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Innovation in India: A review of past research and future directions

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Abstract The rapid economic growth that India enjoyed following the start of its economic reforms in 1991 has led to a growing scholarly interest in Indian organizations and management practices. In this paper, we bring together extant yet dispersed research on one important and salient element of Indian economic growth: innovation. We organize and review the substantive innovation research in India based on its scope and focus, and find that it has yielded unique insights about India’s innovation systems and processes at both the institutional and firm levels. Three interesting trends emerge from this review of the literature. First, a growing body of research has started identifying innovation phenomena unique to India, such as “frugal innovation” and the related notion of “*jugaad*.” Second, a discernible arc in Indian innovation research can be observed, that is, a shift from a focus on the role of the state to the role of MNEs and Indian businesses in innovation. Finally, unlike much innovation research elsewhere, there appears to be significant interest in innovation that serves the need of the

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poor. We conclude with directions for future research on innovation within the Indian context.

Keywords Innovation · India · Review

“We originally came to India for the [low] cost. We stayed because of the quality, and now we’re investing because of the innovation.” ~ Dan Scheinman, Former Senior Vice President of Cisco Systems’ Media Solutions Group.

The rapid economic growth that India enjoyed following its economic reforms starting in 1991 has led to a growing scholarly interest in Indian organizations and management practices (Jain & Sharma, 2013; Nair, Ahlstrom, & Filer, 2007). This work has covered a wide range of topics and identified many unique aspects of Indian management in areas such as corporate governance, state and family firms, internationalization, venture capital, entrepreneurship, and innovation (e.g., George, Rao-Nicholson, Corbishley, & Bansal, 2015; Lockett, Wright, Sapienza, & Pruthi, 2002; Maheshwari & Ahlstrom, 2004; Ramani & Szirmai 2014). As the opening quote suggests, India’s economic growth in the years following initial economic reforms was driven by low cost labor, particularly in information technology (IT), coupled with a surge in private sector and international investments subsequent to the removal of capital restrictions (Chari & Banalieva, 2015). The labor cost arbitrage in IT and related industries spurred the initial exports and brought India much needed foreign exchange; indeed it was dwindling foreign exchange reserves that helped to precipitate the 1991 crisis and propelled financial and industrial reform (Li & Nair, 2007) as it did in China over a decade earlier (Ahlstrom, Young, & Nair, 2003; Harding, 1987). The initial increase in domestic and international investments allowed many sectors of the economy (e.g., communication, media) that were long starved for funds to catch up with latent demand and also upgrade technology and improve productivity. Despite many problems with corruption and stubborn poverty, India’s growth has been swift and visible, increasing employment and income, while creating a vibrant middle class and introducing many modern management reforms (Ahlstrom, 2014; Cooke & Saini, 2015; Gupta & Wang, 2009).

Even with a recent slowdown in economic growth, India is already the fourth largest economy in the world in purchasing power parity terms (Giles, 2014), and is emerging as an innovation powerhouse (Forum for the Future, 2013).¹ In fact, while India’s innovation capacity has clearly contributed to its economic growth thus far (Fan, 2011), many now argue that India will have to rely even more on innovation and entrepreneurship (Chakraborty & Kumar, 2013; Kulkarni, 2013), which are central to both firm and economic growth (Aghion & Howitt, 1992, 1998; Ahlstrom, 2010a). Global clients have started demanding innovation in service delivery (Arora, Drev, & Forman, 2009; Schrage, 2011), and some have noted (e.g., Anand & Anand, 2009) that India’s poverty and challenging social problems can be best solved by innovation

¹ https://www.forumforthefuture.org/sites/default/files/images/GreenFutures/India/India_lowres_SPREADS.pdf

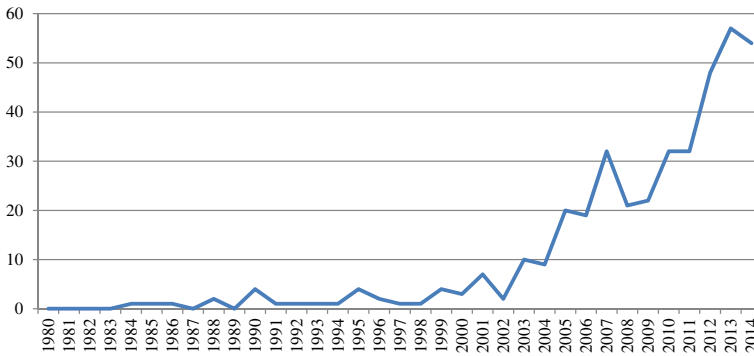


Fig. 1 Count of peer reviewed publications with “India” and “Innovation” in abstract (Based on search on ABI/Inform database)

that serves the poor (Alvarez, Barney, & Newman, 2015; Bruton, Ahlstrom, & Si, 2015; George et al., 2015).

India’s capability to engage in low cost, unique innovation has already attracted the attention of academic and popular media (Govindarajan & Ramamurti, 2013; Prabhu & Jain, 2015; Prahalad & Mashelkar, 2010; Rai, 2014). Cooper (2009) pointed out that the strong education system and the leadership in software and IT services may allow India to use a more innovation-based development path, instead of the low cost path followed by a number of other developing economies. A further indication of the critical importance of innovation to India’s growth is the declaration of 2010–2020 as India’s Innovation Decade by former Prime Minister Manmohan Singh.

Accordingly, because innovation is a topic particularly appropriate and interesting in the Indian context, our aim is to bring together the disparate literature investigating this phenomenon, better defining and thus facilitating its analysis (Ahlstrom, 2010b; Christensen, 2006). As Fig. 1 shows, over the past 20 years we have seen a rise in the number of books and articles focusing on innovation in the Indian context. Thus, in this paper we examine the themes in the various streams of management literature on Indian innovation, and identify issues that need to be addressed in future research to align and categorize the many developments in the field (Christensen, 2006).

While innovation has been studied by scholars from a range of areas such as marketing, economics, and engineering (e.g., Aghion & Howitt, 1992, 1998; Govindarajan, Kopalle, & Danneels, 2011; McCloskey, 2006, 2010, 2013; Mokyr, 1990; Petroski, 1994), our focus is primarily on *Indian* innovation research that has a *management* perspective (Christensen & Raynor, 2003; Nair & Ahlstrom, 2003). That is, our review includes research that addresses institutional, industry, and firm factors that drive (primarily) firm and product innovation. We do not review innovation research in general or specific streams which examine, for instance, *individual* adoption and diffusion of new product innovations.² In the next section, we review existing definitions of innovation first to clarify the domain (e.g., Ahlstrom, Lamond, & Ding, 2009; Christensen, 2006) and proceed to discussing the recent record of innovation in

² Excellent reviews of innovation research in other contexts and domains include Crossan and Apaydin (2010), Fagerberg, Mowery, and Nelson (2006), Gopalakrishnan and Damanpour (1997), Shafique (2013), and Wolfe (1994).

India. Then we organize the existing literature into distinct streams. Finally, we suggest directions for future research.

What is innovation?

The word innovation has Latin origins, and began to appear in English language in the mid-1500s, and not unexpectedly, according to Google word-use graph, the usage of “innovation” has increased steadily ever since that time. Innovation means, “something new or different” (Webster). Economists, business scholars, and practitioners have long realized the value of innovation (e.g., [Aghion & Howitt, 1992, 1998](#); [Ahlstrom, 2010a](#); [Christensen & Raynor, 2003](#); [Mokyr, 1990](#)); and while scholars may disagree about many aspects of innovation research and the findings may be inconsistent (e.g., [Shafique, 2013](#); [Wolfe, 1994](#)), in general they view innovation as a net positive. Even before [Schumpeter \(1934, 1942\)](#) highlighted the role of (radical) innovation in creative destruction, writers such as Adam Smith had written about the role of technological improvements on society and factories and the role of innovators:

“All the improvements in machinery, however, have by no means been the invention of those who had occasion to use the machines. Many improvements have been made by the ingenuity of the makers of the machines, when to make them became the business of a peculiar trade; and some by that of those who are called philosophers or men of speculation, whose trade is not to do anything, but to observe everything; and who, upon that account, are often capable of combining together the powers of the most distant and dissimilar objects.” (Smith, 1776: 18)

Despite this recognition of the relevance of innovation among early social scientists, it was the Austrian school led by Schumpeter that placed innovation at center stage in economics, and explicated its role in economic growth and industry transformation. Besides Schumpeter, several management scholars have also studied innovation and its impact on organizational outcomes. According to [Thompson \(1965: 36\)](#), innovation is the “. . . generation, acceptance and implementation of new ideas, processes, products or services.”

