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Frugal innovation: aligning theory, practice, and public policy

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# Frugal innovation: aligning theory, practice, and public policy

Frugal  
innovation

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## Abstract

**Purpose** – The paper aims to address two key gaps in the literature of frugal innovation. First, it disambiguates frugal innovations into its types, and into the various levels at which it happens. Second, it builds upon the theoretical foundations of resource-based view, new institutional economics, economics of location, and institutional theory to offer testable propositions on determinants of frugal innovations.

**Design/methodology/approach** – This is a conceptual paper. The authors first systematically reviewed the extant literature on frugal innovation and related domains and categorized the existing understanding on the domain into various typologies of frugal innovation. The authors then justified why certain key theoretical lenses are tenable to understand the determinants of frugal innovation and then examined the conditions that enable such innovations.

**Findings** – The paper has three key findings. First, frugal innovation comprises of a frugal mindset, a frugal process and a frugal outcome, which may be practiced distinctly. Second, frugal innovators are of three types: grassroots-level, domestic-enterprise level, and MNC-subsidiary level. Each has their distinctive incentives and styles of frugal innovation. Third, a frugal mindset is encouraged by a resource-scarce environments, weaker institutional intermediaries, and a higher tolerance for uncertainty. Frugal processes are espoused by poor property rights regime and a critical size of lead market; and frugal outcomes are influenced by the network-position of innovators, and the presence of critical lead-markets.

**Research limitations/implications** – The propositions are though testable, but proxies need to be developed to measure the variables, such as a frugal mindset, and a frugal process. Further, the current view on various types and levels of frugal innovation is that of mutual exclusivity, whereas this may not always be the case. Hence, it might be useful to identify contingencies in which these distinctions fade away.

**Originality/value** – The paper is valuable in two key aspects. First, it offers a much-needed theoretical underpinning to the phenomenon of frugal innovation, such that the phenomenon could be better understood and influenced. Second, it nuances the phenomenon by identifying distinct types of frugal innovators in terms of their motivation, institutional influences, and styles of innovation.

**Keywords** Innovation, Emerging economies, Resource-based view, Institutional theory, Economics of location, New institutional economics

**Paper type** Research paper

## Introduction

Growing concerns over sustainability and increased consumerism, shrinking rewards from formal and elaborate innovation management processes, and the high growth rates of emerging markets with low-income consumers have induced firms and nations alike to review their innovation agendas (Radjou *et al.*, 2012; Carayannis, 2012). The view is shifting from that of large-scale funding and elaborate processes, to one of inclusivity, affordability and frugality (Kaplinsky, 2011; Govindarajan and



Trimble, 2012; Prahalad and Mashelkar, 2010). Further, the field of management in general and strategic management in particular is setting its sight on emerging economies to offer insights on newer ways firms and individuals operating in resource-scarce environments carve sustainable competitive advantage (Hoskisson *et al.*, 2000). As a result, there has been a growing interest in studying approaches to innovation that use resources economically and result in products and services that offer “reasonably good performance at low price points” (*The Economist*, 2010). The process through which this is done is often referred to as “frugal engineering”, and the outcome, which are generally low-cost, good-enough products or services, are known as “frugal innovations”.

Frugal innovation is of particular interest to the emerging economies, as this is a means of meeting the needs of a large population with access to disproportionately low resources (Prahalad, 2005). As a result, in most of the emerging economies, there is a fresh thinking about approaches to innovation. Over the last few decades, developing countries tried to build national systems of innovation (Freeman, 1995; Krishnan, 2003) in the image of what existed in the developed world. Therefore, they focused on creation of formal institutional setups, including research and educational institutions, funds for promoting research and development, and innovation clusters. This corroborated the criticism made against the research on national innovation systems, technical change, and economics of innovation of largely ignoring the demand side of the equation, while paying much attention to supply side stimulus (Kaplinsky, 2011). The current interest in frugal innovation has only exacerbated the lack of congruence between national innovation systems and the desired outcomes (Krishnan, 2010). For instance, the Science, Technology, and Innovation Policy, 2013, released by Government of India in March 2013, does acknowledge that there is important innovation outside the formal R&D/innovation system, but it does not go far enough in embracing it for the future. In fact, the focus still remains on strengthening private participation in innovation activities, and hi-tech trade (Science, Technology and Innovation Policy, 2013). While there are organizations, such as National Innovation Foundation, and Honey Bee Network, in India that document frugal innovations, but still commercialization and proliferation of such innovations remain a challenge (Gupta, 2006).

There is thus a lack of alignment between the desired direction of innovation and government policies, particularly in emerging economies (Carayannis, 2012). This lack of alignment could stem from inadequate understanding of the phenomenon of frugal innovation, as it is difficult to influence something which is not well understood. This paper argues that this gap could be bridged by re-visiting the theoretical foundations of frugal innovation. A better appreciation of the theoretical foundations could not only help understand the antecedents and enablers of frugal innovation, but also inform policy makers on ways to influence such innovations at both the grassroots and firm levels. To illustrate the conceptual arguments, this paper considers examples of frugal innovations at various levels, mostly from India.

This conceptual paper is organized in four sections. The first section building upon the literature related to frugal innovation and allied disciplines, and disambiguates frugal innovations into its various types and levels. The second section offers explanations for the phenomenon of frugal innovations by building upon the theoretical foundations of resource-based view, economics of location, new institutional

economics, and institutional theory. The section also offers testable propositions on the determinants of innovation by building upon the said theoretical foundations. The third section offers policy level implications for emerging economies keen on shaping frugal innovations in a more concentrated manner. The final section summarizes the key takeaways from the conceptual work, and areas of further research.

