Technovation xxx (xxxx) xxx–xxx

Contents lists available at ScienceDirect

Technovation

journal homepage: www.elsevier.com/locate/technovation

Business Models for Frugal Innovation in Emerging Markets: The Case of the Medical Device and Laboratory Equipment Industry

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ARTICLE INFO

Keywords:
Business models
Resource-constrained environments
Frugal innovation
Emerging markets
Medical device industry
Western multinationals corporations (MNCs)
Emerging market firms

ABSTRACT

This study investigates business models for frugal innovation (i.e. a specific form of resource-constrained innovation) in the medical device and laboratory equipment industry in the context of emerging markets. Based on original data from five case studies, we investigate how firms can set up value creation and value capturing mechanisms to reach new customer segments in remote rural areas with unprecedented value propositions. With this research, we contribute to the literature on frugal innovation and business models in emerging markets. It is among the first empirical studies to apply a fine-grained perspective on resource-constrained innovation in emerging markets. In doing so, we focus on its most disruptive form, which is when these innovations entail entirely new applications. We advance and detail the value proposition for frugal innovation in these industries and argue that frugal innovation create new markets. Further, we show how firms set up their value creation and value capturing mechanisms to achieve the value proposition and identify two distinct Research & Development (R & D) strategies for frugal innovation.

1. Introduction

The economic growth of emerging markets has significantly influenced the global business landscape. With average growth rates far above Western markets, emerging economies and particularly the BRIICS countries (Brazil, Russia, India, Indonesia, China and South Africa) constitute strategic growth markets (Drummond, 2012; OECD, 2009). Within emerging markets, the so-called middle and low-end market segments represent one of the fastest growing customer segments globally (Kravets and Sandikci, 2014; George et al., 2016). In order to compete successfully in these market segments, firms need to provide customers with “resource-constrained” innovations and business models that create high value at very low cost (George et al., 2012; Mudambi, 2011). These innovations enable Western firms to access these unexploited market segments, offering unparalleled growth opportunities (Baskaran and Mehta, 2016). Authors have used different terms for this phenomenon such as *cost innovation* (Williamson, 2010), *good-enough innovation* (Gadiesh et al., 2007; Hart and Christensen, 2002) or *frugal innovation* (Cunha et al., 2014; Zeschky et al., 2014a). Resource-constrained innovations are particularly difficult to achieve for Western firms that are traditionally specialized in advanced innovation for high-tech products and business models (Halme et al., 2012). However, to successfully tap new markets in the middle or low end, especially Western firms need to develop capabilities for resource-constrained innovation and business models (George et al., 2012; Mudambi, 2011; Zeschky et al., 2014a, Winterhalter et al., 2016). Hence, this article investigates how firms can design and establish business models for emerging markets.

Extant research has provided important first insights on how firms can achieve resource-constrained business models and innovations for emerging markets. Particularly literature on the bottom of the pyramid (Prahalad, 2010) has identified ways to address resource-constrained people, which are often located in rural areas with very basic products in industries such as hygiene and health (Ahlstrom, 2010; Anderson and Markides, 2007; Christensen et al., 2015), food and agriculture (Gold et al., 2013; London et al., 2010) or telecommunications (Foster and Heeks, 2013; Seelos and Mair, 2007). These studies particularly highlight the social element of these business models as they not only make goods affordable for the first time to hitherto non-consumers but also how these models foster prosperity in resource-constrained regions and societies (Sinkovics et al., 2014; Wilson and Post, 2013). So far, very little attention has been paid to more sophisticated solutions in the context of emerging markets, which are typically produced by Western companies. However, if Western companies want to successfully compete in resource-constrained markets it is necessary to make their solutions affordable and accessible to the middle and low-end customer segments.

Resource-constrained innovations for emerging markets differ

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http://dx.doi.org/10.1016/j.technovation.2017.07.002
Received 29 April 2015; Received in revised form 12 July 2017; Accepted 20 July 2017
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drastically from Western products in terms of product novelty and disruptiveness (Wan et al., 2015). Overall, there are very few empirical studies that investigate specific types of resource-constrained innovation and their underlying business models that create them. This is problematic, as firms require varying capabilities to achieve different types of resource-constrained innovations in emerging markets (Zeschkyet al., 2014). Adopting this fine-grained perspective, frugal innovation is the most disruptive type of all resource-constrained innovations as it enables unprecedented applications specifically developed for resource-constrained environments in emerging markets (Wan et al., 2015). To our knowledge, the present article is the first to address these gaps by examining five firms (two Western MNCs and three Indian firms), which successfully implemented business models for frugal innovations in the medical device and laboratory equipment industry. Like many other emerging markets, the healthcare market in India is generally difficult to enter. Additionally it is characterized by a poor infrastructure such as roads, public transport, energy and water supply (Mair et al., 2012). Additionally, people living in rural areas have no knowledge of, access to, or the resources for medical treatment. In India 70% of the entire healthcare infrastructure is confined to the top 20 cities, leaving rural areas heavily under-served (PWC, 2014). This limited access to healthcare has drastic consequences. Roughly twelve million people in India are blind (of a global total of 40–45 million), however 80% of these ailments could have been prevented if screened and treated early enough (Harsimran and Peerzada, 2013). Due to pressing issues like this, emerging countries are in drastic demand of innovations that are able to overcome institutional and infrastructural voids. This article holds several contributions for theory as well as management and policy implications. First, this empirical study, adopting a more fine-grained view of resource-constrained innovation in emerging markets by focusing explicitly on its most radical form (frugal innovations), is the first of this kind. Second, we improve the understanding of the multidimensional value proposition needed for emerging markets and identify the threefold value proposition for frugal innovations in the medical device and laboratory equipment industry. Third, we shed light on how firms can design their business model to achieve a value proposition in the medical device and laboratory equipment industry that fosters frugal innovation. Finally, we identify two specific R & D approaches for frugal business models.

2. Literature review

2.1. Frugal innovation for emerging markets

According to Zeschky et al. (2014b), resource-constrained innovations are low-cost alternatives of existing Western products (i.e. *cost innovations*), re-designed and tailored to be particularly suited for resource-constrained customers in emerging markets (i.e. *good-enough innovations*), or they represent novel products and services that allow new applications specifically developed for customers in resource-constrained contexts (i.e. *frugal innovations*). The phenomenon of resource-constrained innovation in emerging markets is increasingly gaining attention from practitioners and scholars alike. Based on Prahalad's work on the base of the pyramid (Prahalad and Hammond, 2002; Prahalad, 2010) this stream of literature examines how firms can create innovations that provide high value at very low cost for resource-constrained customers. While rather anecdotal reports have provided first insights regarding this topic, rigorous empirical studies are still scarce (Cunha et al., 2014). At the firm level, it was found that emerging market firms make use of these resource-constrained innovations to create a new low-end segment of existing markets (Hang et al., 2015; Lim et al., 2013). A major shortcoming of these studies is that they treated all types of resource-constrained innovations (as explained above) for emerging markets as interchangeable concepts (e.g. Ernst et al., 2015; Hang et al., 2014; Sanchez and Ricart, 2010). However, recent works have shown that these low-cost solutions differ significantly in terms of novelty and target customer segments (Wan et al., 2015).