Thompson’s definition above, and a review of writings on innovation, point out that innovation is not limited to new products, but also includes new processes, organizational structures, and policies ([Daft, 1982](#); [Damanpour, 1991](#); [Goswami & Mathew, 2005](#)). For instance, [Baregheh, Rowley, and Sambrook \(2009\)](#) analyzed the content of 60 different definitions of innovation from multiple disciplines and found many of them converging on the following: “Innovation is the multi-stage process whereby organizations transform ideas into new/improved products, services or processes, in order to advance, compete and differentiate themselves successfully in their marketplace” (1334).

Innovation is also rooted in societal institutions such as education systems, social interactions, culture, and labor market structure ([Lam, 2000](#); [Landes, 1998](#)). That is, the structure, communication, and specialization of societies are a major driver of innovative activity ([Damanpour, 1991](#); [Kaplinsky, 2011](#); [McCloskey, 2006, 2010](#)). Not surprisingly, many use the term “innovation ecosystem” as a way to describe

“collaborative arrangements through which firms combine their individual offerings into a coherent, customer-facing solution” (Adner, 2006: 98). Hence in this review, we focus on factors driving Indian innovation not just at the firm level, but the industrial and macro (institutional) levels as well.

Innovation in India: A historical perspective

India obtained independence from British rule in 1947. While Jawaharlal Nehru, India's first Prime Minister, was convinced about the need to embrace technology and innovation to spur India's economic growth, one prominent Indian freedom fighter and leader, Mahatma Gandhi, believed that it was (British) technology that had ruined the Indian economy, and therefore argued in favor of a low-technology, small scale industry-based development model that would emphasize employment for India's hundreds of millions. Though Nehru's vision prevailed and India adopted central planning with the state controlling many sectors of the Indian economy with a technology-intensive development policy (Ramesh, 1991), Gandhi's views were shared by many who harbored ambivalence or even a lingering suspicion of foreign businesses, technologies, and innovations (Basu, 2004).

In 1950, Nehru launched India on a path of economic development through a series of 5-year plans (Jalan, 1996). Even after his death, successive administrations continued with Nehru's policies. Over time, the public sector came to dominate India's economy, investing in big ticket items such as large factories, infrastructure, and tertiary educational institutions, while seeking to indigenize science and technology (Jain & Kharbanda, 2003). Yet by the early 1980s, there was increasing concern that India's economic plans had not delivered the economic growth that had been achieved in East Asian economies such as Korea, Malaysia, and Singapore. Between 1950 and 1980, India realized an average real growth rate of only 3.5 % (versus the typical 7 % in East Asia) and the government-dominated and heavily-regulated system yielded inefficiencies, shortages, and corruption (Li & Nair, 2007). It was only in 1991, when India faced a severe foreign exchange reserve crisis, that leaders introduced radical reforms to improve the economy. Prime Minister P. V. Narasimha Rao and Finance Minister (and later Prime Minister) Manmohan Singh used the crisis to justify the introduction of far-reaching economic reforms that continued through the 1990s despite changes in administration and leadership (Bajpai, 2002).

The economic reforms have led to greater awareness about innovation among Indian businesses, academia, and government. While in the pre-reform era, suspicion of foreign technology, protection from foreign competition, and regulatory approvals for importing technology had isolated Indian businesses from innovation occurring elsewhere, opening the economy created imperatives for Indian businesses to adapt to the new competitive landscape and adopt new technologies and innovation for survival (Hitt, Keats, & DeMarie, 1998). This is vital not only for generating new innovations, but also for adopting innovations from elsewhere and responding to the entry of innovative foreign competition into the domestic market.

One sign of the growing awareness of the importance of innovation is the annual competition run by India's National Innovation Foundation Innovation. At the first competition organized in 2000, more than 1600 entries were submitted, and the

winning innovations included a bicycle made of bamboo and a water pulley that lets women take rest while drawing water from a well (Appropriate Technology, 2001).³ Moreover, R&D expenditure made by Indian firms in many sectors has increased over the years, especially after reforms led to the entry of foreign firms. As a result, the number of patent applications and approvals has increased gradually over time (see Fig. 2).

In the past decade, several scholars (e.g., Govindarajan & Ramamurti, 2011; Gupta & Govindarajan, 2001; Khanna, 2013) have noted the growth of Indian entrepreneurship and innovations by Indian firms or multinational enterprises (MNEs) in India. Firms such as Tata, General Electric, Infosys, Selco, Bharti Airtel, Aravind, and Narayana Hrudalaya have been in the news for their novel offerings and disruptive innovations (Ahlstrom, 2010a; Li, 2013; Prahalad & Mashelkar, 2010). For example, the Tata Electrical division designed a tamper evident electric meter.⁴ Tata also produced the Swachh water filter line, which has brought potable water in large numbers in the developing world (Ahlstrom, 2010a). Dr. Reddy's lab developed Methyldopa, an inexpensive blood pressure reducing medication. Airtel's business model innovation involved the introduction of modularity, or outsourcing the operation and maintenance of network equipment, towers, lines, IT, and customer service so that it could focus on low cost service. In addition to its business model innovation, Airtel also engages in numerous product innovations. For instance, it recently introduced Song Catcher, where callers can adopt the ringtone of the person they are calling. Naryana Hrudyalaya's business model innovation offers low cost cardiac care by using patient families to offer post-operative care, while other Indian hospitals have recently been recognized for their innovative ways of serving the masses with world-class health care (Govindarajan & Ramamurti, 2013).

Literature on Indian innovation

Methodology

We searched for articles containing the keywords “India*” and “innovation” in leading management journals that appear on widely cited journal listings such as Financial Times Top 45 Business Publications and The University of Texas at Dallas list. Our initial search found that the following journals had not published a significant number of articles on Indian innovation: *Journal of Engineering and Technology Management*, *Strategic Management Journal*, *Academy of Management Journal*, *Academy of Management Review*, *Journal of Management*, *Journal of Management Studies*, *Organization Science*, and *Management Science*. Thus, we broadened our search and queried for peer reviewed publications in the ABI/Informs database that had used the terms “India” and “innovation” in the abstract. This search yielded 530 articles. From this list we dropped articles that had a distinct practitioner focus or were not about innovation in India—for example, our query pulled up articles about Indiana, Native American Indians, or that had mentioned India in the abstract, but were about other emerging

³ http://nif.org.in/innovation/pulley_with_stopper/93, accessed Mar. 30, 2015.

⁴ <http://www.tata.com/company/articlesinside/Showcasing-outstanding-innovations>

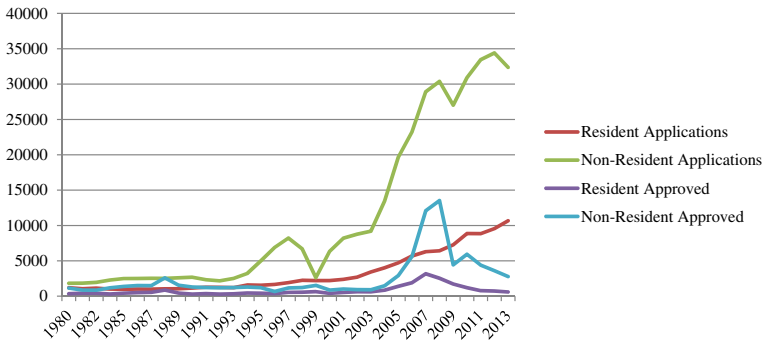


Fig. 2 India: Patents applications and approval (resident/non-resident) (Source: World Intellectual Property Organization, <http://www.wipo.int/ipstats/en/#data>)

economies or one of the BRICs.⁵ Eliminating such articles resulted in 236 articles. Details of a representative sample of the articles included in our review are presented in Table 1.

