

Frugal innovation as a key to supply chain success: projection into the Moroccan context

Bilal Karroumi, and Abdelfettah Sedqui*

National School of Applied Sciences, Abdelmalek Essaadi University, Tangier, Morocco

Abstract. In an economic environment characterized by rapid technological change and limited natural resource constraints, the frugal innovation approach is perfectly situated. This approach considers an economical and alternative solution especially for emerging countries by minimizing the use of funding and scarce natural resources, leading to the design of sustainable supply chain concepts capable of meeting the different consumer demands and integrating into the new global economy. This work serves to: simplify the frugal innovation approach by reviewing the separate definitions of innovation and frugality, the evolution of the approach throughout history, and comparisons of types of innovation; find the intersections and complementarities of these notions with the supply chain of the future; and seize opportunities to apply this frugal innovation approach in an emerging economy such as Morocco. The research has shown that frugal innovation can be implemented in both developing and developed countries and is one of the important factors in developing the economy and making it more competitive.

1 Introduction

In an economic environment characterized by rapid technological change and more demanding consumers, inventors must be able to react quickly to various hazards and guarantee a high level of satisfaction of need. This need in reality is a final result of a process of transformation of natural resources, this transformation leads to invent strategies for a reasonable use of these resources.

From a sustainable development perspective, there is considerable interest in the optimization of natural resources. In this perception, the approach of frugal innovation is perfectly in tune with the aim of creating more social value by limiting the utilization of funding and scarce natural resources and leads to the design of sustain-able concepts capable of responding to different life situations.

Frugal innovation is an approach well known and treated by researchers and inventors from emerging countries (India, Rwanda ...). It is an approach that aims to improve the efficiency of design and development processes while improving the quality of the service provided and optimizing costs.

The evolution of logistics from a Taylorian fragmentation to a global supply chain (Global and Transversal Steering) highlights the importance and efficiency of frugal innovation in a context of increasingly scarce and costly resources on the one hand, and optimal processing times and rapid technological developments on the other.

The Moroccan economy is soluble in the frugal innovation approach and is well placed as an emerging economy to develop this type of innovation. This concept

is confirmed by the innovative solutions of Moroccan craftsmanship under the term "l'bricol", and large investments, such as the Renault-Nissan plant that aims to manufacture a frugal car in a frugal plant. The theory of frugal innovation has the merit of opening up the field of innovation to Moroccan organizations that thought that innovation was exclusively through costly R&D budgets [1].

This work serves to: study the concept of frugal innovation from different points of view; compare this concept with other types of innovation; study its relationship with the sustainable supply chain of the future (Francesco Rocca); simplify the six principles of frugal innovation according to Radjou et al. 2012 [2] in order to identify the opportunities to be exploited in a Moroccan context as an emerging economy.

The remains of this paper are arranged as follows. Section 2 presents a summary of the literature review conducted for frugal innovation and its evolution, its concepts, the supply chain concept and its evolution. Then, in section 3 we describe the relationship of frugal innovation and the supply chain. In Section 4 we present an analysis of the six principles that characterize Frugal Innovation, the exploitation of this concept in a Moroccan context, and how Morocco can benefit and make it an important means of development. Section 5 shows conclusions made for frugal in-novation as well as future opportunities in this field.

2 Literature Review

2.1 Innovation notion

Innovation can be a product or a process, as shown in the literature, which can be grouped into two major categories. The outcome stream; Innovation emerged in

* Corresponding author: karroumi.bilal@gmail.com

new products and production methods. the focus on this stream is used to study the economic consequences of innovation (von Hippel, 1988; Abernathy and Utterback, 1978). The process flow that studies the social and organizational processes that generate the outcomes of innovation, such as the environmental context, individual creativity, and social and economic factors [3].