### Understanding frugal innovation

The word frugal draws its origin from the mid-sixteenth century Latin word – *frugalis*. The Oxford dictionary defines frugal as “sparing or economical as regards money or food”. Frugality was a virtue of the ancient world when economic resources were deficient, and is equally relevant to most of today’s emerging economies where similar conditions exist. Though the usage of the term “frugal innovation” is new, that is not so with the phenomenon. Henry Ford’s assembly line, and Japanese lean processes are good examples of frugal innovations. The utilitarian vision of Henry Ford, coupled with an acute focus on cost minimization, waste reduction, and productivity resulted in substantial job creation and market development (Goddard, 2010; Sehgal *et al.*, 2010). Post-Second World War Japan was another success story of frugal thinking and frugal innovation in processes and products. Constrained by lack of natural resources, restricted international access, and limited space and funds, Japanese firms challenged some of the fundamental assumptions of manufacturing, and pioneered the well-known concepts of lean, just-in-time manufacturing, continuous improvement, miniaturization, and kaizen (Womack *et al.*, 1991).

The term “frugal engineering” was first used by the CEO of Nissan-Renault, Carlos Ghosn in 2006, while describing the engineering approach adopted by India’s Tata Motors in developing the Nano (Sehgal *et al.*, 2010). A broader depiction of the phenomenon is sometimes called as “frugal innovation”. *The Economist* (2010) identifies the virtue of frugal innovations as:

There is more to this than simply cutting costs to the bone. Frugal products need to be tough and easy to use [...] Frugal innovation is not just about redesigning products; it involves rethinking entire production processes and business models.

For the purpose of this paper, we use the following definition of frugal innovation – “meeting the desired objective with a good-enough, economical means”.

Recently, there has seen a surge in interest in frugal innovation, as reflected by the host of publications on the subject, and cases depicting innovations in the emerging markets. Books and articles are replete with describing the success domestic firm and MNCs have experienced in bringing about “low-cost, good-enough” products and services for emerging markets, and in certain cases, developed markets (Pralhad, 2005; Munshi, 2009; Krishnan, 2010; Kumar and Puranam, 2011; Govindarajan and Trimble, 2012; Radjou *et al.*, 2012). But the work has mostly been anecdotal in nature, and has not delved sufficiently into the types of frugal innovations, and the levels thereof. This apart, the works has not been rigorous in explicating the underlying principles of frugal innovation, and hence the phenomenon lack predictability (Bhatti, 2012; George *et al.*, 2012).

Instead of looking at frugal innovation as a monolithic entity, we propose a typological view of the phenomenon. At the basic level, frugal innovation could be thought of as a “mindset”, or a “way of life”. At an activity level, it could be construed

as a “process” or a “workflow”, and finally, the “outcome” could be manifested as a product or a service. To build these typologies, we draw upon the extant literature from fields that have referred to the phenomenon of frugal innovation, albeit using different terms.

Researchers have for long depicted the virtue of an “improvisational mindset” as a means of achieving the goals. Lévi-Strauss (1967) described the practice by adopting the word “bricolage”, which literally means “to do with whatever is at hand”. Baker and Nelson (2005) applied this notion to the nature of entrepreneurship and defined “bricolage entrepreneurs” as those who solve a problem or create an opportunity by applying combinations of the resources available. The combination of resources is akin to Schumpeter’s (1934) definition of innovation, albeit the emphasis here is on resources “available” at hand, and not those which are “required” for an innovation. Again from an entrepreneurial perspective, Sarasvathy (2001) calls such an approach as effectuation, where the innovator or entrepreneur does not intend to predict the future, but instead manages the contingencies with the available resources. Not just entrepreneurs, even employees tend to improvise on the tasks given to them, and in turn create new routines, or new ways of doing things (Feldman and Pentland, 2003). Such an improvisational attitude at the grassroots level, prevalent in many parts of emerging economies, such as India, is often locally called as *jugaad* (Krishnan, 2010; Radjou *et al.*, 2012).

A broader perspective on mindset is offered by George *et al.* (2012), who call for adopting a more inclusive approach to innovation. One which is characteristics by reframing of constraints, bridging access, and enacting new business models. Prahalad and Mashelkar (2010) call such a mindset towards innovating as Gandhian, highlighting the virtues of affordability and accessibility, as against those of abundance. Hence, researchers share a perspective of frugality as a mindset, or a way of life, and not just as a product or a service. Further, such a mindset is not limited to entrepreneurs, or innovators, but is amicable for an individual too.

As a process of problem solving or creating a product, one of the well-known concepts is “lean manufacturing”. Here, the emphasis is on creating value for the end-customers with minimal wasteful efforts (Womack *et al.*, 1991). The end product might not be frugal, but the process is focused on minimizing all non-value adding activities and waste. A similar concept applied to product design or engineering, is often referred to as “lean engineering” or “frugal engineering”. Sehgal *et al.* (2010) identify frugal engineering as a clean-sheet approach to product development that aims at maximizing value for the customers while minimizing non-essential cost. In a similar vein, Kumar and Puranam (2011) identify the pillars of such an approach as robustness, portability, defeating, leapfrog technology, megascale production, and service ecosystems. Once again, we emphasize that a frugal approach or a frugal process may not always lead to a frugal outcome. For examples, continuous improvement or process reengineering initiatives would make the process lean, but the outcome might still be serving the high-end of the market, as in the case of a Toyota cars.