Based on the articles included in our sample, we started to organize the literature into distinct clusters as a means to form an analytical framework for our review (Ginsberg & Venkatraman, 1985). After several iterations of considering different dimensions (e.g., product versus service, technical versus administrative, simple versus complex, incremental versus radical; Damanpour, 1991; Downs & Mohr, 1976; Gopalakrishnan & Damanpour, 1997), we concluded that the literature could be parsimoniously organized using the following two dimensions: Micro versus macro and outcome versus process (also see Crossan & Apyaydin, 2010). Here, micro refers to studies that examine innovation at the firm-level, while macro means those examining innovation at the industry or national level. Outcome focused studies investigate innovation outcomes such as patents, products, and new business models, while process oriented studies examine processes such as information flows, routines, and learning in firms, industries or regions. The framework is shown in Table 2.

Clearly, some research will either fall outside of the categories or straddle the categories. For example, Mishra (2006) examined R&D investments and patents and linked it to the market structure, patent laws, fiscal incentive system as well as firm specific factors such as organizational structure and culture. In this review, we ensure that we do not exclude papers that fall outside of our organizational framework. As changes in India's macro environment sparked its economic growth, FDI, and rise of Indian MNEs, we start with the macro perspective.

Macro/outcome studies

Within the macro-outcome quadrant, we include studies that have examined how institutional conditions and industry structures have impacted innovation outcomes. In recent years, India's economic liberalization program and the impact it had on innovation have attracted the attention of many scholars. Specifically, scholars have examined how increased FDI, entry of MNEs, and liberalized industry, trade, and

⁵ Brazil, Russia, India, and China.

Table 1 Select studies on innovation in India

Year	Authors	Journal	Title	Method	Findings/Abstract
1986	Chaudhuri	<i>Research Policy</i>	Technological innovation in a research laboratory in India: A case study	Study of a major technological innovation in India	Found the following factors were critical to innovation: (1) support of product champion during technology development stage, (2) support of project by leadership, (3) effective relationships developed by the product champion with decision makers in government, (4) close association of the design group team, and (5) links between the technology development and manufacturing enterprise.
1997	Reddy	<i>World Development</i>	New trends in globalization of corporate R&D and implications for innovation capability in host countries: A survey from India	N/A	Since mid-1980s MNEs started performing strategic R&D in developing countries; such R&D helps integrate developing countries into global technology development activities.
1999	Sikka	<i>Technovation</i>	Technological innovations by SMEs in India	Survey of SMEs	Weak linkages exist between universities/R&D laboratories and technology users; little motivation for SMEs to upgrade their capabilities.
2004	D'Costa and Sridharan	Book	<i>India in the global software industry: Innovations, firm strategies and development</i>	N/A	Provides a review of innovations and strategies of Indian firms in the global software industry
2004	Roy and Wilkinson	<i>International Journal of Technology Transfer & Commercialization</i>	International long term business relationship, communities of practice and innovation: A longitudinal case study of NDDB, India and Tetra Pak, Sweden	Longitudinal study of the impact of a long-term international JV by a Swedish company on innovation	Joint venture provides a context for experts to interact and develop explicit and tacit knowledge and skills. Interactions create communities of practice involving networks of suppliers and customers, who in turn create further knowledge and innovation.

Table 1 (continued)

Year	Authors	Journal	Title	Method	Findings/Abstract
2005	Subrahmanya	<i>Technovation</i>	Pattern of technological innovations in small enterprises: A comparative perspective of Bangalore (India) and Northeast England (UK)	Technological innovations by small enterprises in engineering industry in Bangalore and Northeast England	Radical product innovations emerged due to internal factors whereas incremental product innovations emerged due to external factors in both the regions. Lack of spread of previous innovations, low R&D intensity of small industry and Indian economy (reflected in India's low technology achievement index) as well as lack of technical background of entrepreneurs explains the lesser extent of radical and incremental innovations of enterprises in Bangalore relative to that of Northeast England.
2006	Zhao	<i>Management Science</i>	Conducting R&D in countries with weak intellectual property rights protection	Empirical: More than 1,500 firms	Firms performing R&D in India and China with weak IPR tend to use outputs internally to compensate for weak external institutions.
2006	Som	<i>Thunderbird International Business Review</i>	Bracing for MNC competition through innovative HRM practices: The way ahead for Indian firms	11 in-depth case studies	HR innovations lead to organizational innovation.
2006	Seshadri, Kommi, and Ray	<i>South Asian Journal of Management</i>	Creating a crucible of innovation at Trilogy India	Case study of Indian subsidiary of US firm Trilogy	It is the role of the front line managers in the company to drive innovation through corporate entrepreneurship.
2007	Lewis	<i>Studies in Comparative International Development</i>	Technology acquisition and innovation in the developing world: Wind turbine development in China and India	Study examines the development strategies pursued by Suzlon and Goldwind, India and China's leading wind turbine manufacturers	Substantial technical advances are possible in a relatively short time. Suzlon and Goldwind pursued similar licensing arrangements to acquire basic technical knowledge. Goldwind's technology development model lacked Suzlon's network of strategically positioned global subsidiaries that contributed

Table 1 (continued)

Year	Authors	Journal	Title	Method	Findings/Abstract
2007	Popkin and Iyengar	Book	<i>IT and the East: How China and India are altering the future of technology and innovation</i>	China and India	to its base of industry knowledge and technical capacity. Argues how innovation in IT is shifting to China and India. Explores the reasons for the shift.
2008	Richman, Udayakumar, Mitchell, and Schulman	<i>Health Affairs</i>	Lessons from India in organizational innovation: A tale of two heart hospitals	Case study of two hospitals: Fortis and Care Hospitals	Organization innovations allow hospitals to provide low cost care.
2008	Altenburg, Schmitz, and Stamm	<i>World Development</i>	Breakthrough: China's and India's transition from production to innovation	Innovation systems, global value chains and professional networks in four industries	Past efforts in developing innovations rarely led to cutting-edge innovations; paper suggests that if capital accumulation proceeds at the current pace, innovation capabilities will eventually be built up India.
2008	Prakash and Gupta	<i>Singapore Management Review</i>	Exploring the relationship between organisation structure and perceived innovation in the manufacturing sector of India	Survey of 250 employees of four manufacturers of India	Relationship found between complexity, formalization, participation in decision-making and perceived innovation. Negative and significant relationship was found between centralization and perceived innovation.
2009	Flores, Boer, Huber, Pliiss, Schoch, and Pouty	<i>International Journal of Production Research</i>	Universities as key enablers to develop new collaborative environments for innovation: Successful experiences from Switzerland and India	Three successful collaborative environments located in different settings	Described local university's key role in developing new collaborative environments. Proposes method to benchmark and assess different initiatives carried out by universities to develop new successful collaborative environments and identify critical success factors.

