

India's Frugal Innovations: *Jugaad* and Unconventional Innovation Strategies

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Ruchi Sharma¹, Nandita Mishra² and Gauri Sharma³

Abstract

In recent years, many low-cost innovations, to solve the problems of economically weaker sections of the society has emerged, with the goal of bringing together enterprise and social welfare. In reality, all businesses were concerned that high quality and low price may cannibalise their own existence. Concurrently, the customers who were intended to be benefitted from the novel strategy, tend to evade the products, quoting, the quality of the products being inferior and talking about the social stigma of using low-cost goods or products.

The researchers by using different case studies have shown how the companies can effectively and successfully reduce the uncertainties of the market and technological challenges of low-cost products for price sensitive customers. After analyzing the case studies used in the article, it appears that the most important criteria to improve customer perceptions of quality and image is to keep the cost low and provide value for money. The case studies show that organisations that use the networks of open global innovation for the overall collaborative development at various stages of the value chain representing innovation are more likely to succeed with affordability-driven innovations.

Keywords

Frugal innovation (FI), global networks, low-cost product, bottom of the pyramid

¹ Institute of Marketing & Management, Business School, New Delhi, India

² Chetana's Institute of Management and Research, Mumbai, Maharashtra, India

³ Symbiosis Law School, Hyderabad, Telangana, India

Corresponding author:

Ruchi Sharma, Institute of Marketing & Management Business School, Marketing Tower, B-11,
Qutab Institutional Area, New Delhi, Delhi 110016, India.

E-mail: ruchisharma254@gmail.com



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Introduction

Exchange of international communication and ideas increase as globalisation increases. Numerous businesses began to grow quickly, with some becoming multinational enterprises (MNEs) and, as a result of which, business competition and rivalry also increases. Innovation is required not because of competition alone but also because of the changing landscape of fast-growing technology and shifting trends in consumer behaviour. During the last two decades innovation trends have been different from traditional business strategies. The worn-out strategies had to be replaced with new low-cost strategies and the shift was from developed to developing countries. Developing countries were regarded as a 'plan B' target in terms of innovation, but they began to emerge in the financial market, demonstrating potential for rapid economic growth. At the same time, new strategies had to take into account the challenges of emerging markets, like skilled labour, low levels of income, less developed infrastructures before developing the new method of innovation. The methods that were recently introduced to aim for the bottom of the pyramid are reverse, frugal, and *Jugaad* innovation. Ritter-Hayashi et al. (2018) stated that the process innovation suffers when businesses downsize. However, businesses can continue to be innovative amid downsizing thanks to labour adaptability.

Frugal innovations might include marketing strategies and organisational procedures in addition to commercial objects and services. The Punjab Police, for example, established the concept of 'mobile-cum-*naka* contingents' to free up resources linked to police pickets and barriers while battling an armed insurrection in the state in 1990, so providing an effective operational force with little added investment (Tiwari et al., 2017). Also, just because a product was created or built at a low price does not mean it is of bad quality. Instead, they are defined by their low cost and sturdiness, as well as the fact that they are primarily designed for a volume-driven market. Frugal innovation, sometimes known as frugal engineering, is the process of reducing non-essential features from products in order to sell them in developing countries, such as the Aakash tablet. The Indian government made this one-of-a-kind gadget affordable to all students in the country in order to provide them access to the digital world (Sharma, 2013). Le Bas (2020) provided a thorough explanation of FI as a technology paradigm and demonstrated about how FI may improve sustainable performance. Filho et al. (2021) connoted that innovation is a critical concern and component of sustainability, and it is regarded as a tactic that is used to facilitate sustainable development.

'The action or process of innovating' is the lexical-semantic of innovation. However, if innovation is defined as a means of business survival, it means more to businesses. Few innovation scholars have proposed the following definitions: 'about helping growth' (Greenhalgh & Rogers, 2010) and 'the process of making changes to something established by introducing something new that adds value to customers' (O'Sullivan & Dooley, 2008). The new strategies that were introduced to meet the target group in emerging markets, are the innovations embracing low cost of manufacturing and readily available resources in emerging markets (Govindarajan & Trimble, 2012). Therefore, to be sustainable, FIs should

take the entire value chain into account. The affordability of economical goods may also encourage higher consumption, which is another positive impact (Rosca et al. 2018).

Furthermore, emerging markets enable businesses to change their production plans in a more cost-effective manner. Because developing countries have limited input that is valued at a lower rate—technology, infrastructure, and skilled labour. They might easily change their production to produce at a lower cost to reflect this—this is thrifty and *Jugaad* innovation.

The challenge for businesses is to employ innovation to bring down prices to a level that economically disadvantaged people perceive to be reasonable. This is what we mean when we say ‘frugal innovation’. Various ways have been taken to reach this goal. The Aravind Eye Hospital in India is a prime example. Every year, the hospital removes cataracts from over 200,000 people, with each treatment costing an average of \$25. This dramatic cost reduction was accomplished by implementing process efficiency and obtaining higher output from doctors and nurses. In reality, the procedure is free for all impoverished individuals (60% of patients). This is made feasible by subsidising Aravind’s costs, namely by charging other patients between \$50 and \$300, which is still a fraction of the amount charged by hospitals in Western nations (Mukerjee, 2012).