There are two criteria for defining innovations, (Phills et al, 2008). The first is that the idea must be new, without necessarily being entirely original, the user and the application that are concerned by this novelty. That is to say, it can be new for a company or a specific market, but it does not have to be universal. Second, the innovation must improve the current situation to be more effective than the solutions it seeks to replace. Innovation involves capital-intensive research and development by firms, as well as small improvements to existing technology. The "who", "what" and "how" of innovation varies from one firm to another, from a product to a new business model, from basic research to the acquisition of external knowledge. In this context, frugal innovation should not totally new or require human and financial investment which often linked to high-technology R&D [4].

2.2 Frugal notion

Frugal means in the literal sense of the term thrifty or "characterized by or reflecting thrift in the use of resources" (Merriam Webster, 2011) and "simple and plain and inexpensive" (Oxford Dictionaries, 2011).

Simply put, a frugal philosophy embodies "doing more with less." This applies to both the buyer and the seller. For consumer expectation, a frugal product is affordable and cheap. But affordability is not limited to the solution cost, but also extends to operating costs. Frugality means not only reducing the product cost, but also reducing the way it is designed to operate within the situation with limited resources.

Thus, for the consumer, a frugal solution ranges from simple cost to operating with few resources, against the lack of necessary infrastructure and in the way, it operates within complex, different or poorly performing institutions. From a business perspective, to meet the needs of clients in constrained contexts, a cost-effective solution must be pre-designed, produced and delivered [5].

In the same approach, the concepts of low cost, soft discount and hard discount appear; the concept of "low cost" is based on the practice of lower prices than the market average and is mainly used in the field of services (hotels, air transport, car rental). It is also applied in the field of distribution with, in particular, the hard discount model which generates low prices through; a quasi absence of services, a reduction in handling costs (shelving by pallets), a limited number of references offered, a very limited presence of major brands and a high degree of versatility among employees.

2.3 Frugal innovation

Several definitions have been given to the Frugal Innovation approach, except that these definitions agree on some key characteristics. The origin of this approach can be traced back to the term 'Frugal Engineering',

invented by Carlos Ghosn, Chairman and CEO of the Renault-Nissan Alliance in 2006, who was able to innovate cost-effectively and quickly, and under very limited resource conditions (Soni and Krishnan, 2013). The Economist initiated one of the first definitions of Frugal Innovation in 2010: "Frugal products must be durable and easy to use (...). Frugal innovation is not just about rethinking product design; it involves rethinking all production processes and business models" [6].

Similarly, Rajnish Tiwari and Cornelius Herstatt consider the term 'Frugal Innovation' to mean innovative products and services that: "seek to minimize the use of material and financial resources across the value chain in order to reduce the cost of ownership while meeting or exceeding certain predefined criteria of acceptable quality standards" [7].

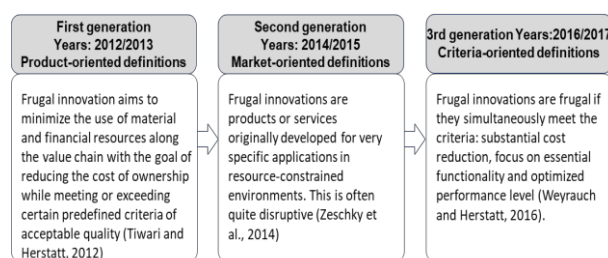
Bhatti, Y.A. (February 1, 2012) considers that frugal innovation can encompass both processes and outcomes and therefore have overlapping meanings. It can refer to frugal innovation processes, such as the process of reverse diffusion (Govindarajan and Ramamurti, 2011), reverse engineering, the use of do-it-yourself (Levi-Strauss, 1967), creative improvisation or jugaad (Gulati, 2010), design processes and the use of tools such as open source techniques. Jugaad is presented as a style of innovation improvisation motivated by scarcity of resources and focus on the immediate requirements of customers rather than their lifestyle (BusinessWeek, 2009).

Frugal innovation can be a product, a service or a business models that aim to provide a good quality at acceptable prices for underserved customers in the low and middle market (Zeschky et al., 2014; Ernst et al. Young, 2011; Soni, 2013). These innovations are developed in a sustainable and profitable way to improve the social value while minimizing the environment impacts, resource use and capital in the company. (Bhatti, 2012; Tiwari and Herstatt, 2014; Radjou and Prabhu, 2015).

