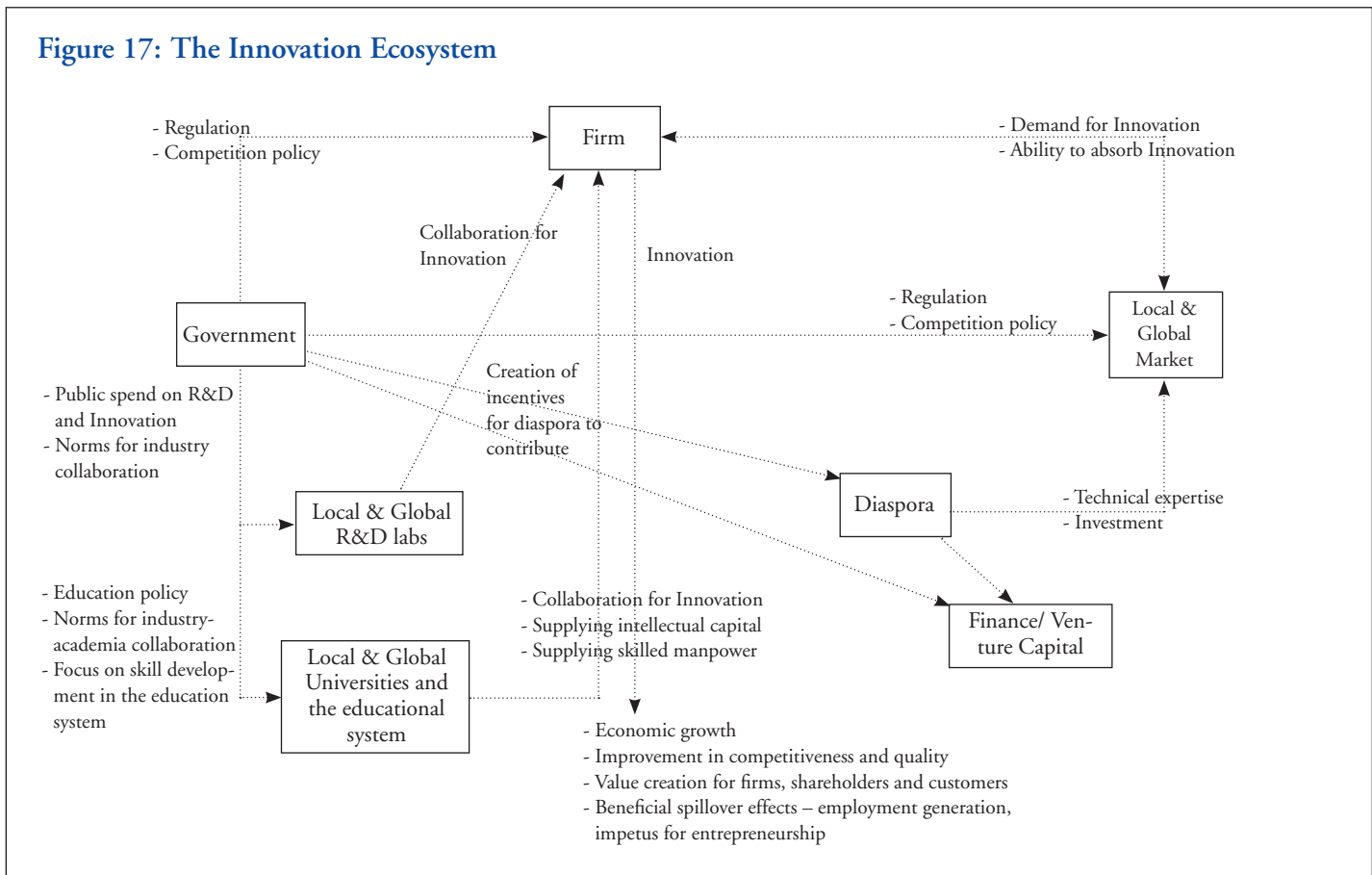
However, large firms have noted other barriers such as: insufficient pricing power to derive value from Innovations; lack of organizational focus on Innovation as a strategy for growth and competitiveness; inefficient knowledge management systems within the company; and poor understanding of customer needs and market dynamics. Similarly, SMEs also express the inability to move beyond the first successful Innovation and develop a sustainable model for continuous Innovation; as well as a poor understanding of customer needs and market dynamics. This is an indication of the need to achieve economies of scale in new to market, new to country and new to world Innovations. Further, Innovation needs to be pursued as a strategy in itself, with benchmarking and clear organizational targets. At the same time, it appears that there is need to also address information asymmetries arising from the markets.