Economic, environmental and social considerations are significant in sustainable business practices, and their interaction affects how well they operate (Høgevoid et al., 2019). Moreover, all businesses in emerging economies face some key challenges—low affordability and ability to pay, lack of proper infrastructure, limited access to health cases, low education and skill, high pollution levels, poor governance, weak legal-system and weak policies. In such an economic environment success necessitate stacking some or all hindrance. While a local firm like Tata in India may be aware of this, it is a new and inconvenient reality for giant multinational MNCs that have concentrated the majority of their resources and concentration on developed countries. These businesses must learn how to service clients with varying purchasing power and requirements. It has been stressed that successful examples such as Logitech in China and Samsung, Tata and GE Healthcare in India had a long and a strenuous path, but they all adopted a unique strategy for growth, by adopting a ‘more with less, for more’ strategy, otherwise known as frugal innovation. Cyrus Poonawalla, the founding father of the SIT, India, for example, ‘got down to creating vaccines since there was a pressing necessity in a developing country like India’. Poonawalla, a former business student, undergone to study immune biology out of a desire to serve society, and is said to offer ‘his vaccinations on a “no loss, no profit” premise in India’ (Mahmood et al., 2014). Prime reasons why India has become a hotbed for frugal ideas appears to be the country’s current socio-economic realities, which have spurred individuals to develop for social welfare.

Prahalad and Hart (2002) and Prahalad (2012) presented a new environment for innovation. The author identified innovation opportunities for markets at the bottom or base of the economic development pyramid in his articles, that is, BOP. According to presented data, the BOP includes 4 billion people living on less than \$2 per day, representing many cultures, ethnic groupings, and needs and abilities.

So far, multinational firms have not regarded this market as a target consumer market. According to the World Resources Institute's (2007) research, this market is worth around \$5 billion in purchasing power parity. The key challenge here is to adjust items to the market's needs. The work is difficult because the market is unorganised, divided into numerous segments, and fragmented. The BOP market can be defined as a collection of niche markets. It is impossible to create a product that meets the needs of all customers due to the large number of them. According to Prahalad, multinational firms concentrated on producing items for the top of the pyramid markets, which have already been identified in terms of customers and are simple to address through marketing channels. The BOP markets necessitate a completely different approach than the enterprise markets. As the customers on this market are diverse, such a strategy must be unique.

The critics were stern within their evaluations. Quite a few evaluations imply that, on the entrepreneurial part, there can be considerable obstructions impeding enterprises' ability to furnish to BOP market necessities due to inherent structural deficits. For example, as quoted by Karamchandani et al. (2011), that with a small number of exemptions in industries like FMCG, that is, consumer packaged goods, pharmaceuticals and telecommunications multinational firms 'have been largely unable to reduce prices and reduction enough to serve poor consumers'. One rationale for this challenge could be the minute scope of emerging markets as measured in the foreign exchange rates (Karnani, 2007). An additional reason may possibly be the alarm of 'cannibalising the existing market for expensive technology', which has been reported to plague several Western companies as connoted by *The Economist* (2012). In any case, Karnani's assessment associated with numerous circulated instances for BOP inventions might have the culmination of 'success stories of selling to the poor' are preferably 'isolated instances', several BOP items that were discovered were rated much superior than their unbranded competitors (Karnani, 2007, p. 96). It is proposed that just 'removing features from existing products in order to sell them cheaper in emerging markets' is considered as a failing strategy. The matured market items are unable to satisfy the unique requirement of the emerging market customers. even when the cost is stripped-down it is considered high in the BOP markets, with no scope for competitive pricing or profitability (Sehgal et al., 2010).

There have been successful examples of innovations driven by affordability model, in emerging economies that have gone on to achieve worldwide success, such as GE's 'Lullaby' baby warmer, which is now sold in 62 countries (Mahalakshmi, 2011), India's Mahindra & Mahindra's small-sized tractors, which are at this instant sold in the United States (*The Economist*, 2012), and the Algae heater developed in India. Such innovations have been coined to be described as 'frugal' for they focus on the basic and functional features and renounce all unnecessary features. The objective of reducing selling price and operational cost is impossible by foraying down features in the advanced products but rather build/start from scratch (Tiwari & Herstatt, 2012a). 'Frugal engineering is an overarching philosophy that enables a true "clean-sheet" approach to product development. Cost discipline is an intrinsic part of the process, but rather than simply cutting existing costs, frugal engineering seeks to avoid needless costs in the first place'.

As some MNCs and their associates in the developing countries have suggested, an interesting aspect of frugal innovation is that it frequently occupies the position in 'Open Global Innovation Networks' (OGINs) and commit to standard assurance and cost reduction as mentioned by Tiwari and Herstatt (2012a).

The argument above, uncovered an intriguing research gap: There is a research need to adopt a simple mindset for developing very low-cost products without affecting the quality of the product. The most crucial frugal innovation is to begin with addressing the problem and not the product. Bhaduri and Talat (2020) explained one significant finding in their research, that was, FIs tend to be practical, user-driven, and problem-solving.

The mixed results of the traditional BOP approach, whilst a new trend concentrating on affordability is gaining traction and technology advancements with innovations appears to be successive in emerging markets. This article ascertains how businesses can handle market and to showcase that in product improvements aimed at price-sensitive customers, there is technological uncertainty. With respect to six case propositions selected on frugal innovations in India, three propositions will be formulated and explored for this goal.

The article is organised along the subsequent lines: The preamble of the concept as discussed above is followed by a conceptual framework for frugal innovations in the second section, and OGINs and its potential relationship with frugal innovations in the third section. The second and third section, lay the ground work for the review of literature and builds a foundation to substantiate cases, that are subsequently assessed in the fourth section through six case studies. The fifth section contains a discussion of the research and its ramifications. Finally, the sixth section has the concluding discussions.

