Chapter 4

Adoption of Open Innovation by Small Firms to Develop Frugal Innovations for Inclusive Development

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Abstract

People at the grassroots level have been developing a growing number of frugal innovations (FIs). Many of them do not have formal education and access to science and technologies. FIs are playing important roles for inclusive development. Open innovation (OI) has been studied in the context of large firms, small and medium-sized firms, or high-tech industries. However, OI has not been explored in the context of FIs. In this chapter, I explore the role of open innovation in three frugal innovation cases that emerged in rural India. I also explore the role of these cases for inclusive development. The chapter enhances our knowledge about OI and expands the scope of OI to new application areas. I find that small firms that develop frugal innovations at the grassroots level need more support in the development stage than in the commercialization stage. They need extensive engagement in open innovation activities, such as networking, collaboration with different partners, and scouting. FIs play a significant role for inclusive development.

4.1 Introduction

Innovation plays a pivotal role in increasing the standard of living, job creation and inclusive development [Bradley et al., 2012]. Open innovation (OI) shows a new way to manage innovation [Chesbrough, 2003]. OI is defined in various ways. A latest definition of OI is given by Chesbrough and Bogers [2014, p. 17] : *"Open innovation is a distributed innovation process based on purposively managed knowledge flows across organizational boundaries, using pecuniary and nonpecuniary mechanisms in line with each organization's business model."* Prior research has explored OI initially in the context of large firms [Chesbrough, 2006] and then in the context of small, and medium-sized enterprises (SMEs) [Brunswicker and Vanhaverbeke, 2015; de Vrande et al., 2009; Hossain, 2015].

There are studies on OI comparing large firms and SMEs [Spithoven et al., 2013]. Yet, small firms that emerge at the grassroots level embrace frugality and offer a unique setting to study open innovation. However, they have been overlooked in the current OI literature [Hossain, 2016a]. One notable exception is a recent book chapter on social open innovation [Chesbrough and Di Minin, 2014]: social open innovation is closely related with the frugal innovation (FI) phenomenon [Radjou and Prabhu, 2015]. Small firms that develop FIs are significantly different from the conventional SMEs along many dimensions [see Levänen et al., 2016]. They are innovation-driven with strong outside the box thinking, developed by individuals who have no knowledge of or access to formal science and technology. Many frugal innovations emerge from much-unexpected sources [Radjou et al., 2012].

Some large firms are heavily involved in the development of FI as well [Zeschky et al., 2014]. FI is the process of reducing the complexity and cost of production. It is defined as *a resource scarce solution (i.e., product, service, process, or business model) that is designed and implemented despite financial, technological, material or other resource constraints, whereby the final outcome is significantly cheaper than competitive offerings (if available) and is good enough to meet the basic needs of customers who would otherwise remain un(der)served* [Hossain et al., 2016, p. 133].

Small firms, such as Embrace, Mitticool, and Jayaashree Industries are showing a sustainable way of serving low-income customers at the grassroots level where innovations need to be developed with a different approach so that they are affordable and appropriate for the underserved customers [Levänen et al., 2016]. These small firms need more external knowledge than the traditional firms do because they lack resources, technology expertise, and marketing tools.

Some of the FIs have trickled up and some others are attempting to trickle up to high-income countries from the low-income countries [Simula et al., 2015]. Many FIs, such as Tata Nano – the cheapest car in the world, and GE's Mac 400 ECG machine are highly cited cases of FIs that show a new way of pursuing innovation and serving customers in both high- and low-income markets [Govindarajan and Ramamurti, 2011].

In this chapter, I intend to contribute to the extant literature by applying open innovation to the new context of FIs in small, grassroots level firms. Individuals, SMEs, and large firms are developing FIs [Simula et al., 2015]. However, I examine the role of OI in small firms that develop FIs based on the open innovation principles. The empirical setting are three grassroots level firms in rural India, that with their introduction of FIs create a positive impact on society and generate profit for the innovating firms. Thus, the chapter points out the role of OI to develop FIs by small, grassroots level firms for inclusive development.