2.4 Frugal innovation evolution

To illustrate a more recent view on the evolution of frugal innovation, we quote below the breakdown of "Pisoni, Alessia; Michelini, Laura and Martignoni, Gloria), who have classified this evolution in the definition of frugal innovation into three generations from 2012 to 2017 (see below table 1).

Table 1. Evolution of Frugal innovation [8].



2.5 Innovation concepts: Similarity of frugal innovation

In relation to other similar concepts, such as "Jugaad", "Base of the Pyramid", "Inclusive Innovation", and

"Reverse Innovation", the frugal innovation is developed to be a more integrated concept (Tiwari & Herstatt, 2014; Hamacher, 2014; Bhatti & Ventresca, 2013). In fact, it fully includes the core characteristics of these individual related terms (Tiwari & Herstatt, 2014, p. 13).

Therefore, we convinced that the frugal is related to the entire innovation process that applies to different types of innovation.

Jugaad
• Jugaad is synonymous with the frugal approach, that is mean the art of improvising an effective solution using limited resources.
Cost Innovation
• A frugal approach offer to customers the lower costs solutions with limited resources but with same functionalities.
Reverse Innovation
• The frugality is linked to the concept of reverse innovation; a new innovation concept from final solution to design step.
Base of pyramid innovation
• The innovation at the base of the pyramid is part of the frugal approach, the concept is linked to the developing country.
Do-it-yourself process (Bricolage)
• Do-it-yourself processes - DIY processes characterized by rapid reaction to existing situation with lower costs.
Disruptive innovation
• Disruptive innovation is associated with the frugal approach by some researchers and this following the flexibility characterized this type of innovation.
Low Cost
• An economic and marketing concept based on the practice of lower prices than the market average which can be obtained through a drastic policy of cost containment or reduction.
Hard discount
• Hard discount refers to sales outlets selling products at prices generally below those normally charged.

Fig. 1. Innovation concepts [9].

2.6 Logistics

Y.Pimor and M.Fender.2008 consider that logistics always covers transport, storage and handling functions and, in production companies, tends to extend its field upstream towards purchasing and supply, downstream towards commercial management and distribution. The military-generated definition is often cited: Logistics is about delivering the right part to the right person at the right time.

However, different logistics can be distinguished by their purpose and their methods [10]:

- A supply logistics system that brings into the factories... commodities required for production.
- A general supply logistics that provides service companies or administrations the various products.
- Production logistics, which consists of bringing to the foot of the lines of production the materials and components needed for production.
- A distribution logistics, that of the distributors, which consists in bringing to the final consumer.
- Military logistics to transport to a theatre of operations the forces and all that is necessary for their operational implementation and their support.
- Support logistics consists of organizing all what is required to keep a complex system in operation.
- An activity known as after-sales service rather similar to support logistics, with the difference that it is carried out in a commercial context by the person who sold a good.
- Reverse logistics, translated as "logistics to backwards" or "returns logistics", which consists of taking back products that the customer does not want or wants to do repair.

2.7 Supply chain

The Supply Chain can be considered as a sequence of processes, a network of organizations or companies or as a dynamic network structure that generates physical, information and financial flows. It can even become a mode of analysis. The SCM is a type of management, coordination, exchange or even a managerial philosophy of this chain [11].

Once again, the variety of definitions could be confusing, but the apparent diversity stems in part from the different possible levels of SCM: operational, tactical or strategic. For example, Halley (2004) defined Supply Chain as following, "The supply chain is defined as a network of interacting firms whose objective is to deliver a product or service to the end user by coordinating the activities associated with the movement of goods from the raw material to the delivery of the finished product through efficient combinations of resources that contribute to the creation and delivery of value." (Halley, 2004, p 55).

2.8 Logistics evolution: From logistic to supply chain

The concept of logistics has undergone an important evolution since 1960, the table below shows this evolution from simplified activities to supply chain management.