The main objectives of this article are to study:

1. How organisations turn constraints into innovative ideas?
2. How frugal innovation is different from standard innovation in addressing the problems of the bottom of the pyramid?
3. How frugal innovation is the ability to generate more business and social value while significantly reducing the use of scarce resources?

Frugal Innovation: A Conceptual Foundation

Ingenious services and products which aim to reduce the amount of physical and economic resources used in entire value chain with a target of lowering ownership costs while meeting or exceeding some pre-defined quality benchmarks can be classified as frugal innovation (Tiwari & Herstatt, 2012a). Scholars have lately created an integrated understanding of FI that considers both commercial and technological aspects. Hossain (2016), for example, defined FI as 'a product, service, or solution that emerges despite financial, human, technological, and other resource constraints, and where the final outcome is less expensive than competitive offerings (if available), and which meets the needs of those customers who would otherwise go unserved'. Ploeg et al. (2021) stated that the firm-level

resource constraints have a significant impact on the firms. The firms adopt FI as a practical tactic to handle such kind of resource limitations. Another result suggested that a crucial driver is the relationship between firm-level and firm-environment performance. Hossain (2016) mentioned that the concept of FI incorporates concerns of cost, essential functioning, simplicity and servicing individuals by means of little financial resources. They define FI as a process of creating value for consumers with limited purchasing power by developing simple low-cost products.

The term 'FI' was coined in developing economies to address the demands of low-income customers by providing innovations with high quality and added value yet at a low cost. However, this may be compared to path-breaking innovation and the notion of 'disturbing the pyramid' in emerging markets, at the same time also concentrating on low-income or price-sensitive consumers in developed countries. It is also a business strategy that is an extension of *Jugaad* innovation for developing low-cost solutions to common issues (Hindocho et al., 2021).

The frugal innovations share a number of features with other terms in the similar category, though not all, as depicted in Figure 1 and explained thereafter.

FI can be disruptive (Christensen & Raynor, 2003), as well as structured. They tend to be disruptive as the business model is aimed at price conscious and unserved consumers (den Ouden, 2012). The global car makers concerted efforts to capture the market share of Maruti Suzuki in India. It made them feel that FI diverts customers from well-established firms to newer firms. The reason is different from perception, it is the cost-consciousness and affordability that makes

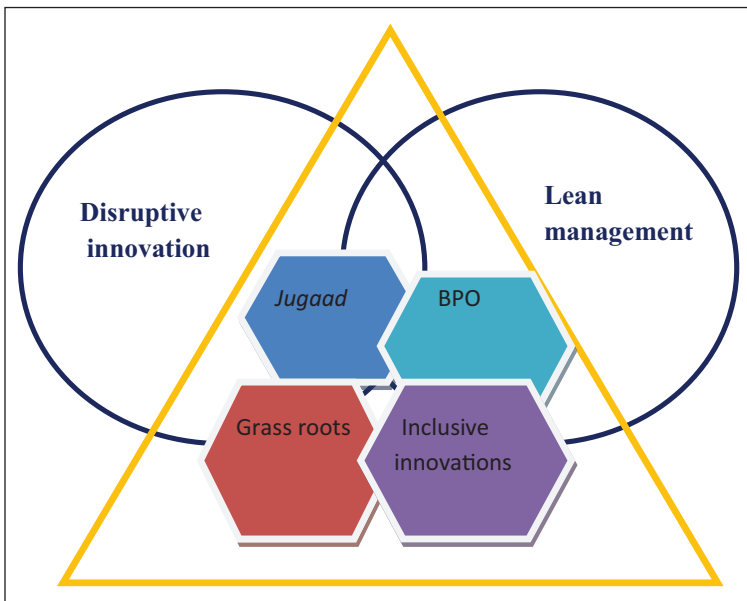


Figure 1. Context of Frugal Innovations.

it possible. Frugal innovations have long term impact on the business of a company, as demonstrated by the Tata Group and Maruti Suzuki in India. The innovations on the other hand, developed by Indian Space Research Organisation (ISRO) demonstrates that frugal innovations are structured and disciplined (Tiwari & Herstatt, 2012a, 2012b)

Sehested and Sonnenberg (2008) connoted that there are several characteristics common between frugal innovation and lean innovation, and which aims to use information more effectively and convert it into value more quickly. The objective of frugal innovation and lean innovation may differ. Lean innovation seeks to define, structure and prioritise value for specific innovation projects Schuh et al. (2011), whereas frugal innovation attempts to rationalise the value chain. The end result of lean innovation may not be a low-cost product like the frugal innovation but in both the types it takes much more than efficient management to create a game-changing disruptive innovation (Hindocha et al., 2021)

A global definition of FI has several semantic benefits, such as a unified understanding and approach—what it is, how it will operate, how it may be used, and what is required. Despite increased interest in and publications on FI, its application, and efficacy, there is still a lack of a full theoretical understanding of FI. To completely comprehend what FI is, a standardised strategy must be devised. It might be argued that FI has a political component because it diverts the focus away from underlying inequalities, injustices and from any country's socio-economic categorisation, resource allocation and geopolitical influence. FI's expansion and implementation were not hampered by the introduction of different definitions, rather, it increased interest in, understanding of, and market for the frugal innovations. Consolidation of the various definitions of FI, on the other hand, has the potential to significantly contribute to practice and research by establishing a reporting group consciously focused on FIs, measuring the impact of such innovations, developing a body of knowledge concerning FI, and building consensus on how such innovations can be reported in a standardised manner.