Frugal innovation as an outcome can take many shapes. An important form of a frugal outcome is an “appropriate technology”. Schumacher (1973) defined such technologies as “a set of small-scale, labor-intensive technologies that are easy to operate and maintain, and have minimal harmful impact on the environment”. Though this philosophy won some adherents in the developing countries, it did not diffuse

widely because during the 1970s low-income countries lacked entrepreneurial abilities, technical capabilities, and effective local demand. However, with the proliferation of global value chains, diffusion of innovation capabilities in low-income countries, and very rapid growth of low-income consumers, the appropriate technologies are finding applications beyond the third-world economies (Kaplinsky, 2011). The appropriate technology, and the modern, capital-intensive technology should be deemed as complementary, rather than substitutes. Such technologies are amicable to addressing concerns of sustainable innovation and development in even developed economies (Akubue, 2000). One instance of appropriate technology in use in rural India is Husk Power System, a captive power generation project that uses local materials, to server local customers, and yet, has a scalability potential (Prasad, 2011).

Another important frugal outcome that often addresses a need in a simple, convenient, and affordable manner, as against the existing host of solutions, is disruptive innovation (Christensen, 1997). It must be observed that not disruptive innovations are frugal in nature, as they may build on a new technology trajectory, something that is not always accessible by producers and consumers in the emerging economies. For instance, *LifeStraw*, a straw that could instantly purify dirty water off bacteria and dirt, to up to 99.9 percent, comes from the technology expertise of the Swiss company Vestergaard Frandsen (Hoffman, 2011). While the product is affordable, it requires a very high investment in research and development, and technology expertise, supporting the argument that not all disruptive innovations are frugal innovations.

The outcomes could also be characterized by the markets that they primarily address. Prahalad (2005) highlighted the entire untapped market that lies at the bottom of the economic pyramid, which comprises of un-served or under-served customers, and how there is money to be made. The products addressing such markets have to be fundamentally very different. Further, Govindarajan and Trimble (2012) propose that some of these products developed by keeping in mind the consumers in the emerging market, might also find customers in the developed markets, a phenomenon they call “reverse innovation”. Citing successful frugal innovations carried out by the likes of General Electric, Procter & Gamble, and Logitech, the authors present a case of why frugal innovation is not just a cause for emerging markets, but in fact has significant spillover effects in terms of new capability development and generating new revenue streams for large MNCs.

So we see that frugal innovation as a concept is being researched in various forms in the extant literature including that of developmental economics (Schumacher, 1973), product and process engineering (Womack *et al.*, 1991; Sehgal *et al.*, 2010; Kumar and Puranam, 2011), sustainability (Pralhad and Mashelkar, 2010; George *et al.*, 2012), business strategy (Pralhad, 2005; 2006; Govindarajan and Trimble, 2012), and attitude and mindset (Krishnan, 2010; Radjou *et al.*, 2012; Baker and Nelson, 2005; Lévi-Strauss, 1967; Sarasvathy, 2001; Feldman and Pentland, 2003).

Table I summarizes the concepts that depict frugal innovation and the categorization that we propose in the paper. It must however be observed that the various conceptualizations identified here are not synonymous with each other, as the thrust for each one varies, but the intent is to highlight that “frugality”, as a concept, has existed in various disciplines for a long time.

While frugal innovations involve some combination of frugal mindset, a frugal process, and a frugal outcome, these are three different avenues where frugality could

Nature of frugal innovation	Terms	Definition	Key contributors
Mindset	Jugaad	An innovative fix; an improvised solution born from ingenuity and cleverness	Krishnan (2010), Radjou <i>et al.</i> (2012)
	Bricolage	Applying combinations of the resources at hand to new problems and opportunities	Lévi-Strauss(1967), Baker and Nelson (2005)
	Effectuation	Identification of ends with the means given while being focused on affordable losses, and exploiting the contingencies	Sarasvathy (2001)
	Improvisation	Agents create new routines by improvising on the existing ones while performing those	Feldman and Pentland (2003)
	Gandhian innovation	Innovation driven by affordability and sustainability, than by premium pricing and abundance approach	Prahalad and Mashelkar (2010)
	Inclusive innovation	Development and implementation of new ideas which aspire to create opportunities that enhance social and economic wellbeing for disenfranchised members of society	George <i>et al.</i> (2012)
Process	Frugal engineering	A clean-sheet approach to product development that aims at maximizing value for the customers while minimizing non-essential cost The six pillars of frugal engineering as: robustness, portability, defeaturing, leapfrog technology, megascale production, and service ecosystems	Sehgal <i>et al.</i> (2010), Radjou <i>et al.</i> (2012) Kumar and Puranam (2011)
	Lean	Creation of value for the end-customer with minimal wasteful efforts	Womack <i>et al.</i> (1991)
Outcome	Appropriate technology	Technological choice and applications that are people-centered, small-scale, labor-intensive, energy-efficient, environmentally sound, and locally controlled	Schumacher (1973), Kaplinsky (2011)
	Disruptive innovation	Products and services that address the non-customers while offering simplicity, affordability and limited features	Christensen (1997)
	Bottom of pyramid innovation	Products and services that address the underserved or un-served markets at the low-end of the economic system	Prahalad (2005, 2006)
	Reverse innovation	Products designed primarily for developing markets, and finding customers in developed markets	Govindarajan and Trimble (2012)

**Table I.**  
Summarization of key concepts that depict frugal innovation

be exhibited. For instance, a rural housewife who prudently manages her budget to buy groceries for her family is exhibiting a frugal mindset; a carpenter who has very limited tools may exercise a frugal process in making beautiful furniture; and an innovator of scooter-mounted-flourmill has actually created a frugal offering.