A well-known example of frugal innovation is M-Pesa, this SMS-based microfinance solution brought banking to the "unbanked" people all over the African continent. The new application here is that people in remote areas get access to financial transaction services by simply sending text messages via GSM – an application non-existent before (Foster and Heeks, 2013). Another example of a frugal innovation is a portable electrocardiograph for rural India developed by General Electric. The application innovation in this example is the portability, which allows for the examinations to be carried out at the home of the patients. Previously, patients had to travel to distant hospitals or medical centers to receive treatment (Govindarajan and Trimble, 2012; Immelt et al., 2009).

2.2. Core elements of business models

Effective business models can be a source of competitive advantage (Markides and Charitou, 2004) and ultimately of overall firm performance (Afuah and Tucci, 2001; Afuah, 2004; Zott and Amit, 2008). They create and capture value for the focal firm and its stakeholders (Chesbrough, 2007; Frankenberger et al., 2013) with the aim of providing a holistic view of the business by combining internal and external factors of a firm (Zott et al., 2011). We adopt the business model definitions provided by Doganova and Eyquem-Renault (2009) and Tongur and Engwall (2014) that consist of the trinity "value creation", "value capturing" and "value proposition". Value creation comprises how a firm creates value and delivers that value to the customer and other stakeholders. This involves the core activities of a firm such as R & D, production and sales (Morris et al., 2005) including processes, capabilities, resources, and channels through which an offering is created and delivered to the customer (Doganova and Eyquem-Renault, 2009). Value capturing refers to the revenue model and defines how a firm appropriates some of the total value created (Amit and Zott, 2001). While some authors consider the revenue model as the firm's gross income (e.g. Johnson et al., 2008), others consider the revenue model as the "bottom line of the business model" as it reflects and integrates the value creation activities into flows of revenues and costs (Doganova and Eyquem-Renault, 2009). Based on the latter perception, we consider value capturing as the reflection of the firm's value creation activities in terms of financial expenses and income. Finally, the value proposition consolidates the embedded value of the firm's offering (Doganova and Eyquem-Renault, 2009) in products or services for the customers.

2.3. Business models in emerging markets

Business models in the context of frugal innovation in emerging markets differ from business models in developed markets (Eyring et al., 2011; George et al., 2012; Landau et al., 2016). This is why many Western firms face the challenge to adapt their existing business models to make them suitable for an emerging market environment (George et al., 2012; Sanchez and Ricart, 2010; Simanis, 2012). Scholars investigating the success factors of business models in emerging markets have found that these business models can be either low-cost replications of established business models for developed markets or entirely new business models, which specifically create value in low-income environments (Sanchez and Ricart, 2010; Chliova and Ringov, 2017). Low-cost replications are often employed to expand market reach, which is mainly achieved by making internal processes more efficient. In contrast, new business models often involve collaborations with external, local partners as these have access to the target market and are already accepted by the local (business) community (London and Hart, 2004; Pitta et al., 2008; Prahalad, 2012). Firms need to create unique business models that are specifically tailored to overcome the challenges and constraints in the emerging market environment (Winterhalter et al., 2016; George et al., 2012). These business models

for emerging markets often entail a strong value proposition not only through cost reduction and consequently lower per-unit-prices for the customer but by offering solutions that increase the customers' willingness to pay for them. In line with this, it has been highlighted that business models in resource-constrained environments need to create value for firms, people and the social environment (London et al., 2010; Mair and Martí, 2006; Seelos and Mair, 2007; Sinkovics et al., 2014; Yunus et al., 2010). Despite the many potential benefits, such as the prospect of reaching new customer segments, Western MNCs often have severe difficulties when doing business in resource-constrained environments (Simanis, 2012; George et al., 2016). Great challenges for them are the often weak institutional environment and missing infrastructure (Hoskisson et al., 2013; Khanna and Palepu, 2000; Ricart et al., 2004). Western business models often rely heavily on or are based on such aspects. Studies on more sophisticated technical products that require a whole new value chain (incl. new product development) are almost absent. A noteworthy exception is Halme et al. (2012) who found that the development of frugal innovation is completely different from what Western firms do for their advanced innovations and that entrepreneurial bricolage is key to set up frugal business models. Overall, research has never specifically investigated business models for frugal innovations and has generally had a bias towards low-tech products (such as agricultural or basic sanitation products). This is a major shortcoming as typical Western firms produce rather sophisticated solutions. Consequently, if they want to participate in the economic development of emerging countries they need to find ways to make their products accessible and affordable to resource-constrained customers. Thus, this study examines how firms can design business models specifically for emerging markets.

3. Research design, data and analysis

Because of the few insights on business models in resource-constrained environments, particularly with regard to frugal innovation, we adopted a qualitative research approach using a multiple case study design based on Eisenhardt (1989) and Yin (2014). We draw from five cases of frugal innovation within the medical and laboratory equipment industry in India and China. All frugal innovations in this study are industrial products in the Business-to-Business (B2B) market, which are marketed at comparable investment levels (i.e., less than US$ 15k). The firms in this study are established Western multinationals (Medtech1 and Labtech1), one Indian multinational (Medtech2) and two growing Indian firms (Medtech3 and Labtech2). An overview of the case firms is also provided in Table 1. For the cases in this study, we interviewed senior managers who were involved in either the development, marketing, and/or general management of the frugal innovations. This provides us with an in-depth understanding of processes and structures within the firms. The interviews were recorded and transcribed in verbatim immediately after the interviews. Subsequently, the interview transcripts were sent back to the interviewees for confirmation before we continued developing the full case studies. In total, we conducted 13 interviews, which lasted between 30 and 120 min, on average 53 min, and which accumulated to a total of 11.5 h interview material (see Table A1). Subsequently, we developed the case studies based on the transcripts and additional primary and secondary data. Data was triangulated (Gibbert et al., 2008; Jick, 1979) by cross-checking interview data with publicly available information and internal documents as well as by interviewing several employees within the same company wherever possible. All data sets were analyzed independently by two researchers (Miles and Huberman, 1994) and the analysis was carried out in an iterative manner, oscillating between data, emerging themes and patterns within the three core pillars of business models (Locke, 2001; Miles and Huberman, 1994). Lastly, we conducted various iterations between literature, data, and our findings until we reached a strong and consistent picture.

3.1. Case overviews

3.1.1. Case 1: Medtech1

Medtech1 is an U.S. based multinational firm with an extensive product and solutions portfolio in the healthcare sector. The company is maintaining a growing portfolio of low-cost products targeted at resource-constrained customers all over the world. The product investigated in this study is a low-cost, portable, and battery-operated ultra sound machine. While the machine has less features and lower performance compared to the firm's advanced machines, it is a first-in-line screening device that delivers immediate results enabling patients to be sent directly to a specialist with more specialized equipment. To develop and market such products, Medtech1 set up a new business unit in China dedicated to the development and marketing of low-cost products especially for rural areas.