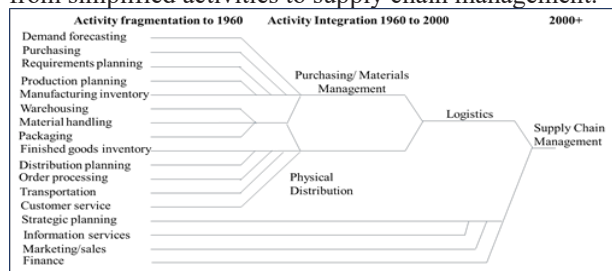


Fig. 2. From logistic to supply chain

3 Frugal innovation and supply chain

Frugal Innovation has a strong relationship with the supply chain, for this reason, we will present the point of view of the authors talking about this relationship as well as their model for making frugal innovation soluble in the global supply chain;

Radjou and Prabhu (2015) propose a decentralized manufacturing strategy of factory-agnostic products based on modular architecture and standardized components. Furthermore, they underline the benefits of establishing local networks for both procurement and distribution activities.

Finally, to ensure the sharing of information flows with the involved parties, they recommend the use of an ERP software.

Millstone (2014) pays attention to the design phase to ensure affordability of products. In addition, she proposes the reduction of the Supply Chain by implementation of small plants near to the end market.

More investigation is needed to develop the link between SCM and frugal innovation, especially in the absence of a standardized model. This work contributes to the development of a structured framework of SC

strategies for frugal innovation, it aims to increase firms' reliance, efficiency and success rate [12].

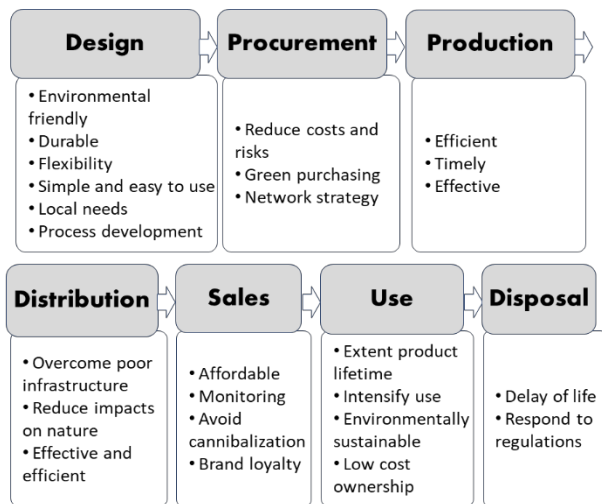


Fig. 3. Framework for Frugal Innovation Supply Chain [12]

4 Frugal innovation and Moroccan context

4.1 Six principles of frugal innovation

Radjou et al. 2012 are the only ones that have defined the principles of frugal innovation, which appear the effective six practices of innovators in complicated condition like emerging economies circumstances. To achieve a good result, these defined principles is basing on frugality, simplicity, adaptability, resilience, inclusivity, passion, and empathy. The six principles are:

- **Seek Opportunity in Adversity:** Entrepreneurs consider situation constraints as an invitation to innovate a frugal solutions. Alchemists make an opportunity from adversity to add a value. This power to create an innovation source from adversity is required for any organization to succeed and prosper.
- **Do More with Less:** Frugal innovators generate a lot with less, and this is totally contradictory to the Western approach that considers bigger is better. This approach has failed to provide essential and necessary services such as education and health care to a large segment of people. The principle of doing more with less can help developed and emerging countries deliver high value while optimizing the use of limited natural and financial resources.
- **Think and Act Flexibly:** For innovators all options are open because of the flexibility mindset. These Frugal Innovation innovators respond quickly to unexpected changes. They don't just think out of the box, but also try to create new boxes. Their boundless thinking leads to incredible solutions that help shape entirely new markets and sectors.
- **Keep It Simple:** Creative simplicity is an essential part of Jugaad. It is used to find good solutions that will do the requested work and meet the created need, it does not seek sophisticated solutions to perform the requested function.
- **Include the Margin:** Include the margin is among the specialties used by innovators to include marginal and

underserved customers in order to make them active traditional customers and value co-creators. this role is ensured by affordable solutions proposed to meet the market needs of these customers.

