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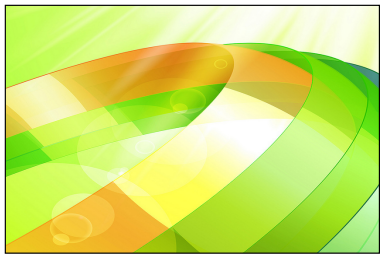

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Innovation and Entrepreneurship in India

Welcome to the January issue of the *Technology Innovation Management Review*. We welcome your comments on the articles in this issue as well as suggestions for future article topics and issue themes.

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Overview

The *Technology Innovation Management Review* (TIM Review) provides insights about the issues and emerging trends relevant to launching and growing technology businesses. The TIM Review focuses on the theories, strategies, and tools that help small and large technology companies succeed.

Our readers are looking for practical ideas they can apply within their own organizations. The TIM Review brings together diverse viewpoints – from academics, entrepreneurs, companies of all sizes, the public sector, the community sector, and others – to bridge the gap between theory and practice. In particular, we focus on the topics of technology and global entrepreneurship in small and large companies.

We welcome input from readers into upcoming themes. Please visit timreview.ca to suggest themes and nominate authors and guest editors.

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Contribute to the TIM Review in the following ways:

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Please contact the Editor if you have any questions or comments: timreview.ca/contact

About TIM

The TIM Review has international contributors and readers, and it is published in association with the Technology Innovation Management program (TIM; timprogram.ca), an international graduate program at Carleton University in Ottawa, Canada.

Editorial: Innovation and Entrepreneurship in India

Chris McPhee, Editor-in-Chief

Punit Saurabh, Guest Editor

From the Editor-in-Chief

Welcome to the January 2018 issue of the *Technology Innovation Management Review*. This month's editorial theme is **Innovation and Entrepreneurship in India**, and it is my pleasure to introduce our Guest Editor, **Punit Saurabh**, Assistant Professor of Strategic Management & Entrepreneurship at Nirma University's Institute of Management in Ahmedabad, India. Dr. Saurabh also played an integral role in our previous India-focused issues in 2014 (timreview.ca/issue/2014/august) and 2016 (timreview.ca/issue/2016/may).

In February, we focus on the theme of **Inclusive Innovation in Developed Countries** with Guest Editors **Sandra Schillo**, Assistant Professor in the Telfer School of Management at the University of Ottawa, **Louise Earl**, Section Chief in the Investment, Science and Technology Division at Statistics Canada, and **Jeff Kinder**, Director of the Innovation Lab at the Institute on Governance.

For future issues, we are accepting general submissions of articles on technology entrepreneurship, innovation management, and other topics relevant to launching and growing technology companies and solving practical problems in emerging domains. Please contact us (timreview.ca/contact) with potential article topics and submissions.

Chris McPhee
Editor-in-Chief

From the Guest Editor

Entrepreneurship is assuming a greater role around the world due to its positive correlation with innovation and economic growth. Developed countries have already followed and relied upon the promotion of a university-based entrepreneurship and innovation development model and have successfully established low-, medium-, and high-technology accelerators for industry creation and sustenance. Emerging nations have been slower to understand the importance of entrepreneurship but are now slowly waking up to the important role that universities and incubators can play in promoting growth through entrepreneurship. In recognition of the wide gap between these two contexts, there are questions being raised as to whether copying the models of the West would best serve the interests of emerging nations. Should an alternate entrepreneurship model better suited to the emerging economy context be adopted? Researchers in developing nations have opined that emerging nations such as India need not apply the models developed and implemented by developed nations such as the United States, and they argue that they should instead try to conceptualize their own growth models, which can be customized and adopted by them due to their unique demographical, geo-political, and social positioning.

In this issue of the TIM Review, our authors collectively provide an overview of various issues relevant to Indian entrepreneurship and innovation, and the role of key stakeholders in promoting them. This issue explores the perspectives of a few selected researchers who provide insights into various aspects of innovation and entrepreneurship for optimum and equitable growth across all sectors and regions of India.

In the first article, **Tripurasundari Joshi** from the Institute of Management at Nirma University explores the dynamics of knowledge sharing in the Indian biotechnology industry. The study is motivated by the question of how firms in the biotechnology sector deal with the complex relationship between technological

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Chris McPhee and Punit Saurabh

knowledge and innovation due to their complex nature and the issues emerging out of knowledge creation and transfer. The author has adopted an exploratory approach to understand the practices of knowledge sharing as well as its perceived impediments at the firm-level in the Indian context.

Next, **Gaurav Mishra** from the Institute of Management at Nirma University and **Balakrishnan Unny R** from the National Institute of Technology, Tiruchirappalli in Tamil Nadu, India, highlight the role of rural entrepreneurs in ensuring the sustainability of telecentres, which provide rural citizens with access to computers and other digital technologies. Using an exploratory approach, the authors examine and compare two projects designed to improve the delivery of government-related services. Based on the results, a theoretical framework is suggested to understand the dynamics between different types of sustainability parameters (financial, social, staff, technology, and institutional) and to improve the design and delivery of services offered through telecentres in developing countries such as India.

In the third article, **Shiv S Tripathi** and **Mita Brahma** from the Management Development Institute in Gurgaon, India, develop a framework to describe models of entrepreneurship prevalent in India. Based on interviews with technology entrepreneurs in India, their framework considers two dimensions – demand/supply and expected loss/risk – to reveal four models of entrepreneurship: incremental, proactive, radical, and reactive. The characteristics of each model are described and detailed examples of India companies applying these models are provided.

Finally, **Rituparna Basu** and **Sarada Chatterjee** answer the question "What barriers do women face in becoming high-tech entrepreneurs in rural India?" They provide a critical assessment of the overall landscape of female entrepreneurship in India and identify seven primary barriers facing women in rural areas: patriarchy, financing issues, illiteracy and language barriers, low risk tolerance, corruption and lack of infrastructure, and competition from their better-supported male counterparts. In addition to discussing the role of government policy and providing a prelude to greater participation by female entrepreneurs in the economic growth story of India, they provide an insightful biographical sketch of an aspiring female entrepreneur, which brings the current challenges to life.

Although there are several interesting and divergent views and methodologies represented in this issue, the authors all agree that there is an urgent need to promote the values of innovation and entrepreneurship across emerging nations for sustainable and economic growth. I hope that you find the issue to be beneficial and will gain interesting insights into the nature of innovation and entrepreneurship being practiced in India.

Punit Saurabh
Guest Editor

About the Editors

Chris McPhee is Editor-in-Chief of the *Technology Innovation Management Review*. He holds an MASc degree in Technology Innovation Management from Carleton University in Ottawa, Canada, and BScH and MSc degrees in Biology from Queen's University in Kingston, Canada. Chris has nearly 20 years of management, design, and content-development experience in Canada and Scotland, primarily in the science, health, and education sectors. As an advisor and editor, he helps entrepreneurs, executives, and researchers develop and express their ideas.

Punit Saurabh is an Assistant Professor of Strategic Management & Entrepreneurship at Nirma University's Institute of Management in Ahmedabad, India. Previously, he was a senior faculty member at the International Centre for Entrepreneurship and Career Development (ICECD) in Ahmedabad, India. Punit received his PhD from the Indian Institute of Technology Kharagpur, India, in the domain of innovation and entrepreneurship development. He has hands-on experience in managing government innovation and entrepreneurship funding programs and is also involved with the academic aspects of entrepreneurship. His research interests include innovation management and entrepreneurship development, and he has varied experience in product funding and commercialization.

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Keywords: India, innovation, entrepreneurship, startups, emerging markets, rural

The Dynamics of Knowledge Sharing in the Biotechnology Industry: An Indian Perspective

Tripurasundari Joshi

> *"Coming together is a beginning, staying together is progress, and working together is success."*
>
> Edward Everett Hale (1822–1909)
> Author, historian, and minister

The role of biotechnology in providing an alternate, more productive approach to new drug development is well accepted globally. Multinational pharmaceutical companies have begun outsourcing product development and its clinical validation to biotechnology firms in India. The sector in India has also witnessed the entry of startups in various phases of the drug development value chain. Technological innovation is a key growth driver in the "bio pharma" vertical in recognition of which numerous alliances are seen in the sector in India. These alliances have put in place a structure for technological learning to happen, which is necessary for innovation. However, the nature of knowledge in biotechnology, in large measure, is both tacit and complex. Such knowledge is difficult to transfer. At the same time, transferability of knowledge is critical to developing technological capability, which in turn can facilitate the technological innovations that are crucial for the growth of the sector in India. The current research is motivated by the question of how the firms in this sector deal with this paradox. An exploratory approach is adopted to understand the practices of knowledge sharing as well as its perceived impediments at the firm level in the Indian context.

Introduction

Globally, new drug development has been the responsibility of pharmaceutical companies with deep knowledge in organic and synthetic chemistry. The cost of developing a new drug based on this chemical route is somewhere between $600 million and $1 billion CAD (Dickson & Gagnon, 2004). Also, it takes well over a decade to convert a drug candidate to a marketable product (Bains, 2004). The drug industry is plagued by low productivity, rising costs of product development, shorter product lifecycles, technology complexity and competitive pressures from generics.

Thus, there is a felt need in the pharmaceutical sector to develop more effective therapeutic agents at lesser cost. As a possible solution, pharmaceutical companies have started outsourcing both product development as well as its clinical validation to biotechnology firms. The biotechnology firms use approaches to drug development that are based on life sciences, which represents a paradigm shift in technical know-how. The discovery and development of drugs through biotechnological methods is an evidence-based approach (Keller, 2001; Miller, 2002) resulting in better productivity. Essentially the "pharma bio" vertical is heavily dependent on technological innovation for survival and growth. In keeping with the multidisciplinary nature of the industry, firms enter into various forms of upstream, downstream, and horizontal alliances. These relationships are made with the expectation that technological capability would develop, which, in turn, would result in better technological innovation (Edwards et al., 2003).

The development of technological capability in a firm requires the continuous building and use of new product and process technology know-how. This is made possible by accessing and sharing knowledge between firms and within firms. A review of the literature about the biotechnology sector in India reveals that there is little documentation in the public domain

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about the state of knowledge sharing processes in biotechnology firms in India. Thus, this study adopts an exploratory approach to understand the firm-level practices of knowledge sharing and its perceived impediments within the Indian context.

Overview of the Biotechnology Industry

Drug development is a long and technically arduous process. In simple terms, it begins by locating a biomolecule that could become the means for blocking the progress of a specific disease. The initial efforts are in the identification of the appropriate biomolecule and certain compounds that can interact with the identified molecule and continue the blocking action. Then, the stages of animal and human testing begin. The new entity becomes a candidate drug once it enters the human clinical study stage. In three phases, the safety, dosage, and efficacy aspects are tested. The firm then would arrange for the drug approved and arrange to market it.

Biotechnology firms are intermediary links in the value chain for new drug development. Their goal is to transfer the technology know-how developed within their organizations to a larger entity (such as an established pharmaceutical company) with manufacturing and marketing muscle. Typically, three types of firms would be involved in the value chain: i) university or national laboratories, who would do the initial identification; ii) biotechnology firms, who may develop the prospective drug by establishing its dosage, safety, and efficacy; and, finally, iii) the pharmaceutical firms, who would obtain approval for the drug and market it. There could be variations in this basic scheme with some pharmaceutical companies involved in clinical testing, too, or for that matter some biotechnology firms involved in contract manufacturing. Biotechnology is a knowledge-intensive, high-tech industry, and the technologies involved are multidisciplinary in nature. As observed by Powell and colleagues (1996), "biotechnology is a competence destroying innovation based on immunology and molecular biology". It is essentially a disruptive technology.