Table 1 (continued)

Year	Authors	Journal	Title	Method	Findings/Abstract
2009	Subrahmanya	<i>Innovation: Management, Policy & Practice</i>	Nature and strategy of product innovations in SMEs: A case study-based comparative perspective of Japan and India	Traces the nature and strategy of product innovations of two SMEs in two different economic environments—Japan and India	Domestic market supported and absorbed innovated products of the Japanese SMEs, whereas the Indian SMEs targeted its innovated products at international markets.
2010	Mehra and Joshi	<i>Innovation: Management, Policy & Practice</i>	The enabling role of the public sector in innovation: A case study of drug development in India	Biotechnology based antifungal drug development	The public sector plays a key role in facilitating the successful commercialization of indigenously developed drug.
2011	Fu and Zhang	<i>Journal of Chinese Economic and Business Studies</i>	Technology transfer, indigenous innovation and leapfrogging in green technology: The solar-PV industry in China and India	Solar photovoltaic (PV) industry.	Role of national environmental innovation systems in sustaining technology acquisition, adaptation and development.
2011	Franco, Ray, and Ray	<i>World Development</i>	Patterns of innovation practices of multinational-affiliates in emerging economies: Evidences from Brazil and India	Sample of over 1,200 MNE-affiliates, factor analysis and segmentation techniques	Demonstrated role played by host nations' industrial policy in shaping innovation practices of MNE-affiliates.
2011	Dolfsma, Leydesdorff	<i>Innovation: Management, Policy & Practice</i>	Innovation systems as patent networks: The Netherlands, India and nanotech	Uses patents granted by the World Intellectual Property Organization (WIPO)	Maps innovation systems using social network analysis to identify co-classification of patents among classes and indicate what characterizes an innovation system. Also offers an analysis of the Dutch and Indian innovation system.
2012	Mathew, Ogbonna, and Harris	<i>Journal of World Business</i>	Culture, employee work outcomes and performance:	Empirical: Survey	Impact of organizational culture on quality of work; quality of work is presented as a contributor to organizational innovation.

Table 1 (continued)

Year	Authors	Journal	Title	Method	Findings/Abstract
2012	Pai, Tseng, and Liou	<i>Innovation: Management, Policy & Practice</i>	An empirical analysis of Indian software firms Collaborative innovation in emerging economies: Case of India and China	Empirical analysis of a patent and citation dataset comprised of all patents granted by the US Patents and Trademark Office to inventors residing in India and China from 1980 to 2009.	Collaborative innovation is better than independent innovation in China/India. Collaborating with countries with advanced technologies results in better innovative performance.
2012	Crescenzi, Rodríguez-Pose, and Storper	<i>Journal of Economic Geography</i>	The territorial dynamics of innovation in China and India	Panel database for regions in China and India	In India, innovation is dependent on a combination of good local socioeconomic structures and investment in science and technology. Indian innovation hubs also generate positive knowledge spillovers to other regions.
2012	Sharma, Nookala, and Sharma	<i>Industry and Innovation</i>	India's national and regional innovation systems: Challenges, opportunities and recommendations for policy makers	Structured interviews, archival data	Develops conceptual framework for studying India's innovation system; explores and explains the challenges and opportunities of India's innovation capacity formed within India through a mapping of industrial firms, educational/research institutions and innovation parks.
2012	Lynn, Meil, and Salzman	<i>Journal of Asia Business Studies</i>	Reshaping global technology development: Innovation and entrepreneurship in China and India	190 interviews conducted in China, India and other countries	MNEs do not tend to think in terms of home-country; mobility of employees, and short-term focus prevent emphasis on implications of off-shoring of technology

Table 1 (continued)

Year	Authors	Journal	Title	Method	Findings/Abstract
2012	Tiwari and Herstatt	<i>Journal of Indian Business Research</i>	Assessing India's lead market potential for cost-effective innovations	In-depth analysis of four successful product innovations from India from different industries	innovation, moreover policies of technology nationalism are futile. Identifies characteristics of frugal innovations, their development process and success in domestic and overseas markets.
2013	Velu and Khanna	<i>Journal of Indian Business Research</i>	Business model innovation in India	Examines sample of innovative firms based on reports in business press	New entrants use business model innovation, incumbents adopt efficiency innovation.
2013	Schreiner and Lerman	<i>Banking Law Journal</i>	Using patents to protect financial process innovations in Europe, China, and India	Case study	Discusses how the US, Europe, China, and India examine patent applications for financial processes, and how different countries allow patent holders to enforce their patent rights.
2013	McMahon and Thorsteinsdóttir	<i>Research Policy</i>	Pursuing endogenous high-tech innovation in developing countries: A look at regenerative medicine innovation in Brazil, China and India	Case study	Innovations in Brazil, China and India are demand-driven and occur under conditions unique to countries with lower-resources. Firms play a smaller role in innovation; important to consider wider innovation actors in the study.
2014	Lodh, Nandy, and Chen	<i>Corporate Governance: An International Review</i>	Innovation and family ownership: Empirical evidence from India	Empirical: Firms listed in BSE	Family ownership and business group affiliation has a positive impact on innovation productivity.

Table 2 Framework used in this study to classify existing research on Indian innovation

	Level: Micro	Level: Macro
Focus: Outcome	<p><i>Impact of firm variables on innovation outcomes</i></p> <p>Typical antecedents: Ownership, structure, strategy, HR systems/policies, business group membership, firm R&D investment</p> <p>Contingencies: Size, profitability, export markets</p> <p>Focus: Product, service, and business innovations and patents</p> <p>Theory: IO, contingency, RBV</p> <p>Methodology: Positivistic, regression</p>	<p><i>Impact of macro factors on innovation outcomes</i></p> <p>Typical antecedents: Institutions and institutional changes: Liberalization, FDI, patent policies, industry structure, R&D tax policies</p> <p>Contingencies: Ownership, industry, competition</p> <p>Focus: Product, service, and business innovations and patents at firm, industry, and country levels</p> <p>Theory: Institutional</p> <p>Methodology: Positivistic, regression</p>
Focus: Process	<p><i>Impact of firm variables on processes or impact of processes on outcomes</i></p> <p>Typical antecedents: Employee skills, team/organization culture, HR policies, leadership, structure and strategy, resources and capabilities, inter-organizational linkages</p> <p>Contingencies: Micro processes, motivations, learning, absorptive capability</p> <p>Focus: Product, service, and business innovations and patents, ROI and micro processes involved in innovation: knowledge creation, learning & retention</p> <p>Theory: Learning/knowledge, RBV</p> <p>Methodology: Descriptive/positivistic, cases, regressions</p>	<p><i>Impact of macro factors on processes</i></p> <p>Typical antecedents: Institutions and institutional changes, liberalization, FDI, patent policies, industry structure, R&D tax policies</p> <p>Contingencies: Firm factors, regional socio-political and economic systems</p> <p>Focus: Agglomeration, spatial economics, linkages among institutions and knowledge flows, knowledge spillovers</p> <p>Theory: Learning/knowledge, agglomeration</p> <p>Methodology: Descriptive/positivistic, cases, regressions</p>

patent policies have impacted innovation. For instance, Das (2004) found that after economic liberalization, while R&D in certain segments of India's private sector increased, it decreased in the public sector; overall, R&D spending among firms in most industries decreased, and innovation output suffered. According to this study, easy access to foreign technology likely reduced the need for in-house R&D. Similarly, Kathuria (2008) examined the impact of FDI on R&D investments by medium and high tech firms, and found that FDI flows have a negative impact (initially) on R&D; economic reforms allowed such firms to import technology instead of investing in development and innovation.

Though Das (2004) found that overall R&D spending has decreased, Dubey and Dubey (2010) noted that spending by R&D centers set up as wholly owned subsidiaries (or partnerships) by MNEs in India has increased. For example, Singh (2006) noted that

large firms such as IBM, AMD, Intel, Broadcom, and Cisco have set up chip design facilities in India. Confirming this trend, Chakrabarti and Bhaumik (2009) found that United States (US) MNEs have driven recent growth in patenting from India. However, as Asakawa and Som (2007) noted, increasing R&D spending in India by MNEs did not necessarily mean that it was effective; instead they urge MNEs to be aware of the unique challenges posed by the institutional environment.

While MNEs have played a critical role in innovation during recent years, several studies have noted the role played by the Indian government in innovation in the past. Mahmood and Singh (2003), using US patent data, examined the role of foreign multinational, business groups, individuals, domestic firms, and research institutes on innovation over 30 years. They found that patent holding in India was relatively concentrated—the top 50 patent holders had a larger share of the patents than China. Furthermore, though there was a significant proportion of domestic firms and MNE subsidiaries in the top 50, the largest patent holder was Council for Scientific and Industrial Research (CSIR), a government owned organization. Consistent with this theme, Krishna (2007) discussed the critical role of public research organizations such as CSIR in innovations in India. He supported his thesis by describing CSIR's role in developing greener leather tanning technologies, and using tissue culture to reduce the time it takes for bamboo plants to flower.