4.2 Prior research

In general, the success of innovations has been measured based on their return on investment [Gu, 2016]. However, many scholars argue that innovations should increasingly be measured by other outcomes, such as societal impact [George et al., 2012; Herrera, 2016]. Solving problems at the grassroots level is important for innovations with societal impact [Gupta, 2006]. The frugal innovations at the grassroots level in a rural setting has only recently received attention in the academic literature especially due to their societal impact [Hossain, 2016a]. Despite the significance of grassroots level innovation for sustainable development, its

impact is poorly understood [Hossain, 2016b]. Embracing open innovation for frugal innovation seems to be an interesting approach for the grassroots level firms that have very few internal resources and competences and are confronted with very specific innovation requirements from customers given the low-cost setting.

SMEs engage in many open innovation practices [van de Vrande et al., 2009]. In the context of Korean SMEs, Lee et al. [2010] found that networking is an important way to facilitate open innovation practices in SMEs. Among Swedish SMEs, Parida et al. [2012] revealed that different open innovation practices result in different innovation performances: technology sourcing is associated with radical innovation and technology scouting with incremental innovation performance. Using data of SMEs in Belgium, Spithoven et al. [2013] argue that SMEs are more effective (than large firms) in the application of different open innovation approaches. SMEs' engagement in external knowledge sourcing is beneficial for the successful launching of an innovation and value appropriation from the innovation [Brunswicker and Vanhaverbeke, 2015]. Open innovation is a promising option for high-tech SMEs [Su et al., 2016; Vanhaverbeke, 2017]. Some SMEs are very successful in out-licensing their technologies [Bianchi et al., 2010]. Among Spanish innovative SMEs, Hochleitner et al. [2016] found that open innovation traits are more prevalent in pioneer than follower SMEs. A study by Huang et al. [2015] indicates that external knowledge sources from inter-firm networking are more valuable in gaining benefits of open innovation in Chinses SMEs.

Embracing open innovation to develop frugal innovation at the grassroots level is an uncharted territory [Hossain, 2013]. OI was initially studied in the context of developed countries [Chesbrough, 2003] and limitedly explored in Asian countries, such as China [Huang et al., 2015] and South Korea [Lee et al., 2010]. So far, to the best of my knowledge, the extant literature has not considered OI at the grassroots level, especially not in the context of FI.

Anecdotal evidence indicates that OI is also crucial at the grassroots level where characteristics of the innovations and the partners involved with those innovations are different from the other contexts. Hence, exploring OI at the grassroots level is important to enrich our knowledge on OI and to expand its scope.

4.3 Methods

For this study, I selected three cases: Mitticool, Jayaashree Industries, and Ksheera Enterprise. These cases are widely cited in the literature and media. They have reached a mature stage in their life cycle and therefore they are suitable for an in-depth understanding of frugal innovation with the objective to understand the role of open innovation in their development.

Mitticool has emerged from its flagship product Mitticool – a clay refrigerator that keeps food items fresh for several days without electricity. Jayaashree Industries was established based on the innovation of a low-cost sanitary napkin making machine. The third case – Ksheera Enterprise – developed low-cost milking machine, which are designed for milking one to several animals. Data sources used for this chapter include face-to-face interviews with the three innovators and their key office bearers, expert interviews, in-field observations in India, secondary interview data, documentaries, press releases, media reports, and other secondary documents. Three cases are considered to be appropriate for an explorative study in a multiple case setting [Eisenhardt, 1989]. The interviews with the innovators were long and conducted in several phases. They were partially recorded with due permission and the interviews were partially transcribed.

Multiple sources of data collection were applied for triangulation, in order to boost the validity of data though cross verifications [Denzin and Lincoln, 1994]. Triangulation – combining different kinds of data – improves the accuracy and reliability of a study [Jick, 1979]. I used an open-ended questionnaire that is appropriate for in-depth exploration of a phenomenon as suggested by the epistemologically constructionist approach [Rubin and Rubin, 2011].

The chapter is based on the exploration of three frugal innovation cases. An overview of these three cases has been depicted in the following section.