- **Follow Your Heart:** According to the innovators of Jugaad Concepts, trusting the heart and following it is the key to success without the need to rely on formal studies to choose which products to manufacture. Although knowing their clients is necessary, they are based on intuition and empathy [2].

4.2 Makers and Favorable Spaces for Frugal Innovation

Makers are at the meeting point of resources and methods that are close to those of design and industry, but they envisage production according to logics that are more of a hobby. Learning by doing, decentralization and sharing of skills; self-production, personal accomplishment through making and emancipation through digital manufacturing techniques [14].

In high-tech DIY communities, "Fab labs" and "Makerspaces" are frequently looked at through the prism of innovation. they are workshops open to the community and they usually have sophisticated and digital equipment, these spaces indeed seem to be able to embody currents of thought seeking ways of emancipation with technological developments. "Fab labs" and "Makerspaces" therefore deserve to be analyzed and accredited to make them solid spaces of frugal innovation. Fab labs are located within educational institutions such as colleges, schools and universities; in addition to focusing more on students, while Makerspaces are suitable spaces for tinkerers, craftsmen and hobbyists to showcase their skills through innovative and frugal ideas [15][16].

These principles have a considerable contribution in the concept of collective intelligence that aims to achieve an inclusive circular economy, an economy that offers innovative solutions at affordable prices and aims to increase the efficiency of resource use and decrease the impact on the environment.

4.3 Moroccan context

During this section we have exposed the opportunity for Morocco to adopt this concept of frugal innovation. This exhibition will take into consideration the two following aspects; the Moroccan economy at the global level and the applicability of frugal innovation concepts to the Moroccan context;

Morocco is classified as a developing country, which brings it closer to countries in Asia (India...), Latin America (Brazil, Peru...) and some African countries (Rwanda, Ethiopia). The living conditions of the population and the limited natural resources are among the main points that link the Moroccan context to these countries that have known success stories with frugal innovation. The main drivers for the birth of this concept are high costs and limited resources. In Morocco the frugal innovation approach is discussed for the first time informally at the fifth international meeting in Dakhla, Morocco, on December 7-8, 2017 as part of innovation axes that Morocco can adopt (shows figure 4 below).

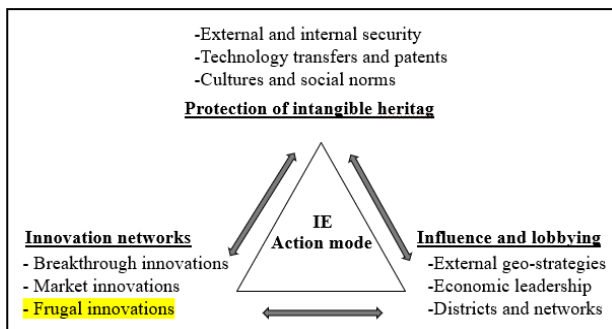


Fig. 4. Economy Intelligence action mode of Morocco (Wilinski, 1967, Baumard and Harbulot 1997, Baulant, 2015) [13].

The applicability of the concept of frugal innovation in Morocco requires a framing and development to succeed more than an initiation of the concept from the beginning, because frugal innovation is already shown its adaptation to the Moroccan context at the level of small and grand projects:

Small investment: we often hear the term "bricol" to refer to the ingenious way in which simple and destitute people manage to find innovative solutions to expensive problems or the expression "Système D" in use in French-speaking countries.

Major investment: the principle is integrated by the management of the Renault-Nissan group Carlos Ghosn through the manufacture of a frugal car in a frugal factory.