While the above studies make clear that the government played a critical role in innovation policies prior to reforms, the impact of such policies on innovation remains unsettled. Some have suggested that the constraints and barriers to technology imports allowed the development of domestic R&D and innovation, while others note that it was adversely impacted (e.g., Fan, 2011; [Bhattacharya, 2011](#)). Supporting the positive perspective, Guennif and Ramani (2012) noted that India's pharmaceutical industry's success in global markets (compared to Brazil's) can be attributed to government policies. Likewise, Kingston (2013) stated that Ireland's joining the international patent system in 1925 does not appear to have helped with innovation, whereas India's refusal to join may have helped with the development of its generic drug industry. In contrast, Sahoo and Shrimali (2013) in a study of the solar power industry, discussed how domestic content requirement in solar cell technology (favoring crystalline silicon cells and modules) adversely impacted innovativeness and competitiveness of the solar industry as developers preferred thin-film technology. [Desai \(1984\)](#) offered a more balanced perspective on the impact of government policies and explained how import substitution pressures led to the development of different types of domestic technology, which may have helped trigger the innovative capabilities of Indian firms. However, he acknowledged that there were many downsides as well, such as high cost, poor quality of capital equipment, and inability to import state-of-the-art technology.

Some studies have examined the impact of government policies on specific industries, with the pharmaceutical industry generating substantial attention in recent years. While in the past, the Indian pharmaceutical industry was largely content to reverse engineer products for domestic markets, Chaturvedi, Chataway, and Wield (2007) analyzed how changes prompted by public policy created new opportunities for pharmaceutical firms and made them research driven firms focusing on global markets. Within the broader liberalization theme, scholars have also examined the impact of specific changes, such as India's signing the Trade Related Intellectual Property Rights (TRIPS) patent law provision in 1994. [Sampath \(2006\)](#) conducted a survey of the

Indian pharmaceutical industry to analyze the impact of patent rights on biomedical innovation. She found that patent protection in the biomedical sector had a negative impact on the number of projects pursued by firms under the TRIPS compliant regime.

We also found that studies that have conducted cross-country comparisons (e.g., [Tseng, 2009](#)) were particularly helpful in identifying India's unique innovation ecosystem. [Tseng \(2009\)](#) examined the technological innovation, innovation configurations, and strengths of BRIC countries. Based on an analysis of patents granted by the US Patent and Trademark office from 1976 to 2006, the study examined whether the innovations were incremental/radical, fundamental/applied; India scored higher on *incremental* innovation.

In contrast to the above studies that examined national institutions, several studies have focused on industry level factors and their impact on innovation. [Desai \(1985\)](#) examined how market structure was related to innovation generation and adoption by firms across 37 industries. The paper provides rich discussion of the complex factors that drive innovation. Similarly, [Misra \(2007\)](#) examined the impact of market structure on R&D spending from 2000 to 2006 in more than 100 industries in the Indian manufacturing sector and found that there is an inverted U-shaped relationship between market concentration and industry innovativeness. He also found that the nature of the relationship was different for investment in product and process innovation and such investments were dependent on potential profit margins. Adopting a more focused approach, [Prasad Mohanty and Augustin \(2014\)](#) examined the evolution of one Indian firm, Mahindra & Mahindra (M&M), and how it has become innovative in response to challenges and opportunities in its industry. Specifically, the liberalization of automotive industry in the 1990s encouraged M&M to pursue internationalization by upgrading its technological capabilities and adopting an entrepreneurial growth model.

Overall, the macro-outcome based studies offer a rich area of work. As the above discussion suggests, scholars have examined how Indian regulations, patent laws, integration with the global economy, and national R&D policies have impacted firms in several industries. Based on past research, we believe that it is fair to characterize the impact of the role of the Indian state on Indian innovation as mixed. While tariffs may have prevented Indian firms from being exposed to state-of-the-art technologies and innovation, it also shielded Indian firms from sophisticated foreign rivals and forced local firms to improvise. However, prior studies have failed to disentangle endogeneity and other mixed impacts of the governmental policies and interventions on innovation across various industries. Longitudinal cross-industry studies that incorporate the industry life-cycle into the analysis may be able to offer unique insights as to in what stage and what industries protectionist policies could encourage/hurt innovation. Due to the Indian state's deep involvement in many aspects of the Indian economy in the past, recent reforms and regulatory changes offer an attractive context to examine questions about innovation (cf. [Jain & Sharma, 2013](#), on the telephone industry in India).

In addition, India exhibits a substantial diversity in sub-national institutions, which may also result in heterogeneous innovation outcomes across regions (cf. [Chan, Makino, & Isobe, 2010](#); [Gong, Chow, & Ahlstrom, 2011](#)). Unfortunately, studies looking into the array of formal and informal institutions within the Indian context, particularly in their role in innovation, are still few. Needless to say, the broader Indian innovation eco-system is in a state of flux and it is too early to discover any clear patterns on how it will shape innovation outcomes. Based on early studies, it appears

that a very uniquely Indian eco-system is developing that involves MNEs, and professionally/family managed local firms that are tapping into the vast pool of Indian knowledge workers to develop innovations that serve the global elite and the local poor. In terms of theoretical background, institutional theory and industrial organization frameworks could offer the conceptual underpinnings for research in this stream. For instance, Schneider and Paunescu (2012) draw on the varieties of capitalism and national business systems literature to demonstrate how institutional configurations, as opposed to individual institutions, result in radical versus incremental innovation. A more holistic approach to institutions and industry conditions in the Indian context is likely to enhance our understanding of innovation outcomes in India as well. Increasing availability of data about patents (and other innovation metrics) make intra-national, regional, single industry, multi-industry studies, and cross-national comparisons feasible.

Macro/process studies

Studies in this group examine how national institutions influence innovation processes across firms and industries. One exemplar in this category would be Zhao's (2006) research, which found that weak intellectual property (IP) rights protection required MNEs to be careful about R&D investment in India. According to Zhao's results, in such instances, MNEs may engage in R&D that can be internally utilized, or develop alternative technology protection regimes that are internal. It is not just the weak IP protection, but also its lack of transparency that could pose hurdles to innovation (Acemoglu & Robinson, 2012; Rodrik, Subramanian, & Trebbi, 2004). Abraham and Moitra (2001) found, based on their analysis of patent applications in the field of Electric Communication Techniques in India and the US, that to make Indian patent data more useful for Indian firms, Indian industry needed access to detailed information on rivals' innovations. The recent changes in Indian patent laws have also attracted scholarly attention; Bowonder, Thomas, Rokkam, and Rokkam (2003) examined its impact on innovation processes at Dr. Reddy's laboratories (DRL)—they found how it led to DRL's focus on molecular discovery, which eventually led to DRL's expansion into international markets.

Some scholars have examined how institutional differences across countries explain differences in innovation processes among them. Chataway, Tait, and Wield (2007) investigated the research capabilities of pharmaceutical industry in developed countries, and then examined if Indian pharmaceutical industry's innovation model replicated the Western model or created an alternative model. They found that since liberalization, innovation in the Indian pharmaceutical industry is industry-led and imitative; however, it has not pursued risky and radical innovation, and lack linkages with governments, MNEs, and international funding agencies, which may prevent it from having a more significant impact on global markets. Similarly, in a comparative study, Franco, Ray, and Ray (2011) examined how host country industry policies (in Brazil and India) impacted knowledge and technology transfer into MNE affiliates. The study revealed how the MNE's innovation processes responded to their institutional environments. Specifically, in India, high tariffs to import of technology and government-funded research for certain areas resulted in a blend of practices among MNEs that involved

development of internal competencies combined with linkages with partners to access complementary skill sets.