4.4 Cases

4.4.1 Mitticool

Mitticool is a clay made refrigerator invented by a traditional porter Mansukhbhai Prajapati from a small village of Gujarat State, India. The pottery is his family business by tradition. From childhood, he was used to helping his parents in various household activities including in pottery works. In 1979, his family lost everything due to Machhu Dam break down, they had to move to a nearby town, and he dropped out from class ten after a failed attempt to pass. He started working in a tiles manufacturing firm as a teenager to support the family. Sadly, within a month, he got an eye injury while working in the chimney of the tiles manufacturing factory and had to leave the job. When his eyesight improved in 1984, he started a tea lorry near the highway but he had to close down the shop within six months due to continuous sarcastic comments from his acquaintances. However, during his tea business, one of his uncles visited him in the tea lorry and asked for a person who would be interested to work in a rooftop tiles manufacturing unit. He shown his interest, joined the unit as a trainee in 1985, worked for three years, and learned all the jobs of the unit.

He got the idea of his own enterprise while working at the tiles manufacturing unit. In general, a potter works manually and can make about 100 items per day. Seeing that tiles manufacturing machine with hand press can produce a large quantity of items, he thought that the operating mechanism of a tiles manufacturing machine could be used to make earthen pans. In 1988, he quit the job and took a loan of around US$500 from a local money lender to start his own business. With that money, he purchased a small piece of land for his factory and other machinery, such as dyes, presses, soil mixing machine, and electric pottery wheel. By modifying an existing roof tiles making hand machine he developed a hand press machine with a manufacturing capacity of 700 earthen pans per day. With numerous hurdles and unsuccessful attempts, he gained knowledge over time to produce quality pans with his machine.

He built his factory and started manufacturing 50 pans per day, carried items on his bicycle and sold them in different villages. However, he has

received complaints from customers that his pots were not properly heated and that they broke easily. He had to lower the price of his pots. Meanwhile, he started experimenting with various proportions of mixtures of raw materials to understand the right combination of materials for making pots. In 1989, he also started using the electric-operated wheel and presses, which enabled him to manufacture a large number of pots in a shorter time.

A turning point of his business was in 1995 when a businessperson was looking for someone who could supply clay water-filters because the businessman needed to deliver them to Nairobi, Kenya. Eventually, he found Mansukhbhai who delivered 500 water-filters in eight days to the businessman at a price of US$ 3.30 each, double the initial agreed price as the quality was much better than expected. His inspiration for Mitticool refrigerator came from a caption "the broken fridge of the poor" in a local newspaper in 2001 depicting a water filter manufactured by him. After three years of experimentation, he managed to develop a clay refrigerator. In 2005, he received an order of 100 refrigerators for US$ 3340 from a civil engineer. This was featured in a local newspaper. All raw materials – mainly sand and sawdust – were locally available. The current price of a Mitticool fridge of 50 liters capacity is about US$80.

4.4.2 Jayashree Industries

Arunachalam Muruganantham from the southern part of rural India invented a low-cost sanitary napkin manufacturing machine with a grassroots mechanism to solve unhygienic practices of women in rural India during menstruation. He has been recognized as Time Magazine's 100 most influential people in the World 2014 for his achievement. In 2016, he was awarded Padma Shri – the fourth highest civilian award in the Republic of India – for social work. Presently, he has over 1300 sanitary napkin making machine installed in 27 states across India and seven other countries. Moreover, his plan is to expand his business into 106 countries. Most of the women in India use ashes, newspapers, sand husks and dried leaves to take care of the menstruation. Consequently, they suffer from various diseases. He aims "*creating one million livelihoods for*

poor women and making India a 100 % sanitary napkin using country up from the current level of only 2% in rural areas."