According to the findings, FI is a disruptive innovation for each of its target markets and has had a major impact on or change in those markets. Another verdict demonstrates that FI is focused on value chain operations, with the primary goals being cost reduction and the affordability of the good or service (Neumann et al., 2020). Cost reduction, functionality, and performance level are the three main parts in which frugal innovation occurs. Cost reduction consists of aspects like 'considerably lower initial cost or purchase price', 'reducing the total cost of ownership', and 'minimising the use of material and financial resources'. Core functionality includes features such as 'functional and focused on necessities', 'minimising the use of material and financial resources', and 'user-friendly and simple to use'. Lastly, with respect to performance level, Frugal innovation is characterised as 'simple to use', 'dependable', 'robust', 'high-end technology', 'quality maintenance', or 'meeting or exceeding certain set criteria of acceptable quality standards'. Simultaneously, low-cost innovation must satisfy extremely particular demands that are frequently unmet by mature-market items (Oliver Wyman Group, 2016).

Various concepts like, 'Jugaad', 'grassroot innovation', 'bottom of the pyramid', can be compared to FI. It can be stated that frugal innovation has been the mechanism to integrate and bring these diverse concepts underneath one umbrella. To mention that FI are aimed at the foot of the layer, may not be correct. FI, strives to address the unfulfilled customer needs. The ability to reduce a high-quality product at a lower cost, despite of the infrastructural challenges is the value proposition of frugal innovation. The success of the FI products depends upon the ability of the potential customer to pay for the product (Tiwari & Herstatt, 2012a), the product in fact competes primarily in opposition to non-consumption. Further, the FI products or services must have sufficient volume to facilitate production despite its thin margin.

Frugal innovation differs from the conventional BOP because one main issue concerning BOP is the quality perception and brand image of the products. While firms are distressed that superior quality, low value products will disperse their general course of businesses, the buyers have in general behaved in a repudiated approach. The unnecessary publicity created by media for Tata Nano's development and launch, was washed away when Tata Nano's sales fall far short of the high expectations. On the basis of an estimation, the Nano got Tata Motors \$220 million in global publicity. Yet, a report quoted a competitor car maker saying: 'Nobody wants to buy the world's cheapest car' [importance added]. Infact, when the Tata Group's cost-effective water filter, the Tata *Swach*, was launched, Ratan Tata, the company's CEO, acknowledged this challenge. Mr Tata was careful to emphasise during the launch that the goal was not to develop lower priced products, but to reach the greatest number of audience as mentioned in *Economic Times* in the year 2009. The Executive VC of INIF, Professor Anil Gupta, who worked extensively to encourage grassroots innovation, have been quoted saying—'people still feel that good technology still comes from abroad' (Malhotra, 2009), which demonstrates that prospective customers are concerned about quality, whether real or perceived.

According to various research, BOP buyers, despite their financial constraints, prefer sophisticated products that do not bear the connotation of being a poor person's item. In Asia, Africa, and Latin America, across the country, an examination of services and products marketed at BOP buyers ascertained that these are 'motivated not just by survival and physiological needs but seek to fulfil higher order needs, either to build social capital, for cultural reasons, or as a compensatory mechanism' have recommended that just 'stripped-down' variations of available products and technologies do not 'match the aspirations of the potential customers'. The accomplishment of the cost-effective MS's cars has been an outcome of their goodwill as 'good quality products for affordable price' as mentioned by Tiwari and Herstattin (2012b).

On the basis of analysis, its recommended to facilitate:

'Frugal innovations have a greater chance of commercial success if their value proposition incorporates the twin objectives of reducing the cost-of-ownership while matching customer aspirations for quality and image'.

Moreover, considering the latest application of frugal innovations, in India, there was a tremendous deal of collaboration between scientific institutes, the

government, and industry. Healthcare and medical infrastructure, education, everyday necessities, and the migration issue were all equally vital. Innovations flourished at this time of necessity. There are several reasons for the speedy reaction, including the exigency of the humanitarian situation and the government's practical approach to crowd accumulating ideas. This time, humanitarian needs were driving innovation rather than the urge for 'monetisation'. As a result, digital technology, communication, and cooperation organisations have become widely used to increase access to information and services. Among the technological advancements include the invention of ventilators, PPE kits, the Arogya Setu app, and so on. Thus, it is righteous to say that it is possible that FI was at its peak in India during the epidemic. There were little resources, limited time, and the current infrastructure was on the verge of collapsing (Ganesh et al., 2021).

Open Global Innovation Networks are Catalysts for Cost-effective Innovation

Some previous findings (Tiwari & Herstatt, 2012a, 2012b) suggest that one method to accomplish the identical objectives of providing excellent goods/products at a low cost of ownership is to make the best available utilisation of opportunities for 'open innovation' (cf. Chesbrough, 2006) on a worldwide level. 'As organisations attempt to advance their technology, open innovation is a mechanism that presupposes companies may and should utilise both internal and external plans, as well as internal and external links to market'. Open innovations are concerned with bringing external skills and knowledge into the organisation ('outside-in') and also with ascertain fresh revenue channels by providing us age rights of in-house development to other firms ('inside-out'), 'especially when the technology has future capabilities but it is not part of the organisation's core strategy' (OECD, 2008, p. 11). The initial definition of innovation was limited to company R&D, open innovation has evolved to include a wider range of disciplines and viewpoints (Gassmann et al., 2010).

