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Value capture and value creation: The role of information technology in business models for frugal innovations in Africa[☆]

Rachel Howell^{*}, Cees van Beers, Neelke Doorn

Faculty of Technology, Policy, and Management, Delft University of Technology, Jaffalaan 5, Delft, Netherlands

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ABSTRACT

Bringing value to end consumers is one of the main challenges for businesses in emerging markets. This paper examines the role of information technology (IT) advancements in frugal innovation and in influencing new business models to bring frugal innovations within reach of the poor. A thorough review of theoretical concepts of business models and their applicability to the Bottom-of-the-Pyramid (BoP) literature and frugal innovation is given. IT has three characteristics that have influenced both business models and frugal innovation. First IT reduces transaction costs, sensor prices have decreased, and IT's externalities have increased the economic and social value from one innovation. By discussing the case of a high-technology low cost weather sensor system deployed in sub-Saharan Africa, this paper demonstrates how IT has introduced new frugal innovations, and influenced new business models. The success of the weather station diffusion has been due to the value of the weather data generated, the adaptive business model, and the co-creation approach throughout the station and business model design. IT has played a strong part in diffusing new innovations in Africa, but also has the potential to exclude certain groups. Future research should explore how IT and frugal innovation can lead to inclusion.

1. Introduction

Advancements in information technology (IT) have changed the economic landscape in Africa by creating opportunities for new and cheap innovations. Two accelerating trends facilitated these developments: increasing computing power and decreasing prices per unit of computing power (Nordhaus, 2007). IT applications are often considered important promoters of economic development by reducing information costs, promoting innovation and increasing inclusion (World Bank, 2016). Although sub-Saharan Africa has the lowest IT development index of any region, it has also seen the fastest increase in mobile phone access, a trend that has stimulated innovations such as mobile money payment (Pick and Sarkar, 2015).

Two new possibilities of IT applications are 1) new and low-cost innovations due to more equal access to information and ease of inventing which increase the economic development potential, 2) new business models that can allow the low-cost innovations to realize this potential economic development. The combination of IT innovations like mobile payment with the rapid diffusion of mobile phones and the

sharp decrease in sensor technology prices provides opportunities for innovators to design innovations that more accurately reflect the local preferences and values of consumers that live in resource-constrained environments. The second possibility – new business models – has not received much attention in the academic literature yet (Hossain, 2016; London et al., 2010). The low-cost and value-sensitive designed innovations often made possible by IT are an example of so-called frugal innovations (Bhatti, 2012; Rao, 2013). One of the goals of frugal innovation is reducing technological complexity without sacrificing user value. Frugal innovations build upon the idea of innovating around resource-constraints typical in Africa and maximizing value for money (Bhatti, 2012).

A sector in which frugal innovations can have an important impact in African countries is the agricultural sector (Aker, 2011; Nakasono et al., 2014). As rain-fed agriculture is the backbone of many African societies, agricultural outputs can be improved by accurate weather forecasting. Weather forecasting on the African continent is limited due to the sparse and poorly maintained network of weather stations across the continent (Snow et al., 2016).

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^{*} Corresponding author.

E-mail address: R.J.Howell@tudelft.nl (R. Howell).

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Table 1
Categories of literature on technology production for and in developing countries.

Category	Features
Technology transfer	Large scale technical systems designed for developed countries and implemented in developing countries
Appropriate technology	Small scale, locally made/designed
Jugaad innovation	“Good enough”, grassroots, meeting local needs, bottom up approach
Frugal innovation	Low resource use, high quality, created under cost and resource constraints but often with high technology, can be top down or bottom up, much of the recent literature is focused on MNC entering BoP markets through frugal innovations.

This paper examines the role of business models in addressing the dual business challenge of value capturing and value creation. Value capturing refers to revenue generation for the innovating organization and value creation relates to the impact of the innovation in the local economic and social environment. Scant research exists on exploring how business models can assist in overcoming the tension between profitability and development impact. Although research exists on the role of mobile phone access and IT in development (see (Aker and Mbiti, 2010; James, 2009, 2012, 2016)) less research examines the role of IT in business models and frugal innovation diffusion. Technological advancements like IT have enabled new business models for frugal innovations, but frugal innovation literature is in its infancy and is limited in its exploration of how to successfully bring these innovations to the market from a business perspective. While much of the literature on frugal innovation is focused on India, this paper focuses on the African context. Therefore the research question addressed in the paper is: *How has IT advancement influenced new business models for frugal innovations that contribute to the dual business challenge of value capture and value creation in Africa?*

In the next section, IT advancements and frugal innovations as a new phenomenon are described. In order to set the context for the necessity of business models, in Section 3 the dual business challenge of value creation and value capture are defined and described in relation to Prahalad's Bottom-bottom-of-the-Pyramid concept. Section 4 picks up the lines of Sections 2 and 3 through a review of business model definitions and the role of IT in their development. The application of business model literature and the role of IT in creating and capturing value are examined in Section 5 through the lens of a case study, a frugal weather station system that is currently being deployed across the African continent. Section 6 provides discussions about this case and its relation to literature. Conclusions and possible future research lines are presented in Section 7.