Muruganantham was fascinated by science from his childhood. At an early age, he used to modify and repair farming equipment. He lost his father when he was studying in his ninth grade and needed to start working to support his family. His work life started as a helper in a local workshop which made farming equipment. He also worked as a machine operator, insurance agent, firm laborer and yarn-selling agent [NIF, 2009]. His entrepreneurial journey started soon after his marriage in 1988. He saw his wife carrying a dirty rag and he inquired about the rag. His wife replied, "it is none of your business". Eventually, he understood that she was using it to take care of her menstruation. Thus, he learned how women treated menstruation in a highly unhygienic way. He realized that it is not only his wife but also most other women applied the same practices. The next day, he went to buy a packet of sanitary napkin for his wife. He witnessed that the seller wrapped the packet with old newspapers and he felt as if he is buying something illegal. Also, he checked the package and found that apparently the price of the item is exorbitantly high compare to the cost of used materials and that triggered him to make low-cost sanitary napkins. However, he needed women to volunteer to experiment his napkins. He approached his wife and then his sisters to volunteer. His wife and other female family members were embarrassed to cooperate and his wife was very critical about his experiment.

He approached some female medical students to participate in his experiment. Approaching them was very challenging for him as a workshop worker. After insisting for a long time, 20 medical students agreed to participate. When he requested to return the feedback forms, he witnessed that some girls were filling-in the forms of the other girls. He then decided to use the napkins himself. He walked and cycled putting animal blood in a football tube and placing the tube in his body to understand menstruation. After one year of trials, he still was not successful in understanding the mechanisms to make sanitary napkins work. Meanwhile, people of his locality thought he was insane. His wife left him, which is rare in Indian culture.

Pretending he was a local municipality employee, he returned to the previously contacted medical students and provided sanitary napkins and

asked them to return used sanitary napkins. He collected the used napkins and piled them on the floor of his room to examine them. Seeing this awkward activity, his mother also left him.

With further experiment, he got a basic understanding of functionalities of sanitary napkins during the next two and a half years. Initially, Muruganantham mistakenly believed that raw materials used in branded sanitary napkins by multinationals were cotton. He requested a local professor to help him to understand if his belief is true. With the help of the professor, he wrote letters to the multinationals and potential suppliers pretending himself as a businessperson who wants to establish a business in southern India and who was searching for raw materials. He ordered some samples, subsequently received the samples, and found that the raw material used for sanitary napkins are wood fibres which is suitable as materials to drain fluids and maintaining the shape of the sanitary napkins. As wood fibre is not that expensive, he felt that the cost of the machines that are used by multinationals to manufacture sanitary napkins is the key reason for the high cost. Muruganantham developed a sanitary napkin manufacturing machine in four and a half years using locally available materials. After numerous trials, finally in 2004, he was successful in developing the first usable version of the machine to make sanitary napkins. There were two models, a manually operated model at a cost of US$ 2000 and semi-automatic model at US$ 3500 [NIF, 2009].

4.4.3 Ksheera Enterprise

Ksheera Enterprise is located in a small village called Murulya in the southern India. It was established in 2003 to manufacture low-cost milking machines with the brand names MILKMASTER and IMILKER. A farmer and now a retired schoolteacher Raghava Gowda had a cow that needed to clean regularly and milk manually every day. Often, milking was neglected as there was no enough time for it and the cow got an udder infection. Gowda also had strained nerve from manually milking. He pondered upon finding an alternative solution of milking the cow. He started to invent a hygienic and ergonomic low-cost milking machine, inspired by the gutter spray pump, which is used to spray insecticides. He also considered the electricity scarcity of different regions. He took a sabbatical year, paying

for a substitute teacher, from his school to focus on the development of the machine. With various trial and error during four years, he developed a functional milking machine with a capacity of milking 1.5–2.0 liters per minute. He was able to develop several types of machines with different power sources.

He has been recognized with a national award for grassroots innovation from the president of India. So far, over 10 000 machines were manufactured and some of them were exported to Sweden, New Zealand, Mexico and Kenya. In India, various milk unions provide a subsidy to farmers to purchase these low-cost milking machines. Ksheera Enterprise is also used dealers to sell machines. At present, it has a capacity to make 250 machines per month and employs 25 fulltime technicians.

These three cases show the emergence of different types of innovation and business models. Hence, understanding them from the lens of OI is not only intriguing but also an exploration of new frontiers of OI. Open innovation takes place in three ways – inbound, outbound, and hybrid [West and Bogers, 2014]. I examine these cases to see how they apply different OI approaches in their successful journey from ideation to commercialization.