Another shortcoming with the extant research on frugal innovation is that not sufficient attention is paid to the various levels at which frugal innovation happens and the various agents involved in it. For instance, improvisation by a farmer in sowing the field is very different from creating a new product addressing a market, to creating a leaner and faster way of performing a cataract operation. Apart from explicating frugal innovation into a mindset, process, and an outcome, there are three-distinct entities which are involved in the act. The three types of frugal innovators operate at the levels of grassroots, domestic-enterprises, and MNC-subsidiaries.

Grassroots-level frugal innovators are individuals or a group of people who attempt to solve a given problem adopting locally available ingenuity, and in doing so creates a novel solution. A scooter-powered flour-mill, a terracotta-based refrigerator, and motorcycle-based tractor, are some instances of innovations emerged from people at the grassroots level. In India, the National Innovation Foundation, and SRISTI Library Database offer a repository of ingenious solutions and innovations culled out from the grassroots-level across India (Gupta, 2006). Most of these innovations happen with very limited support from the formal institutions, and hence while such solutions are adept at addressing the local problem reasonably well, they often fail to scale up (Krishnan, 2010).

On the other hand, there are several domestic firms which have reconfigured their processes and business models to address the fledging domestic market mostly located at the base of economic pyramid. We call them as domestic-corporate frugal innovators. Whether it be the affordable, yet world-class healthcare provided by Narayana Hrudayalaya, and Aravind Eye Care Hospital, or the solar lamps designed by SELCO, and affordable power generated from husk, on offer by Husk Power Systems, what is common across all such endeavors is intent of addressing a social cause in a profitable manner by adopting process and business model innovations (Pralhad, 2006; Jayashankar, 2012; Prasad, 2011). Most entrepreneurs that start such ventures do not intend to solve their own problems, unlike the case with grassroots-level frugal innovations, but instead find a business opportunity to be frugal while meeting the needs of a large market (Munshi, 2009).

The last category includes the MNC-subsidiary frugal innovators. The large domestic market, coupled with cheap and good quality talent available in India and China has attracted several MNCs, such as General Electric, Unilever, Phillips, and Harman, to set up their R&D units. The low-cost ultrasound and ECG scanner by General Electric, or water purifier by Unilever (Govindarajan and Trimble, 2012) are instances of MNC subsidiaries approaching the local markets with a new mindset of product innovations. In many cases, the MNCs have to forego their tried and tested approaches to managing innovation in favor of more parsimonious approach characterized by low-cost experiments, and improvisations (Radjou *et al.*, 2012).

Successful frugal innovations are more than products or services. Instead they entail exploring new business models, redefining the meaning of value-for-money, aiming for radically new cost targets, taking a clean-slate approach, and honing an attitude of parsimony (Pralhad and Mashelkar, 2010; George *et al.*, 2012; Sehgal *et al.*, 2010;

Radjou *et al.*, 2012). Anderson and Markides (2007) identify the creation of frugal innovation as the creation of new “who”, new “what”, and new “how”. They deem that innovation in emerging markets do not look at creating new customers, but instead serving the underserved; this is achieved by increasing affordability and acceptability of products through dramatic improvements in price-performance ratios; and by ensuring availability through generating awareness and by adopting unconventional means of market reach. In essence, the innovation is as much about the product, as is about the form and means in which the offering reaches to the hitherto underserved customers.

Influencing frugal innovation could happen at a mindset level, by interventions such as providing training programs, sharing best practices, or shaping appropriate behaviors. The interventions could also be at a process level by exercising lean principles for product design, or process reengineering; and finally at the outcome level, which might involve new business models and new offerings to the market (George *et al.*, 2012). Similarly, an understanding of the types of innovators (grassroots-level, domestic-enterprise level, or MNC-subsidiary level) would help enhance understanding of appropriate policies that would encourage frugal innovations at the desired level.

The next section attempts to offer theoretical explanations to the phenomenon of frugal innovations, and identifies the conditions which shape frugal innovations.

### **Determinants of frugal innovations**

As stated earlier, one of the significant gaps in the literature on frugal innovation is that there is lacking sufficient explanations of the conditions which favor or demand frugal innovations. The intent in this section is to look at the extant theoretical foundations that best help us understand the basis of frugal innovations and offer predictability to the phenomenon. The first task is to identify the theories that are tenable to explain the phenomenon, and then offer some testable propositions on how various types of frugal innovations (mindset, process, and outcome) can be influenced for the types of innovators (grassroots-level, domestic-enterprise, and MNC-subsidiary).

Researchers have proposed some of the theoretical foundations that can offer help in studying strategic management and innovation management at both systems and firm level in the emerging economies context. Hoskisson *et al.* (2000) deem that transaction cost economics, institutional theory, and resource-based view, can offer interest insights on the strategy formation process for firms operating in low-income, rapidly growing economies. From an innovation systems perspective, Carayannis (2012) highlight the need to understand the causes that lead to infrastructural, capabilities, and institutional failure. Such a discourse again falls under the dominant theoretical foundations of new institutional economics, and resources-based view of the firm. Further, George *et al.* (2012, p. 5) propose to explore the phenomenon of inclusive innovation by looking at the theoretical lenses of:

[...] resource assembly, deployment, and development; 2) social and organizational networks; 3) governance and agency; 4) transaction cost and organizational economics; 5) competition and strategy; 6) stakeholder engagement and property rights; and 7) adoption of innovation.

Taking a more parsimonious approach in adopting the theoretical lenses, the paper zeroes down to the following four: resource-based view (including capabilities),

new institutional economics (including transaction cost, and property rights), institutional theory (including social and organizational networks), and economics of location (including infrastructures, and adoption of innovation). Here, is how we think that these theoretical lenses lend insights in explaining the phenomenon of frugal innovations.

We first investigate into the way resource availability, or lack of it, influences the nature of innovation.