3.1.2. Case 2: Medtech2

Medtech2 is an emerging market multinational (EMNE) based in India, which develops medical devices targeting major city hospitals as well as remote healthcare centers and rural doctors. The company's operations are mainly based in India and it maintains a dedicated unit that develops products specifically for the healthcare needs in rural areas. Medtech2 has developed a portable electrocardiogram (ECG) that enables the screening of large quantities of patients in remote areas. While data acquisition from the patient's body involves standard electrodes, the ECG data processing is performed by an ordinary laptop that is available at the doctor's office. The frugal product developed is a small interface connected to the laptop via USB that contains the necessary software to perform the analysis using the processing power of the customer's PC. With its integrated transmitting unit the ECG data can be sent to hospitals or healthcare centers where specialists can analyze them.

3.1.3. Case 3: Medtech3

Medtech3 is an Indian company that aims at developing solutions for healthcare problems in India. The firm developed an intelligent prescreening device for rural clinics and optometrists to detect preventable blindness. Currently, it is the firm's only product and is developed, produced, and mainly sold in India. Medtech3 developed the product, manufactures it with the help of partners, and sells it using distributors and direct selling. The device is rugged, portable, easy to use, and can be operated with a battery or a solar panel. For complicated cases, the

Table 1
Overview of case firms. EM = Emerging Market.

	Medtech1	Medtech2	Medtech3	Labtech1	Labtech2
Foundation	1896	2007	2010	1984	2000
Headquarters	U.K.	India	India	Netherlands	India
Employees (global)	> 50, 000	> 440	> 65	> 4000	> 50
Size of low-cost product portfolio	med-large	med-large	one product	one product	one product
EM context	China	India	India	China and other EMs	India
EM experience	20 years+	7 years	4 years	10 years	12 years
Employees in EM context	5200	> 400	> 65	> 400	> 50

machine has a telemedicine application, through which the results can be sent to a specialist over the internet, enabling fast healing before the patient becomes irrevocably blind.

3.1.4. Case 4: Labtech1

Labtech1 is a Dutch multinational enterprise that provides sample and assay technologies for molecular diagnostics, applied testing and research. Its traditional customers are large hospitals and laboratories in Western markets and in major cities of emerging economies. Labtech1 developed a portable device for the detection of an infectious disease, which can be operated in rural, resource-constrained areas in China and other emerging markets. A small group of Western engineers was assigned to develop this device with the help of external partners. Production takes place in South East Asia. The product can operate only 48 samples compared to over 300 in advanced Western machines. However, it executes the analysis up to four times faster than advanced machines. The final distribution and examinations are usually performed by NGOs, which also carry medicine for immediate treatment.

3.1.5. Case 5: Labtech2

Labtech2 is an Indian company that developed a device for the detection of infectious diseases, targeted at smaller hospitals as well as remote healthcare centers and rural doctors. Labtech2 developed its frugal product internally and outsourced production and sales to a joint venture with a group of Indian diagnostic companies. The joint venture maintains production facilities in India and markets its products in 88 countries. The product under investigation is battery-operated and designed in a way that non-medics can operate it. It allows faster testing of a single sample than established systems and patients receive their test results instantly at the treatment site. While the device can test only one sample for one disease at a time, the individual examination is very quick, making it viable for small hospitals, doctors and for primary healthcare centers.

4. Results: value proposition, creation, and capturing for frugal business models

The analysis of the data shows that value proposition, creation, and capturing inherently depend on each other. In resource-constrained environments, the value proposition to the customer is an affordable solution that creates very high value for them. On top of that, all business models not only served their target customers but also improved the entire healthcare system in the respective target market. To live up to this value proposition, the firms needed to be very innovative but also strict in their value creation activities. The value created by the firms was captured mostly by product sales – apart from invaluable marketing effects. Table 2 provides the full overview of the five business models in this study (or examination).

4.1. Value proposition

All value propositions of the case firms are specifically targeted for the needs of rural patients, which differ drastically from needs of traditional patients in major hospitals. For example, the ophthalmologic device developed by Medtech3 allows the early detection of symptoms leading to blindness so that these can be treated before blindness sets in. This creates a tremendous value proposition for people in rural India, where severe eye problems are omnipresent and where access to and availability of eye specialists is almost inexistent. Therefore, the device was built to be handled easily due to the lack of doctors to operate the instruments. Traditional eye screening devices habitually require specialists and are often only used when patients already suffer from a severe loss of sight. These machines are expensive, bulky and rely on a stable infrastructure and are purely stationary. As traveling from rural regions to hospitals or eye clinics in major cities is time-consuming and costly, many people in need of treatment simply do not receive it. In contrast, the device of Medtech3 is durable, portable and can be operated by people without medical training and is thus designed for use in the harsh, rural conditions in India. The machine can be run with a battery or a solar panel and integrates five devices into one at approximately 20% of the cost of traditional machines. A built-in software analyzes the screening results and automatically performs the diagnosis. For complicated cases, the machine offers a function through which the results can be sent to a specialist via the internet. As the CEO of Medtech3 said: *"You can carry it in a suitcase. It is rugged and has already been transported on bus tops and even on horses. Right from day one it was designed to keep it affordable; this is the most, most, most important part of our design"*.

The motivation and value propositions were very similar for Labtech1 and Labtech2, both developers of detection devices for infectious diseases. In remote areas of India or China, it is very difficult for patients to get access to basic testing and treatment. The patient-to-lab worker-ratio is even lower than the patient-to-doctors ratio and was for the case of China at 1:7000 in 2010 (WHO, 2014). Traditional, advanced detection machines are used in central laboratories and hospitals in major cities to test large quantities of blood samples and other substances for a multitude of diseases. The testing procedure of these high-end machines is fully automated and executed in a sterile environment by well-educated and expensive lab specialists. They can test more than 300 samples in six to eight hours. Due to the full automation, the required presence time to operate the machine is very low and the lab specialist's free time can be used to do other analyses in the lab while the machine is running, thereby increasing the overall lab efficiency. The situation is completely different for small rural hospitals, clinics or NGOs working in communities where it is more important to have people tested and treated immediately. Hence, the frugal products were designed for speed and not overall efficiency, doing the job in 1–2.5 h. As a consequence, the number of tests that can be carried out with the frugal machines is low, however at a higher frequency. This way, a single patient or a small group of people receives their tests on the same day, which is of utmost value to infected patients. Furthermore, the device developed by Labtech1 is able to work in a hot and humid environment and tolerates temperature variations of the sample. It can be operated by lay people as the product has only one button (i.e., the start button) and displays the test results in a very an intuitive manner (i.e., green smileys for not infected, red smileys for infected). As the Head of Global Lifecycle Management and Project Head explained: *"We can deploy the product in any market in the world because it is so intuitively easy to use"*. In case of an infection of a patient, NGOs are provided with vaccination and other medicine to allow immediate treatment of more common diseases while people with more severe diseases are immediately sent to a specialist. The same value propositions in the field of ultrasound and ECG are provided by other two cases of Medtech1 and Medtech2.