While the above group of studies focused on the impact of macro factors on firm processes, another group of studies has focused on the impact of such factors on industry and regional innovation processes. Research in spatial economics and regional agglomeration has examined how market and regional policies interact to create regional innovation systems (for example, software firms in Bangalore) and how they influence innovation ([Chaminade & Vang, 2008](#)). [Chaminade \(2011\)](#) compared the geography of linkages of the automotive and software industries in (Pune) India and (Greater Beijing) China. Using surveys and interviews, she identified how the networks among customers, suppliers, and MNEs are different in the two regions and across industries and how they impact innovation. Results revealed that there was a significant difference between Pune and Greater Beijing with regard to both the organization and the geography of the networks. Firms in Pune depended more heavily on local–global relationships while those in Beijing were more concentrated in domestic markets.

Similarly, [Crescenzi, Rodríguez-Pose, and Storper \(2012\)](#) used patent data to compare and contrast the spatial patterning of innovation systems across China and India. In contrast to China, they argued that in India, such clusters generated positive knowledge spillovers. They relate the landscape of innovation in India to “specific socioeconomic and institutional conditions of Indian states, such as the differences in social filter, networks, policies and practices” ([Crescenzi et al., 2012: 1078](#)).

Within this stream, one group of studies has examined linkages among firms, customers, universities, and developmental organizations. For instance, [Roy and Banerjee \(2011\)](#) identified the differences across Indian cities in terms of the interaction between university, government labs, and industry in bio-medical research. Several scholars working in this stream have noted the weak linkages that exist between the technology generators (universities and R&D laboratories) and technology users (especially the smaller organizations and their lack of motivation to upgrade capabilities) ([Sikka, 1999](#)). [Joseph and Abraham \(2009\)](#) examined the factors that increase the industry-academia linkages and the outcomes of such linkages, specifically finding that in the Indian context firm-academia interaction led to innovativeness. Similarly, [Chandra and Krishna \(2010\)](#) examined the linkages of the five Indian Institutes of Technology (IITs) with industries and analyzed the interfaces and knowledge transfer process. Providing an example of a successful collaboration, [Samii, Van Wassenhove, and Bhattacharya \(2002\)](#) discussed how the UN Industrial Development Organization (UNIDO) linked up with other organizations to upgrade the capabilities of automotive component suppliers in India to enable them to supply world class manufactures. Relatedly, [Reece \(2007\)](#) examined how an Indian firm bred a salt-tolerant form of hybrid rice through linkages with national and international institutions. Some guidance on how these networks could be developed is offered by [Sharma, Nookala, and Sharma \(2012\)](#) who used a survey of managers to examine India’s opportunities and challenges in cooperation between industry, education intuitions, and government labs. The need to establish a more vigorous link between industry, academia, and the government R&D labs appears to be a common theme ([Chandra & Krishna, 2010](#); [Chidambaram, 2011](#)) among many of the macro process studies.

A few studies have examined the role of the national culture and informal institutions on innovation processes. [Russell \(2008\)](#) noted that while innovation

remains a critical priority for Indian industry's competitiveness, cultural factors, hierarchical structure, and testing practices deterred innovative performance. Though not explicitly focusing on cultural analysis, Liu, Kaza, Zhang, and Chen (2011), using network analysis, described the important role of status in social networks on diffusion of knowledge and innovation in the nano-technology literature in China, Russia, and India. Likewise, Khandwalla (2014), one of India's leading writers on creativity and innovation, developed a model that integrated the role of government, educational institutions, and civil society in generating innovation. As studies in this category illustrate, innovations comprise various micro processes, including learning and knowledge flows. Thus, unraveling the links between the macro structure (institutional and industrial) and their impact on micro processes will be critical to understanding how innovation occurs in the Indian context.

Overall, studies in this category suggest that over the years, India's policies and societal structure have created a very unique eco-system that drives the innovation processes within and across firms, industries and regions. While the policies are undergoing rapid changes, it is not clear whether the past processes have changed uniformly across sectors or new processes have been fully established. In our view, innovation efforts may be constrained by processes that were established over the years when state control and regulations were more intrusive—processes tend to be inertial and sticky, hence the challenge for innovators would be to identify ways to prune and modify them. Additionally, we still lack a proper understanding of how and why the innovation process differs across industries in India. The unique features of the Indian eco-system and industries provide fertile grounds to pry open the black box of the innovation process in India by bringing in theories of industry recipes, mental models, and imprinting. Recent changes in India's institutional and competitive environments offer opportunities for scholars to examine how such changes are impacting or disrupting innovation processes within and across firms.

Micro/outcome studies

Studies in this category examine firm level factors and how they influence innovation outcomes. Within this group we include studies that have examined the impact of firm ownership, R&D, HR policies, structure, and strategy on innovation. For example, Lodh, Nandy, and Chen (2014) found that family ownership and business group affiliation have a positive impact on innovation in India. Some studies have specifically examined the link between R&D investment and innovation. For example, Dubey and Dubey (2010) found that despite increased R&D spending, Indian pharmaceutical firms have not seen a substantial increase in their drug pipeline and approval of new molecular entity (NME) rate, though there has been an increase in incremental innovations and applications for new drug approvals.

Some studies in this group also looked at the moderating factors that influence the link between R&D and innovation outcomes. Mishra (2010) pointed out that the changes in Indian patent law in 2005 had led to an increase in R&D investment; however, the investment was not uniform across firms, and has not led to a proportionate increase in innovations. He found that more than half of the Indian pharmaceutical firms did not engage in R&D spending, and that such spending was a function of the past profitability, size, capital intensity, and exports. Highlighting the role of

appropriate skills-sets for innovation, Deolalikar and Roller (1989) found that patenting by Indian firms was related to the availability of human capital rather than R&D investment, capital, or organization size. Findings regarding the effectiveness of R&D spending on innovation appear to be mixed, and more studies are needed to understand the contingency factors that influence the relationship.

Because of India's strengths in service exports, several studies have looked at service innovations. Thakur and Hale (2013) compared factors influencing service innovation in the US and India and their impact on firm performance. The study tested its hypotheses using a survey instrument in the financial, medical, food, hospitality, and communication services. They found that there were some differences in factors driving service innovation in India and the US; in India, it was the competitive environment that was more strongly associated with service innovation, whereas in the US, it was demanding customers. However, in both countries innovation was associated with superior performance.

While a majority of studies have examined product/service innovations, Velu and Khanna (2013) focused on business model innovation. They identified 95 business model innovations reported in popular business media and examined each one in detail to identify its characteristics. They found that business model innovations tend to be made by new firms, whereas existing firms adopt efficiency innovation. Examples of business model innovation included pharmaceutical firms that do contract research for Western pharmaceutical firms—a topic that has also been examined by Awate, Larsen, and Mudambi (2015) and Haakonsson, Jensen, and Mudambi (2013). Such business model innovations were not just limited to pharmaceutical and IT, but were also occurring in consumer goods and other areas.

Surprisingly, this group of research was underrepresented in our review. While scholars have examined the impact of ownership and R&D spending on innovation outcomes, there are several other firm level factors that could have potentially been examined as determinants of firm innovation. Corporate governance practices, managerial capabilities, business and corporate strategy, and organizational change capacity and routines are all areas which remain unexplored in the context of innovation in India. Here, rich theoretical frameworks such as the resource-based view or dynamic capabilities view could offer strong theoretical framing for additional inquiry. Such theoretical framing would allow scholars to not only examine the impact of firm factors on innovation, but also how they interact to influence outcomes. Also, due to government's involvement in many sectors of Indian economy, examining the firms' capabilities and resources such as political ties or network attributes could help disentangle the mixed results.

Given the changes occurring in the Indian corporate landscape, scholars have significant opportunities to engage in this area of research. We highlight some of this potential in the section on future research.

Micro/process studies

This group of studies examined intra-firm processes that are related to innovation. Broadly, these studies focus on the “how” of innovation. Among one of the earlier studies in this group, Chaudhuri (1986) examined the managerial processes involved in a major technological innovation and found that the following factors were critical:

presence of product champions and upper leadership support, effective relationship between leaders and key decision makers in government, close association among innovation team members, and connection between the technology development and manufacturing enterprise.

