

Observations on Indian Scientific Innovation Output

Rahul Thakurta

Information Systems

Xavier Institute of Management

Xavier Square, Bhubaneswar

India

Kaushik Banerjee

Intellectual Property Management

Zydus Research Centre

Cadila Healthcare Ltd

Sarkhej-Bavla N.H. No. 8A, Moraiya, Ahmedabad

India

Observations on Indian Scientific Innovation Output

Rahul Thakurta and Kaushik Banerjee

ABSTRACT

Innovation has been referred to as the process by which value enhancement is planned and achieved for the benefit of society. Industrial innovation is comprised of several factors which constitute the input, process, and output dimensions of the innovation process. Industrial innovation has been assessed via several indices and primarily by patents and research and development (R&D) intensity. Previous authors have used R&D intensity to measure the innovation potential of a nation or particular sector. We analyze the status of innovation in India by measuring the number of patent applications filed in the Indian Patent Office, and compare this to the reported figures of other countries. The findings indicate that the innovativeness of the Indian scientific and technological sectors is low compared to several developed and developing countries. This surprising result was arrived at by measuring innovation by R&D intensity. The findings from this study imply that the innovation output from India may not keep up with the innovation output from other countries. We suggest several reasons why this is the situation and provide recommendations for changing this course.

Keywords: Innovation in India, organizational innovation, R&D intensity, patents, government policies.

Introduction

Innovation is critical for the development of any society. Research has proven the importance of innovation for the sustained growth of a knowledge economy (Crossan and Apaydin, 2010; Eveleens, 2010; Greer and Lei, 2011). Innovation has been defined as a ‘... process by which varying degrees of measurable value enhancement is planned and achieved, in any commercial activity’ (National Knowledge Commission, 2007: 6). This process which may be breakthrough or incremental, and it can occur systematically or sporadically in an organization. The innovation process can be achieved by: (a) the introduction of new or improved goods or services, (b) the implementation of new or improved operational processes, or (c) the implementation of new or improved organizational and administrative processes. The final outcome can result in the improvement of market share, competitiveness, and the quality of the product/services that are produced by an organization. An associated benefit of the innovation process can be reduction in costs.

In this paper, we focus on the status of innovation in India. We assess innovation using two metrics drawn from the literature: patents and R&D intensity. We cite reports which have used these metrics for analyzing the extent of innovativeness of various Indian sectors such as in

drug and pharmaceutical sector, manufacturing sector. We argue that the results indicate that India is lagging behind many developed and developing nations in terms of successful innovation. We develop new measures which we argue can be helpful for identifying suitable policy interventions which can, in turn, enhance the dissemination of the value of innovation at all levels of a society. In India, most research and educational programs are carried out by the government through its various institutes, universities and public sector organizations. It is therefore imperative that the government and its institutions take an active role in improving India's innovativeness. Appropriate policies and programs to address these issues are identified in this paper, developed and implemented by the government in conjunction with industry and academia which can contribute to an ecosystem conducive to innovation in India.

Innovation in India

Industrial innovation includes new products, processes, operations, marketing and sales techniques, manpower management, resource allocation, and the development of new specific know-how etc. ("National Knowledge Commission", 2007). Each of these types of innovations alone or in combination represents areas where an organization can innovate in order to achieve competitive advantage. Typical indices for measuring the innovativeness include the following:

- number of patents filed and granted
- number of new products and processes
- the number of technology transfer agreements entered into
- number of technologies developed and transferred
- new technologies commercialized
- products developed as a function of R&D expenditure
- ratio of an organization's investment in R&D compared to the firm's sales (R&D intensity)

The various OECD (Organization for Economic Co-operation and Development) manuals including the Oslo Manual and Patent Manual provide several tools both conceptual as well as operational, for developing and using the existing technological indicators and statistical sources for measuring innovation.

Patents are one of the most important innovation indicators to assess the technological competitiveness of any nation, region, or sector (Frietsch et. al., 2010). Patents are granted for protecting innovative products and processes from being copied so that the innovator can generate value from the invention. They represent the rights granted in the respective countries for innovators for preventing others from using their inventions without their consent. These rights are not global, but have to be obtained in each country of interest and their scope varies by country. Filing patents involves a cost, and unless there is adequate return on investment of filing a patent application in a particular country either at present or at a future perceived date, there is no incentive for the innovator to apply for a patent. Therefore the trend in patent filing is not

only an indicator of the present technological profile, but also provides indications of a country's perceived market potential (Frietsch et. al., 2010).