Further, all value propositions not only delivered high value for the end-customer (i.e. patient or rural communities), and the B2B customer (i.e. doctors and small hospitals) but also reduced the overall cost for the entire healthcare system in the emerging market. Most of these system cost savings occur because these products come into play as prophylactic pre-screening device or locally at the patient's domicile with the aim to treat people where they live. Through this, these primary health care devices help reduce the number of patients in hospitals as only severe cases that need hospital treatment will be sent there. This saves resources in terms of "doctor's time" who can focus on patients that need their help the most. All frugal value propositions improved the healthcare system by making it more efficient.

4.2. Value creation

To achieve the frugal value propositions, firms optimized costs in every value creation activity to meet the harsh price-performance requirements of their resource-constrained customers. At the same time,

Table 2
Overview of frugal business models.

	Value Proposition	Value Creation				Value Capturing	
		Engineering	Sourcing	Production	Sales	Expenses	Income
Medtech1	• Affordability and access to healthcare at low costs (possibly for the first time) • Patients do not have to travel to remote hospitals • Easy to use for rural general practitioner • Efficiency gains for the healthcare system	• Recombination of established technologies (imaging and probing unit) into a new, software-based product (new product platform) • Dedicated R & D unit, located in China	• Low-cost raw materials including local supply chain in China • Global sourcing for critical parts	• Low-cost production in China	• Customers: rural hospitals, clinics, and doctors • Access to customers through new additional sales units for rural areas in China	• Cost minimization in each step of the value chain (see value creation)	• Product sales
Medtech2	• Affordability and access to healthcare at low costs (possibly for the first time) • Patients do not have to travel to remote hospitals • Easy to use for rural general practitioner (telemedicine) • Efficiency gains for the healthcare system	• Decomposition of multipurpose machines through decoupling image acquisition and processing by using established technology (new product platform) • Dedicated R & D unit, located in India	• Low-cost technology sourcing from India, commodities sourced from China	• Low-cost production in India	• Customers: rural hospitals and clinics, State of India (primary healthcare centers) • Access to customers through extensive network of sales agents and 100+ dealers to achieve coverage even in remote areas	• Cost minimization in each step of the value chain (see value creation)	• Product sales
Medtech3	• Affordability and access to healthcare at low cost (possibly for the first time) • Preventive screening: preventable blindness can be detected and treated immediately • Ease of use: no doctor required (telemedicine + automated analysis by software) • Efficiency gains for the healthcare system	• Recombination of established technologies into a new, software-based product (new product platform) • R & D unit located in India	• Low-cost raw materials including local supply chain in India • Global sourcing for three critical parts	▪ Low-cost production in India (partly outsourced)	• Customers: (rural) hospitals, eye clinics, and primary healthcare centers • Distribution still in growth phase: channels via distributors and direct selling	• Cost minimization in each step of the value chain (see value creation)	• Product sales • Pay-*per*-use • Leasing • Software as a service
Labtech1	• Affordability and access to healthcare at low costs (possibly for the first time) • Preventive screening: infections are detected before people have symptoms • Ease of use: no specialist required • Speed: 48 samples in 2.5 h instead of 300+ in 6–8 h • Efficiency gains for the healthcare system	• Decomposition of multipurpose machines into a focuses single purpose device (new product platform) • Dedicated, global virtual team	• Low cost raw materials including local supply chain (apart from critical components)	• Low-cost production in South East Asia	• Customers: Country governments and NGOs • Final distribution with the help of NGOs	• Cost minimization in each step of the value chain (see value creation)	• Product sales
Labtech2	• Affordability and access to healthcare at low costs (possibly for the first time) • Patients are tested where they are treated (in rural hospitals or rural primary healthcare centers) • Ease of use: no specialist	• Cost saving through new (but established) technology not used for his analysis before (new product platform). • Dedicated R & D unit, located in India	• Low-cost raw materials including local supply chain in India • Global sourcing for one critical component	▪ Low-cost production in India (outsourced to JV partner)	• Customers: Hospitals, rural clinics and primary healthcare centers • Distributor (JV) with its sales force	• Cost minimization in each step of the value chain (see value creation)	• Product sales • License fee • Shareholder income (from stake in JV)

(continued on next page)

Table 2 *(continued)*

Value Proposition	Value Creation				Value Capturing	
	Engineering	Sourcing	Production	Sales	Expenses	Income
required ● Speed: 1 sample in 120 min instead of 300+ in 6–8 h) ● Efficiency gains for the healthcare system						

the firms' product development activities focused on novel applications, which were based on established technologies that were tailored to the specific customer needs. This innovation approach allowed the firms to meet strict cost criteria whilst simultaneously creating unprecedented applications for resource-constrained customer. This drastic – and to some extent paradox – focus on application innovation and cost minimization can be termed the "frugal mindset" of organizations doing business in resource-constrained environments.

4.2.1. Identifying rural patients' and doctors' needs

As the previous section shows, frugal products were precisely developed to enable medical examinations in rural areas. Consequently, the value proposition for patients (i.e. the end-user) is the affordable provision of healthcare solutions, often for the first time in their lives. A statement by the Managing Director of Labtech2 summarizes the motivation for frugal product innovations in emerging markets: "*In our case it [the need for the application] was the limited resources in developing countries. During the development of the device, we have never compromised on any specifications of the actual need. We only left out features that don't affect the need directly.*" Due to the unique circumstances in emerging markets, especially in light of the poor or missing public infrastructure, the firms took specific measures to obtain a new perspective on customer knowledge. The Western firms employed dedicated teams, which were separated from their premium products' business model to explore local conditions and requirements, while the local firms relied on the personal experience of the founders. The local firms Medtech2, Labtech2, and Medtech3 possessed deep customer knowledge due the personal experience of the founding team who were all natives and had worked in the industries for many years. Medtech2 additionally set-up a dedicated rural market unit to gain even more market knowledge. As the CEO of Medtech3 said: *"Market knowledge is the most critical thing. Because we knew the market very well, we understood the limitations in the market very well and we were able to come up with an appropriate product. Building the product is comparably easy when you know what you have to build"*. Only through this intimate understanding of market and context conditions did Medtech1 know that rural doctors are not familiar with ultrasound technology, let alone the handling such machines. Therefore, they developed their frugal product to be used very intuitively by local doctors. The lack of professional doctors was an even greater constraint in other cases. The head of the rural healthcare business at Medtech2 said: *"So, we went to the rural areas; we saw that most of the primary healthcare centers, based by the government, were vacant – because there were no doctors."* Similarly, Labtech1 did not develop a machine for lab specialist but for non-medics working for NGOs. Hence, they developed a device that could be operated by people without prior knowledge of neither the disease nor any diagnostic device.

4.2.2. Creation and delivery of the application innovation

In all cases, the newly developed applications had only become possible through new frugal product architecture, which were based on existing technologies and were designed for portability. The cases show that frugal innovation is fundamentally different from anything that would be developed for customers in mature Western markets. Two main approaches were observed to achieve the frugal product architecture: first, the *transfer of a new but established technology* from another context and second, the *decomposition of multi-purpose machines* into focused single-purpose devices. Three cases (Medtech1, 3 and Labtech2) applied the first approach. The two Medtech firms took existing software technology (initially developed for other applications) and transferred them into the medical application (e.g. ultrasound and eye screening). Labtech2 incorporated a very different but established core technology into their device compared to the one traditional devices were using. The other approach was applied by Medtech2 and Labtech1, both decomposing the traditional multifunctional high-end machine into a tailored device that focusses on one single operation. In

case of Labtech1 this means that the product can detect exactly one type of virus; for the case of Medtech2 the device only serves as a technical interface that processes and transmits data (i.e. ECG data).