Biotechnology processes are technically complex, requiring sophisticated analytical skills as well as an intuitive judgement in decision making (Aggrawal, 2007). This field presupposes deep skills in the people involved in a scientific project. These skills take many years to develop and hone. The know-how in this sector can be developed mainly through continuous interactions among the multiple specialized disciplines (Quinn, 2000). Projects in this sector can be categorized as high risk with high probability of failure at any stage in the value chain.

In spite of these challenges, the biotechnology sector has made a significant contribution in terms of a deeper molecular understanding of pathology, which in turn has supported the development of effective drugs and vaccines targeted to those diseases (Miller, 2002).

Biotechnology in India

In India, the total biotechnology investment in the country is estimated to be in excess of 187 billion INR (approximately $3.6 billion CAD) (ABLE, 2017). According to the 2011 biotech industry survey produced by industry associations, the total industry turnover of the biotechnology sector in India was in the range of $4 billion USD at that time (The Hindu, 2011). The industry in India is characterized by a shortage of qualified manpower, weak laboratory infrastructure, and a lack of access to scientific literature. Though these weaknesses have been acknowledged and corrective actions are being put in place, they have an impeding effect on overall innovation.

The Indian process patent regime brought in by *The Patents Act, 1970* (IPI, 1970) led the way for reverse engineering of biomolecules from imported clones and manufacturing standard operating practices adopted from the developed markets. Because of this, Indian expertise in process development needs strengthening. Though Indian academia has played a robust role in transferring process development technologies to the industry, they have not made a serious impact. Besides, India is now a signatory to the Trade-Related Intellectual Property Rights (TRIPS) Agreement (https://en.wikipedia.org/wiki/TRIPS_Agreement), which means it will enforce product patents in all manufacturing sectors. With the re-engineering option no longer viable, manufacturers now have to develop their innovation capabilities. To this point, a major impediment to the growth of the sector has been an insufficient number of innovative companies to reach a critical mass (Frew et al., 2007)

Technological Innovation and Learning in the Biotechnology Sector

Given the high-tech, knowledge-intense nature of the industry, biotechnology innovations are by default

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technology led. Technological innovation is defined as "an organization's ability to enhance its technological innovativeness and create new customer value propositions by offering new products and services, adopting new technologies, or creating new skills and competencies" (Huang, 2011). Technological innovation can be manifested as new offerings, the adoption of new technologies, or creating new process know how. For a firm to sustainably develop technology innovations, the individuals within the firm have to develop technological capability. This can be built through the process of technological learning. The nature of technological innovation in biotechnology would include new drug identification and development capabilities as also clinical testing and regulatory compliance know how.

Technological learning is "the process by which a technology-driven firm creates, renews, and upgrades its latent and currently used capabilities based on its stock of explicit and tacit resources" (Carayannis, 2006). The resource-based view of firms regards technological learning and the subsequent building of technical competence as a core competence that can be hard to copy. Technological learning can be both external and internal. External learning involves learning from alliances with other firms. It expands a firm's knowledge base (Bierly III et al., 2009) and also reduces innovation time. Internal learning is a transfer of knowledge among individuals or firms. Both types of learning have a positive effect on the performance of organizations.

The biotechnology sector involves a lot of experimentation at the various stages in the value chain and provides many opportunities for developing deep skills with time. Repeated trials ensure learning and any interference with this process would hamper innovation by not allowing the integration and honing of technological learning (Harlow, 1949). Teece, Pisano, and Shuen (1997) refer to learning as both an individual and an organizational process.

Absorptive Capacity and Knowledge Sharing in the Biotechnology Sector

The concept of absorptive capacity relevant in the biotechnology sector. Cohen and Levinthal (1990) first introduced this concept as "the ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends". Zahra and George (2002) further delineated the concept into potential and realized absorptive capacity. The former refers to "a firm's capability to identify and acquire externally generated knowledge that is critical to its operations" as well as "the firm's routines and processes that allow it to analyze, process, interpret and understand the information obtained from external sources" (Zahra & George, 2002). The latter refers to a different skill which is "a firm's capability to develop and refine the routines that facilitate combining existing knowledge and the newly acquired and assimilated knowledge" as well as the "organizational capability based on the routines that allow firms to refine, extend, and leverage existing competencies or to create new ones by incorporating acquired and transformed knowledge into its operations" (Zahra & George, 2002). Absorptive capacity develops incrementally in organizations and supports them in being more sensitive to new technology absorption opportunities in the environment. As Phene and colleagues (2006) put it, "when the knowledge base is diverse, it is possible to potentially create more new combinations of knowledge".

Both variety and depth of knowledge are important for technology-led organizations to absorb new knowledge more efficiently. Besides, given that innovation involves a process of establishing new linkages in the existing knowledge base, both variety and depth of the knowledge base in an organization can also facilitate the occurrence of innovations. Weak development of absorptive capacity becomes a barrier to the firm in recognizing technological opportunities and this in turn affects its ability to innovate and remain up to date with the latest developments and proactive in its innovative strategy.

According to Zahra and George (2002), absorptive capacity can be said to be a dynamic capability for a firm. It stands to reason that, if absorptive capacity is to be developed as a dynamic capability, sharing of knowledge with other firms (through alliances) as well as within the firm becomes an important process. Knowledge sharing can help firms to survive in the marketplace (through zero-order dynamic capabilities: Winter, 2003), build resources and capabilities (first-order dynamic capabilities: Teece et al., 1997), and develop the capability to build capabilities (second-order dynamic capabilities: Collis, 1994). In contrast to absorptive capacity, knowledge sharing is the process of transferring know-how from one individual or firm to another. Knowledge sharing can be explicit or implicit. Although the former can be represented in a way that others can assimilate it (i.e., it can be codified), the latter largely remains unavailable to others. It can only be used by the person in possession of such knowledge.

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A lot of the knowledge in the biotechnology sector is tacit and complex. Tacit knowledge "refers to the implicit and non-codifiable accumulation of skills that results from learning by doing" (Reed & DeFillippi, 1990). It is recognized as a provider of sustainable competitive advantage because of its inherently non-copiable nature (Grant, 2013). However, this is more relevant in traditional industries where several firms may compete for the same product space with similar technologies. In the biotechnology industry, typically each firm is working with a unique technology and drug candidate, at least in the early development phases. Therefore, the challenge with tacit knowledge is different in this industry. Knowledge that is tacit is harder to codify and share, which can become a challenge for fruitful cooperation among alliance partners and project teams within the organization. It can lead to a poor conversion to innovations with commercial potential.

In terms of the complexity of knowledge inherent in the biotechnology sector, Simonin (1999) explains that it arises because "the number of interdependent technologies, routines, individuals, and resources linked to a particular knowledge or asset is high" and this "is expected to affect the comprehension of the totality of an asset and to impair its transferability". Thus, organizational routines play a key role in the sector by enabling biotechnology firms to "keep track of and hold on to their capabilities" (Cyert & March, 1963), and learning processes greatly influence how such organizational routines are created (Zollo & Winter, 2002).

At a firm level, knowledge sharing is the means for learning and creating routines to create the necessary capabilities. At the industry level, knowledge sharing can contribute in several ways to address the issue of reduced productivity in drug manufacturing firms, for instance, by designing more efficient testing processes that could improve quality and reduce the time required for regulatory approval. Knowledge sharing may also result in more effective drug protocols, that is, more effective research designs for testing drug candidates.

This is the paradox facing biotechnology firms in India: on the one hand, the nature of knowledge in biotechnology is difficult to transfer; on the other hand, transferability of knowledge is necessary to develop technological innovations, which are crucial for the growth of the sector in India. This paradox motivates the current research and leads to the question of how the firms in this sector are dealing with this paradox.

Objectives and Methodology

This study is an exploratory attempt to obtain a firm-level view of the knowledge-sharing practices employed and the impediments they face because of the tacit and complex nature of the knowledge in biotechnology. The study also attempts to inductively derive the beliefs and reasoning behind the knowledge-sharing practices.

The two objectives of this study are:

1. To develop a preliminary understanding of firm-level knowledge-sharing practices in the biotechnology sector in India.

2. To understand impediments to knowledge sharing at the firm level, if any.

To reach these objectives, interviews were conducted with seven individuals with extensive scientific, managerial, entrepreneurial, or manufacturing experience in the biotechnology sector in India (Table 1). Due to the exploratory nature of the study, the interview subjects were identified as a judgement sample, meaning they were recruited for the interviews through personal contacts of the author, who has a background in the field. The judgement sample included respondents with a range of experience across the spectrum of the industry.

The interviews were conducted over a period of eight weeks. The interview protocol was semi-structured in the sense that key open-ended questions relating to the research objectives were framed in advance and used as a guideline for discussions. The questions related to the shared understanding of knowledge sharing in firms and its perceived relevance, formal and informal mechanisms employed in the firms to facilitate knowledge sharing, and the impediments faced with respect to sharing knowledge. Discussions on each question were carried out until saturation was reached and no further new points emerged. A total of 33 hours were spent on the discussions for the entire sample with an average time of 95 minutes. Probing was used extensively to facilitate an understanding of the reasoning behind the various practices. Extensive notes were taken and key points were confirmed with the respondents. The notes were integrated during analysis. Cooperation was enlisted after providing for conditions of anonymity and confidentiality.

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Table 1. Overview of the sample of respondents interviewed for this study

Respondent	Years of Experience	Nature of Experience
A	15	Scientist in national laboratory and biopharmaceutical company; basic research; domestic experience
B	9	Founder manager of a biotechnology startup; pharmaceutical development studies; domestic experience
C	22	Employee manager with a contract research and manufacturing company
D	16	Scientist entrepreneur; contract research organization
E	26	Pharmaceutical formulations; quality control; domestic business experience
F	24	Pharmaceutical company manufacturing experience; technology transfer; international and domestic experience
G	19	Pharmaceutical company R&D manager; international and domestic experience

Findings on Knowledge-Sharing Dynamics

Facilitators of knowledge sharing

The interviewees in this study felt that, in their experience, knowledge sharing is high in teams that involve one or more organizations as in the case of a drug development team consisting of members from a biotechnology firm and scientists involved in basic research in a university or national laboratory. This finding is expected given that alliances always bring in new knowledge which in itself is a motivator for knowledge sharing in a knowledge-based industry. Other instances of intense knowledge sharing happen in firms when teams pursue accreditation goals or are involved in active business development work to procure contracts. In these cases, there is a shared sense of purpose to achieve recognition for the competencies in a firm. Field notes reveal that knowledge sharing in many firms is normally tied to solving technical issues as they arise on projects. Intensive sharing occurs until a solution is reached, and the respondents reported that this activity added substantial value.

Inhibitors of knowledge sharing

Time pressure for project completion almost always reduces knowledge sharing. Situations where not completing projects on time could result in the confiscation of intellectual property rights (which is the case according to Indian regulations) further discourage sharing of knowledge that is not immediately useful to facilitate the project at hand. Knowledge sharing may be compromised when team members from within an organization come from different levels of the hierarchy. A major reason advocated was that tacit knowledge of people lower in the hierarchy may not be shared with people higher in the hierarchy because of perceived power distance between Indian employees. A certain caution would be exercised by juniors in the team in the presence of more experienced seniors, partly from a fear of their opinions not being accepted and partly out of a desire not to transgress boundaries of authority. The literature recognizes the existence of different influences on employee knowledge sharing activities, such as individual, organizational, and technology factors (Lee & Choi, 2003). Firms in India could look at how organizational enablers could be put in place to overcome such cultural inhibitions.

Often, organizational members may not be aware of the depth of tacit knowledge available through other members until an opportunity arises from the environment. A case was quoted by respondent A about how a team member shared certain technical inputs with respect to stability studies in an interaction with the alliance partner. Through this incident, some members in the organization became aware of the team member as a locus of knowledge.