Two of the 'new' streams that support open product transformation are proliferation of innovation and the context and aspects of FI. For example, during pandemic, it has been noticed that the institutions, wherever the government has aided ecosystems for the purpose of innovation as well as start-ups such as STIs—Science and Technology Incubators, were capable to take off first because the necessary resources and infrastructure were already in place. The IITs and IISc National Laboratories were well-motivated and well-equipped to develop in the appropriate domains. The partnership between the Government of India's Office of the Principal Scientific Advisor (PSA) and the Confederation of Indian Industry (CII) was outstanding. The PSA and CII offices were at the forefront of the development of technological progress, funding, and technology transfer. Through 190+ industrial and charitable relationships, opportunities worth more than ₹10 billion were created for 50+ institutions, primarily in agriculture, waste management, health and energy (Ganesh et al., 2021).

As a result, our second proposal is as follows:

‘Companies can increase the probability of offering an attractive value proposition for successful frugal innovations if they are able to successfully connect their product development process with global innovation networks’.

Companies with the strategically planned goal of helping markets for low-cost innovations must hunt for admission to niche lead markets which are equipped through networks of open innovation. The best places to find frugal ideas are in lead markets. Development in parallel.

Individual businesses and entrepreneurs may continue to work in a decentralised fashion, but corporations and the product development activities in the formal sector should be focused on specific lead markets. Thus, it brings us to the final point:

‘Building innovative potential in product-centred “lead markets” enhances the likelihood of identifying and gaining ingress to appropriate worldwide innovation web’.

Methodology

The research propositions are always regarded to be especially helpful with respect to ascertaining ‘why’ and ‘how’ features of enquiries, especially in the case of actual world phenomenon which is still in the procedure of emerging (Eisenhardt, 1989; Yin, 2003). The research involving many cases are always regarded as ‘a powerful mean to create theory because they permit replication and extension among individual cases’ (Eisenhardt, 1991, p. 620). Here, we will elaborate six different propositions based on FI in this section, with the exception of Tata Nano case (Tiwari & Herstatt, 2012a, 2012b). The cases have been chosen such that, in addition to providing insights into the three claims made above, they also meet some additional criterions. One of the main selection criterion, for example, is that the innovations in questions have already been commercialised and is deemed to have a good and improved social well-being (‘greater good’). Second, they must have included some OGINs in their innovation processes at the very least. Third, they were chosen as a group to depict a broad range of industries, intra industry segment(s), and also entrepreneurial types as mentioned in Figure 2. For instance, the Tata Nano depicts the low-cost passenger vehicle segment, but the Tata Ace is a professional truck-driving vehicle segment, who were previously reliant on less safe three-wheeler goods’ carriers.

EVMs are the result of collaboration between government establishments and state-driven public sector firms. The battery-run *Chotukool* refrigerator and the Tata *Swach* water filter, represent two unique cases of consumer goods, whereas Vortex’s solar-automated ATMs are aimed at B2B buyers or business customers, such as banks. In addition, the cases allow for a wide range of variance in business size and functions. Although the two Tata Group companies are component of a

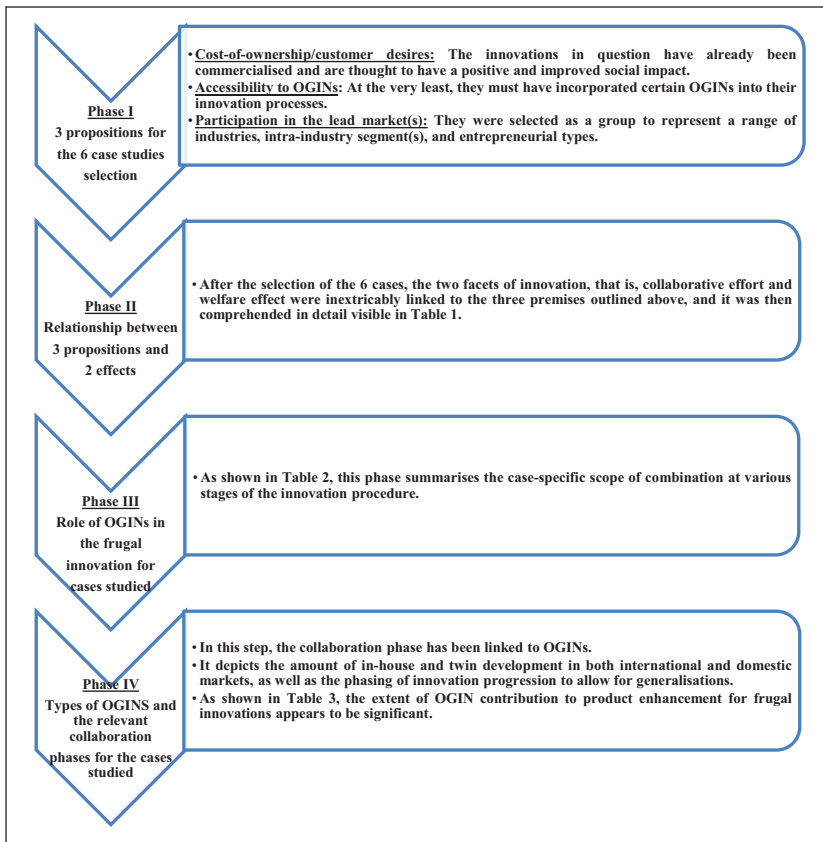


Figure 2. Research Framework.

big combination that operates on a worldwide scale, EVM manufacturers are sizable, public-sector companies having a domestic focal point (even if they export), and Vortex on the other hand is a medium sized company. It can be mentioned here that the entrepreneurs are thus motivated to change the unfavourable equilibrium he observes around him; he seeks a pleasant balance, and he does not stop by optimising the existing system with minor changes; instead, he seeks to devise a completely new solution to the problem (Chakraborty et al., 2021). The case studies have been condensed for space reasons, and they mainly focus on two aspects—collaborative effort and welfare effects in the creative process.