The role of the individual and the individual's interaction with the organizational eco-system in the innovation process was examined by Waychal, Mohanty, and Verma (2011) in an empirical study within an IT company. They found that employee self-confidence and a culture of celebrating success were related to innovative thinking and value creation. Organizational culture's impact on innovation has also been examined by others (e.g., Dixit & Nanda, 2011); Mathew, Ogbonna, and Harris (2012) found that organizational culture impacts quality of work, which in turn impacts innovation. Bhatnagar (2014) examined the role of perceived supervisor support, reward, and recognition on employee innovative behaviors. She found that recognition and rewards mediated the relationship between perceived supervisor support and innovation. Drilling down further into a more micro level, Bhaduri and Kumar's (2011) study focused on the role of extrinsic and intrinsic motivators in innovation activities and concluded that innovation was driven by intrinsic factors.

Taking a broader structural view, Krishnaswamy and Kamala (1979) discussed how investment in R&D could be more effective when the function was linked to marketing and production. In contrast, adopting a more strategic approach, Bettiol, Di Maria, and Grandinetti (2012) examined the competing pressures of standardization and creativity to generate innovation in knowledge intensive business services firms (KIBS) in India and Italy. Similarly, Krishnan (2012) examined the innovation strategies (e.g., exploration versus exploitation, market-pull versus technology push, internal versus external development of capabilities, and product versus process focus) within leading Indian firms. He found that leading firms use business model innovations to enhance affordability of their products and services, and use technology as a means to deliver such innovation. Such firms differed in their innovation process from other firms in that they were ambidextrous on all four innovation dimensions identified above. Plechero and Chaminade (2013) examined how firms in three industries (auto component, software, and green biotech) have globalized their innovation. They included three distinct modes (or processes) of globalization of innovation in their study: exploitation of innovation, sourcing of technology, and research collaboration.

Some studies have focused on firm level resources and capabilities required for innovation. Kale (2010) examined the learning processes involved in the development of R&D capabilities that support innovation. He examined inter-firm variation in such capabilities and how they were created. Many firms lacked innovation capabilities, and after economic reforms, such firms sought to acquire them through internationalization and acquisitions (Chittoor, Sarkar, Ray, & Aulakh, 2009). Focusing on acquisition integration process and innovation, Sen and Rubenstein (1989) examined the role of R&D in acquisition integration and found that involving in-house R&D groups in both the acquisition and implementation phases of the external technology process was very beneficial in improving the efficiency of the process.

Several studies have approached innovation processes from a knowledge creation and management perspective. Birasnav and Rangnekar (2010) surveyed employees in Indian manufacturing firms to identify knowledge management processes and how these processes were linked to innovation culture. Veng Søbørg (2011), employing

knowledge creation theory and a case study approach, identified factors that prevent knowledge creation within Scandinavian R&D centers in China and India, and skill sets involved in process innovation. He found that while weak socialization skills may impede effective knowledge transfer and consequently hurt the innovation process in foreign invested R&D units, it was codification skills that spurred innovation in India. Likewise, Roy and Gupta (2007) examined product development in a small foundry in India and analyzed how the processes depart from Nonaka and Takeuchi's socialization-externalization-combination-internalization (SECI, 1995) model. The authors discussed how the case study setting supported as well as departed from each element of the model, thus helping reveal the uniquely Indian way of knowledge creation.

Another group of studies look at the influence of inter-organizational linkages on innovation processes. For example, Kumar and Subrahmanya (2010) examined how small and medium enterprises (SMEs) partner with MNEs in the auto industry and found that SMEs mostly received product related and purchase process assistance with little assistance for their production, marketing, human resource, financial, and organizational requirements. Yet even such assistance was critical in enhancing these SMEs' innovativeness and performance. Rai, Pedersen, and Kazakevičiūtė (2010) used three case studies to understand the co-creation of innovations in India's ICT industry. They found that much of the co-creation was focused on the domestic market; co-creations occurred through joint ventures rather than alliances, and it led to sharing of knowledge. According to Maini (2005), the development of India's first electric car company REVA occurred through knowledge sharing within a joint venture between Maini Group and AEV LLC of California.

Taking a broader approach, Karna, Täube, and Sonderegger (2013) examined characteristics of MNE subsidiaries embedded in networks within geographic clusters (such as Bangalore) and their impact on innovation through knowledge flows. Likewise, Pai, Tseng, and Liou (2012) offered a solution to the problem of low effectiveness of R&D spending; examining patent data, they found that in India, collaboration with participants from advanced countries on innovations were more effective than independent work.

While many studies above examined linkages among Indian firms and MNEs or government institutions, some have examined linkages among firms and customers. Subrahmanya (2007), for example, examined how Indian SMEs in the Bangalore area have responded to customer demands that resulted in innovation and have even allowed two of the foundries to enter international markets. In another study, Kim, Basu, Naidu, and Cavusgil (2011) examined the innovativeness of born global firms and how their customer orientation leads to innovativeness—the relationship being mediated by their technological expertise. Alam (2012) investigated how local firms and MNEs differ in business to business new service development processes. Interestingly, he found that MNEs tend to target new markets with new services, whereas Indian firms tended to focus on moderately innovative services. He also found that MNEs had a more rigorous idea generation process than the indigenous firms. Another paper on service innovation (Alam, 2013) used a longitudinal study to examine the development process of new service projects in real time and found that firms used different approaches such as customer advisory panel and innovation retreats to generate new services.

This stream of research on organization processes associated with innovation has identified one uniquely Indian approach to innovation—*jugaad*. *Jugaad* is a word in the Hindi language, which is spoken in much of northern India. It means improvisation under resource constraints, which speaks to the heart of the “frugal” nature of Indian innovation and pragmatically minimizing the use of resources across the value chain in order to reduce offering cost, while maintaining an acceptable quality standard (Jain, 2012; Prabhu & Jain, 2015; Prahalad & Mashelkar, 2010). Tiwari and Herstatt (2012) examined characteristics of frugal innovation, its development process and success in domestic and overseas markets. Their work offers MNEs insights into developing frugal innovations and asserts that such innovation need not be national, but could be part of global innovation networks. However, more research is needed to explain how Indian MNEs can integrate the innovation initiatives across their global networks and how they can translate their experiences overseas into local innovations.

Overall, the research on innovation processes, factors that influence them, and how they differ across firms, appear to be fairly rich with the most interesting ones focusing on processes that are uniquely Indian. More studies that identify processes like *jugaad*, and compare them to organizational processes in other contexts, would help enrich the broader literature on Indian innovation. In essence, while what we know about the different innovation processes Indian firms develop, and the unique organizational characteristics driving these differences, is impressive, many open questions remain. For instance, given the dynamic nature of Indian economy, it is surprising that few studies discuss organizational imprinting and the evolution of innovation processes over time within Indian organizations.

In terms of methodology, unlike the previous group of studies that used archival data, studies in this group tend to use surveys or detailed case studies. For instance, a comprehensive case study of Ranbaxy Pharmaceuticals by Bowonder and Mastakar (2005) illustrated how leadership, strategies (e.g., joint ventures), and market focus together led to innovation and growth. These studies are rich in detail, though it would be helpful for studies in this group to validate their findings with archival sources and more rigorous methods. In any case, process based studies have the potential to uncover uniquely Indian issues that enable or constrain innovation.

Discussion

In recent years, scholars, practitioners, and policy makers alike have argued that innovation by Indian firms will play a critical role in India’s economic vitality and growth. The purpose of this paper was to contribute to this discussion by reviewing extant studies on innovation in India to not only take stock of the research but identify its contours, uniqueness, and develop some implications and guidance for future research.