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Notably, the findings show that, although knowledge sharing is high in alliances, when the Indian firm has several alliances in place and when the same team members within the firm are involved in projects with more than one alliance partner, knowledge sharing goes down. In such cases, just enough knowledge sharing happens to achieve the immediate project goal. Having many alliances compromised knowledge sharing because more time was spent on the administrative aspects of managing the various alliances and multiple projects have to be completed as per given deadlines. This problem is compounded when the performance depends on the number of alliances (at the firm level) and the number of projects completed (at the individual level).

Founders' background

Founding members of firms who have had scientific careers, either in laboratories or pharmaceutical biotechnology companies, before taking up entrepreneurship tend to take a personal interest in setting up formal means for knowledge sharing and actively promote them among the technical staff. An important observation from the interviews is that founders of firms who hail from a non-pharmaceutical biotechnology background are more preoccupied with business development issues related to funding, alliance management, and the like. They may not actively or formally sponsor knowledge-sharing initiatives. It is largely left to individual scientific personnel to do it as they see fit.

Formalizing knowledge sharing

The respondents were divided in their opinions about formalizing knowledge sharing in organizations. As understood by the scientists, formalization would include mechanisms such as holding regular in-house seminars and workshops, writing whitepapers and reports as learning outcomes from completed projects, creating databases, and so on. In several cases, attempts to formalize knowledge sharing were seen to be artificial and not significantly contributing to business outcomes. They add value to individual-level knowledge and confidence, but it is difficult to trace their contribution to innovative project outcomes.

Arguments in favour of setting up formal mechanisms included codification of knowledge and an "awareness about the loci of expertise and the levels of expertise within the organization" (Respondent E). That is to say, the firm as a team would become aware about which individuals possessed what kind of knowledge and its level of sophistication. In the pharmaceutical-biotechnology context, this could mean experience in using a particular technique or richer troubleshooting when confronted with unexpected laboratory results. Further, it would enable some form of codification through the creation of troubleshooting manuals or reports that could be placed in the general repository for access by the team. Although almost all the respondents agreed on the near impossibility of codifying all tacit knowledge, they also felt that "any codification efforts, however meagre, are likely to contribute to overall productivity in projects" (Respondent F).

There was also a strong opinion about allowing knowledge sharing to happen on a need basis in projects. The reasoning was that knowledge sharing is more "accurate, complete, and rich" (Respondent A) when it happens as part of a project with a specific mandate because team members take the process seriously and they want the project outcomes to be positive. This attitude gives rise to an intrinsic commitment that makes a qualitative difference in the content and the way knowledge is shared. Also, the recipients are more engaged and receptive to the knowledge being transferred. A further reasoning was that knowledge acquired in such a situation is likely to be retained better, albeit as tacit in nature.

Knowledge sharing as part of routines set up by the management, such as regular workshops and other forms of supervised mechanisms, were not welcome to some of the scientists who preferred learning on a need basis and who felt it was difficult to anticipate in advance what they needed to know. Indeed, there was so much diversity in knowledge in this sector that "one could not assimilate knowledge in the expectation that someday in the future it could come in useful" (Respondent B). However, the chances of that knowledge becoming obsolete could not be ruled out. On closer probing, it was revealed that, in complex projects, as in projects that were new to the firm, it was difficult to anticipate the expertise that would be required.

What one respondent said about their project team was revealing. One of their project teams have worked successfully on several projects, and "their level of technical expertise and their comfort and understanding of one another all works together well" (Respondent G). When asked whether they could identify what worked for the team, the manager responded that it had not occurred to them to ask that question and "anyways it does not matter really, so long as the team continues to deliver on our innovation goals". It appears that the

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firm is happy to facilitate and allow what works to keep working without trying to impose a structure based on analysis and reflection. However, all respondents agreed on the utility of formal mechanisms such as regular email or newsletter updates on information about new projects, grants, discoveries and industry news, and so on, because this helped them to remain abreast of developments within the company and industry.

It can then be broadly inferred that the respondents are distinguishing between "know what" and "know how". Among the various mechanisms for knowledge transfer, apprenticeships and project-based deep interactions are considered by the respondents to be both effective and necessary for sharing know how.

One practice reported by one of the respondents in a firm that he worked with in the initial years of his career involved appointing an expert who was typically someone with multiple domain expertise and long tenure with the organization to support in responding to queries from less experienced team members. This practice worked well in the normal course except in situations where the investment of time and effort exceeded the perceived acceptable levels by the expert. In such cases, formal incentivization for the expert is required to keep the practice effective. However, in this particular case, giving a monetary incentive did not work as well because of the reduced gap in expertise between the expert and others and the subsequent loss in knowledge power acted as a disincentive.

Some instances of judgement-based knowledge sharing that were shared by the respondents involve a certain amount of discretionary evaluation of technical options or situations. In these cases, the knowledge is deeply personal and intuitive. Two considerations prevent knowledge sharing in these cases. One is the fear of sharing away the very know how that distinguished the knowledge holder as an authority in the domain, and the other is that there may be counter arguments about its veracity.

Team members in a project typically also have some parochial concerns. As one respondent who has grown from a purely technical career path to a managerial one in the pharmaceutical biotechnology sector puts it very strongly, non-routine sharing of deep knowledge involving time and effort and which can make a lasting impact on the realized absorptive capacity needs to be wired into the compensation and reward systems in the firm. It is additional effort that needs to be recognized as such.

A major impediment to knowledge sharing identified by a scientist respondent is the technical variety in projects undertaken by a firm. If the skills or expertise are not complementary, it would hinder meaningful sharing of know how. Often in complex pharmacokinetic decision-making studies, knowledge sharing is slow and tentative. As pointed out by a respondent, this may be the case sometimes even in not so complex studies but where the team has no prior execution experience. This reflects the theoretical observation made in literature. The degree of knowledge codifiability is of importance in determining the speed of the knowledge transfer (Zander & Kogut, 1995). Lack of time and preoccupation with administrative work is another reason cited for poor knowledge sharing in some quarters. In a growing organization, only knowledge that concerns the survival aspects of the firm is shared willingly. These patterns are formalized as routines and represent what is referred to as zero-order capabilities. Most firms have these in place.

Monitoring of knowledge sharing differs across the value chain. In the product development phase, when familiarity with the candidate drug is weak, monitoring is tighter and formalization of sharing is seen. This is not the case in areas such as repeat clinical trials requiring only minor modifications to procedures. Knowledge sharing as part of routines such as clinical procedures are said to happen smoothly and efficiently. A more lasting impact on knowledge sharing, especially the tacit form, is expected to happen by building a culture of sharing in organizations. However, this takes time and commitment and could happen organically as biotechnology firms evolve.

A notable observation from the personal experience of a respondent refers to the failure of a knowledge-sharing initiative in his current organization (a clinical research organization) because the recipients and the provider did not agree on the knowledge-sharing tools to be used in a specific knowledge-transfer exercise. Whereas the provider was willing to codify it in the form of whitepapers, the recipients were more comfortable with an apprenticeship program that the provider felt was too time consuming given his work commitments.

Other impediments mentioned during the course of the interviews include both organizational and personal or individual concerns. If systematic knowledge sharing is done on a regular basis, one significant organizational concern is employees leaving for better prospects. Against the background of a shortage of

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technical talent in the industry, this is an avoidable risk. Finally, although active knowledge sharing may not always be formally rewarded, its absence as part of workflow requirements are brought to the notice of the concerned team members, discussed, and rectified. This practice reflects the awareness that the Indian biotechnology firms have about being low on the learning curve given that they are in what is still a young industry.

As to the question on how tacit knowledge in individuals benefits the firm, the respondents opined that its manifestation happens in several ways. Those possessing it are able to process available data and "recognize patterns in it which others who lack that knowledge cannot" (Respondent B). Also, they are able to take quicker judgements or decisions that turn out right at the end of the project.

When a new project is obtained by a company, a key person is involved directly with the alliance partner. This person later transfers the knowledge acquired to other members in the organization. The richness of knowledge transfer is compromised because a lot of the tacit part cannot be transferred. To overcome this limitation, the key person is involved in all processes or activities, which reduces the versatile use of such resource persons. A solution used by organizations is to involve more members. A possible solution tried out by some firms is to appoint more key people to do the knowledge assimilation and transfer. In such cases, the effectiveness of knowledge transfer also depends on the collective assimilation by the group. Group dynamics during assimilation and transfer become important determinants of the extent and success of the transfer process.

Although involving a larger group would ensure that knowledge is dispersed in the firm, a shortage of human resources often acts as a barrier, which is a reflection of the macro-level constraint in the Indian biotechnology sector. Knowledge sharing is also hindered by the businesslike approach to problem solving adopted by some founder CEOs who do not have a science background. Scientists would prefer to complete the knowledge assimilation and sharing process, thereby bringing it to its logical conclusion so that the phenomenon in question is thoroughly understood. To achieve this, most of the respondents agreed that the means to achieve genuine transfer of knowledge is through observation, which can be facilitated through apprenticeships and mentoring.

A final but important point to emerge was the realization that knowledge sharing is also not very effective from an organizational point of view until individual technical staff fully understand the unique needs of their firm and have adapted their individual expertise to achieve the firm's goals. A hindering factor mentioned is a lack of a sufficient number of projects for them to work on.

Given that knowledge management as a discipline is still evolving in the Indian biotechnology space, each firm needs to assess the right mix of codification and network sharing that would be ideal given their firm's goals and strategies.

Conclusions

This study has provided an initial understanding and the rationale for the dynamics of knowledge sharing in the biotech sector in the Indian context. Knowledge sharing appears to be an idiosyncratic process for every firm given their level of current expertise and their strategies to achieve a competitive position in the market. Apparently, knowledge sharing is more free flowing when it spans organizational boundaries than when it spans organizational hierarchies. Barriers to knowledge sharing are more than the facilitating factors, as the findings reveal. This may be in keeping with the prominence of tacit knowledge in the sector. Experiential learning is important since knowledge is tacit and the tools which are felt to be effective include mentoring and apprenticeships.

To understand the implications, the findings of this exploratory study need to be related to the theoretical observations made in the literature regarding high-technology, dynamic, and knowledge-intensive industries. Eisenhardt (1989) refers to "high velocity" dynamic markets in which dynamic capabilities take on unique characteristics. They are experiential, iterative, and less predictable. The firms in such industries typically respond to these characteristics through the use of real-time information, intensive communication, knowledge creation, experimentation, prototyping, cross-functional teams, and multiple alternatives that are cross-functional. These strategies help to manage risk and build competitive advantage. However, the key challenges faced by firms are continuous knowledge transformation and its continuous erosion because of lack of structure. The levels of ICT usage appears patchy based on first impressions from this study. A more detailed study on the types and levels of ICT usage in different

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segments (e.g., clinical research, vaccines) could be useful. A segment-level approach is suggested because the extent of knowledge codifiability could differ across segments.

More insights are needed to understand how the dynamic capability of absorptive capacity is being operationalized in the Indian context. Possible answers to this would involve development of a suitable culture and setting up systems and structure to facilitate this. Future research using a multiple case design could look at these issues more closely for a deeper understanding.

About the Author

Tripurasundari Joshi is an Assistant Professor in the marketing area at the Institute of Management at Nirma University in Ahmedabad, India. She holds postgraduate qualifications in science and business administration. She has 13 years of corporate experience in business development, corporate planning, and management consultancy in the managerial cadre. She has carried out numerous research and business advisory assignments for large corporate clients. She has also worked on technology status and technology market assessment studies for the Government of India, and she has executed several projects funded by the World Bank and Asian Development Bank. She has received grants for working on social projects sponsored by national institutes of repute such as the Indian Space Research Organization. Since 1999, she has been involved as a full-time core faculty member in the Marketing area of Business Management and has been active in institution-building activities in various academic administrative capacities. She has authored several books, monographs and technical notes and has presented and published research at national and international conferences. She has also visited universities and industry associations in Australia, China, Singapore, and Hong Kong for research and business interactions.