The resource-based view of the firm states that a firm's competitive advantage stems out of possession and exploitation of idiosyncratic resources and capabilities (Barney, 1991). For a firm to yield a competitive performance, it has to either have an endowment of resources and capabilities, or be able to source these from the environment (Sirmon *et al.*, 2007). The emerging economies are characterized by environments that lack resources, or more specifically, are non-munificent in nature (Hoskisson *et al.*, 2000). Since one of the most important capabilities for competing is to bring about innovations in a predictable and sustained manner (Teece, 2007), the question is – what types of innovation approaches does a firm situated in resource scarce environments adopt? We propose that resource scarce environment espouse a frugal approach to innovation.

Sirmon *et al.* (2007) state that in a firm that lacks idiosyncratic resources or has resource-parity with the competition, the role of a manager is vital. The manager mobilizes “scarce” resources and develops new configurations to yield distinctive possibilities. Teece (2007) in fact advocates that when faced with constraints, individuals behave like entrepreneurs to sense and seize opportunities, and in turn configure existing capabilities or create newer ones. Such an approach calls for “mindful improvisation”, and often results into creation of new routines (Feldman and Pentland, 2003). Such an improvisational approach when situated in a resource-scarce environment is often referred to as bricolage or *jugaad* (Baker and Nelson, 2005; Krishnan, 2010). The end result might not be a world-class solution, but is instead good enough for addressing a problem.

Yet another approach is by adopting *ad-hoc* problem solving, which Winter (2003) remarks is an alternate to investing in building costly capabilities for problem solving. An improvisational mindset cares about solving the problem at hand by applying the resources at hand, and is not concerned about the scalability or sustainability of the solution. Radjou *et al.* (2012) deem that such a mindset is characterized by resilience, frugality, adaptability, simplicity, inclusivity, and compassion. Resource scarce environment, would certainly induce a frugal mindset, but translation of such a mindset into a process or an outcome may be contingent on other factors.

Hence, we offer that:

*P1.* A frugal mindset would be encouraged when an individual or a firm is located in a resource-scarce environment.

From the factor markets, we now move to the product markets.

Success of frugal innovations at any level is difficult without a significant advantage offered by the location:

Otherwise, why hasn't much of frugal innovation happened in all the markets characterized by underserved customers or scarce resources? Why countries such as India and China lead the pack in terms of innovation? One explanation could be “Economics of Location” (Porter, 1990).

Building on Porter's Diamond Framework, Beise (2004) proposed the concept of "lead-markets". Driven by the nation-specific advantages on cost, demand, transfer opportunities, export, and market structure, such markets lead in developing new products, and such products often emerge as global dominant designs. Porter (1990) calls these as "home-base", where most sophisticated of a firm's work regarding R&D and strategy deployment happens. Beise (2004) takes the case of diffusion of mobile telephony standard-GSM, during 1980s from the lead-markets of Nordic countries to other developed countries. Even with a small domestic market, firms in Finland and Sweden led the emergence and diffusion of GSM standard to countries such as Japan, the USA and rest of Europe, and eventually to most parts of the world. Such lead-markets are the first to experience a need for specific innovation, push firms to experiment with new features, help simplify the innovation development process, demonstrate superiority of an innovation among competing standards, signals on which paths to avoid, and help firm anticipate changes in other markets (Beise, 2004). However, the analysis has so far been limited to developed economies.

In a recent work, Tiwari and Herstatt (2012, p. 111) took the logic of lead-markets to study the emergence of frugal innovations in India. Citing the successful proliferation of Indian innovations, such as Tata Ace, Tata Swach, and Vortex Gramateller, Tiwari and Herstatt identify India's advantage by stating that:

[...] with its large volumes, dynamic markets, cost advantage, strong technical capabilities, extensive global linkages, and finally a young and aspiring population, India is endowed with an enormous lead market potential.

The size of such lead-markets are very critical for domestic-enterprises and MNC subsidiaries for the success of their frugal innovations, as the business models need high volumes to be feasible. For instance, Narayana Hrudayalaya, and Aravind Eye Hospital exploit the economies of scale and scope, apart from cross-subsidization, to keep their costs low, and operations viable (Pralhad, 2006). The key here is that customers are looking for a good-enough, low-cost products or services without the frills associated with the way such products were initially conceived in a more resource abundant environment.

Also such lead-markets must post the most challenging of the tasks for the product designers and service providers intending to meet the market demands. The success of Tata Nano, not only in terms of breaking new grounds in price-performance ratios for an automobile, but also achieving process inventions in the approach, could well be attributed to the target of USD2,000 that Ratan Tata posed to the team (Chacko *et al.*, 2010). Often the products conceived in such stringent scenarios strike a chord with the developed markets, as highlighted by Govindarajan and Trimble (2012) in their description of reverse innovations.

Hence, we propose that:

- P2. Frugal processes and outcomes would be greater in a lead-market where customers demand good-enough, low-cost products and services.

While the presence of lead-markets could encourage the domestic firms and MNCs to look them as beachheads for performing experimenting on frugal innovations, these do not offer sufficient reasons for grassroots-level innovators to get motivated. Most of people at the grassroots-level intend to solve their own problems, and any large-scale

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exploitation of the solution is incidental. So the question remains that – what drives a grassroots-level frugal innovation? We deem that the explanation lies in the nature of institutions.

North famously defined institutions as:

[...] humanly devised constraints that structure political, economic and social interactions [...] they consist of both informal constraints (sanctions, taboos, customs, traditions, and codes of conduct), and formal rules (constitutions, laws, property rights) (1991, p. 97).