4.5 Analysis of the frugal innovation cases

4.5.1 Personal traits and source of ideas

Sourcing of ideas is a key aspect of the open innovation concept [Dahlander and Gann, 2010]. A commonality between all three innovators is that they all are technicians by profession or fascination. Mitticool's innovator has been working in a tiles manufacturing factory where he learned technical skills. The innovator of the sanitary napkin making machine was a workshop assistant. Although the innovator of milking machine was a schoolteacher and farmer he was involved in developing various devices for farming and household purpose. As a child, he was well known in his school for his interest in technical things. Hence, deep involvement in technical activities induces individuals to become innovative.

Mansukhbhai got the idea of making Mitticool from a newspaper article where one of his pots was featured as “the fridge of the poor”. Muruganantham inspired by seeing the taboo and hardship females go through in their menstrual period and feeling multinationals are charging high prices for their sanitary napkins despite the low cost of raw materials used in their sanitary napkins. Raghava Gowda developed the milking machine after facing personal problems with milking and seeing others facing similar problems. All of them have identified the problem to be solved first-hand.

4.5.2 Outside the box approach

Previous research shows that inbound OI is the most widely used OI approach among the three approaches identified by Gassmann and Enkel (2004). This is also the case for grassroots level innovations, especially for FI. The three innovators, who had no training in formal sciences and technology, developed these FIs. They needed to source knowledge from various external sources. Mitticool, for example, received technical support from research institutes, customers, and individual experts. One noticeable thing is that all three innovators started by getting ideas from other industries. The Mitticool refrigerator was developed by taking an idea from tiles making mechanisms whereas Ksheera Enterprise’s milking machine was developed by seeing the mechanism of gutter sucking pump. A first-hand witness of the problems women face during their menstruation period triggered Muruganantham to develop affordable sanitary napkin making system. Jayaashree Industries is also active in outbound OI: it provides technology and support to other local people to establish new sanitary businesses which typically owned by women and non-government organizations (NGOs). It thus transfers technology along with necessary supporting services to external parties in order to develop new businesses..

4.5.3 Open business model

Firms are increasingly adopting open business model – using external sources for strengthening their internal innovation or external paths for

commercialization [Chesbrough, 2010]. All three firms used external knowledge from industries and research institutes for their technological advancement. They got most of their knowledge without paying any significant amount of money. Several organizations such as National Innovation Fund (NIF) and IIM, Ahmedabad have provided holistic support – financial, technical and other support – for bottom-up grassroots innovations with frugality. These firms use dealers, and partner with interested groups, such as NGOs, community, and state organization to commercialize their products. The open business model has brought both opportunities and threats for small firms. A unique business model (Jayashree for example) is more challenging to copy than product innovations – Mitticool and Ksheera – as argued by Chesbrough [2010].

4.5.4 Networking for innovation

It is important to emphasize that the networking in grassroots organizations is local. All necessary raw materials, technicians and other experts were locally available. Collaboration for innovation was limited to local partners and institutes. They used a significant amount of time for experimenting with different options for innovation. A large part of the collaborative support from external organizations and individuals took place informally. The innovator of the Mitticool needed to understand the different ingredients that should be used to gain an optimum mixture of raw materials. Furthermore, the heating temperature is also crucial. There were countless attempts with different combinations of materials and heating temperature. Even though local institutes provided some support about material combination and temperature, experimentation in the actual setting was the key to become successful. In the case of Ksheera Enterprise, collaboration with a local workshop and individual experts who are knowledgeable about properties of different materials were crucial for developing the milking machine. Similarly, Jayashree Industries also closely collaborated with local partners, such as small workshops and experts. All three firms got support from external entities to develop, test raw materials and products, fine-tune and package the product, and get the intellectual property (IP) right.