In order to understand the status of innovation in India, let's look at the data of the number of patents filed in India vis-à-vis in some other countries between 2006 and 2009 (Table 1) (Bhattacharya, 2012a). The data clearly indicates that India is far behind in comparison to the scenario existing in say USA (1,230% more than India in 2009) or in China (817% more than India in 2009).

Table 1: Patent Applications Filed Over Time in Selected Countries

	2006	2007	2008	2009
India	28,940	35,218	36,812	34,287
South Korea	166,189	172,469	170,632	163,523
China	210,490	245,161	289,838	314,573
USA	425,967	45,6154	45,6321	45,6106

Source: Gathered from Bhattacharya, 2012a

Another indicator of innovativeness is reflected in the number of patents filed by citizens in a country over time, for example in India between 2006 and 2009 (Table 2) (Bhattacharya, 2012b). The percentages show the relative values in comparison to the total number of patents filed in India in the respective years. The number of patent filings by Indian nationals is a very small fraction of the total number of patents filed in each year.

Table 2: Patent Applications Filed by Indians

	2006	2007	2008	2009
India	5314 (18%)	6040 (17%)	6161 (17%)	7044 (21%)

Source: Gathered from Bhattacharya, 2012b

The R&D intensity metric is often used to show the innovativeness of different organizations and the industry in general. A report based on the R&D intensity metric demonstrates high R&D intensity figures of the different industry sectors (Sinha and Kshitij, 2012). The report concludes with a positive note on the innovativeness of the Indian sectors with the drug and pharmaceutical sectors reporting the highest net increase in R&D intensity figures. The increased trend in R&D intensity appears to be promising.

However, we disagree with the above report's conclusion related to organizational innovativeness. The process of innovation has three distinct phases: input, transformation and output. R&D intensity which compares an organization's investment in R&D with the sales figures is mostly related to the input side of innovation. The R&D intensity metric fails to consider the output which again can be measured in three different ways: innovative sales (as

percentage of total sales), number of patents, and product announcements. Additional arguments identifying the limitations of R&D intensity as a measure of innovation include:

1. In today's networked world, research is often conducted in a collaborative manner. Several R&D laboratories across different countries might collaborate for developing a product, process etc. In these cases, it might be difficult to judge the contribution of an individual laboratory to the entire project.
2. Many R&D laboratories might be involved in problem solving and developing more efficient solutions to certain problems. Such solutions might not fall in the category of innovations and therefore not be awarded any patents.
3. Research is unpredictable and there is a high risk of failure. The R&D intensity metric thus represents innovation effort as it focuses more on the input side of innovation.

The arguments suggest that high R&D intensity does not necessarily provide a true picture of innovativeness. High value implies that R&D investment is high compared to the sales figures. This is also possible if the sales figure is low while R&D investment figure is high. High value of R&D investment can be interpreted as the concerned organization's commitment to innovation. It however fails to indicate whether such innovations are a success, or has the innovation reached the target population.

Managerial Implications

In the previous section, we argue that the status of innovation in India does not look promising as compared to some other developed and developing countries. There may be a number of reasons that contribute to this phenomenon. Some of the more pressing ones needing immediate attention and suitable intervention are listed below, along with suggestive plan of action where-ever possible.

1. The importance of innovation and the benefits of obtaining proper Intellectual Property (IP) protection need to be spread and continuously emphasized at all levels of the society.
2. Lack of trained manpower, knowledge and awareness, infrastructure, institutional support results in ineffective utilization of innovative ideas. This contributes to waste of human capital with respect to time.
3. The culture of innovation has not developed in India in comparison to many developed and some developing countries. There is still a lack of proper appreciation

- of the value of innovation and its effect on the development of society. Intellectual asset as a valuable resource needs to be better appreciated.
4. There is a lack of funding for innovative ideas and products. There is a need for venture capitalists and mechanisms for funding startups in order to provide the necessary push.
 5. Lack of effective partnership and cooperation between the industry and the academic institutions also hampers the growth of IP. Better cooperation and coordination among them will not only lead to generation of commercially exploitable intellectual products and services, but also help to develop a culture of innovation.
 6. Since the field of patenting and its use to create value is evolving in India, we have an opportunity to create the right ecosystem in terms of building appropriate skill sets, knowledge, infrastructure and processes. For this to happen, there is a need for sufficient number of qualified and skilled people both in the industrial sector and in private practice, in order to develop a vibrant and performing IP environment conducive to innovation in India. Specialized education and continuous training provided to innovators and practitioners in this field should support an innovative ecosystem in India.