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Understanding the Role of Rural Entrepreneurs in Telecentre Sustainability: A Comparative Study of the Akshaya and eSeva Projects in India

Gaurav Mishra and Balakrishnan Unny R

> *"We all of us need assistance. Those who sustain others themselves want to be sustained."*
>
> Maurice Le Sage d'Hauteroche d'Hulst (1841–1896)
> Priest, writer, and orator
> In *The Way of the Heart*

In rural areas of India, telecentres provide access to computers and other digital technologies and have been utilized as a delivery channel for various government services. Following a public–private partnership (PPP) model, there is a general belief among policy makers that the revenue from government-to-consumer (G2C) services would be sufficient to cover the village-level entrepreneurs' cash flow requirements and therefore provide financial sustainability. Also, the literature suggests that telecentres have a large enough market for public-access businesses to be commercially viable. In India, around 100,000 telecentres are being set up to serve 600,000 villages – one telecentre for every six villages – to provide one-window access to government services. In the literature, a lack of government services is often quoted as a reason for telecentre failure. This study, using an exploratory approach, aims to understand the parameters that relate to the sustainability of telecentres across a number of common, government-related services. It is observed that some telecentres perform better than the others even though they have the same number of government-related services. Reasons for such differences are explored and the learnings from this research will benefit the stakeholders who are engaged in providing telecentre-based services in other developing countries. In addition, a theoretical framework is suggested to understand the dynamics between different types of sustainability parameters such as financial, social, staff, technology, and institutional. The findings of this research have policy implications in terms of the way services are designed and delivered through telecentres in developing countries such as India.

Introduction

Information and communication technologies (ICTs) are hailed as important tools for rural development and are considered essential for enhancing livelihoods of people in rural areas (Gilbert et al., 2008). According to Geldof and Unwin (2005), ICT can be used as a tool for strengthening education, improving public services and governance as well as for supporting agriculture and the service industry. Telecentres are seen as one of the most successful means to promote ICT diffusion in developing countries because they increase the access of ICT to people, particularly the poor people living in remote rural areas (Gopakumar, 2006).

Roman and Colle (2002) define a telecentre as a public place where people can access a variety of communication services. However, telecentre implementations in developing countries have not always been successful. In addition, there is not much research on the cause of collapse of telecentres though sustainability of telecentres is a key issue debated surrounding the use of ICT-enabled projects in developing countries (Harris et al., 2003; Sigweni et al., 2017).

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In India, there is a lot of emphasis put on the implementation of telecentre-based projects given the opportunities they provide to rural citizens. For example, in the Government of India's National e-Governance Plan (tinyurl.com/y8twn3w8), with a commitment of around one billion dollars, 100,000 telecentres are to be established in rural areas to improve service delivery to citizens and businesses (IIITB, 2005; Mukerji, 2008). These telecentres are implemented based on the public–private partnership (PPP) model and mainly for-profit organizations. Under this model, public organizations provide a suite of services and other necessary support to telecentres. The entrepreneurs are supposed to invest, maintain, and operate the telecentres. In this model, the PPP is a contractual agreement between the government and a village-level entrepreneur to supply infrastructure assets or services for telecentres, which are known as "common service centres" under the National e-Governance Plan. The government is responsible for managing the implementation of the project and providing e-government services such as application forms, income and caste certificates, and utility payments such as electricity, telephone, and water bills. Within the national plan, the aim of the Common Service Centre Scheme is to establish one common service centre for every six census villages. The Government of India envisages common service centres, or telecentres, as integrated front-end delivery points for services from the government, the private sector, and the social sector for the rural citizens of India. Through a social development approach, telecentres intend to help individuals and communities to address social needs of the disadvantaged and excluded less-resourced majority of a community. However, the said approach generates considerably high social capital since it is community driven, but it is weak on financial sustainability (Meddie, 2006).

Problem statement

Much literature is available on studies of telecentres in India. For example, Bhatnagar (2003) analyzed the effectiveness of the Bhoomi project, whose aim was to computerize land records and to reduce corruption with respect to the land records of farmers in the state of Karnataka, India. He concluded that there was a decrease in corruption as the project reduced the discretion of government officials by the introduction of an online form to request alterations to land records upon their sale or inheritance.

For village-level entrepreneurs, the sustainability of telecentres is crucial because their livelihoods depend on them. However, the literature defines several types of ICT sustainability, namely: financial, technological, social, institutional, and staff. Financial sustainability refers to the capability of telecentres to earn sufficient income for ongoing maintenance and operation. Technologically sustainability ensures that any change in technology does not affect the availability of products and services through telecentres (Misund & Hoiberg 2003), and technological sustainability is therefore related to financial sustainability (Kuriyan & Toyama, 2007). A socially sustainable telecentre is able to meet the service needs of citizens. Institutional sustainability is the relationship of ICT-enabled projects to various public and private institutions for services, infrastructure, support, etc. Staff sustainability refers to the continuous availability of skilled staff for telecentres; it is the capacity or extent to which trained people, or their trained replacements, continue to work on the same project.

Policy makers believe that the revenue from government-to-consumer (G2C) services would be sufficient to cover the operator's cash flow requirements. Also, the literature suggests that telecentres have a large-enough market for public access businesses to be commercially viable. However, a lack of financial sustainability is often seen as the cause of telecentre failure. However, other types of sustainability are also discussed in the literature on telecentres, such as social (Tschang et al., 2002); technological (Proenza, 2001); institutional, staff, and environmental (Harris et al., 2003); political (Pade et al., 2006); and service-related (Rao, 2008).

Moreover, many models define the evolution of entrepreneurial ventures (e.g., Levie & Lichtenstein, 2010; Morelli, 2003; Rao, 2008) may be applicable. According to Fuchs (1998), telecentres follow product lifecycles, and throughout the life of telecentre development and establishment, it is important for the entrepreneurs to adopt and follow the principle of "demo or die". When the demonstration does not work, it is important to understand why and take appropriate steps to make sure that the telecentre does not then die due to recurring errors. Indeed, telecentre-based projects that are located in poor rural areas might have to be self-sufficient by the end of the project lifecycle (Mercer 2005). Hence, we have to understand the telecentre evolution in the light of a product lifecycle. In addition, we also need to understand the factors influencing the sustainability of telecentres at different stages of evolution, from their introduction, growth, and maturity to their decline. However, there is limited understanding of

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how different types of sustainability parameters are related to the stages of telecentre lifecycle and how they are interrelated.

Through this study, we attempt to provide a theoretical framework to understand the dynamics between different types of sustainability parameters – including financial, social, staff, technological, and institutional – and relate them to the stages of the telecentre lifecycle. Based on literature review, the authors are of the opinion that these five sustainability parameters are crucial to the running of telecentres. Thus, due to time and resource constraints, we have limited our scope to only these five sustainability parameters. However, in future, we intend to address other sustainability parameters of telecentres. In addition, we try to identify the roles of telecentre stakeholders at different growth stages. The overall objective of this study is to draw lessons that would help in improving the sustainability of telecentres throughout their evolution.

Research Methodology

A social constructivist epistemological position is taken for the research. The basic idea behind constructivism is that reality does not exist objectively, rather it is constructed by human beings subjectively. According to Madon (2004), a constructivist approach is most common in interpretive case studies. The telecentres movement is seen as an innovation in rural areas and, according to Gaiani and colleagues (2009), important factors affecting the use of innovations can be identified using a constructivist approach whereby each person is seen as a unique individual with unique peculiarities and backgrounds. There is lack of information on the critical sustainability issues affecting the development of ICT-based projects in rural communities (Meng et al., 2013); therefore, we took an exploratory approach. An exploratory approach is suitable where little information exists regarding the workings and impacts of the programs under study (Barkley, 2006).

We collected the data using qualitative methods, including focus groups and semi-structured interviews. Qualitative methods of data collection helped us answer the "why" and "how" part of the problem statement.

For the study, we selected two projects in rural India: the Akshaya project (Box 1) in the Kollam and Mallapuram districts of Kerala and the eSeva project (Box 2) in the West Godavari district of Andhra Pradesh. Both have been running for more than five years, meaning they can provide greater insights on sustainability than relatively newer ones. In addition, the projects also provide a number of e-government services, which provides an opportunity to study diverse services and their delivery.

We selected study subjects on the basis of convenience sampling due to time and resource constraints (Table 1). In addition to holding a focus group for each project, we interviewed 50 entrepreneurs and 4 government project officials from the Akshaya project and 28 entrepreneurs and 3 officials from the eSeva project.

The sample size was deemed appropriate for the study because we stopped interviewing new respondents at a point where no new value-driven information was being provided. A greater number of entrepreneurs than

Box 1. The Akshaya project (tinyurl.com/yclfnxr5)

The Akshaya project aims to address the issues of ICT access, basic skill sets, and availability of relevant content and government services in rural areas of Kerala, India. The project was launched in November 2002 in the Malappuram district of Kerala as a pilot. Its goal was for at least one person in every family in the district to be computer literate. Based on encouraging results, the project was rolled out throughout the state of Kerala in 2004. The main services provided through Akshaya centres are e-payment of utility bills such as electricity, water, and telephone bills. In addition, traders and business can file their sales tax returns in Akshaya telecentres. Citizens can also book train tickets through e-ticketing facilities. The Akshaya centres also provide technical education, mostly in computer software and hardware. However, they have spread their activities into other fields such as bioinformatics, medical transcription, and mobile communication. Keltron (keltron.org), an undertaking of the Government of Kerala, collaborated with the Akshaya project to provide a medical transcription course. The India Gandhi National Open University (ignou.ac.in) offers a distance education programme through the telecentres in areas including art, science, social science, and information technology, and the fee structure is such that the courses can be afforded by the disadvantaged sections of the society.

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officials were chosen for the interviews because they are central to telecentre sustainability. The government has provided a platform for the entrepreneurs to earn revenue through telecentre services. The entrepreneurs belong to the local communities, and therefore, they provided rich data on how the local context and their actions have influenced sustainability parameters at different stages of their evolution. Project officers were useful in providing details of project implementation, service roll-out, and other related aspects of the project sustainability. Table 1 provides an overall profile of the respondents across both projects.

We used grounded theory coding for the analysis because it is useful in studies of comparatively unexplored areas (Samik-Ibrahim, 2000). Also, given that the focus of the study is to build theory, grounded theory helps to explain, at a broad conceptual level, a new and unexplored process, action, or interaction about a phenomenon (Creswell 2002). Thus, we qualitatively examined the texts from the interviews, field notes, and relevant documents by means of basic coding and interpretive analysis. The texts were then analyzed to identify relationships, themes and patterns in the discourses regarding how they related to the research objectives. The qualitative responses of the respondents were analyzed by developing theoretical categories from the data, which helped in analyzing relationships between key categories (Charmaz, 1990). We used both predefined codes from our literature review of telecentre sustainability (e.g., social sustainability, technology sustainability) and custom codes. Each piece of content was analyzed at an individual level and then compared across participants to identify patterns and common categories.

Table 1. Overall profiles of the study subjects (i.e., entrepreneurs and project officials) from the Akshaya and eSeva projects

Parameter	Details
Average Age	27 years
Education	70% have a graduate degree 10% have a post-graduate degree 20% do not have any degree
Average Annual Income	Rs. 200,000 (approx. $4000 CAD)
Gender	80% male; 20% female

Box 2. The eSeva project (esevaonline.ap.gov.in)

The objective of the eSeva project is to provide vital information that was formerly inaccessible to citizens in rural areas at the click of a button and therefore this project is described as "citizen centric". The project regards information as a crucial for bringing about a change in human lives. ICT is deployed for bridging the gap between citizens and government. The project was initiated by government in the West Godavari district of Andhra Pradesh. The major focus of the project was to provide government-to-citizen (G2C) and customer-to-customer (C2C) services in rural areas. To provide these services, 150 telecentres were opened in the district in 2003. The main services available when launched were:

- online filing of complaints and grievances: citizens had the option of making a complaint against any government official and were able to hold government officials accountable
- online application registration: the centres enabled web citizens to apply online for any government scheme, for example, a loan towards self-employment or an old age pension)
- issuance of certificates (e.g., from government related to nativity/residence, income, and caste)
- issuance of land records (e.g., farmers could apply for the latest land-related documents, register a change in land title)
- online auctions and bidding
- payment of dues/utility bills
- access to information related to government contact details, police station, hospital, fire station, etc.
- matrimonial services for prospective brides/bridegrooms
- online civil supplies allotment (e.g., to collect allotment orders online from the centre without having to "grease the palms" of government officials)
- tele-medicine/tele-agriculture/e-education and citizen forum (e.g., services for an online discussion forum to citizens through the portal for problems and issues in their locality, put ideas forward, etc.).