2. Information technological advancement and frugal innovation

Recent interest in and occurrence of frugal innovations relates to the emergence of new technologies in the last two decades, particularly information technologies. IT is considered as a General Purpose Technology (GPT) (Jovanovic and Rousseau, 2005). GPTs are pervasive for society, experience rapid improvements and declining user costs over time due to externalities of technical systems, and help spawn innovations (Lipsey et al., 2005). Examples of GPTs are the steam engine in the 17th century and electrification of factories and households in the beginning of the 20th century. The resulting innovations are not necessarily produced only by high-technology IT firms but are also created by enterprises supplying new products or production systems using IT platforms. The disruptive character of IT as a GPT together with the reduction of user costs over time has created opportunities for innovators and users to re-design or create newly designed frugal innovations.

In the 1950s and 1960s Multinational Corporations (MNCs) were the main vehicles for technology transfer from developed to developing countries. Technology was designed with the developed country's requirements and needs in mind and, via MNC affiliates, applied to products for developing countries' markets. The result was flawed as it led

to the use of labor-saving technologies for labor abundant countries with relatively low-priced labor and hence small potential to contribute to local economic development (Jones, 2010).

In 1973, Schumacher introduced the idea of appropriate technology. Schumacher's focus was on creating small scale technologies with the locality in mind either through design or manufacture of the product (Kaplinsky, 2011; Schumacher, 2011). However, the emphasis on the locality, limiting resource use, and minimizing harm through the use and design of technology that fits with its intended users was criticized for being more charity- or non-governmental organization (NGO)-focused (Kaplinsky, 2011). The Indian equivalent to innovation on a local scale is Jugaad, a term that emerged from India in the 2000s. Like appropriate technology, Jugaad has been a bottom-up and needs-based approach with a strong focus on the local innovator. Jugaad is a Hindi word that means ‘hack’. Jugaad innovations are innovations that make do with limited resources and perform basic functionalities (Brem and Wolfram, 2014). Frugal innovation could be viewed as an extension of these two terms, with fewer limitations on the local dimension of the innovator, and greater focus on wider diffusion of innovations.

The link between high and low technology as well as the profit motive may give the concept of frugal innovations the opportunity to become a link between the standard technology transfer ideas to the appropriate and/or jugaad kind of technology (see Table 1).

Much of the literature on frugal innovation emphasizes the reduction of costs that can come through supply factors such as stripping away of unnecessary technological features, lower resource use or use of new technology (Radjou and Prabhu, 2014; Rao, 2013; Tiwari et al., 2014; Tiwari and Herstatt, 2012; Zeschky et al., 2014). More recently, the term frugal innovation is considered to refer to innovating around constraints (Rao, 2013; Zeschky et al., 2014). Here the frugal innovations are demand-driven as they are induced by creative ideas to circumvent or change technological, institutional and organizational constraints. Bhatti and Ventresca (2013) discuss how frugal innovation can be conceptualized and propose that frugal innovation is the outcome of three sets of constraints: resource scarcity, institutional voids or complexities, and market affordability. Considering the three constraints that Bhatti mentions, it could be argued that many frugal innovations are meeting needs that are often public goods/infrastructure-related since these services are typically lacking in resource constrained environments due to poor governance and institutions (Table 2).

Frugal innovations could also be viewed as outcomes of resource constraints or ‘bricolage strategies’, since frugal innovations are a result of the coupling of resource constraints and customer price expectations (Cunha et al., 2014; Ernst et al., 2015; Ravishankar, 2016). However, frugal innovation literature mostly discusses the cost reduction being

Table 2
Frugal innovation features of TAHMO.

TAHMO frugal innovation features	Literature
Outcome of institutional & resource constraints	(Bhatti, 2012; Cunha et al., 2014; Ernst et al., 2015)
Low cost	(Agarwal & Brem, 2012)
Solves existing problem	(Bhatti, 2012)
Use of high technology (IT) to reduce maintenance	(Radjou and Prabhu, 2014; Rao, 2013)

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