Conclusion

In this article, we examine the status of innovation in India and how it is measured. By considering data related to patent applications filed and R&D intensity metrics from different sources, we demonstrate that India is lagging behind several developed and developing countries in terms of innovativeness. We present a list of six possible explanations to the cause that we think needs immediate attention. These are inadequate diffusion of innovation issues, wastage of human capital, lack of innovation culture, lack of innovation funding, inadequate industry-academia partnership, and absence of innovation ecosystem. By adopting proper measures to address these issues in course of time, it may be possible for India to change the tide and improve the status of innovation existing currently.

About the Authors:

Rahul Thakurta, PhD, is an Associate Professor of Information Systems at Xavier Institute of Management, Bhubaneswar, India. His primary research interests are software process and project management, and technology adoption and diffusion. He is also the Managing Editor of *Research World*, and holder of the DAAD Research Fellowship. He can be reached at rahul@ximb.ac.in

Kaushik Banerjee, M.Sc., LL.M, leads the IPR related activities at Zydus Research Centre, Cadila Healthcare Ltd, Ahmedabad, India. A qualified Patent Attorney, he also teaches IP to post graduate students of pharmaceutical sciences at various institutes in Gujarat as a visiting faculty. His areas of interest include legal and commercial aspects of patenting specifically in the field of pharmaceutical sciences, innovation and its role in development of society, technology transfer, adoption and knowledge diffusion. He can be reached at kaushik.banerji@zyduscadila.com

References

- Bhattacharya, Sujit. 2012a. "India's International Patenting Activity." Pp. T4 68-81 in Parthasarathi Banerjee (Ed). *India Science and Technology Report 2011-12*. New Delhi, India: CSIR-NISTADS.
- Bhattacharya, Sujit. 2012b. "India's Patent Activity in the Domestic Patent Office." Pp. T4 61-67 in Parthasarathi Banerjee (Ed). *India Science and Technology Report 2011-12*. New Delhi, India: CSIR-NISTADS.
- Crossan, Mary M., and Apaydin, Marina. 2010. A Multi-Dimensional Framework of Organizational Innovation: A Systematic Review of the Literature. *Journal of Management Studies*, 47(6): 1154-1191.
- Eveleens, Chris. 2010. *Innovation Management; a Literature Review of Innovation Process Models and their Implications*. Nijmegen, NL: Lectoraat Innovatie Publieke Sector. Accessed July 27, 2014 at: <http://www.lectoraatinnovatie.nl/wp-content/uploads/2011/01/Innovation-management-literature-review-pdf>.
- Frietsch, Rainer, Ulrich Schmoch, Bart van Looy, John P. Walsh, Robert Devroede, Maurice Du Plessis, Taehyun Jung, Yu Meng, Peter Neuhäusler, Bert Peeters and Torben Schubert. 2010. *The Value and Indicator Function of Patents*. Studien zum deutschen Innovationssystem, Nr. 15-2010. Berlin, Germany: Expertenkommission Forschung und Innovation.
- Greer, Charles R., and David Lei. 2011. Collaborative Innovation with Customers: A Review of the Literature and Suggestions for Future Research. *International Journal of Management Reviews*, 14(1): 63-84.
- National Knowledge Commission. 2007. Innovation in India. Accessed July 27, 2014 at: http://www.knowledgecommission.gov.in/downloads/documents/NKC_Entrepreneurship.pdf.
- Sinha, Bikramjit, and Avinash Kshitij. 2012. "Innovation in Indian Listed Companies." Pp. T3 13-20 in Parthasarathi Banerjee (Ed). *India Science and Technology Report 2011-12*. New Delhi, India: CSIR-NISTADS.

Disclaimer

The views presented in this paper are those of the authors only and do not represent the views or opinions of the institutes to which they are affiliated.