⁴⁶ For a full text of the said recommendation, refer to <http://knowledgecommission.gov.in/recommendations/legal.asp>

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7.8 Systemic Reforms

Innovation is an effort that requires the synergistic use of cumulative energies of the industry, the government, the educational system, the R&D environment and the consumer. The Innovation Ecosystem, as seen from Figure 17 below, is a complex environment that requires the coordinated functioning of a number of diverse factors in order to function effectively. Innovation also needs to become as wide spread as possible, spreading across the entire economy, from the grassroots to the large firm level.⁴⁷ As already noted above, crucial to the goal of increasing Innovation led growth is the need to bring about reforms in the education system, especially in respect of higher education and skill based marketable vocational education. Therefore, the



⁴⁷ See, for example, the World Bank study on Innovation (as noted in supra note 7 as above) which states that, 'to unleash its Innovation potential, India needs to develop a strategy that: focuses on increasing competition as part of improving its investment climate, supported by stronger skills, better information infrastructure, and more finance—public and private; strengthens its efforts to create and commercialize knowledge, as well as better diffuse existing global and local knowledge and increase the capacity of smaller enterprises to absorb it – if all enterprises could costlessly achieve national best practice based on knowledge already used in India, the output of the economy could increase more than five-fold; fosters more inclusive Innovation—by promoting more formal R&D efforts for poor people and more creative grassroots efforts by them, and by improving the ability of informal enterprises to exploit existing knowledge.', in the Executive Summary. See also, the notable work carried out by the National Innovation Foundation in respect of grassroots Innovation.

mandate of the NKC, which is to guide policy and direct reforms to allow India to effectively use and create knowledge capital, is critical and extremely relevant to furthering the cause of Innovation and entrepreneurship in the Indian economy. It is felt that a comprehensive effort to address these issues would act as a critical enabling factor for India to be amongst the global leaders in Innovation.

Annexure 1

List of Respondents

The following is the list of large firms that responded to the questionnaire, in alphabetical order:

- 1 Arvind Mills Ltd
- 2 Ashok Leyland Ltd
- 3 Aurobindo Pharma Ltd
- 4 Ballarpur Industries Ltd⁴⁸
- 5 Bharat Forge Ltd
- 6 Bharat Heavy Electricals Ltd
- 7 Bharat Sanchar Nigam Ltd⁴⁹
- 8 Biocon Ltd
- 9 Cadila Healthcare Ltd
- 10 Central Bank of India
- 11 Citigroup Global Services Ltd.
- 12 CRISIL Ltd
- 13 Essel Group of Companies – Zee Group
- 14 Fortis Healthcare Ltd
- 15 Glenmark Pharmaceuticals Ltd
- 16 Great Eastern Shipping Co Ltd
- 17 Gujarat Co-operative Milk Marketing Federation Ltd
- 18 HCL Infosystems Ltd
- 19 IBM India Ltd
- 20 ICICI Bank Ltd
- 21 Indian Airlines Ltd⁵⁰
- 22 Infosys Technologies Ltd
- 23 Jagran Prakashan Ltd
- 24 Jet Airways (India) Ltd

⁴⁸ The response of Ballarpur Industries Ltd is not part of the findings of this report, since it was received after 20th April 2007.