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Findings and Discussion

Based on the qualitative analysis, we identified four stages in the telecentre lifecycle and their relationships with the different types of sustainability (financial, technological, social, institutional, and staff) (Figure 1).

First, there is the *introduction* stage, when the telecentre has been created in the rural area. In this stage, the participants felt that there is a need for extensive support from the government agencies as they are unaware of the regulatory requirements. Also, a speedy registration and approval process will help the telecentres. There is also a need for training to use the ICT resources of the telecentre. One of the entrepreneurs of the eSeva centre [ES14] said that, at the start of the project, government support ensured that an appropriate suite of services was available, but that frequent leadership led to the closure of around 90% of services. However, the Akshaya project started with just a few services available, including an e-literacy programme, and other services were added later. As stated by one Aksaya respondent [AS34] noted: "When the e-literacy was programme was over, additional services like e-payments were started". In addition, private players supported the centres with additional education-based services such as Intel Learn. Such support was not observed in the case of the eSeva project as "only e-payment services are active now" [ES21]. The government support in the initial and subsequent phases ensured a continuity of services. Therefore, in the initial stages, institutions have to do some handholding, which can be reduced as the telecentre matures and offers more services.

However, the role of the entrepreneurs is also important in the initial stages as they are mobilizers for creating trust in rural citizens towards the centre and its services. For example, during the first few months after setting up her telecentre, one entrepreneur [AS13] raised awareness by going door to door to tell people about the services available – even though she was known to most villagers. It is necessary to create trust in citizens in the early stages of a telecentre's lifecycle.

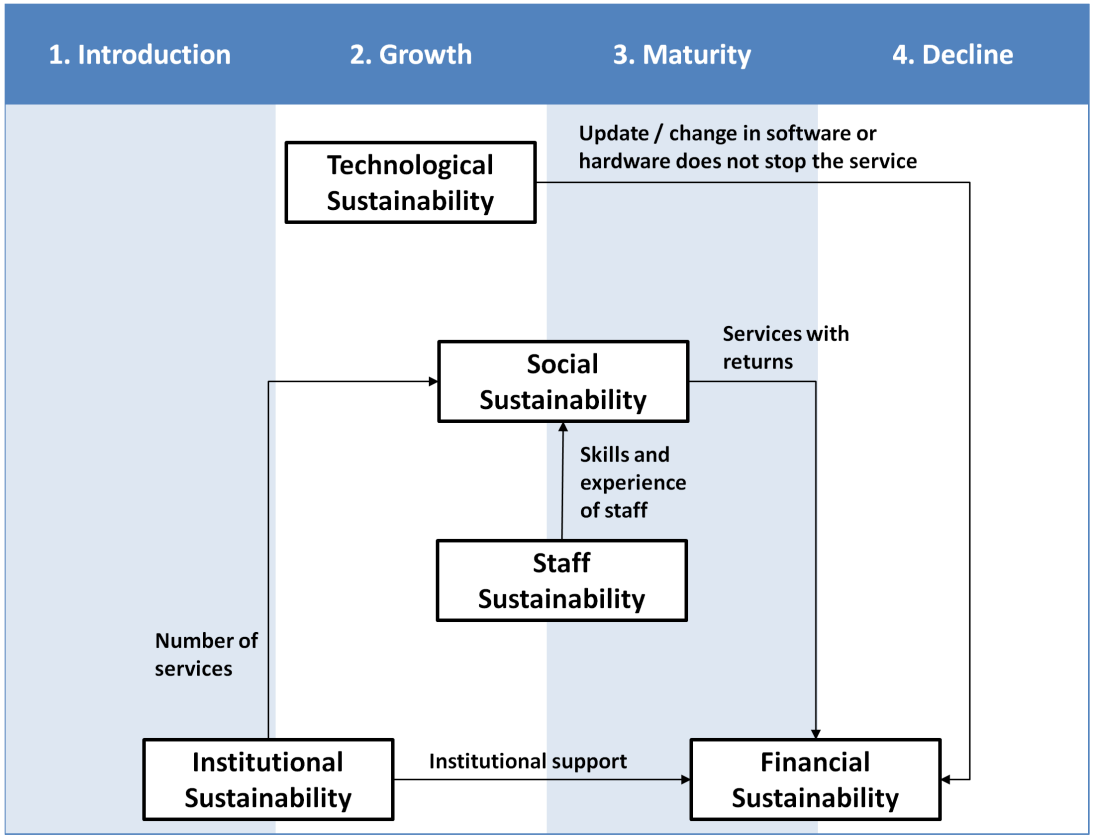

Figure 1. The key relationships between the different types of sustainability across the four stages of the telecentre lifecycle

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Other innovative approaches used by entrepreneurs included talking about services at village level meetings, during religious gatherings, etc. Such social influence creates trust and motivates people to use telecentre services. It was observed that entrepreneurs who engaged with villagers on a consistent basis from the inception of their telecentres had greater footfalls.

The second stage in the lifecycle is the *growth* stage where the telecentre's benefits have been accepted by the public and thereby there is a rise in the use of the services. The participants felt that there are so many factors that may hinder the growth of the telecentre. The first factor is the disruption in the technology infrastructure. Any issues here will have a significant impact on the people's confidence in the technology, which they are just beginning to trust. As rural citizens do not directly interact with high technology, the role of entrepreneur/employee is very significant. Rural citizens were time conscious and expected prompt services. This promptness of service delivery is of value to people, and any shortcoming in service delivery will affect trust. Therefore, entrepreneurs have to ensure that they and their employees are aware of the technology usage. Also, it was observed that entrepreneurs who were skilled in handling hardware and software issues of both the computers and other related peripherals were often able to provide continuous, uninterrupted service, and thereby enhanced customer trust. Therefore, where entrepreneurs do not have such skills, they should maintain backup resources for smooth service delivery. The second factor is support from the community, which is vital at this stage. Many participants relied heavily on the support from community leaders to make the telecentre part of the community's daily activities. The participants also felt that their presence in local events helped in spreading awareness. Given that most of the telecentre entrepreneurs are from the local community, there was limited resistance from the public. At this stage, entrepreneurs should seek to provide additional services that might be relevant in the telecentres' social context. For example, an entrepreneur [AS12] noted that many people from his village went to the Persian Gulf for jobs, so he started offering UAE Exchange services in his telecentre to meet the demand for this particular money exchange. Similarly, a telecentre located in the panchayat (local village) provided the entrepreneur with the opportunity to develop service to provide all the necessary assistance to customers in filling in government application forms. Also, it was seen that services such as telephone bill payment were not relevant in some eSeva centres because there were no landline telephone facilities in many villages. Therefore, not only is a continuous flow of services essential for financial sustainability, but also relevant and socially acceptable services – customized to the local context – have to be provided.

The *maturity* stage is when the community has completely accepted the use of the telecentre. In this stage, the transactional services provide the major part of the revenue. Most eSeva entrepreneurs depend on e-payment services for the financial sustainability of their centres. They even go to villages to collect electricity bills using hand-held billing machines. There is constant flow of revenue from services such as utility bill payments. The number of customers at this stage is more or less constant. However, due to inflation, increase in rent, increment in the salary of operator, etc., the operational costs tend to increase over a period of time. Hence, entrepreneurs have to increase suite of services in addition to what is provided by government. Services may be added based on the social context as discussed earlier or they may collaborate with other private players for additional services. For example, some Akshaya entrepreneurs added medical transcription courses at their centres. In another instance, some centres included computer courses to enhance their revenue. The entrepreneurs who were not able to enhance their revenue struggled to meet operational expenses once their customer base became constant. Also, the participants noted that, in this stage, employee attrition is at the maximum, thereby putting a strain on the telecentre operations. To overcome this issue, some entrepreneurs engage youths of their own villages. Our data shows that operators who belong to the local community have been working in the centres for an extended period of time as they are averse to any relocation. The services provided up to the maturity stage are not observed to provide social development as the major emphasis of entrepreneurs is revenue generation. Though there were services that related to social capital in the earlier stages, entrepreneurs did not take interest in promoting those services due to lack of revenue generation capability of such services. At the maturity stage, some entrepreneurs started focusing on information-based services to enhance social sustainability. The underprivileged used the centres for various information services such as providing contact details of government officials, information on government schemes, etc. By doing, this the entrepreneurs felt that they were providing a service to society, and their reputations in their villages have increased.

The last stage in the lifecycle is *decline*. Many participants felt that this stage will be delayed as there are

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more services being introduced by the government that will keep the telecentres in constant demand. An example of a new service is the Aadhar (foundation) card process, which was launched by the Unique Identification Authority of India (UIDAI) to provide unique biometric identity numbers to all residents of India. However, compared to Akshaya telecentres, eSeva telecentres have insufficient services for financial sustainability. eSeva entrepreneurs feel that there must be more financial support from the government to help make the telecentres sustainable. Although such a demand was not explicitly expressed by the Akshaya entrepreneurs, they expressed their need for continual training and support from the government.

Conclusion

The literature suggests that telecentres generally struggle and often fail to achieve financial sustainability. However, financial sustainability is associated with a number of factors including better management, strategic locations, local demand, new service development, locally relevant services, external linkages, and networking (Sey & Fellows 2009). However, in this study, different sustainability issues were seen as particularly relevant at different stages of the telecentre lifecycle. Both Akshaya and eSeva projects have commercial services (e.g., utility bill payment) and non-commercial services (e.g., information), and it is reflected in the literature that the commercial model is better for financial sustainability and the non-commercial or social model fosters social capital (Toyama & Kuriyan, 2007; Meddie, 2006). Based on our results, we conclude that the social capital model can be added to the commercial enterprise model at the maturity stage of the telecentre lifecycle because financial sustainability can be ascertained with commercial services. When the centres are financially sustainable, additional social capital services may be included. Also, a mechanism should be devised by the entrepreneurs to fix costs for such services given that most entrepreneurs studied have difficulty in setting the price for non-commercial services.

This study, though set in India, has a global reach. Telecentre-based projects are implemented in many parts of the world, and most of them focus on empowering citizens. The findings of this research have policy implications in terms of the way government services are designed and delivered through telecentres in developing countries. Thus, learnings from this study may also be useful in the implementation of telecentre projects in other parts of the world.

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Technology Entrepreneurship in Emerging Markets: An Exploration of Entrepreneurial Models Prevalent in India

Shiv S Tripathi and Mita Brahma

> *"In the business world, the rear-view mirror is always clearer than the windshield."*
>
> Warren Buffett
> Business magnate, investor, and philanthropist

Are the features and processes of entrepreneurship – such as wealth creation, risk taking, vision, identification of a niche market, launching new products, and so on – common across the world? Many would assume they would be. However, firms that are entrepreneurial in nature and belong to emerging markets may or may not follow the established models of developed economies. In this study, we sought to explore various types of entrepreneurial models that are prevalent in an emerging market. For this purpose, we collected primary and secondary data to identify characteristics of technology-based entrepreneurial firms in India. Based on the two dimensions of degree of demand/supply and expected loss/risk, we identify four models of entrepreneurship – incremental, proactive, radical, and reactive – and illustrate each model with examples from Indian companies.