As outlined above, the firms took measures that allowed them to focus exclusively on understanding the true customer, and market needs to craft proper value propositions. Medtech1 maintains a separate R & D unit within its ultrasound business that is located in China dedicated to the development of low-cost products for emerging markets. With regard to marketing and sales, Medtech1 employs a dedicated sales force for the low-cost segment products in rural areas that complements its existing sales force targeting at urban hospitals. Medtech2's ECG device was developed internally in India by a dedicated unit specifically responsible for resource-constrained, rural areas. Similarly, at Labtech1, a dedicated and independent group of engineers focuses solely on the frugal product development and makes the product design as well as the specification of the components. The product specification is based on market insights from local sales units in emerging markets as well as field trips to rural regions. *"We thought: If you have nothing – and I mean literally nothing – what do you need to conduct the analysis? So, we started with a zero-environment in mind: no electricity, no water, and no educated staff"* (Project Head at Labtech1).

4.3. Value capturing

4.3.1. Income

While our case firms applied very special approaches to create and deliver value to the customer, the approaches for value capturing was very straightforward. In a nutshell, the attitude of the firms regarding value capturing can be summarized by the statement of the Managing Director of Medtech1's Technology Center in China: *"If you can make your product and business model low-cost enough, you can still make a very good margin"*. All firms, apart from one, appropriated value through traditional product sales. Medtech3 is the only one applying several revenue models such as pay-*per*-use, software as a service or leasing to even better accommodate the financial constraints of their customers.

4.3.2. Expense minimization for frugal value creation

As outlined by our cases, the firms had an extreme focus on cost minimization in all value creation elements including R & D, supply chain, manufacturing, and sales. The frugal product architecture is not only crucial to enable the application innovation but the design of the products itself is the biggest lever for cost reduction. Frugal innovations in this study have less features and/or performance compared to existing Western standards but at the same time feature characteristics, which are superior to Western products. Due to their unique product architectures, these devices work with much cheaper, established technologies and require only a fraction of material and components compared to advanced products. Labtech1's product for example only needs two electric motors instead of 38 in their Western product. Moreover, the firms innovated the frugal product architectures without new technology development, thereby limiting overall development costs and increasing the value captured from product sales (Chliova and Ringov, 2017).

At the same time, all firms benefitted from local cost advantages in emerging markets. Product development was carried out mostly by local engineers, i.e. native people located in India or China to both improve the value orientation and the cost position. Labtech1 is an exception as it designed their product mostly in the West, however outsourced the actual product development to save cost. In line with common Western strategies (Weber et al., 2010), production of and sourcing for these frugal innovations are localized in low-cost countries in Asia, mainly in China and India. An additional benefit of local operations are the lower transportation and logistics costs due to the market proximity. Finally, dedicated marketing and sales units/channels for rural customers – often located in the emerging market and led by local people – support these units. The use of local sales people and existing sales channels of partners and distributors enabled the firms to appropriate further cost savings compared to building new channels or train existing sales people for selling frugal products.

While Medtech1's sourcing is set-up globally, most of the materials for frugal products are sourced from low-cost suppliers in China, thereby minimizing transportation cost and ensuring short response times. Production is also localized in existing facilities in low-cost countries, mostly in China. For the frugal product, Labtech1 sources globally, most in emerging markets, with the exception of critical core components. Production takes place in production facilities in South East Asia. The devices of the Indian firms are produced and sourced in India to leverage local cost advantages. *"The cost of labor is low in India. Most medical products are manufactured in rather small numbers and hence a lot of manual intervention is required. The cost of manual technical labor in India is about 10% of the costs in the developed world. Hence we are able to provide low cost for low volumes",* said Medtech2's Managing Director.

The cases show that partnering with other firms and outsourcing were commonly used vehicles to achieve the low-cost requirements of the frugal value proposition. While outsourcing for cost reasons is a well-established business practice (Kenney et al., 2009), data from the cases showed that outsourcing came particularly into play when the firms were lacking crucial frugal competences and the internal development of these would be too expensive. With the cost pressure inherent in frugal innovation, there is only little room for additional costs to build specific capabilities internally. The firms therefore outsourced activities in cases of missing low-cost competencies or capacities, which were, however, essential to achieve the low-cost positions. Labtech2, for example, teamed up with a partner that contributed with low-cost production know-how and an extensive international sales network. R & D is done internally at Labtech2 but sourcing, production, as well as sales and service is done in the joint venture. The partner executes these steps in their own existing facilities and delivers the products through their sales force. These measures reduce the costs for Labtech2 to R & D expenses. As Labtech2's MD explained: *"The reason why we tied up with our partner firm is that they already have distributors [in India and] in 60 other countries… So, the joint venture is manufacturing and sales […] all the sales people are in the joint venture and not in Labtech2."*

Similarly, Labtech1, which is specialized in complex high-end product developments, lacked the low-cost development capability needed for the frugal product. Therefore, only the design and specification was done internally, while the majority of the product development was outsourced to firms specialized in low-cost product development. In addition, NGOs organized Labtech1's distribution of the products to the rural communities and operated the machines in the field. *"Of course, we could have built competences and new sales channels in-house, but this would have been far too expensive to pay off in the end"*, commented Labtech1s's Project Head. The same pattern applies for the other two cases: Medtech2 realized low-cost production internally, while Labtech2 completely outsourced production and sales. Table 2 provides the full overview of the five business models under study.

5. Discussion and implications

This study provides insights regarding the specific value proposition of the frugal business models. The business model of the firms in this study yield three value propositions for three customer groups. Being a B2B firm, they provided their direct customers with low-cost products at high affordability, and provided operational requirements such as battery-based operation, durability, or easy handling. Furthermore, the firms also address end customers or, in this case, the patients. The value proposition for them is access to affordable healthcare in rural environments. Finally, all cases entail a third value proposition towards the entire healthcare system by generating overall gains of efficiency: frugal innovations allow basic examinations to be taken outside of the hospital by staff with basic training so that specialists in hospitals can focus on severe health cases that need a fully trained specialist. In other

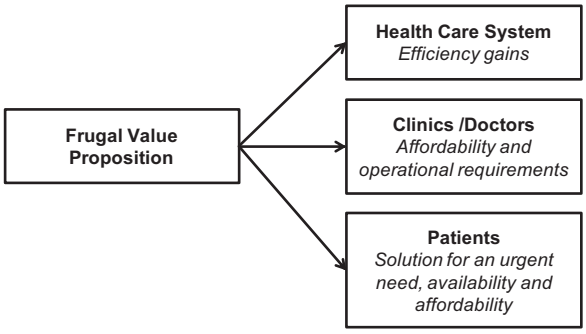


Fig. 1. The value proposition of frugal business models in the med-tech sector.

words: frugal innovations and their underlying business models in the medical sector increase the efficiency as they enable a more efficient distribution of scarce resources in the local healthcare system. Fig. 1 visualizes the frugal value proposition for the medical device and laboratory equipment industry towards all customer groups.