By exploiting the six principles of frugal innovation, Morocco can achieve good results by framing and formalizing the frugal innovation approach, knowing that it has all the conditions to value this concept of innovation; the limited resources, the cost of living, and the ingenuity that characterize Moroccan people. Below, we have presented some uses of the principles of frugal innovation in the Moroccan context:

- **Seek Opportunity in Adversity:** It aims to change the constraints to opportunities; Morocco for example can exploit the high temperature in the south of Morocco to produce renewable energy, transfer the vision of unemployed youth from waiting job opportunity to small entrepreneurship encouraged by government and exploitation of external industrial investments to create internal competences capable of inventing high quality Moroccan brands...
- **Do More with Less:** This principle can be applied simply by thinking about what already exists in a new way to create a better solution; it is required to encourage the concept of reuse and recycling (plastic, paper...), to improve the benchmarking approach between the different sectors in Morocco, to take advantage of the experiences of external countries to create value internally as well as the exploitation of free software and databases to propose and invent a new solution locally.
- **Think and Act Flexibly:** Not to limit the thinking spirit especially at the level of schools and education centers and encourage the brainstorming approach without eliminating any idea or opinion which can be a big succeed projects.
- **Keep It Simple:** Search the short way to get the job done; this principle will be used at the level of

administrative services, education as well as at the level of health in Morocco as new solutions to avoid a lot of light issues that become a big problem.

- **Include the Margin:** Include the segments targeted by projects or decisions to make them more useful and respond as needed to the maximum; This approach will enhance the value of Moroccan brand and will help to win the targeted segments confidence on different sectors.
- **Follow Your Heart:** Be passionate is enough to develop a great solution; A good principle should be used for "Fab labs" and "Makerspaces". We emphasize here that nature is the source of all innovations that exist today, so we must trust our hearts.

We underline that what has been presented above are only a few examples for each principle of frugal innovation, otherwise all principles can be used for all sectors and domains.

Morocco is well positioned to strengthen its presence in the African market and integrate global markets with frugal, sustainable and affordable products. In addition, the strategic position of Morocco in North Africa helps to penetrate the various markets. All of these advantages are guiding Morocco to achieve great success by adopting this frugal innovation approach.

5 Conclusion and Future Research

The economic world is undergoing a strong pressure from different aspects; consumer demands, competition, limited resources, this pressure is increasing in the developing countries, at this stage appears the importance of frugal innovation concept as a solution accessible to everyone specifically the developing countries Morocco as an example.

This paper highlights the concept of frugal innovation and its introduction in the supply chains of the future, and then it explains the feasibility of integrating this concept in the Moroccan context.

Then, we presented the importance of the six principles of frugal innovation, and we highlighted how Morocco can adopt them by listing some examples for each principle that show the applicability and positive impact that this concept will bring to the Moroccan context. Taking into consideration the favorable conditions in Morocco, the probability of success of this concept is high, especially since the reasoning principle exists intuitively among Moroccan people. Frugal innovation only needs a framing or formulation to become structured.

Future research can clarify the constraints of implementing this frugal innovation in Morocco and the areas to prioritize for this concept to be successful and give quick results, which will encourage the implementation of this concept in the Moroccan context. And after answering the question how Morocco can strengthen its commonality with developed countries through innovation and frugal supply chains knowing that the Western country is beginning to adopt this concept as a solution to meet the needs of a very large part of consumers around the world.