We were encouraged by the richness of Indian innovation research. While its impact has not been pervasive in top management journals, high quality work has been done in management and allied fields by a large group of scholars, some of whom have dedicated years or even decades to this research stream. As must be evident from the above review, scholars have adopted several different perspectives and theories to frame research on Indian innovation, including institutional, industrial organization,

social network, resource/knowledge-based view, cultural, governance, and structural theories. Studies on innovation have included large samples as well as detailed case studies within firms and sometimes across firms within an industry. While it is difficult to say that an overarching, simple and generalizable theme can capture the state of Indian research, our review finds that the Indian innovation eco-system is distinctive, rapidly undergoing changes, and thus offers exciting opportunities for future research.

Future research directions

Our review suggests that there are many unanswered questions in the Indian context for innovation research. As Fig. 2 suggests, the number of *approved* patent filings from India continues to be low. Researchers could examine the macro and micro factors and processes that positively or negatively impact the ability of firms to translate innovation processes and applications to actual commercially-viable innovation in the Indian context. At the macro level, scholars could further explore how institutions impact innovation. For example, how do Indian university and secondary school curricula impact the development of research capabilities and innovation? It is clear that the Indian Institutes of Technology (IITs) and many other well-respected scientific and engineering institutes in India have the potential to play a much larger role in generating innovation. Policy makers could examine how incentive systems in such institutes influence faculty involvement in research and enhance linkages with industry. Further, scholars and policy makers could examine the level and effectiveness of funding to support research and innovation processes. For example, in the US, National Science Foundation (and other federal and state governments organizations such as Department of Energy, Department of Science) have established an extensive framework to solicit, evaluate, and fund research projects at universities. In addition, private foundations and funds complement such government-funded projects.

Beyond formal institutions, scholars could examine how informal institutions facilitate or hinder innovation (Acemoglu & Robinson, 2012; Parente & Prescott, 2002; Wang, Ahlstrom, Nair, & Hang, 2008). For example, Tansuhaj, Gentry, John, Lee Manzer, and Jin Cho (1991) examined how cultural values of fatalism, traditionalism, and religious commitment were related to the willingness to try new products. Similar studies that incorporate such institutions could help develop a uniquely Indian perspective on innovation. For instance, what is the role of culture in interpreting and valuing innovations and their impact? How does India's unique socio-cultural environment influence knowledge flows and risk taking attributes and impact innovation and diffusion process? Such institution based studies could uncover how India's national business system is configured in relation to other varieties of capitalism (Judge, Fainshmidt, & Brown, 2014), and what these institutional differences entail for innovative output. As discussed earlier, a more nuanced approach focusing on sub-national institutional differences and their influence on innovation output and process is warranted as well.

At the micro-level, a fascinating area of work could be to follow Koppman and Gupta (2014) and examine how distributed work—where scientists and engineers work on different parts of projects in different geographic locations—combines knowledge and creates innovations. As Khavul, Peterson, Mullens, and Rasheed (2010) argue, globalization of innovation by emerging market firms may require development of new

capabilities. In this context, scholars could examine how effective foreign companies (and Indian MNEs) are in managing innovation across subsidiaries. How do ownership structure (e.g., business group, family, state), governance, firm size, and firm age independently and in interaction influence innovation? What are the uniquely Indian organizational problems (and solutions) in managing innovation? For instance, Duran, Kammerlander, van Essen, and Zellweger (2015) showed that family firms tend to invest less in R&D, but are more innovative on average due to a unique process of translating research investment into innovative output. How does this process work in Indian family, state-owned, or foreign-affiliated firms? Much work remains to be done in order to pry open the black box of the Indian innovation process.

In addition, more work is needed that examines administrative innovations, as well as the reasons for Indian firms' preference for incremental instead of radical innovation, innovation commercialization, and product development. In addition to studies that examine the antecedents of innovation at a firm level, we also need studies that examine the impact of innovation on firm performance, customers (Tarafdar, Singh, & Anekal, 2013) and corporate governance (Ravishankar, 2013).⁶ At the industry, regional, or national level, scholars could use established theoretical frameworks such as the Diamond Model (Porter, 1990) to understand Indian innovation type, volume, and productivity. Finally, it is still unclear how Indian firms' internationalization affects their innovation process and outcomes, which future research could endeavor to uncover.

Limitations

Any study that attempts to review a broad topic such as innovation is constrained to limit its scope due to journal page limit guidelines. While our focus in this review was primarily on the antecedents of innovation, a vital area of research on innovation, which we excluded from this review, examines the consequences of innovation. Both macro and micro studies have examined the performance implication of innovation (Manimala, Jose, & Thomas, 2006). For instance, Hsu (2009) found that patent stocks were positively associated with market returns and premiums. Similarly, Chadha (2009) found that foreign patent rights of Indian pharmaceutical firms were positively associated with export performance. However, we also find cases (e.g., Amitabh's [2013] study of the glass industry) where increasing competition was causing some firms to focus more on efficiency and productivity improvement rather than innovation. Clearly, there is need for more studies in this area.

Another significant omission in this paper was the review of research on agricultural innovation. Unlike Dong and Saha (1998), we do not examine technology adoption or diffusion rate of innovation in the unorganized, agricultural sector (Raina, 2003). Das (2011) pointed to the need to integrate rural SMEs into the formal sector, the financial markets, and global markets; such integration would also unleash innovation and productivity. Relatedly, we also did not examine innovations in social entrepreneurship (Bhatt & Altinay, 2013). We believe these are areas that deserve more research.

⁶ Messner (2011) pointed out the role of governance in tapping into the potential gains from innovation in offshoring activities (in addition to factor cost savings).

While we noted the omissions, we must also acknowledge that sometimes we included papers in our review that may have fallen outside the boundaries we defined if they helped us understand the uniquely Indian innovation process. For instance, we included papers in our review that were not strictly about innovation processes or outcomes, but focused on R&D spending. While R&D investment is not equivalent to innovation, we found that including papers that focused on R&D did help us assess the Indian innovation landscape.

Conclusion

With its large number of renowned universities and research institutions, India has the potential to become a global hub of (growth-encouraging) innovation. However, the lack of successful patent filings from India suggests that there are several hurdles that must be overcome for India to become an innovation superpower. First, our review shows that India suffers from a lack of innovation infrastructure. As Mathew (2011) notes, while many have iPhones, a vast section of India's populace lacks access to necessities that are taken for granted in more developed countries. In order to fully maximize its innovative potential, India needs to develop its legal, physical, scientific, technological, and medical infrastructures. Thus, more research is needed not only on the outcomes associated with infrastructure investment, but also on how such investment results in innovation. The role of MNEs entering India in filling these institutional voids is another fruitful research avenue. In addition to development of such infrastructure, policy makers need to examine how to strengthen the linkages among the different institutions (Acemoglu & Robinson, 2012).

Second, India needs to develop its eco-system to support entrepreneurship. In our view, innovation and entrepreneurship go hand in hand; fostering entrepreneurship requires a focus on the channels to fund new business ideas, such as angel investors and venture capitalists (Alvarez et al., 2015; Bruton, Ahlstrom, & Singh, 2002; Lerner, 2009). Relying on banks alone to support new start-ups will not be enough, as such institutions are more geared to fund large ongoing enterprises and may be more risk averse. Prior studies have proved the significant role of venture capital (VC) industry in fostering entrepreneurship and innovation in the West (Florida & Kenney, 1988) and in Asia (Bruton, Ahlstrom, & Yeh, 2004). Here, research looking into factors attracting international VC funds, and the effective ways in which a VC industry can flourish within India is warranted (cf. Bruton et al., 2002).

Finally, and perhaps most importantly, in order to realize the enormous innovative potential of the Indian population, rural areas must be developed by introducing policies that advance education, health, and wealth creation. Furthermore, the emerging literature on Indian innovation suggests that innovation needs to address the widespread poverty in the country and be appropriate to the context; thus, we believe that the title of a paper by Kaplinsky (2011) "Schumacher meets Schumpeter" regarding lower-end technological innovation, captures India's innovation needs perfectly. We hope that this paper brings to light the need for more concerted and collective scholarly efforts (Abrahamson, 2008) to study innovation and supporting prescriptive measures to further encourage innovation in India (Acemoglu, 2003).

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