Overall, the cases reinforce the notion that frugal innovations are disruptive innovations as suggested by earlier studies (Christensen and Raynor, 2003; Markides, 2006; Wan et al., 2015). While extant research has already highlighted that resource-constrained innovations create new low-cost segments of existing markets (Hang et al., 2015; Lim et al., 2013) this study suggests that resource-constrained innovation can even create new markets if they entail a new application. Consider the case of Medtech1: The frugal ultrasound created a whole new market segment for mobile ultrasound applications through which ultrasound technology can now be used in completely new settings such as rural clinics or ambulance vehicles. This applies for all cases in this study as they all transformed a procedure, which was initially bound to an existing infrastructure and professional staff into an easy-to-use, mobile application.

Also, the cases show how firms organized their value creation activities to achieve the frugal value proposition. Due to the significantly different market and institutional environment in emerging markets, firms are forced to tailor their business model to meet the challenges these markets and customer segments pose (Landau et al., 2016). The firms' overall business model design is tailored to reduce cost wherever possible (e.g. in manufacturing, sourcing and partnering in all value chain activities) to achieve the frugal value proposition (R & D) and to reach customers in resource-constrained contexts (e.g. specific sales teams and channels as well as partnering). This is in line with literature arguing that cost concerns are generally a major driver for a firms' presence in low-cost countries (Dunning, 1993; Lee, 1986; Lewin et al., 2009; Weber et al., 2010) and business model literature arguing that business model gaps are a major driver for open business models (Frankenberger et al., 2014). The main lever for frugal business models, however, remains in firms' R & D and how they achieve the new application. Another crucial factor that has been shown in the cases and was previously discussed in literature (Baskaran and Mehta, 2016) is the incorporation of indigenous knowledge along the value creation process to deal with needs and resource-constraints. Overall, our study supports earlier findings that all components of the business model needed to be adjusted (Landau et al., 2016). Further, this study is the first to identify two generic approaches, either a technology transfer from another domain or the decomposition of a multipurpose machine into a single purpose device to enable frugal innovation.

5.1. Implications

5.1.1. Theoretical implications

In this article, we have analyzed the business models of five firms that have implemented business models for frugal innovation in the medical and laboratory equipment industry in India and China. In doing so, this study advances the understanding of innovation and business model design for resource-constrained environments. The main theoretical contributions of this study are as follows: This study is the first to adapt a more fine-grained view of low-cost innovation in emerging markets by focusing exclusively on frugal product innovations. While extant research on resource-constrained innovation has mainly argued that these sorts of innovations create low-end segments of existing markets, we provide evidence that frugal innovations can create entirely new markets. Second, this study advances the understanding of business model innovation in the context of resource-constrained innovation. The understanding of the multidimensional value proposition needed for emerging markets is addressed and the threefold value proposition for frugal innovations in the medical device and laboratory equipment industry is identified. Also, it has been found that the value proposition for frugal innovation addresses at least three different customer groups, thus specifying and detailing earlier studies on value propositions for resource-constrained environments. Overall, the nature and magnitude of adaptation of business model components when expanding to emerging markets is highlighted and elaborated on.

5.1.2. Policy implications

The research in this paper holds implications for policy makers and governments in Western as well as in emerging markets. From a Western standpoint, frugal innovation can be seen as beneficial from two perspectives. Firstly, from a business perspective, these innovations should be understood as an investment that will secure jobs at home in the long run. The profitable business environment in emerging markets offers Western firms the opportunity to expand existing market segments or create entirely new ones, which enables them to grow their business in the long-term. Further, entering these markets prepares Western companies for the growing local competition that will only grow stronger in the coming years. Increasingly, firms from emerging markets are also entering traditional markets in the West, often with low-cost solutions. By already competing with them in emerging markets, Western firms can prepare to also fend off these firms in Western markets. Secondly, frugal innovations can function as profit-based aid, as they often satisfy basic needs (e.g. healthcare, sanitation and energy supply) for the first time. Simulaneously, these innovations help to include people into the formal global economy by perceiving them as customers, instead of just providing free goods to them via humanitarian aid initiatives. Additionally, local market players are actively involved throughout the process. This participation in the formal economy decreases the dependency on development aid, which is mainly financed by the governments of industrial countries. Therefore, Western policy makers need to create settings that enable and foster the development of these innovations for their domestic companies. In practice this could be achieved by offering financial support (e.g. subsidies or risk capital) or the provision of technical and market know-how for firms that want to start such an endeavor.

On the other hand, frugal innovations are immensely attractive for governments and policy makers in emerging markets. These administration in such countries face vast challenges that often cannot be solved by the public sector alone. Frugal innovations from the private sector can relief the system by filling gaps or by overcoming institutional and infrastructural voids. This not only helps local people in many aspects of their lives but at the same time safes resources that the government can invest into other projects. For this to be possible, policy makers need to build an environment that supports local but also Western firms in creating frugal innovations. This can be achieved by market liberalization, better market access for foreign firms, an enhancement of the infrastructure or the legal system (e.g. patent enforcement) and subsidies for this particular type of innovation.

5.1.3. Managerial implications

The findings of this study also have several implications for management practice. Overall, it becomes evident that Western firms in

particular need to develop a frugal mindset with in their organization, if they plan to create frugal business models. This frugal mindset represents the creation of very high customer value at very low costs for resource-constrained people in emerging markets. The findings suggest that this can be achieved with several tactics within the three core elements of the business models. First, while local firms may naturally possess in-depth customer and market know-how, Western MNCs should establish dedicated organizational units that focus on these markets. This might requirei that new organizational units for need sensing, R & D, and customer interaction are built. Here, firms need to lay the foundation to achieve frugal innovation within their organization. Second, based on this in-depth understanding of the customer and the market context, firms should develop the threefold value proposition at very low cost. Specific solutions that are tailored to the customers and context requirements need to be created. To realize this task, firms can draw upon the two frugal R & D strategies presented in order to arrive at simple but robust and simultaneously cheap solutions for resource-constrained customer. After all, a low-cost solution that does the job is worth more than no solution, especially in markets where people are in severe need.

On the cost side, firms must take every possible action within their value creation activities to reduce costs to a minimum. The entire ecosystem of the firm needs to profit from increased efficiency. Ultimately, low-cost is not an option to ensure or improve profitability in this business segment; it is the prerequisite to initiate business in the first place. In line with Prahalad (2010), we argue that frugal products do not compete with other low-cost alternatives but they compete with non-consumption, leaving rural doctors and hospitals with the choice between a frugal product solution or no solution at all.