Introduction

In this article, we revisit theories of entrepreneurship to explore some of the unique features of technology entrepreneurship and how they may interact with the distinctive features of emerging markets. With the help of inputs from practicing business models and 20 personal interviews with technology entrepreneurs, we propose a framework that describes how the various technology entrepreneurship models in emerging countries are derived.

A successful venture creates wealth for its entrepreneurial team and it creates value in the marketplace (Sarasvathy, 2001). However, technology has changed both the perspectives on uncertainty in new ventures, as well as the estimates of outcomes. Crowdfunding and digital marketplaces have created a platform where available resources, capabilities, constraints, and risks are redefined. Technology has simultaneously changed the rigid boundaries between phases of a new product or service. The outcome is dynamic, non-linear, continuously tested in the marketplace, and evolving (Nambisan, 2017).

Emerging markets have greater uncertainty in their political and business environments. They have greater constraints by way of economic and government policies, and in infrastructure. However, given an opportunity, the constraints can at times be surmounted by a leapfrogging technology or the use of technology to develop a new business model. Emerging markets present highly skilled and low-cost labour; unmet needs of the consumer; and differing buyer behaviour in diverse segments. They present challenges of finding early adopters, marketing and distribution issues, and low-price points. The firms that succeed do not follow the established business models of the developing economies. They succeed by finding innovative methods of aggregating the demand or supply, or of making access or usage easier for the customer, by using innovative business models (Thukral et al., 2008).

Following the opening up of the economy, and the subsequent rapid expansion of the mobile and Internet sector in India, there has been a surge in the number of startups being established in the country. Most of these startups use technology as an enabler. Therefore, in this study, our approach was to look out for patterns in

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the entrepreneurial models of some of these firms using technology at the core of their business model. We collected primary and secondary data to identify the characteristics of entrepreneurial firms in the technology domain only. We compared and contrasted the business models of these firms with models of developed markets, and we developed a framework to position these models. Overall, this framework is intended to represent the types of entrepreneurial models of emerging market firms whose core enabler of business model is technology as compared to any other resource.

Entrepreneurial Models and Technology Entrepreneurship

Most entrepreneurial research in developed nations has focused on new venture creation. The dimensions explored are the environment in which the venture gets created, the individual(s) creating the venture, the process of its creation, and the type of venture itself. Research has focused on the process of identification and exploitation of opportunities as being at the heart of the entrepreneurial process. Researchers have explored how, why, and when opportunities come into existence. Why, when, and how some people discover these opportunities and not others. And, out of these, why, when and how, some entrepreneurs (and not others) exploit the opportunities. The venture-creation process that followed opportunity identification and the performance of the business venture were in a sense, consequences of the opportunity-discovery activity (Shane & Venkataraman, 2000).

Factors such as prior knowledge – of markets, of technologies, of customers and of business processes – have been explored as factors contributing to the opportunity-recognition process (Shane, 2000). These explorations reiterated the position of individual entrepreneurs and entrepreneurial teams as being pivotal to the opportunity identification process. The processes following opportunity recognition and identification are usually to do with planning and designing, gathering resources, identifying customers and markets, producing and selling the product, while building the organization and managing regulatory processes (Gartner, 1985). The effectuation process, however, starts on a different note, with the process of identifying the available means of evaluating constraints and of exploring alternatives, while keeping risks and losses at an affordable level. This process works more often in dynamic and non-linear environments. The entrepreneurs look for alliances as a method to manage uncertainties in the future, to create markets, and to build cooperative allies for contingencies (Sarasvathy, 2001).

As a specific type of entrepreneurship, technology entrepreneurship is defined as "an investment in a project that assembles and deploys specialized individuals and heterogeneous assets that are intricately related to advances in scientific and technological knowledge for the purpose of creating and capturing value for a firm" (Bailetti, 2012), and at its heart is the establishment of new technology ventures. Individual technology entrepreneurs have been categorized as researchers, producers, users and opportunists as per their technical orientation and background. However, technology entrepreneurs are often a mix of these attributes. Also, entrepreneurial teams have a combination of these attributes (Jones-Evans, 1995). Technology entrepreneurs differ in the ways in which they draw on resources and structures to exploit technology opportunities. They may focus on self-dependency or on the right network and alliances (Tzu-Hsin et al., 2005).

The process of technology entrepreneurship is about recognizing, creating, and exploiting opportunities, and assembling resources around a technological solution, irrespective of the organizational context (Bailetti, 2012; Ratinho et al., 2015; Spiegel & Marxt, 2011). The technological solution opens up new possibilities, it allows the reduction of transactional costs (Williamson, 2005), and it has the ability to use new a technology product paradigm to provide a solution to a market gap (Ratinho et al., 2015). Technology entrepreneurship differs from general entrepreneurship in that it focuses on technological opportunities that require deep technological as well as managerial capabilities (Prahalad & Hamel, 1990; Walsh & Linton, 2011). In other words, it requires a higher level of technical capabilities and management of a risky environment (Harms & Walsh, 2015). Alternatively, it involves the same opportunity identification, organization, and execution found in any other form of entrepreneurship but around a focused technology and a business model that makes it unique.

Entrepreneurship in Emerging Markets

Entrepreneurship is found to contribute to wealth creation and poverty alleviation in nations. By creating disruptive influences, it contributes to a better wealth distribution in the country. It creates jobs and improves the standards of living. It addresses gender inequality in

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the process. It also builds a better balance for regional economic development indices (Noel & Banerjee, 2014). However, in an analysis of R&D spend as a percentage of GDP, India ranked far behind China, Brazil, and Singapore (UNESCO, 2018). Thus, the science, technology, and innovation policy of India has identified measures to improve a national knowledge network, infrastructure, and investments. It includes measures such as enrichment of the knowledge base; incentivizing R&D in the public and private sectors; improving governance in science and technology institutions; fostering collaboration between academia, industry, and scientific establishments; promoting collaboration through clusters; supporting the financial system; providing a platform for best practices and innovations; improving the flow of technology; developing and protecting intellectual property rights; and implementing geographic information systems (Planning Commission of India, 2018).

In terms of entrepreneurship, less than 16% of the Indian population within the 18–64 age group were found to be engaged in entrepreneurial activity, as compared to 41% percent in China, and 48% percent in Brazil (Chaurasia & Bhikajee, 2016). In India, some of the factors that inhibit entrepreneurship are: its caste system, its cultural values that affect the acceptability and utility of entrepreneurship, and governmental regulations that have a monitoring and control perspective (Dana, 2000). On the other hand, the Indian entrepreneur is known for "jugaad", or frugal innovation. Consumers, governments, and organizations benefit from the practice of such flexible and inclusive forms of innovation to be able to find sustainable solutions (Prabhu & Jain, 2015), especially in an emergent market such as India.

Emerging markets present a significant growth potential, with a positive and significant growth rate of gross domestic product, and growing aspirations of their people. However, they present unique challenges as well. To build sustainable solutions in keeping with the varying needs of different socio-economic segments, products and services have to build on greater knowledge from the customer. As per Goyal and colleagues (2017), some of the approaches companies in emerging markets have taken are:

1. Leverage volume-based cost efficiencies because they increase market share. This approach involves sufficient value creation for the given market segment.
2. Bundle offerings in various innovative ways to suit different pockets, and thus to capture different tiers of the market.
3. Separate and unbundle various business processes into separate units. This allows organizations to focus on processes relating to their core competencies, and thus drives efficiency.
4. Follow open innovation of both types: "outside in" by using external ideas and research and "inside out" by licensing or sharing internal innovation ideas and products.
5. Follow a "hub and spoke" arrangement of infrastructure and business services, with the smaller spokes in the less accessible and less developed areas.
6. Use crowdsourcing and grow a network of multiple suppliers. This builds safeguards for contingencies and also reduces dependence on key resources.
7. Offer "price-minus" or "challenge-cost" pricing. This involves working out a suite of features for a product to match the paying capacity of the buyer while at the same time creating a value proposition.

Furthermore, research by Majumdar and co-authors (2010) on 876 firms in the Indian software industry found that, on one hand, the more dominant firms undertake higher-margin activities. The less powerful firms, on the other hand, follow a more uncertain path, with lower revenues per employee.

Method

We contacted 20 technology entrepreneurs in India and asked about their current business, how they had identified opportunities, what motivated them to pursue these opportunities, and how they continuously adapted their business with feedback from associates, as suggested by Karlesky (2015). A discussion guide was used for this purpose, and we found that we reached theoretical saturation with 20 respondents.

Technology entrepreneurship firms have been broadly explored in the literature as per the themes of the environmental factors influencing them, the strategies deployed, and processes of organizing their resources and technologies (Shane & Venkataraman, 2003). The four control variables to select the firms in this research were: i) they were using technology as the core of their

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business model; ii) they had a presence throughout India; iii) they were successful; and iv) they must have been in operation for at least the past 3 years. The firms explored in this research belonged to the following domains: information technology; travel and entertainment; embedded systems; cloud computing; and the banking, financial services, and insurance sectors. All were technology-based entrepreneurial firms that operated in urban and semi-urban India. Here, technology-based entrepreneurial firms means those companies that use technology (i.e., proprietary technology, including single-sided or multi-sided platforms) at the core of their business model. It means that, if one removes the technology part from the business model of these firms, they will cease to exist. Therefore, these firms used technology as their core competency and were either selling products or services themselves or provided a platform for clients and servers.

We used the theories of two classical economists towards entrepreneurship given by Joseph Schumpeter (1974), who focussed on the demand-side innovator, and the other used by Frank Knight (1964), who based his analysis predominantly on the type of risk an entrepreneur was taking to arrive at the synthesized (Leyden & Link, 2015) model to analyze the approaches of the companies. We adopted a framework of comparing the entrepreneurship firms based on a dual approach. First, we examined the entrepreneurial firm's approach to providing technology solutions to the customer; second, we examined the entrepreneurial firm's approach to risk management in an effectuation mode. Based on their inputs followed by a content analysis of the interviews from 20 respondents using the discussion guide, the results were grouped into four approaches as described below. The responses were categorized based on the approach followed by these technology entrepreneurs to launch a new venture. In total, four themes (approaches) emerged out of the content analysis. The first approach comprised firms developing a minor yet unique value proposition using technology as the differentiator, in a market where already a number of players existed. The second approach comprised those companies who tried to capture the need of the market before anybody else could do so, distinctively keeping the entire country's market in mind. The third approach was followed by companies who disrupted the market by offering a technology solution that never existed before. A fourth approach was followed by some companies who seconded an earlier player and typically followed a "me too" strategy.

Results

For each technology firm we surveyed, we classified their use technology to create value propositions for their customers. We then classified this use along two dimensions – the degree of change brought about and the degree of risk taken – which yielded four approaches to technology entrepreneurship (Figure 1):

1. Incremental
2. Proactive
3. Radical
4. Reactive

As listed in Figure 1 and described in the subsections that follow, our exploratory research found examples of all four models in the firms surveyed. As entrepreneurs decide on methods of opportunity exploitation, they are guided by considerations of containing losses and covering for contingencies (Sarasvathy, 2001), and by the economic factors of demand and supply (Dawson et al., 2016). Rather than making grand plans, they make incremental plans based on their means and constraints. However, the ready availability of capital, social, and relational capital may change their risk perceptions.