Discussion

These two facets of innovation (collaborative effort and welfare effect) are inextricably linked to the three premises outlined above as mentioned in Figure 2, and as comprehended below and in Table 1.

1. Reduced cost-of-ownership, when paired with consumer needs for image and quality, minimises possible customer resistance to innovation and raises the likelihood of effective dissemination (Ram & Sheth, 1989). Synergies amid diverse players from diverse technology and business areas can be used to achieve a favourable value proposition.

2. For 'technology fusion', the access to OGINs might be considered helpful (Kodama, 1992) or product analogies which can help to reduce the product development cost and increase the product affordability. The welfare effect of inventions as a result, would be strengthened. By definition, the OGINs represents collaborative efforts and reduce the uncertainties of the market and technology in product development by leveraging a broad and shared knowledge base as well as established technologies in the partners' portfolios.

3. A large base of domestic demand comes from the lead markets which are well-priced and cost-effective (Beise, 2004). They can aid in lowering the production costs, allowing for more affordability for customers with limited resources. Lead markets are characterised by a large degree of aggregation of businesses and supportive industries quoted by Porter (1990). The probability of forming collaborations is increased by the lower presence of qualified potential partners.

Table 1. Shows the Relationship Between the Three Propositions and These Two Effects.

	Proposal I	Proposal II	Proposal III
Case Study— Aspects	Cost-of-Ownership/ Customer Desires	Accessibility to OGINs	Participation in the Lead Market(s)
A	B	C	D
Welfare-effect	A good value proposal enhances the likelihood of production acceptance and dispersal.	To create cost-effective solutions, use 'technology fusion' and analogies.	Economies of scale (cost-reduction) can be achieved by lead markets as they have a large demand size.
Collaborative-effect	By leveraging mutual synergies, a favourable value proposition can be achieved.	OGINs aid in the decline of technological and market uncertainty.	Access to OGINs is made possible by a larger concentration of supporting industries and enterprises.

Table 2. A Summary Showing the Role of OGINs in the Frugal Innovation—Cases Studied.

Case	Tata Nano (Case-I)	Tata Ace (Case-II)	Electronic Voting Machines (EVMs) (Case-III)	Chotukool Refrigerators (Case-IV)	Tata Swach (Case-V)	Vortex ATMs (Case-VI)
Inception—stage I	<p>A The idea generating process for developing target specifications involves more than 600 car component suppliers. Suppliers of 2-wheeler components are also included in order to find and leverage analogies and synergies.</p> <p>B The proposal was started by the Electronic Commission of India (ECT).</p>	<p>More than 4,000 probable buyers took part in a way to better comprehend and contextualise the necessities for any disrupting product.</p>	<p>Idea development in collaboration with Innosight, an innovation consulting firm co-founded by Professor Clayton M. Christensen (a renowned proponent of 'disruptive innovations') ethnographic research in rural households</p>	<p>Titan Industries and Tata Research Development and Design Centre (TRDDC) collaborated on idea generation.</p>	<p>The Indian Institute of Technology Madras has launched an incubation project (IIT-M)</p>	
Execution—stage II	<p>C Italy's furnished final clarification to the design. More than 50% of the elements were considered as exclusive parts created by suppliers by themselves. The suppliers of global and domestic origin such as Continental, Bosch, Tata, Dens, Sona Group, Johnson Controls Automotive contributed radical innovations from their own businesses</p>	<p>Alternative Fuel Systems Inc. (AFS) of Canada was contracted to outsource 81.5% of the content to 120 suppliers with specialised TML Gas injection technology training for production and design requirements.</p>	<p>ECI collaborated with Electronics Corporation of India Ltd. (ECIL) on developing the prototype. Bharat Electronics Ltd. (BEL) and ECIL worked together on joint product development</p>	<p>Employs 'thermos electric cooling', a skill developed by Jean-Charles Peltier, a French citizen in the first half of the 19th century</p>	<p>Design directions are created by an external partner: TCS and Titan Industries the two independent Tata Group companies, collaborated on the project.</p>	<p>Collaboration with IIT-M to develop technologies for dealing with spoiled currency notes</p>

(Table 2 continued)

(Table 2 continued)