5.2. Future research

To our knowledge, this is the first study to empirically investigate frugal innovation defined as an entirely new application for emerging markets. Many research avenues evolve from such exploratory research. *First*, the findings of this study describe the status-quo, not the development, of the firms' frugal business models. As many studies in business model research adopt a static view, there is rather limited insight in the question how business models evolve and how tactics within value creating and capturing activities vary and change over time. This is particularly true for business models for frugal innovation. Longitudinal studies analyzing the dynamics of frugal business models over time would improve our understanding how they can be effectively changed and adapted to specific circumstances. *Second*, future research could advance our understanding of the multidimensionality of the value proposition in emerging markets, specifying it in other industries and markets. *Third*, while this study has focused on frugal business models in emerging markets, it has been argued that frugal products may be commercialized in developed markets as well (Govindarajan and Ramamurti, 2011). For research concerned with the global dimension of business models, it would be interesting how these business models differ from the ones in emerging markets. Following this road, one major question that has not yet received much attention despite its high importance for globally operating Western firms is how these firms can integrate low-cost business models for emerging markets in their global operations (Kachaner et al., 2011; Markides, 2012). Overall, frugal innovation and business models in emerging markets are two thriving fields of research whose integration offers rich opportunities for future research.

Acknowledgements

This work was supported by the Swiss National Science Foundation (Grant number P1SGP1_158830).

Appendix: List of interviews and interview partners

See Table A1.

Table A1
Overview of interviews.

Firms	Interview partners	Interviews	Minutes
Medtech1	• Director Global Research-Europe • General Manager China Technology Center • General Manager of Global Technology Healthcare	5	190
Medtech2	• Managing Director and founding member • Head of Rural Healthcare Business • Head of European Design Center	3	135
Medtech3	• CEO and founding member	1	95
Labtech1	• Head of Global Lifecycle Management Instruments • Product Manager	3	180
Labtech2	• Managing Director and founding member	1	95

References

Afuah, A., 2004. Business Models: A Strategic Management Approach. McGraw-Hill, Boston, MA.
Afuah, A., Tucci, C.L., 2001. Internet Business Models and Strategies. McGraw-Hill International Editions, Boston, MA.
Ahlstrom, D., 2010. Innovation and growth: how business contributes to society. Acad. Manag. Perspect. 24, 11–24.
Amit, R., Zott, C., 2001. Value creation in E-business. Strateg. Manag. J. 22 (6–7), 493–520.
Anderson, J., Markides, C., 2007. Strategic innovation at the base of the pyramid. MIT Sloan Manag. Rev. 49 (1), 82–88.
Baskaran, S., Mehta, K., 2016. What is innovation anyway? Youth perspectives from resource-constrained environments. Technovation 52–53, 4–17.
Chesbrough, H., 2007. Business model innovation: it's not just about technology anymore. Strategy Leadersh. 35 (6), 12–17.
Chliova, M., Ringov, D., 2017. Scaling impact: template development and replication at the base of the pyramid. Acad. Manag. Perspect. 31 (1), 44–62.
Christensen, C.M., Raynor, M., 2003. The Innovator's Solution. Harvard Business School Press, Boston, MA.
Christensen, L.J., Siemsen, E., Balasubramanian, S., 2015. Consumer behavior change at