⁴⁹ BSNL's response is not part of the findings of this report, since it was received after 20th April 2007.

⁵⁰ Indian Airlines' response is not part of the findings of this report, since it was received after 20th April 2007.

- 25 Jindal Stainless Ltd
- 26 Kirloskar Brothers Ltd
- 27 Kotak Mahindra Bank Ltd
- 28 Kudremukh Iron Ore Company Ltd⁵¹
- 29 Mahindra & Mahindra (Mahindra Group)
- 30 MSPL Ltd.
- 31 National Bank for Agriculture and Rural Development (NABARD)
- 32 National Mineral Dev Corp Ltd
- 33 NTPC Ltd
- 34 Nuclear Power Corporation of India Ltd
- 35 Oil and Natural Gas Corporation Ltd
- 36 Oil India Ltd
- 37 Pantaloon Retail
- 38 Philips Electronics India Ltd
- 39 Power Grid Corporation of India Ltd⁵²
- 40 Punjab National Bank
- 41 Reliance Industries Ltd
- 42 RPG Enterprises
- 43 Rural Electrification Corpn.
- 44 Sesa Goa Ltd
- 45 Shopper's Stop Ltd
- 46 SICPA India Ltd
- 47 Singareni Collieries Co Ltd
- 48 Star Group India
- 49 Steel Authority of India Ltd
- 50 Sun Pharmaceuticals Industries Ltd
- 51 Syndicate Bank
- 52 Tata Consultancy Services Ltd
- 53 Tata Group⁵³
- 54 Tata Motors Ltd
- 55 Tata Steel Ltd
- 56 Thermax Ltd
- 57 West Coast Paper Mills Ltd
- 58 Whirlpool India Ltd

⁵¹ Kudremukh Iron Ore Company Ltd responded to NKC by sending material on their Innovation activities. They did not fill up the questionnaire.

⁵² Power Grid Corporation of India Ltd responded to NKC by sending material on their Innovation activities. They did not fill up the questionnaire.

⁵³ Ratan Tata responded to NKC by sending material on Tata Group's Innovation strategy. He did not fill up the questionnaire. Therefore there are 58 respondents on this list, of which 55 have filled up the questionnaire. The analysis in this document is based on 52 responses.

Categories of large firms

1. Manufacturing	
a. Mining	4
b. Automotive	3
c. Home appliances	2
d. Paper	1
e. Steel	3
f. Energy, electricity, power, oil and gas	6
g. Energy and Environment	1
h. Pharmaceuticals	4
i. Textiles	1
2. Services	
j. IT/ ITeS	5
k. Banking and Financial Services	8
l. Healthcare delivery	2
m. Aviation	1
n. Retail	3
o. Shipping	1
3. Both	
p. Biotechnology	1
q. Media	3
r. Diversified	3
TOTAL	52

The Small and Medium Enterprises (SMEs) as well as other organizations that participated in the NKC study on Innovation, in alphabetical order, are as follows:

- 1 Abhinav Enterprises
- 2 Accurate
- 3 Affair
- 4 Agricultural & Processed Food Products Export Development Authority (APEDA)
- 5 Ajay Windecor Products
- 6 Ajinkya Enterprises
- 7 Artzone
- 8 Asha Chemicals
- 9 Athitya
- 10 Atul Electro Formers Pvt. Ltd.