Case	A	Tata Nano (Case-I)	Tata Ace (Case-II)	Electronic Voting Machines (EVMs) (Case-III)	Chotukool Refrigerators (Case-IV)	Tata Swach (Case-V)	Vortex ATMs (Case-VI)
Commercialisation—stage III	D	To save logistics and inventory expenses, major suppliers should be located in the same location as the plant.	Establishment of 300 a fresh 'lean' distribution points solely concentrated on sales and extending the complex network of stockholders throughout free training for mechanics of the rural areas	The Government of India, particularly ECI, is actively encouraging the use of EVMs in further allied nations as a measure to strengthen the democracy aspect.	To develop the web of stakeholder (and create a new source of earning/income in rural and semi-urban places), villagers and social entrepreneurs distributed them in partnership with the Indian Postal Department.	Possibility of making an online buying for delivery across India, as well as access to the Tata Group's enormous retail network, and support from NGOs that engage in social welfare activities and provide free water filters to someone in need.	The World Bank Group and the Tata Capital Innovations Fund provided funding in collaboration with the WIZ- ZIT Bank of South Africa

Summarisation of the Case Studies

After describing six successful Indian frugal innovations, regarding the intended ‘collaborative effect’ and the ‘welfare effort’, to begin, Table 2 summarises the case-particular scope of combination at various stages of the innovation procedure. The collaboration phase will be correlated to OGINs in a subsequent step.

These insights especially related to the cases, have now been in Table 3, that depicts the amount of in-house and the twin development in both international and the domestic markets, as well as the phasing for the progression of innovation to allow for generalisations.

The extent of OGIN contribution in the product enhancement for the frugal innovations appears to be significant, as evidenced by Table 3. Despite the fact that the propositions were chosen for having some aspects of collaboration, the scope of true co-operation, as measured through the participation of external partners in the diverse stages of the creative procedure, is rather considerable. The home base included the highest level of development activity. The firm’s internal R&D capabilities and national collaborative partners (domestic-owned as well as MNC-affiliated) were the most imperative sources of ideas/thoughts, execution and also commercialisation, showing that in such a market, local competencies are required. ‘Domestic in-house development’ (column-b) and ‘domestic collaborative development’ (DCD) (column-d) were the most common types of product development. It is observed that in the case of DCD, the partners might

Table 3. Types of OGINs and the Relevant Collaboration Phases.

Product Innovation	In-house Development		Collaborative Development	
	Closed-Model	Open Global Innovation Network (OGIN)		
	Domestic	Offshore	Domestic	Offshore
(a)	(b)	(c)	(d)	(e)
Case I: Tata Nano	Inception Execution Commercialisation	Inception Execution	Inception Execution Commercialisation	Execution
Case II: Tata Ace	Inception Execution Commercialisation		Inception Execution Commercialisation	Execution Commercialisation
Case III: EVM	Inception Execution Commercialisation		Inception Execution Commercialisation	
Case IV: Chotukool	Inception Execution Commercialisation		Inception Execution Commercialisation	Inception Execution
Case V: Tata Swach	Inception Execution Commercialisation	Inception Execution	Inception Execution Commercialisation	Inception Execution
Case VI: Vortex ATMs	Inception Execution Commercialisation		Inception Execution Commercialisation	Commercialisation

be, and frequently are, MNC partners. The Tata Nano, for example, was developed and executed in part by Indian subsidiaries of German manufacturer Bosch. The contribution of 'off shore collaborative development' in frugal inventions was discovered in five of the six problems, though to various degrees. Their cooperation appears to have been requested most frequently during the execution phase (four times out of five). In the cases discussed here, 'off shore in-house development' (OID) was determined to be the less common kind of OGINs. Only Tata Group companies be determined to have in-house capabilities of development at offshore sites. The only product in the study that did not entail off shoring cooperation was EVMs.

Implications of the Discussion

Examinations of Propositions

At this juncture we will scrutinise the facts given by the propositions in relation to the three affirmations developed in the two sections, that is, second and third.

Value Proposition—Its Role

The report's goal is to map and analyse recent movements inside India's research and innovation industry. It accomplishes this goal with an impressive economy of words and a wealth of information from a range of sources, both domestic and foreign. Particularly noteworthy is the way the data is presented, both in tables and in figures created with the aid of a visualisation expert. More than 320 end notes are included. One won't miss anything if they quickly read the executive summary, introduction, findings, and suggestions. The study examines the laws, organisations, and sectors promoting research and innovation in India. The culture of inventive improvisation, skill in business model innovation, and new sources of social funding that define India's thrifty innovation are vividly shown for the reader. Additionally, the writers did not exclude any problems that need be fixed. The report calls for frugal innovation to become a strategic focus for collaboration between India and the UK. This is because of India's propensity for frugal innovation, which the authors believe would be ideal for Britain and other advanced countries that are going through a phase of lackluster growth and public austerity and are facing severe competition from emerging markets. The welfare effect was definitely strengthened by these which states that the affordability of products help to develop the basic living quality of the customers. The Tata Nano serves as an excellent illustration of this principle. The complicity of well-structured and well-known component suppliers like Bosch, with a pas of German automotive type of engineering, might aid Tata not only in terms of actual vehicle quality but may also aid in terms of promised quality. In turn, Bosch hoped to gain beneficial outcomes in frugal engineering whilst also pursuing the strategic goal of capturing a relevant market position that could have been occupied by a contender and then utilised as a launch pad in well developed markets like Germany as quoted by Palepu et al. (2011). Moreover, it also demonstrates how

collaboration can assist OGIN partners in utilising mutual and common synergies. Even the Tata Nano's initial set back supports this reasoning. The customer opinion on quality flaws and the stigma of driving a 'cheap' vehicle caused the early set back. TML could quickly quell the worries with transparent investigations consisting of independent international forensic expert. The Tatas, on the other hand, had to learn a key marketing lesson: the innovative, creative facets and global-standard quality hall be highlighted rather than the emphasising on the cost savings or reductions aspects.