Institutional development is a complex and long-drawn process, which is shaped by path dependencies, and its actors. Both economic institutions and social institutions shape innovation activities at an individual level and a firm level. However, Williamson observed that “(in the study of institutions) as compared with technological innovations, the study of organizational innovation has been comparatively neglected” (2000, p. 600). Our interest is to investigate how institutions, both formal and informal, shape the nature of innovations that the various actors engage in.

We first look at the impact of formal institutions, taking in the perspective of transaction cost economics. Calling the emerging markets as “transaction arenas”, where buyers and sellers are not easily or efficiently able to come together, Khanna and Palepu (2010) propose the notion of “institutional voids”. These voids occur due to missing intermediaries, resulting into an increased transaction cost and hence it renders a market underdeveloped. Firms in developed markets would have an access to risk-capital through well functioning capital markets, an access to talent through vibrant labor markets, and intelligence through the existing information markets, but that is not the luxury firms and individuals operating in emerging economies have. One way of looking at such deficiencies is as limiting formal innovations, but another viewpoint is that such deficiencies favor informal, or frugal innovations. In fact, often such frugal innovations might not happen in realms of tight environmental and legal regulations, as depicted by the gas-guzzling, make-shift transport mechanisms people in hinterlands of India have devised to meet their commutation needs (Radjou *et al.*, 2012).

The grassroots-level frugal innovators tap into their locally available resources, and ingenuity to solve personal and societal problems without relying on institutional support (Gupta, 2006). Such a bricolage approach or jugaad mindset, attempts to meet the desired objective with the resources available at hand (Krishnan, 2010; Baker and Nelson, 2005). Often the end goals might also get shaped by the constraints that the innovators encounter (Sarasvathy, 2001).

Domestic firms operating in such institutionally weak environments innovate by adopting new business models, process innovations, serving the hitherto underserved/un-served customers, and by creating new service delivery models (Singh and Chaudhuri, 2009; Chakravarthy and Coughlan, 2012). Firms often overturn the conventional wisdom in “doing more with less for more” (Prahalad and Mashelkar, 2010). For instance, the scarcity of trained medical practitioners and nurses pushed Aravind Eye Hospital to adopt an assembly line approach of performing cataract operations (Munshi, 2009), a concept similar to the way Japanese firms responded to the physical and material constraints posed by the nation post-Second World War (Womack *et al.*, 1991).

The MNCs, which largely come from developed economies, find it difficult to get acclimatized to the poor, or in some case almost absent, economic intermediaries. They rely on partnerships with local firms, and academic institutions to get an access to the locked resources and capabilities, and over a period of time learn the “rule of the game” in the new context (Kumar and Puranam, 2011). Other responses include investing in development of local industry base, experimenting with products and business models, and attempting to change the context (Khanna and Palepu, 2010). We argue that the weak formal institutions impact the three types of players differently in their propensity to engage in frugal innovations. We deem weaker institutions to be more favorable for domestic-enterprises, and grassroots-level innovators. However, the impact of weaker institutional intermediaries on MNC’s frugal innovation activities might be difficult to ascertain:

*P3.* Economies characterized by weak or missing institutional intermediates would encourage frugal processes.

Another important dimension of formal institutions is the strength and enforcement of property rights (Williamson, 2000). A regime which is weak in formulating and enforcing property rights does not offer sufficient incentives for the inventive class to invest its private resources in generating intellectual property which would have a public benefit. In such a regime, the tendency would be to resort to frugal mindsets and process improvisation than frugal outcomes, especially in the form of products. The case of the Indian pharmaceutical industry is very telling in this regard. Between 1970 and 2005 when the patent regime awarded process-patents instead of the more stringent product patents, the Indian pharma industry sharpened its capabilities on reverse-engineering branded drugs and captured a significant share of the world’s generics market (Krishnan, 2010). The process of creating generic drugs from new chemical entities would well be deemed as a frugal process, as the intent remains to keep the cost low while meeting the stringent regulations. The strength of the property rights regime would influence the nature of innovations performed by individuals and firms.

Hence, we offer that:

*P4.* Economies characterized by a weaker property rights regime would encourage frugal mindsets and processes, more than frugal outcomes.

So much for the formal institutions, but the informal institutions also has an impact on the nature of innovations practiced by individuals and firms. The institutional theory suggests that individuals and organizations get embedded into an institution because the building blocks are considered proper, adequate, rational, and necessary, and by modeling their internal structures likewise, organizations avoid the cost of illegitimacy (Meyer and Rowan, 1977). Important to the discourse on innovation is the classification of mechanisms of institutionalization – coercive, mimetic, and normative (DiMaggio and Powell, 1983).

The forces of isomorphism, and hence extent of institutionalization, acts differently on the three types of frugal innovators. As grassroots-level frugal innovations are often located in rural setups, they are embedded in tight social ties and hence their behavior is shaped largely by the social norms (Coleman, 1988). There are very strong social sanctions if one attempts to break-away from the dominant value systems. Further, Krishnan (2010) observes that Indians tend to gravitate towards improvisation

as against a systematic approach to problem solving because of poor teamwork, the enduring importance of upward hierarchical progression, and a brahminical attitude that gives brainwork a superior position over physical work. This corroborates with Hofstede's (2001) evaluation of Indian culture as characterized by collectivism, and a higher tolerance for uncertainty. A collectivist culture offers a greater resistance to a radically new idea, but is more admissible to an improvisational approach (Krishnan, 2010). Similarly, tolerance for ambiguity indicates people's comfort with a good-enough solution, instead of a world class ones. The terracotta-based refrigerator, or a scooter-mounted flour-mill are instances of applying a frugal mindset to solving a personal problem (Gupta, 2006; Vijay, 2012). Hence, at the grassroots level, the social norms espouse a frugal mindset towards addressing personal problems; as such an approach does not radically disturb the social equilibrium and invite sanctions.