1. Incremental

Companies in this category are based in a quadrant where the expected risk is low and the firms aim to make a small change in demand and supply. Such firms identify an existing need and develop a technology solution around it to fulfil the need in a much better way or provide for ease of use through their technology solution, all by keeping the risk levels low. The technology solution is unique, scalable, and fulfils a major existing need of the consumers. Some examples of companies belonging to this quadrant are:

- **Ferns N Petals** (fnp.com) is one of the largest retail chains that sells flowers and gifts. Founded in 1994 in New Delhi, India, it started with selling roses and other flowers for weddings and birthdays, at parties, and at its retail stores. Vikaas Gutgutia, the founder, did try branching off into a food business, but that was not a success. Vikaas realized he knew the flowers business best and could link up with the best people in the flowers business, assuring customers of a standard quality, something he had failed to manage in the

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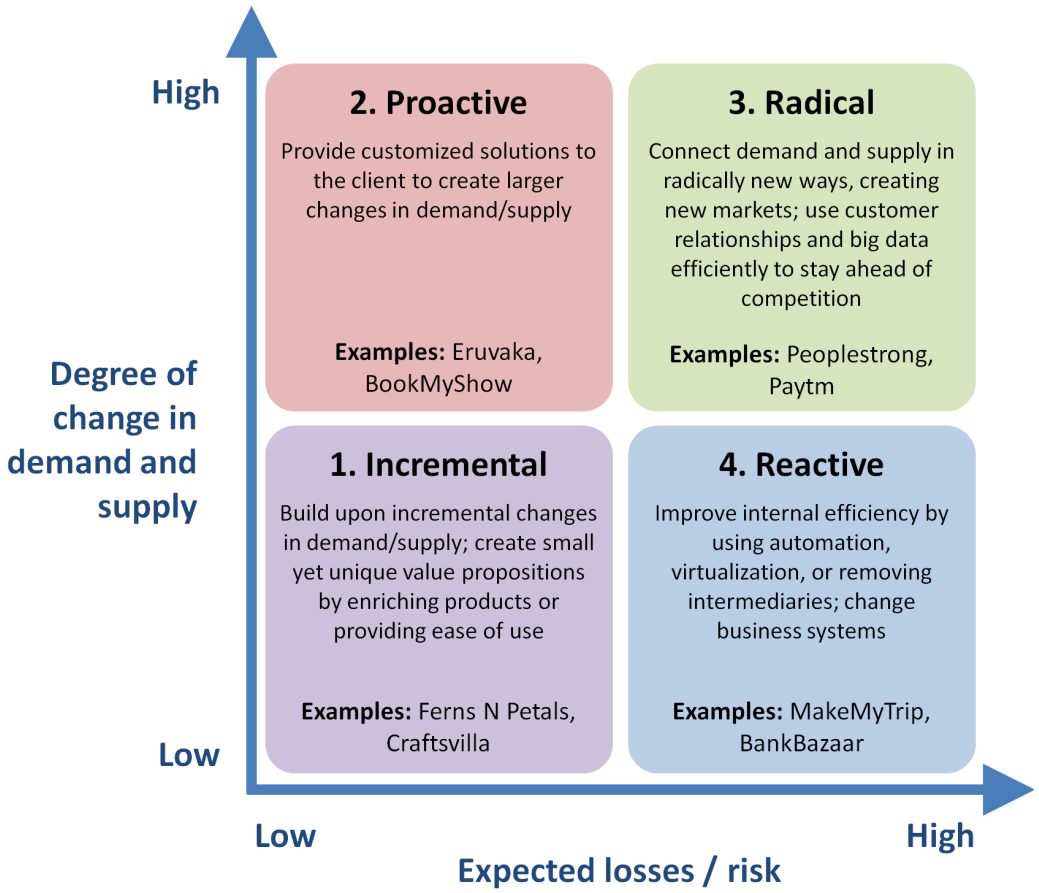

Figure 1. Models of technology entrepreneurship and examples of Indian firms for each type

food business. In 2009, Ferns N Petals revenues stood at INR 300 million (approximately $6 million CAD), and by 2012, revenues had increased to INR 1.45 billion ($38 million CAD) with a profit of INR 130 million ($2.5 million CAD). Vikaas decided it was time to go global (Thomas, 2013). The company uses an e-commerce platform to take orders from and supply to cities across India and 150 countries across the globe. It has also expanded its products to other gifts, cakes, and chocolates. It takes orders online and delivers the cakes and flowers along with the sender's message fresh through its outlets across the world. It is now a truly global company, taking orders and messages from one country, and delivering to the receiver across the world.

- **Craftsvilla** (craftsvilla.com) is in the business of traditional apparel, accessories, beauty products, and home décor. It has successfully created an online marketplace to bring artisans, designers, and consumers together on the same platform. It was founded by Manish Gupta and Monica Gupta in 2011 as a purely Internet-based firm. Craftsvilla has been successful in making a range of quality hand-crafted products accessible online. Buyers of crafts and apparel were slow to adopt e-commerce, but the consistent quality and service levels of Craftsvilla paid off. Also, the company has successfully cultivated a chain of vendors, and this process has helped organize the ethnic craft industry (Nexus, 2015).

2. Proactive

Companies in this quadrant try to provide a customized solution to the client and aim at making huge strides in terms of demand and supply. In other words, they propose massive shifts in demand and supply in a low-risk sector by focusing on an identified or hidden need based on customer problems. In the proactive model, the customer is not able to demand a solution because they are not aware that there can be a technological solution to their current problem. Some examples of proactive orientation are given below.

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- **Eruvaka Technologies** (eruvaka.com) uses artificial intelligence (AI) to monitor the data of aquaculture ponds. Sreeram Ravi, the founder, had worked in a Japanese electronics firm, manufacturing chipsets and routers. Back in his village, he came across the problem of fish dying due to depleted oxygen levels in his uncle's pond. To farm efficiently, pond owners needed to know the oxygen levels, the temperature, and the pH level of the water so they would then be able to take corrective action, if required. Sreeram's company now tracks this data with floating buoys that measure all the water parameters. The data is transmitted to the owner's smartphones through a cloud-based application. The application can also make a voice call or send an SMS or email to the farmer/owner. Sreeram has been growing along with his customers, understanding their needs, and tweaking his product accordingly. Sreeram believes that only technology-aided, cost-effective solutions can make agriculture sustainable and profitable. His company now provides AI-driven monitoring to the aerators in the ponds as well, thus helping the farmer save on energy bills (Chamikutty, 2014).

- **BookMyShow** (bookmyshow.com) is India's largest online ticketing company for movies and events. It was started in 1999 by Ashish Hemranjani and two co-founders. It currently has more than a million users. The company has made several innovations and strategic alliances. It acquired Burrp, a food technology company, to complement its movie and event business, and to provide its customers a richer experience (Your Story, 2017). Whatsapp has recently entered into a deal with BookMyShow to use it as a default ticket confirmation channel (FE Online, 2017). Whatsapp has 200 million users in India, and the collaboration will help both organizations use data more cleverly to customize their offerings to customers (Arakali, 2017). One possibility is that BookMyShow may be able to aggregate customer preferences for their choice of movie, theatre location, date and time. It has linked up with Vkaao (http://vkaao.com) to provide a web platform that allows customers to make these choices. BookMyShow plans to use data analytics to curate movies and show customers genres of movies more in line with their stated preferences (The Hindu Business Line, 2017).

3. Radical

These are the companies falling under the quadrant where they connect demand and supply in radically new ways, create new markets, and use existing customer relationships and big data efficiently to stay ahead of the competition. This is also a high-risk proposition, as at this stage, the client and server both are large. Suppose, for example, that the technology solution does not work or encounters issues, such as with government regulations. At the same time, another risk is creating parallel competition if the technology solution provided by them has huge potential throughout the industry and other players would like to copy it. Some examples include the following:

- **Peoplestrong** (peoplestrong.com) is a leading human resources (HR) solutions management company. It uses technology to provide a cloud-based product for managing HR operations from the "entry to exit" of an employee. The company has adopted five principles: i) usability: making operations simpler for the employee as well as the employer; ii) mobility: 24x7 access via applications on mobile handsets; iii) analytics: using data to provide insight; iv) cloud-based storage for security and easy access; and v) social reach: using social media and automation. The company was founded in 2005, and it is now present in over 40 Indian cities. It boasts of an impressive clientele of 175 multinational and large Indian organizations (Balakrishnan, 2017). At the time the company started, some parts of the recruitment and training processes would be outsourced. For most processes, companies were not ready to send employee data to a third-party service provider. However, Peoplestrong has not only won the trust of its clients, it has continuously innovated its services. It provides strong assessment tools and analytics to its clients as a decision support system. It has now made AI-based chatbots available to clients to answer most routine queries. This leaves HR professionals free to spend time on more strategic tasks (Singh, 2017).

- **Paytm** (paytm.com) is an Indian e-payments and e-commerce organization. It was founded in 2010 by Vijay Shekhar Sharma, primarily to enable mobile-to-mobile payments. In 2015, Paytm received a licence to start a payments bank. Paytm services are available through a browser and through an application operating on Windows, Android, and iOS systems. The Paytm wallet system enables users with a smartphone to access and pay for train and air tickets, taxis, mobile and electricity bills, movie and event tickets, and fuel at petrol pumps, among other uses. The company has thus facilitated cashless transactions for a large number of users. It currently has more than 3 million offline merchants and more than 200 million users in India. Paytm has now started offering a social messaging interaction among its users and merchants by integrating a chat and messaging service (Bhalla, 2017). During the celebrations of the Diwali festival in October 2017,

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the company facilitated the purchase of gold through its portal by linking up with the government organization Minerals and Metals Trading Corporation. Paytm says that a million customers used the services within six months forINR 1.2 billion (approximately $23 million CAD) worth of gold transactions (BT Online, 2017).

4. Reactive

Technology entrepreneurs in this quadrant typically follow the aggregator model, where they try to provide a one-stop shop to meet needs related to one particular area. For example, they may develop technology solutions that allows users to compare various insurance policies and an option to buy them, book everything related with travel, or compare the features of automobiles. Or, they may provide a logical extension of a discussion or rating forum to become an integrated solution provider in a particular domain. They are reactive in the sense that these solutions typically do not aim to provide any shift in demand and supply a "me too" solution through aggregation. The risks are higher in this case as there is typically no unique selling proposition or strategy of these players, and they act like aggregators. Some examples are given below:

- **MakeMyTrip** (makemytrip.com) is an Indian online travel company. Founded in 2000, it started as an organization to facilitate Indians travelling into India from abroad. Foreign travellers could manage flight tickets, hotel reservations, rail and bus tickets, and other local travel bookings. At that time, these services were provided through a maze of local travel agents. The Indian traveller was used to managing this process through local relationships. However, over time, the company managed to establish its name and remove intermediaries from many of these processes. The Indian customer, too, was simultaneously becoming more and more adept at using smart devices, and the company started its Indian operations in 2005. The company has been constantly innovating to make its mobile apps friendly for the common user. It has expanded its international operations as well. Currently, it is present in 50 cities in India and has offices in South East Asia, Europe, Australia, and the USA. In the process, it has contributed to automation in booking of all travel modes as well as in booking in the homestays market.
- **BankBazaar** (bankbazaar.com) was founded in 2008 by a team of six people in Chennai, India. It enables users to compare terms for offers from banks and financial services companies. Some of the products that can be compared are credit cards, insurance policies, investment funds, and loans. More than 30 banks and several insurance companies have partnered with Bankbazaar to be featured on its website and mobile platform. This allows the banks and financial services companies to target customers with loans and insurance policies on a need basis. Bankbazaar is paid by the banks and financial service providers with whom it has partnered. Customers are able to check their eligibility and their credit rating, and they can compare offerings from various organizations vis-à-vis their own needs and paying capacities. The company expanded in 2016 to Singapore and in 2017 to Malaysia (Dasgupta, 2017). Its mission is to offer customers a paperless, seamless service, and to facilitate growth for its clients dealing with financial services (Thomas & Bhattacharya, 2017).