- 11 Auto Cluster Development & Research Institute Ltd.
- 12 Beed Cyber Infotech
- 13 CADLine India
- 14 Cartoprint
- 15 Clean Foods Ltd
- 16 Dayal Fertilizers Group
- 17 Digital Empowerment Foundation
- 18 Dnyaneshwar Vidyapeeth
- 19 Electronica Machine Tools Ltd
- 20 Engg Tools & Equipment
- 21 Feelings
- 22 Golopore IMS
- 23 GreenGarden
- 24 Hoyt Engineering Solutions Pvt. Ltd
- 25 Ideal Computer Education
- 26 Ideal Diamond Products Pvt. Ltd
- 27 Indian Academy of Foreign Trade & Development
- 28 Innova Rubbers Pvt. Ltd.
- 29 Innovative Technomics Pvt. Ltd.
- 30 Intelux Electronics Pvt. Ltd.
- 31 International Institute of Corporate Management
- 32 International Institute of Information Technology
- 33 KNOW-IT
- 34 KPMG
- 35 Lakshmi Embroidery
- 36 Logus Business Systems
- 37 Macintel
- 38 Maharashtra Knowledge Corporation Ltd
- 39 Mana Pet Clinic Labs
- 40 Manjushri Extrusions Ltd
- 41 Mavin Adhesives Pvt. Ltd.
- 42 Medsynaptic Pvt. Ltd.
- 43 Melk Services
- 44 Membrane Filters Pvt. Ltd
- 45 Mutha Founders Pvt. Ltd
- 46 N V Electronics Pvt. Ltd
- 47 Neelesh Engineers
- 48 Nichrome India Ltd.
- 49 Nirmity Electronics Pvt. Ltd
- 50 Paranjape Metal Shapes Pvt. Ltd
- 51 Pragati Leadership Institute Pvt. Ltd.

- 52 Praj Industries Ltd.
- 53 Prajakta Computer Education
- 54 Prescient Technologies Pvt. Ltd.
- 55 Rezonant Design
- 56 Rohini Industries
- 57 Ronak Associates
- 58 SAI Test Plat Pvt. Ltd.
- 59 SEMCO ELECTRIC Pvt.Ltd
- 60 Serum Institute
- 61 Shree Systems
- 62 Simply Delicious
- 63 Smile Automation Pvt. Ltd
- 64 Sumanya HMX Systems Ltd
- 65 Symtronics Automation Pvt. Ltd.
- 66 System India Computer and Management Services
- 67 Tact Global Services
- 68 Teamfill
- 69 Tecel Magnetics
- 70 Technical Associates Ltd
- 71 Tony Travels Pvt Ltd
- 72 Unite Industries
- 73 Virane Engineers
- 74 Voicetech Solutions
- 75 Weaver Computer Embroidery System
- 76 Yenkey Instruments & Controls Pvt. Ltd.
- 77 Zarekar Computers
- 78 Zephyr Industries / Zephyrs Systems

A Note on Methodology

Chapter IV studies the impact of firm structure and processes on Innovation by studying the following:

1. Impact on Innovation Intensity

The factors that we take up in Chapter IV may have a continuous distribution (that is, one which may have infinitely many possible outcomes, such as age of firm, size of firm, etc.) or a discrete distribution (one which has a finite number of possible outcomes, such as nature of ownership – public/ private/ government). In the former case, we correlate the factor in question with Innovation Intensity. In the latter case, we split the sample and compare the average and median Innovation Intensity for the different values of the discrete variable (for instance, in the case of nature of ownership, we compare the average and median Innovation Intensity for privately owned firms, publicly held firms and government owned firms i.e. PSUs).

2. Impact on propensity to be ‘Highly Innovative’

In addition to using Innovation Intensity as a measure of innovative capability of a firm, we introduce an additional measure of innovativeness. We have seen in Figure 3 in Chapter II that 42% of the large firms and 17% of the SMEs in our sample have introduced Innovation that is new to the global market in the last 5 years. From this point on, we define such firms to be ‘Highly Innovative’, and study whether efforts made by firms to establish processes to manage Innovation do in fact result in firms becoming ‘Highly Innovative’.

To check how this definition relates with Innovation Intensity, see the table below. It can be seen that Highly Innovative firms have higher Innovation Intensity as compared to the entire sample. (Note that since the distribution of Innovation Intensity is skewed, the median is a better measure to consider in this case.)

	Average Innovation Intensity	Median Innovation Intensity
Entire sample	11.15%	5.88%
Highly innovative firms	11.38%	8%