References

1. <https://www.esca.ma/blog/linnovation-demystifiee-innoviez-aujourd'hui-grace-a-linnovation-frugale/> (15/02/2021).
2. Radjou, N., Prabhu, J. & Ahuja, S. *Jugaad innovation: Think frugal, be flexible, generate breakthrough growth*. (John Wiley & Sons, 2012).
3. Phillips, J. A., Deiglmeier, K. & Miller, D. T. Rediscovering social innovation. *Stanf. Soc. Innov. Rev.* **6**, 34–43 (2008).
4. Bhatti, Y. A. What is frugal, what is innovation? Towards a theory of frugal innovation. *Theory Frugal Innov. Febr. 1 2012* (2012).
5. Bhatti, Y. A. & Ventresca, M. How can 'frugal innovation' be conceptualized? *Available SSRN 2203552* (2013).
6. Soni, P. & Krishnan, R. T. Frugal innovation: aligning theory, practice, and public policy. *J. Indian Bus. Res.* (2014).
7. Tiwari, R. & Herstatt, C. Frugal innovation: A global networks' perspective. *Unternehm.* **66**, 245–274 (2012).
8. Pisoni, A., Michelini, L. & Martignoni, G. Frugal approach to innovation: State of the art and future perspectives. *J. Clean. Prod.* **171**, 107–126 (2018).
9. Radjou, N. & Prabhu, J. *Frugal Innovation: How to do more with less*. (The Economist, 2015).
10. Pimor, Y. & Fender, M. *Logistique*. (Dunod, 2008).
11. Belin-Munier, C. Logistique, chaîne logistique et SCM dans les revues francophones de gestion: quelle dimension stratégique? in *XXIIIème conférence de l'Association Internationale de Management Stratégique (AIMS)* 26 p (2014).
12. Rocca, F. Supply Chain Management for Frugal Innovation Product. *Tec. Lisb.* (2016).
13. Baulant, C. Nouveau regard sur l'IE: comment le Maroc peut s'insérer dans la nouvelle économie mondiale? (2020).
14. Bosqué, C. Enquête au cœur des FabLabs, hackerspaces, makerspaces. Le dessin comme outil d'observation. *Tech. Cult. Rev. Semest. D'anthropologie Tech.* 168–185 (2015).
15. Rumpala, Y. «Fab labs», «makerspaces»: entre innovation et émancipation? *Rev. Int. Léconomie Soc. Recma* 85–97 (2014).
16. Van Holm, E. J. What are makerspaces, hackerspaces, and fab labs? *Hackerspaces Fab Labs* (2014).
17. Arabshahi, G., Arabshahi, M. & Zaafarian, R. A study on how open innovation influences on supply chain behavior. *Uncertain Supply Chain Manag.* **2**, 271–274 (2014).
18. Bound, K. & Thornton, I. W. Our frugal future: Lessons from India's innovation system. (2012).
19. Dwyer, B. M. Innovations in Education & Training International. *Prep. 21st Century Paradigm Our Times* **32**, 269–277 (1995).
20. Fulconis, F., Pache, G. & Reynaud, E. Frugal supply chains: a managerial and societal perspective. *Soc. Bus. Rev.* (2019).
21. Hamacher, S. Exploring the Frugal Innovation Process. (2015).
22. Hartley, J. New development: Eight and a half propositions to stimulate frugal innovation. *Public Money Manag.* **34**, 227–232 (2014).
23. Hossain, M. Mapping the frugal innovation phenomenon. *Technol. Soc.* **51**, 199–208 (2017).
24. Hossain, M. Adoption of open innovation by small firms to develop frugal innovations for inclusive development. in *Researching Open Innovation in SMEs* 115–135 (World Scientific, 2018).
25. Meagher, K. Cannibalizing the informal economy: Frugal innovation and economic inclusion in Africa. *Eur. J. Dev. Res.* **30**, 17–33 (2018).
26. MARYNA, N. FRUGAL INNOVATION: A NEW BUSINESS PARADIGM.
27. Winterhalter, S., Zeschky, M., Gassmann, O. & Weiblen, T. Business models for frugal innovation: the role of Resource-Constraints. (2014).
28. Dou, H. & Koné, H. L'innovation frugale dans les pays en développement et la nécessité d'une protection intellectuelle appropriée. *Mondes En Dév.* 29–45 (2016).
29. Haudeville, B. & Le Bas, C. L'innovation frugale : signification et frontières d'un concept. *Innovations* **51**, 5–8 (2016).
30. Haudeville, B. & Le Bas, C. L'innovation frugale, paradigme technologique naissant ou nouveau modèle d'innovation? *Innovations* 9–25 (2016).
31. Kacioui-Maurin, É. L'innovation des prestataires de services logistiques: entre opportunités et contraintes. *Logistique Manag.* **20**, 21–30 (2012).
32. Mériade, L. Innovation frugale et culture chinoise: le cas de l'innovation shanzhai. *Innovations* 47–67 (2016).