4.5.5 Joint venture and acquisition

A joint venture is an option for firms that develop new products through open innovation. However, finding a right partner with strong complementary resources is a challenge for them. Some multinationals approached Mitticool and Jayashree Industries to acquire but the offers were not that lucrative. Furthermore, Mitticool, for example, does not want anyone to change its brand name. The Mitticool is a consumer item that competes with the traditional refrigerators. Hence, it is important to understand which type of partner it should find to set up a joint venture. Recently, Mitticool started negotiation with a sanitary manufacturing firm to use the distribution channel of that firm. Ksheera Enterprise wants to expand its business through the dealership and joint venture. However, it stumbles with unscrupulous people who produce inferior quality products and offer more commission to dealers. Some large firms showed their willingness to acquire Jayashree Industries but it has no interest in such a deal.

4.5.6 Collaboration for funding

Open innovation entails collaboration with external partners to source ideas, technologies, and knowledge. Firms also collaborate with external partners for funding purpose. Hence, whether collaboration for funding can be considered as an element of OI phenomenon is interesting to bring into the discussion. Financial support from NIF had given all three firms a great opportunity to pursue their dreams. In all three cases, individual innovators struggled to finance the development and commercialization of their ideas. In the development stage, Mansukhbhai took US$11670 bank loan, which increased to US$31670 accruing interest and capital. He had to sell his ancestral family home to pay off the loan. At his critical juncture, he was approached by NIF and received US$3340 from the NIF without any collateral. Subsequently, he received bank loan at a very low-interest rate with a special loan scheme. Similarly, Muruganantham received financial support from NIF without any collateral or guarantor and this fund enabled him to install 82 units in 13 states across India [NIF, 2009]. Jayashree Industries collaborated with local financial institutes, and NGOs to raise

funding. Gowda got funding initially from his family members – a brother and a son-in-law – and then from banks for the commercialization phase. Moreover, Ksheera Enterprise closely collaborated with various associations and got financial support from them. Special loans from some associations to farmers to buy milking machine help Ksheera Enterprise to expand its business. Funding by external parties thus plays a key role in frugal innovation. Hence, it is worthwhile to consider funding as an important element of open innovation in the process of FI.

4.5.7 Collaboration for commercialization

Previous studies indicate that SMEs collaborate more for commercialization than product innovation [Hossain, 2015]. However, all three firms needed more support in the development phase rather than the commercialization phase. Nevertheless, external support for commercialization is significant. GIAN and NIF played a key role in business development, trademark design, marketing, media coverage and networking for these three innovations. NIF supported Mitticool in the off seasons (e.g., in rainy seasons) when the selling record and the cash inflow are both low. It helped Mitticool to sell its products on an online platform called Big Bazaar.

Muruganantham had problems in both financing his business and selling his products. Initially, Muruganantham's wife started selling sanitary napkins among the relatives and neighbors. Inspired by ATMs, he has also developed a vending machine in 2008 with a capacity of 25 sanitary pads with a coin slot that could be set up in colleges, hospitals, and public places to supply sanitary napkins on demand [NIF, 2009].

In these three cases, collaboration in both development and commercialization were significant. These three innovations have received extensive media coverage and recognition at the regional and national levels. It helped the firms to be known by potential customers. Moreover, they have featured in international media, such as BBC and The Economist. Even though many customers know the innovations, a large section of the target customers is still beyond reach. Moreover, customers from distant locations have no idea how and where to buy a product. An

important way to expand the market is through the dealership in different regions. Both Mitticool and Ksheera Enterprise actively collaborate with dealers whereas Jayashree collaborates with NGOs, community associations, schools, hospitals and government organizations to expand their ventures. Muruganantham deals with customers directly. Word of mouth is the main marketing tool used by the three firms. The main sales channel is direct to customers. For example, Mitticool uses its own and other online marketplaces where customers can directly place their product orders. Telephone order is a frequently used means for the three firms to receive orders.

4.5.8 Patent infringement

Low-income countries have weak patent protection systems. Hence, innovations are very vulnerable and others can easily copy and sell at a lower price there. Moreover, when the innovation is simple in nature and the market is not well established, patent infringement and copying are very common. Mitticool is a very simple innovation. Because of various constraints, its expansion in the large Indian market is challenging. One option is to sell through dealers, but in order to attract dealers it is essential to offer a significant commission. Mitticool offered around 25% commission on the selling price. However, other products – inferior in quality and lower in price than the Mitticool – are available in the market. Moreover, dealers get more commission on selling copied items. In low-income markets, price is the key deciding factor. Both customers and dealers are more interested in lower-priced, inferior quality products. Ksheera Enterprise faces a similar challenge with its dealers.