the base of the pyramid: bridging the gap between for-profit and social responsibility strategies. Strateg. Manag. J. 36 (2), 307–317.
Cunha, M.P.E., Rego, A., Oliveira, P., Rosado, P., Habib, N., 2014. Product innovation in resource-poor environments: three research streams. J. Product. Innov. Manag. 31 (2), 202–210.
Doganova, L., Eyquem-Renault, M., 2009. What do business models do? Innovation devices in technology entrepreneurship. Res. Policy 38 (10), 1559–1570.
Drummond, A., 2012. Research on emerging economies: challenges are always opportunities. Glob. Strategy J. 2, 48–50.
Dunning, J.H., 1993. Multinational Enterprises and the Global Economy. Addison-Wesley, Wokingham.
Eisenhardt, K.M., 1989. Building theories from case study research. Acad. Manag. Rev. 14 (4), 532–550.
Ernst, H., Kahle, H.N., Dubiel, A., Prabhu, J., Subramaniam, M., 2015. The antecedents and consequences of affordable value innovations for emerging markets. J. Product. Innov. Manag. 32 (1), 65–79.
Eyring, M., Johnson, M., Nair, H., 2011. New business models in emerging markets. Harv. Bus. Rev. 89 (1), 88–98.
Foster, C., Heeks, R., 2013. Innovation and scaling of ICT for the bottom-of-the-pyramid. J. Inf. Technol. 28 (4), 296–315 (Nature Publishing Group).
Frankenberger, K., Weiblen, T., Gassmann, O., 2013. Network configuration, customer centricity, and performance of open business models: a solution provider perspective. Ind. Market. Manag. 42 (5), 671–682.
Frankenberger, K., Weiblen, T., Gassmann, O., 2014. The antecedents of open business models: an exploratory study of incumbent firms. R & D Manag. 44 (2), 173–188.
Gadiesh, O., Leung, P., Vestring, T., 2007. The battle for China's good-enough market. Harv. Bus. Rev. 85 (9), 80–89.
George, G., McGahan, A.M., Prabhu, J., 2012. Innovation for inclusive growth: towards a theoretical framework and a research agenda. J. Manag. Stud. 49 (4), 661–683.
George, G., Corbishley, C., Khayesi, J.N., Haas, M.R., Tihanyi, L., 2016. Bringing Africa in: promising directions for management research. Acad. Manag. J. 59 (2), 377–393.
Gibbert, M., Ruigrok, W., Wicki, B., 2008. What passes as a rigorous case study? Strateg. Manag. J. 29, 1465–1474.
Gold, S., Hahn, R., Seuring, S., 2013. Sustainable supply chain management in 'Base of the Pyramid' food projects—a path to triple bottom line approaches for multinationals? Int. Bus. Rev. 22 (5), 784–799.
Govindarajan, V., Ramamurti, R., 2011. Reverse innovation, emerging markets, and Global strategy. Glob. Strategy J. 1, 191–205.
Govindarajan, V., Trimble, C., 2012. Reverse Innovation. Harvard Business School Press, Boston.
Halme, M., Lindeman, S., Linna, P., 2012. Innovation for Inclusive Business: intrapreneurial Bricolage in Multinational Corporations. J. Manag. Stud. 49 (4), 743–784.
Hang, C.C., Garnsey, E., Ruan, Y., 2015. Opportunities for disruption. Technovation Elsevier 39–40, 83–93.
Harsimran, J., Peerzada, A., 2013. India spawning top notch medical devices companies with cutting-edge tech at affordable prices. The Economic Times, available at: 〈http://articles.economictimes.indiatimes.com/2013-02-08/news/36993332_1_medical-devices-perfint-healthcare-warmers〉 (Accessed 12 September 2013).
Hart, S.S.L., Christensen, C.M., 2002. The great leap. MIT Sloan Manag. Rev. 44 (1), 51–56.
Hoskisson, R.E., Wright, M., Filatotchev, I., Peng, M.W., 2013. Emerging multinationals from mid-range economies: the influence of institutions and factor markets. J. Manag. Stud. 50 (7), 1295–1321.
Immelt, J., Govindarajan, V., Trimble, C., 2009. How GE is disrupting itself. Harv. Bus. Rev. 87 (10), 56–65.
Jick, T.D., 1979. Mixing qualitative and quantitative methods: triangulation in action. Adm. Sci. Q. 24 (4), 602–611.
Johnson, M., Christensen, C.M., Kagermann, H., 2008. Reinventing your business model. Harv. Bus. Rev. 86 (12), 50–59.
Kachaner, N., Lindgardt, Z., Michael, D., 2011. Innovating low-cost business models. Strategy Leadersh. 39 (2), 43–48.
Kenney, M., Massini, S., Murtha, T.P., 2009. Offshoring administrative and technical work: new fields for understanding the global enterprise. J. Int. Bus. Stud. 40 (6), 887–900.
Khanna, T., Palepu, K., 2000. The future of business groups in emerging markets: long-run evidence from Chile. Acad. Manag. J. 43 (3), 268–285.
Kravets, O., Sandikci, O., 2014. Competently ordinary: new middle class consumers in the emering markets. J. Mark. 78 (4), 125–140.
Landau, C., Karna, A., Sailer, M., 2016. Business model adaptation for emerging markets: a case study of a German automobile manufacturer in India. R & D Manag. 46 (3), 480–503.
Lee, J., 1986. Determinants of offshore production in developing countries. J. Dev. Econ. 20, 1–13.
Lewin, A.Y., Massini, S., Peeters, C., 2009. Why are companies offshoring innovation? The emerging global race for talent. J. Int. Bus. Stud. 40 (6), 901–925.
Lim, C., Han, S., Ito, H., 2013. Capability building through innovation for unserved lower end mega markets. Technovation 33 (12), 391–404.
Locke, K., 2001. Grounded theory in Management Research. Sage, London.
London, T., Hart, S.S.L., 2004. Reinventing strategies for emerging markets: beyond the transnational model. J. Int. Bus. Stud. 35 (5), 350–370.
London, T., Anupindi, R., Sheth, S., 2010. Creating mutual value: lessons learned from ventures serving base of the pyramid producers. J. Bus. Res. 63 (6), 582–594 (Elsevier Inc.).
Mair, J., Martí, I., 2006. Social entrepreneurship research: a source of explanation, prediction, and delight. J. World Bus. 41 (1), 36–44.
Mair, J., Martí, I., Ventresca, M.J., 2012. Building inclusive markets in rural Bangladesh: how intermediaries work institutional voids. Acad. Manag. J. 55 (4), 819–850.
Markides, C., 2006. Disruptive innovation: in need of better theory. J. Product. Innov. Manag. 23, 19–25.
Markides, C., 2012. How disruptive will innovations from emerging markets Be? MIT Sloan Manag. Rev. 54 (1), 23–25.
Markides, C., Charitou, C., 2004. Competing with dual business models: a contingency approach. Acad. Manag. Exec. 18 (3), 22–36.
Miles, M.B., Huberman, A.M., 1994. In: Holland, R. (Ed.), Qualitative Data Analysis, 2nd ed. Sage, Thousand Oaks.
Morris, M., Schindehutte, M., Allen, J., 2005. The entrepreneur's business model: toward a unified perspective. J. Bus. Res. 58 (6), 726–735.
Mudambi, R., 2011. Hierarchy, coordination, and innovation in the multinational enterprise. Glob. Strategy J. 323, 317–323.
OECD, 2009. Globalisation and Emerging Economies. OECD Publishing, Brazil, Russia, India, Indonesia, China and South Africa.
Pitta, D., Guesalaga, R., Marshall, P., 2008. The quest for the fortune at the bottom of the pyramid: potential and challenges. J. Consum. Mark. 25 (7), 393–401.
Prahalad, C.K., 2010. The Fortune at the Bottom of the Pyramid: Eradicating Poverty through Profits, 5th ed. Wharton School Publishing, Upper Saddle River, NJ.
Prahalad, C.K., 2012. Bottom of the pyramid as a source of breakthrough innovations. J. Product. Innov. Manag. 29 (1), 6–12.
Prahalad, C.K., Hammond, A., 2002. Serving the world's poor, profitably. Harv. Bus. Rev. 80 (9), 48–57.
PWC, 2014. Indian healthcare industry, available at: 〈http://www.pwc.in/industries/healthcare.jhtml〉 (Accessed 11 August 2014).
Ricart, J.E., Enright, M.J., Ghemawat, P., Hart, S.L., Khanna, T., 2004. New frontiers in international strategy. J. Int. Bus. Stud. 35 (3), 175–200.
Sanchez, P., Ricart, J.E., 2010. Business model innovation and sources of value creation in low-income markets. Eur. Manag. Rev. 7, 138–154.
Seelos, C.C., Mair, J., 2007. Profitable business models and market creation in the context of deep poverty: a strategic view. Acad. Manag. Perspect. 21 (4), 49–63 (Academy of Management).
Simanis, E., 2012. Reality check at the bottom of the pyramid. Harv. Bus. Rev. 90 (6), 120–125.
Sinkovics, N., Sinkovics, R.R., Yamin, M., 2014. The role of social value creation in business model formulation at the bottom of the pyramid – implications for MNEs? Int. Bus. Rev. 23 (4), 692–707 (Elsevier Ltd.).
Tongur, S., Engwall, M., 2014. The business model dilemma of technology shifts. Technovation 34 (9), 525–535 (Elsevier).
Wan, F., Williamson, P.J., Yin, E., 2015. Antecedents and implications of disruptive innovation: Evidence from China. Technovation 39–40, 94–104 (Elsevier).
Weber, M., Hiete, M., Lauer, L., Rentz, O., 2010. Low cost country sourcing and its effects on the total cost of ownership structure for a medical devices manufacturer. J. Purch. Supply Manag. 16 (1), 4–16 (Elsevier).
WHO, 2014. Global Health Observatory Data Repository, available at: 〈http://www.who.int/gho/health_workforce/physicians_density/en/〉.
Williamson, P., 2010. Cost innovation: preparing for a 'Value-for-Money' revolution. Long Range Plan. 43, 343–353.
Wilson, F., Post, J.E., 2013. Business models for people, planet (& profits): Exploring the phenomena of social business, a market-based approach to social value creation. Small Bus. Econ. 40, 715–737.
Winterhalter, S., Zeschky, B.M., Gassmann, O., 2016. Managing dual business models in emerging markets: an ambidexterity perspective. R & D Manag. 43 (3), 464–479.
Yin, R.K., 2014. Case Study Research: Design and Methods, 5th ed. Sage, Thousand Oaks.
Yunus, M., Moingeon, B., Lehmann-Ortega, L., 2010. Building Social business models: Lessons from the Grameen experience. Long. Range Plan. 43 (2–3), 308–325 (Elsevier Ltd).
Zeschky, M., Widenmayer, B., Gassmann, O., 2014a. Organising for reverse innovation in Western MNCs: the role of frugal product innovation capabilities. Int. J. Technol. Manag. 64 (2/3/4), 255–275.
Zeschky, M., Winterhalter, S., Gassmann, O., 2014b. From cost to frugal and reverse innovation: mapping the field and implications for global competitiveness. Res. Technol. Manag. 57 (4), 20–27.
Zott, C., Amit, R., 2008. The fit between product market strategy and business model: implications for firm performance. Strateg. Manag. J. 29, 1–26.
Zott, C., Amit, R., Massa, L., 2011. The business model: recent developments and future research. J. Manag. 37 (4), 1019–1042.

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