Conclusion

The matrix given in Figure1 suggests a way to classify technology firms into four quadrants on the basis of the anticipated changes in demand and supply of that product or service and the amount of risk involved for the technology entrepreneur at the organizational level. It represents the organizational strategy and the type of business objective a technology entrepreneur is intending to focus on, assuming that the required technological capabilities pre-exist within the technology entrepreneurship firm. The model suggests a method to compare and contrast different technology ventures in India and in other emerging countries. Individual attributes that contribute to a lower or higher level of risk tolerance among entrepreneurial individuals and teams can be explored in future research. The availability of technology expertise in the founding team, human capital, knowledge of markets, and knowledge of the customer can be explored as determinants for selecting a business model to change the sources of supply, of demand, or both. The scope of this article was limited to India, but could be expanded to consider firms from other emerging markets.

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Q&A

Rituparna Basu & Sarada Chatterjee

Q. What Barriers Do Women Face in Becoming High-Tech Entrepreneurs in Rural India?

A. Diversity in India is not just about culture but includes a multitude of dimensions ranging from rural to urban and including both economic status and gender. Managing diversity can be challenging because formal and informal codes of conduct and culture often create meaningless distances that deter both economic and social progression. Such are the gender distances in India. In a country with a population that exceeds 1.3 billion people – approximately 48% of whom are women – female entrepreneurship stands at a dismal 10% of the total number entrepreneurs, and there is a considerable rural–urban gap (Saxena, 2016). Despite the country's encouraging 30% representation at the level of corporate senior management, the 2015 Female Entrepreneurship Index released by The Global Entrepreneurship and Development Institute (GEDI, 2015) ranked India 70th out of 77 countries. This low rank indicates an unfavourable environment and hence low confidence around the existing ecosystem for female entrepreneurship in India.

However, any holistic index fails to capture the nature of the dichotomy that is prevalent in India. The Government of India (2016) estimates, based on the 6th economic census (2013–2014) published by the Ministry of Statistics and Programme Implementation, that there is 21% female ownership in agricultural proprietary establishments compared to just 13% in non-agricultural proprietary establishments. A closer look reveals that such estimates are often inflated, with reporting of ownership data over real entrepreneurial data. The domination of activities such as livestock rearing in agricultural establishments and that of education in the non-agricultural establishments reveals the sub-optimal level of female entrepreneurial activity in India across rural as well as urban sectors.

Hope comes in the form of success stories of female entrepreneurship, such as:

- *Kiran Mazumdar Shaw,* Founder and Chairperson of Biocon (tinyurl.com/yal4lwsj)
- *Ekta Kapoor,* Joint Managing Director and Creative Director of Balaji Telefilms (tinyurl.com/y9rdu22k)
- *Priya Paul,* Chairperson of Apeejay Surrendra Park Hotels (tinyurl.com/yd8g5veg)
- *Ritu Kumar,* fashion designer (ritukumar.com)
- Shahnaz Husain, CEO of Shahnaz Herbals Inc. (shahnaz.in)
- *Ravina Raj Kohli,* CEO of Channel Nine (tinyurl.com/ybvvw6bd)
- *Lathika Pai,* Founder and Trustee of Sonder Connect, a platform to invest in and mentor women entrepreneurs (sonderconnect.com)

But the reality is that most well-known successes come with the urban advantage and enviable lineage of education and opportunity. Entrepreneurial success stories of *rural* origin are rare and exceptional. However, those exceptions are inspiring, such as:

- *Chetna Gala Sinha* (tinyurl.com/yc9qh3r9), who founded the Mann Deshi Mahila Sahkari Bank (manndeshibank.com) to empower female entrepreneurs through microfinancing and entrepreneurial support
- *Lalfakzuali,* a single mother who now is running a thriving handloom business (tinyurl.com/y78ck68a), aided in part by the Milaap (milaap.org) crowdfunding platform for personal and social causes

In aiming to make such success stories the norm rather than the exception, the challenges are many. In this author's view, the following primary barriers are facing potential female entrepreneurs in rural India:

1. *Patriarchy:* Despite progression across the various strata of the Indian society through more liberal customs and an easing of caste codes, the greatest de-

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terrent to potential female entrepreneurs, especially in the rural sectors, remains the ingrained male domination. Males as inherent heads of the family exercise their control over decisions and finances in particular. Cases of discrimination against females begin in childhood, starting from their basic education to food, nutrition, or any other opportunity. Unlike urban women, rural women are raised to look after the well-being of the family, bear and raise children, and perform household chores almost single handedly. This situation leaves little room for the entrepreneurial socialization of women in rural areas.

2. *Financing issues:* The majority of women in rural India suffer from inadequate financial resources, personal savings, and tangible security due to their over-dependence on males owing to the dominant male culture. Access to external funds become a tall order for these women because the banks and financial institutions are averse to extending credit facilities to women on the assumption of their early discontinuation succumbing to social and family pressures.

3. *Illiteracy and language barriers:* The most recent census (Government of India, 2011) estimates the female literacy rate in India at a little more than 65% overall, with certain parts of rural India reporting much lower rates. Lack of education and skill training for rural women represent a huge problem that stifles empowerment and independence. Illiteracy among rural women often restricts their approach and scope for knowledge advancement, making them shy and suffer from low self-esteem and self-confidence. Digital illiteracy also limits their access to technology.

4. *Low risk tolerance:* The age-old patriarchal norms described above result in economic dependence and the protected nature of women's lives in rural India, preventing them from entering the high-risk world of business because they are tied to their roles of running a household life. Attitudes of risk aversion coupled with their financial constraints, low education levels, lack of role models, motherhood, and low self-confidence add further to their conditioned instinct of staying cocooned in their traditional roles.

5. *Lack of infrastructure and corruption:* Modern facilities and infrastructure are largely unavailable in a majority of rural areas, which impedes the overall entrepreneurial activity. Basic materials for setting up an office are also absent on many occasions. Over-dependence on corrupt intermediaries (middle*men*) make it even more difficult for women to implement their ideas and work with dignity. A lack of sales and marketing professionals in rural areas also impedes the success of such ventures.

6. *Poor support network and low mobility:* Rural women are pretty much cut out from the zone of action. The present ecosystem in rural areas lacks connectivity and networking opportunities for the women who might benefit by interacting and learning from successful female entrepreneurs sharing their ideas and their journey. Advisory services or mentoring are rarely available. There is hardly any motivation at play due to the lack of social acceptance of women entrepreneurs. Social norms and their family responsibilities also restrict their mobility and hence their efforts.

7. *Competition:* Imperfect organizational setups by first-time female entrepreneurs often face a sharp blow from stiff competition from their male counterparts. Most of them are oblivious to formal urban setups and face a huge challenge in scaling up their venture and reaping returns.

The challenges above are interrelated and couple up with one another to make it difficult for the women in rural India to come out of the protected environment – to start thinking outside the box to create something new and undertake activities that they have never done before. Specifically for technology entrepreneurship, the biggest impediments are those of illiteracy and a lack of education and skill, which restricts women, preventing them from being able to think concretely about how they will set up and then later manage the operation. Most of them are ill-equipped in terms of the finance and handling their "go to market" strategies. Indeed, as the case in Box 1 illustrates, women in rural India must overcome daunting challenges to realize their entrepreneurial aspirations.

Policies and Prospects

Recognizing the need to propagate and develop women entrepreneurship in India, the government has taken up various measures from time to time. From the mid-1980s the five-year plans were constituted with special chapters on "the integration of women in development" that suggested more inclusion of women in training, development, and decision making.

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Box 1. The case of an aspiring entrepreneur

Although the details have been altered for purposes of confidentiality and illustration, this case demonstrates typical challenges facing women in rural India today.

Consider Geeta, a 24-year-old woman living in a remote village at Bankura, a rural district in West Bengal, India. She is somewhat fortunate, being the youngest of four sisters in the family, and could resist marriage while the elder three were all "married off" as soon as they turned 18. Geeta's mother hand embroiders sarees, and following the untimely death of her husband, found that her meagre income barely covers the household expenses. Thus, her mother could not support Geeta's education beyond class 12 (high school) because her younger brother, who is now 16 years old, needed to continue his studies. Unlike most girls of her age, who would have started their family by now, Geeta works as a casual worker in the "Anganvadi", which is type of centre to support rural mothers and provide childcare services India that were started by the Indian government in 1975 as part of the Integrated Child Development Services program (ICDS; tinyurl.com/yaqe4728) to combat child hunger and malnutrition. In the evenings, she tutors class 3-4 students in the neighbourhood to help provide for her brother's education and other household expenses. Her mother knows that, without Geeta, her son would have to stop his education, so she does not pressure Geeta towards marriage.

Geeta dreams of founding a computer course centre in the village to spread computer literacy. But there is no one to help her with her idea, and she has no clue how she will manage the finances. When she spoke to the bank officials, they asked her umpteen questions about her guarantee, her marriage plans, etc. Moreover, despite her interest in the technology, she has no formal training in computer skills. How will she manage? She remains clueless and quite depressed because everyone ridicules her for being too ambitious. They say she should instead get married and start a family. For an aspiring entrepreneur like Geeta, the problem is not the zeal or the motivation, rather she is bound by circumstances. She lacks formal training to turn her dream into reality, and cannot access the mentoring that could help her get on the right track.

Initiatives such as the Prime Minister's *Rojgar Yojana* (Employment Scheme) (tinyurl.com/y7ognw9o) were launched by the Government of India in 1993 to specifically provide self-employment opportunities to unemployed youth and women. Later, discontinuation and reintroduction of the scheme also took place to suit changing needs specific to rural and semi-urban populations with a broader agenda of creating youth employment opportunities.

A host of specific schemes by nationalized banks, such as Punjab National Bank's *Mahila Udhyam Nidhi* (Women's Venture Fund) (tinyurl.com/y8ak5xhb) were introduced to assist women entrepreneurs in setting up projects in the small-scale sector. The *Mahila Vikas Nidhi* (Women's Development Fund) (tinyurl.com/yajwqqj3) was specially designed to provide training and employment opportunities through the creation of necessary infrastructure and by encouraging women in rural areas to start their ventures.

An award-winning state-oriented initiative, the *Kanyashree Prakalpa* (Kanyashree Project) (tinyurl.com/yaqwja6x), was started in Bengal to help 3.4 million rural girls and encourage their families stand against child marriage and support education for their daughters.

The results of these initiatives have been slow to appear but have been encouraging, including the gradual entrepreneurial socialization of rural females starting their micro-enterprises in spinning, weaving, handlooms, handicrafts and other areas. Yet, the representation of rural women entrepreneurs in technology remains poor due to lack of technical and financial support.

Conclusion

Government initiatives and interventions are important ways of mobilizing the development process and empowering the female population in rural India. However, it is time to reflect on what is working and focus on the positives over the negatives. The ecosystem is still in the making and we understand that it will be characterized by highly complex interlinks. Research in the field is also multi-faceted and often ambiguous.

Q&A. What Barriers Do Women Face in Becoming High-Tech Entrepreneurs in Rural India? *Rituparna Basu and Sarada Chatterjee*

Hence, a generic framework based on entrepreneurial education and research which may be applicable in the urban context (e.g., Basu, 2014) may not work in the rural context. Looking at the gravity of the social/cultural challenges that operate at the root level of the challenges for potential rural women entrepreneurs would need an ecosystem that would work around changing the mindset of the general masses.

A well-sequenced action plan around policies in marriage arrangements, access to education, business taxation, incubation programs, adequate incentives, etc. should be aligned to create an enabling environment for rural women entrepreneurs. Channels for spillovers from urban activation should also be encouraged, especially in the context of high-tech entrepreneurship, which normally requires a developed ecosystem. Networks that offer funding, role models, mentors, and other resources, with a rural–urban connection, will bring in long-term stability of the ecosystem. Here, media would have an important role to play in raising the awareness and bringing the rural women entrepreneur's success stories to the limelight. The changes or the impact would not arrive overnight, but sustained efforts are bound to bring results. Awareness would instill conviction that would pave way for action to take the nation to its next level of rural female entrepreneurship.

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