Therefore, it was difficult for the firms to expand their businesses at an expected level. Jayashree Industries faces limited challenges in terms patent infringement. The uniqueness of its sanitary napkin manufacturing machine is that not just the machine but also the raw materials are unique and difficult to copy. For example, raw materials are imported from countries such as Canada and the USA. People who want to copy its business model would find it difficult to acquire all necessary materials to build a complete setting.

4.5.9 Inclusive development

Unlike many traditional innovations, FIs developed by grassroots level firms play a pivotal role in inclusive development. For example, Mitticool has generated full-time employment for about 30 local people. The refrigerator works through a natural process and is made mainly of clay: it does not need electricity. Therefore, it contributes to sustainability. The Mitticool has provided communities to work in supporting activities as suppliers, distributors, and salespersons – there are several hundred people indirectly employed. Similarly, Ksheera Enterprise also generated 25 full-time jobs for technicians along with several full-time positions at the management level. The technicians are mostly students of the innovator or students of the local school in which the innovator used to teach. It provides a way to milk in a hygienic manner whereas the traditional milking process is unhygienic.

Jayashree Industries contributes to inclusive innovation in a different manner. Even though it has several direct employees, each machine generates employment for several women in activities such as sales, and manufacturing. Therefore, it plays a significant role in women empowerment. Furthermore, it provides hygienic low-cost sanitary napkins to low-income women who traditionally use filthy rags for their menstruation. It creates awareness among people of different backgrounds on the importance of using hygienic sanitary napkins. Thus, these three firms play a pivotal role in supporting sustainability and inclusive development.

5 Discussion

This book chapter has explored a new avenue of open innovation research. It demonstrates the potential of open innovation to develop frugal innovations at the grassroots level for inclusive development. Small firms at the grassroots level mainly use inbound open innovation even though there is some evidence from the three cases that they engage in outbound open innovation as well. All three small firms found their ideas of frugal innovations outside the industries with purely outside the box thinking. Due to weak intellectual property regimes in developing countries,

appropriation of frugal innovation is a pressing challenge. Moreover, the challenge of appropriation is even more important when innovations are just simple products without any high-end sophistications (e.g., Mitticool and Ksheera Enterprise). It results in misappropriation of intellectual property through patent infringement and wide imitation of products. However, a frugal innovation with a strong business model is likely to last longer in the market. This is illustrated by the Jayashree Industries case.

At the grassroots level, technical skills along with basic education are important to enable individuals to innovate. People at the grassroots level have limited access to science and technologies.

Even though previous studies argue that the small firms embrace open innovation rather at the commercialization than at the development stage this is not the case for small firms at the grassroots level developing FIs. These small firms need open innovation more in the developing stage than in the commercial stage. Furthermore, they need support for basic commercialization activities, such as trademark design, networking, and finding possible selling outlets. Small firms are complacent once they achieve profits. Eventually they put less emphasis on business expansion. Scaling up is a pressing challenge for these small firms.

Small firms at the grassroots level do not have an established environment, such as science parks, incubators, living labs, and other hubs to get day-to-day support. Government initiatives to nurture these small firms are very limited not only in the development phase but also in the commercial phase. Even though the market share of these small firms is very low they show the potential of a new way to serve unserved customers and contribute to inclusive development. Moreover, they induce local innovation potential and entrepreneurial spirit. Thus, frugal innovations at the grassroots level contribute to sustainable development in a different way.

5 Conclusion

This book chapter shows the potential of adopting open innovation by small firms to develop frugal innovations. It expands the scope of open innovation literature into a new context. It also connects two research streams – open innovation and frugal innovation – to understand the

overarching spirit of innovation at the grassroots level. Small firms at the grassroots level need to engage extensively in open innovation activities, such as networking, collaborating, and scouting. I am confident that this chapter will inspire other scholars to explore frugal innovation at the grassroots level as a new application field of open innovation.

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