In emerging economies, domestic firms are mostly subjected to mimetic isomorphism. Since innovation remains an uncertain task, and hence there is a tendency to follow the first-movers (DiMaggio and Powell, 1983). Frugal innovations, especially as an "outcome" signals to the peer community that such an approach is possible and that there is a market to be exploited. However, due to lack of capabilities and resources available to the domestic-enterprise, frugal outcomes are relatively difficult to produce. For instance, only after the launch of Tata Nano, several Indian automobile firms, such as Mahindra and Bajaj Auto significantly increased their commitments to develop a low-cost car (Chacko *et al.*, 2010). The first moves, such as *Shantha Biotech*, the producer of India's first low-cost Hepatitis-B vaccination and *Su-Kam*, the producer of low-cost inverters, found it difficult to get social acceptance (Munshi, 2009).

The assessment of cases of frugal innovations by domestic-enterprises locate in emerging economies indicate that most of such efforts are centered around frugal processes, which leverage newer approaches and business models of serving hitherto unaddressed markets (Pralhad, 2006; Gupta, 2006; George *et al.*, 2012). The large un-served population in such emerging economies inherently offers the firms an avenue to experiment with new business models and process innovations to meet a societal need, while being profitable. Further, as compared to the MNC-subsidaries, the domestic-enterprises have a greater understanding of the local consumer behavior and the local ecosystem, essential in marking an innovation successful (Kumar and Puranam, 2011). So we posit that in emerging economies domestic-corporate would invest their scarce resources in adopting frugal processes, than aspiring for frugal outcomes.

The impact of domestic institutions on an MNC-subsidy is an interplay of the extent to which the subsidiary is embedded in the local ecosystem versus that in the parent or global ecosystem. Often the approaches needed to cater to the market in emerging economies with frugal products and processes is incongruent with the dominant logic of the parent organization. This can either be seen as an internal conflict or an opportunity to add new capabilities to the parent organization. Hence, their innovation agenda and approach is torn between local responsiveness and global (or parent) integration (Birkinshaw, 1997). Since frugal innovation calls for addressing the local market by adopting local means of innovation, local embeddedness tips over embeddedness in the global (or parent) value chain if an MNC aspires to innovate frugally.

An MNC-subsidary willing to engage in (frugal) innovations in the domestic market must not only develop new capabilities, but also bring about an extension to its

charter (Birkinshaw, 1997). While studying MNCs efforts in producing frugal innovations in emerging economies, Zeschky *et al.* (2011) proposed one of the best practices as setting up of local organizational structure, and deployment of a local project manager. Similarly, Govindarajan and Trimble (2012) insisted on MNCs setting up Local Growth Teams (LGTs) to build local competencies for developing frugal innovation. Because MNCs have a greater resource pool, set of distinctive capabilities, a strong brand, and a global ecosystem, they are more adapt at undertaking frugal innovation at an “outcome” level, than their domestic counterparts. The case of Unilever’s Puteit, Bosch’s Common Rail Diesel Engine, General Electric’s ultra-cheap ECG machine, and ultrasonic device, are but instances of how MNC-subidiaries can leverage their resource pool and local knowledge in creating frugal outcomes (Munshi, 2009; Kumar and Puranam, 2011; Radjou *et al.*, 2012).

Hence, we argue that:

- P4. A collectivist society with a greater tolerance for ambiguity would encourage a frugal mindset amongst grassroots-level innovators.
- P5. Domestic-enterprise in an emerging economy would have a higher rate of frugal process innovations than frugal outcome innovations.
- P6. MNC-subidiaries in an emerging economy would have a higher rate of frugal outcome innovations than frugal process innovations.

Another important dimension of the institutions is the position of an individual or a firm in a social network. Social networks have three key economic outcomes:

- (1) affect the flow and quality of information;
- (2) form an important source of rewards and punishments by formation of norms; and
- (3) create trust in the face of impending opportunism through obligations and expectations (Coleman, 1988; Granovetter, 2005).

While Coleman (1988) impresses upon the importance of strong ties, and the resulting social capital, Burt (2000) and Granovetter (2005) argue that sparse networks support innovation by being rich in new information and ideas. When it comes to frugal innovations, the location of an innovator in the social fabric plays a very important role.

So far we posited that the grassroots-level innovators mostly hone a frugal mindset because they are embedded in strong social ties, and have limited access to non-redundant information and resources. This is one reason that whatever frugal process or outcome such innovators are able to muster fails to scale up or yield greater rewards (Gupta, 2006). However, if a grassroots – level innovator has an access to non-redundant information, and is able to mobilize ideas and resources from distinct sources, such an innovator could transform the frugal mindset into frugal process or outcomes (Burt, 2000). For instance, the idea of terracotta-based refrigerator – Mitticool, was conceive in late 1980s, but only in recent years, the product saw a real demand in the market (Vijay, 2012). This was in many ways because the innovator did not have an access to convert a frugal mindset into a viable outcome. Institutional support, such as National Innovation Foundation and Honey Bee Networks, act as catalysts for converting frugal mindsets into frugal process and outcomes that are

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impactful and scalable. In absence of such mechanisms, the network position of the innovator is vital in getting the person access to newer ideas and resources.

Hence, we reckon that:

- P7. An access to multiple networks that offer non-redundant information and resources would enable a grassroots-level innovator to produce frugal processes and frugal outcomes.