OGINs for Frugal Innovations—Its Importance

The second statement, that firms can increase their chances of providing the proper unique and value proposition by successfully integrating their product enhancement procedure into open global ingenious networks, is likewise supported by several instances. The utility of present technologies (Kalogerakis et al., 2010) was emphasised (in all cases) to prevent avoidable expenses and keep the focus on affordability of the product. All of the preceding instances are the result of joint growth in OGINs that span firm and, in few cases, domestic boundaries. Using developed, external skills helps to get opportunity to know-how and improves quality, perception and image of the product. This notion is applied by the collaborative development of Vortex ATMs, which was already shown by the example of the Tata Nano. The presence of the renowned IIT-M functions as a safeguard to potential buyers in banks, which historically act in a much of a conservative approach with respect to the adoption of new technology due to high safety concerns. Many potential voters and political activists have been reassured by the collaboration of two well-known public-sector firm and India's Election Commission. The cases also appear to back up the link between OGINs and their share to the decrease of market and technology uncertainty that was caused from the communal effort.

Lead Markets—Engagement

A lead market should idyllically have an outsized amount of consumers with similar socio-economic and/or geographic situations that can be compared with numerous others in other regions of the globe (Beise, 2004). The resulting scale economies aid in lowering costs and increasing the welfare effect of thrifty inventions. The above all cases it can be observed that, as a key market for frugal innovations, India delivered significant scale economies to the pioneering businesses.

Concurrently, the serious consolidation of domestic-based collaborative partners who are nationally bought or MNC-affiliated, in the metamorphosis procedures of frugal innovators braced the proposal that establishing transformation potentials in product-centred lead markets may enhance the chances of identifying and accessing suitable OGINs. Moreover, statistics on foreign automation alliances, as well as royalty remitments and receipts, show that India is becoming increasingly capable of gaining opportunities to enter the area of OGINs. India has seen a considerable inflow in FDI for the purpose of developing local R&D proficiency. Despite the lack of factual data with respect to the amount of FDI

whose major objective was to perform R&D in India, the RBI conducts a prototypical examination of audited annual books of accounts filed by a sample of FDI enterprises, with the sample size and contributors varying over time.

Conclusions

The findings of the present research shows that in archetype of developing 'low-cost' transformations to ascertain latest revenue streams remains valid, a significant re-alignment is required. Purely cost-driven improvements aimed at 'the poorest of the poor' which appeared to fail to meet all of the high expectations placed on them thus far. In instances, social blot clubbed with purely functional and 'cheap' products have developed (in some cases, an imaginary) perceptions of poor quality in the opinions of those who shall be the intended beneficiaries, most of the firms have been competing hard to provide great quality products at defensible prices due to the insufficiency with respect to consumers' real purchasing power at the market exchange rates in the disintegrated retail.

It is obvious that the traits and features of frugal innovation are dependent on the target markets, which have varying demands and local or confined situations. As a result, the characteristics of frugal innovation might differ widely. As a result, frugal innovation includes much more than merely developing a cheaper version of an established product. It necessitates a completely new approach, one that involves digging deep to understand the true needs of bottom-of-the-pyramid customers, identifying gaps that can be turned into opportunities, and rethinking the company's organisational structure and how it delivers goods or services (solutions) on a large scale.

Despite increased interest and attempts to comprehend, create, and develop frugal innovations with the goal of efficiently alleviating issues, there still remains the challenge of conceptualising and characterising such frugal innovations because of its extensive overlap with other types of innovation. However, this might be owing to the varying definitions of other terms included in the definition of FI, such as sustainability, low income, and adequate. Defining FI as a concept must not distract from its primary goal. To identify a FI might be easier if it is compared against any existing alternative rather than any ill-defined idea. Therefore, it states that there is a significance in having a shared knowledge and understanding of frugal innovation (FI) in order to assist initiatives for its worldwide adoption and dissemination.

The examination of six fairly doing well low-end-driven product innovations ('frugal innovations') from several enterprises and businesses show that adopting a collaborative development procedure in open global innovation networks can enhance the probability of commercial success. Such networks enable enterprises to gain opportunities to new and present technologies, synchronise fresh ideas, and overcome the hindrances of a disintegrated customer base by joining forces. A promising remedy is to create products which are not of necessity aimed at 'the poor', but relatively at price-conscious customers who, by their wish or otherwise,

buy products that minimises the cost of ownership while also meeting their ambitions for individual and family well-being, economic advancement, and social acknowledgement. Also, COVID-19 highlighted the inventive spirit of the country's young researchers and innovators. A collaborative approach provided quick solutions with clarity on demands and directions for innovation. It also proved that industry intends to encourage indigenous inventions and has the capacity to scale up for a specific goal. If the government provides critical technological demands from each line ministry, a collaborative strategy coordinated by PSA and CII with business and academics be able to allow inexpensive and deep science discoveries with limited resources. Adopting strategies that enable rapid innovation in crucial areas with little resources will eventually lead to advancement and high-end technological growth.

As a result, there is a need to revise the mindset which experiences more at ease when developing the high-quality materials and products and after that stripping them downward for the impoverished. We thus, necessitate a contemporary style of thinking which will create appealing, well-developed items which shall be made accessible in basic variations and 'stripped up' to compeer the expectations of customers on an individual basis based on their readiness to spend. OGINs can play a critical role in enacting this paradigm shift by leveraging their expertise, resources, and access to market for multiple customer divisions.

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