So far we identified some of the theoretical lenses that offer explanations and hence predictions to the phenomenon of frugal innovation. The theoretical viewpoint adopted were resource-based view, economics of location, new institutional economics, and institutional theory; and propositions were offered in terms of how specific types of innovations (mindset, process, and outcome) are honed at the levels of grassroots, domestic-enterprise, and MNC-subsidary. We now look at the policy level imperatives of such explanations.

### **Policies for shaping frugal innovations**

At the beginning of the paper, we highlighted the lack of alignment between the sources of frugal innovations, and the investment governments in emerging economies are making in terms of their systems of innovation and science and technology policies. A more nuanced understanding of the nature and drivers of frugal innovation is likely to offer guidelines. At a policy level, there could be implications drawn on how governments can influence frugal innovations in an emerging market context. Frugal innovations often could be the most desired ways of meeting the demands of a large population with a limited paying capacity. From the appropriate technology revolution documented by Schumacher (1973), to the recent interest in inclusive innovations, frugality as an approach has wide implications.

One of the immediate policy level interventions is to strengthen the patent regime that would create better incentive mechanisms for frugal innovators to graduate from innovating on processes to focusing on outcomes. Frugal outcomes, especially in terms of products, have a wider implication, as demonstrated by LifeStraw or Unilever's Purit. For instance, while India did sign the TRIPS treaty in 1994, and is product-patent complaint since 2005, capabilities for product innovations are still nascent (Krishnan, 2010). In the interim, a simplification of existing patent system would lower the threshold for one to seek intellectual rights protection and enforcements such that there is sufficient incentive for oneself and social welfare, without encouraging rent appropriation behavior. While the domestic-enterprises start to migrate from frugal process innovations to frugal outcome innovations, a more matured regime would encourage MNCs to increase their focus on emerging economies as their lead-markets for frugal innovations. The product and process innovations done by MNC-subsidaries would have significant spillover effects for building capabilities in the marketplace.

Another imperative at a policy level is to build on native knowledge and ingenuity. Most of the grassroots-level frugal innovators attempt to solve their personal problems by applying local ingenuity, but since these approaches are *ad-hoc* they are not stored for a later use. Such solutions can in fact find applicability in solving commercial or social problems at a larger scale, as argued by Gupta (2006). By building on native knowledge and ingenuity, we not only preserve the wisdom, but also create a knowledge repository for prospective applications in other domains. One way of

preserving and exercising native knowledge and ingenuity is by setting up rural innovation laboratories where quick and frugal proof-of-concepts could be conducted to test out new ideas. These labs could be setup on a hire-basis where people with ideas can economically collaborate with others, including academic institutions and industry. At the levels of schools, laboratories could be setup, sponsored by the State or industries, where students can learn improvisation and increase their familiarity with technology. These micro-labs do not call for huge investments, but provide the quintessential incubator for idea generation, concept testing and collaboration.

We also propose that there be a greater appreciation of process and business model innovation, as most often a frugal mindset fails to translate into a frugal product or process because of lack of appreciation of a wide range of possible non-technical innovations. The domestic-enterprise frugal innovators have demonstrated that process and business model innovations are equally, if not more important than product innovations, in the context of emerging economies (George *et al.*, 2012). There is a need for generating awareness and adequate knowledge about how to design business model innovations in higher-education programs. Further, a lot more sensitivity needs to be infused amongst students on the social and economic problems that emerging economies are facing and how these are hotbeds for potential innovators. On the lines of the technology and science labs at schools, there could be business model labs that could be setup at higher education institutions where students can try out various business models in conjunction with industry and NGOs. This way we tap into fresh talent towards an urgent cause, and inspire innovation in turn.

Finally, we confer that frugal innovations and frugal innovators of all types be celebrated. A climate that encourages frugal innovations would take time to be created, as is true with any institutional change (Williamson, 2000). For long, Indians have exhibited their creative flairs outside of India, as depicted by a huge population of successful Indians in high-tech firms in the Silicon Valley (Kumar and Puranam, 2012). America has made a culture of celebrating innovations and innovators (Freeman, 1995), and if India needs to move up the innovation value chain, the same needs to be done back home. Here, again government, both at the state and the centre level could play a crucial role. The Padma Awards, bestowed by the Government of India for outstanding achievement by Indians, could parallel awards for innovations. In addition to this, State Governments could identify budding innovators, narrate their stores through media channels, and felicitate them.

### Conclusion

The paper was encouraged by the opportunity to offer clarity and rigor to the much talked about phenomenon of frugal innovation. We offered two key contributions in this paper. First, we disambiguated a frugal innovation into three types: a frugal mindset, a frugal process, and a frugal outcome. We also identified three prominent types of innovators practicing frugal innovations as: grassroots-level, domestic-enterprise level, and MNC-subsidiary level. The second key contribution of the paper is that we adopted the theoretical lenses of resource-based view, economics of location, new institutional economics, and institutional theory in offering testable propositions on determinants of frugal innovations. We delved into explanation of conditions that espouse a certain frugal innovation type at a particular level. The paper also offered policy level recommendations on how the phenomenon could be systematically influenced.

This was a conceptual paper. We have taken care while crafting the propositions by using parameters that are measurable, and hence the propositions could be put to test subsequently. Especially, it would be a creative exercise to measure the variable of resource-scarcity, and size of lead markets, and to identify proxies to measure frugal mindset, and frugal process. Further, the three types of frugal innovations and the three levels thereof are so far presented as mutually exclusive, but that may not always be the case. A contingency view could offer a better understanding. However, we still deem that the paper makes a contribution in at least starting a discourse on looking at the phenomenon of innovation from a theoretical, and hence predictability lens, instead of a hitherto anecdotal approach mostly adopted.

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