

FRUGAL INNOVATIONS: A MULTIDISCIPLINARY REVIEW & AGENDA FOR FUTURE RESEARCH

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Full citation - Dabić, M., Obradović, T., Vlačić, B., Sahasranamam, S., & Paul, J. (2022). Frugal innovations: A multidisciplinary review & agenda for future research. *Journal of Business Research*, 142, 914-929.

Acknowledgment: We would like to thank Alexander Brem, Gassmann Oliver, Mario Pansera, Michael Condry, Prabhav Garudadwajan, Soumodip Sarkar, Sudeendra Koushik, for their helpful comments and suggestions.

Funding: This research has received funding from the Horizon 2020 Programme of the European Union within the OpenInnoTrain project under grant agreement no. 823971. The content of this publication does not reflect the official opinion of the European Union. Responsibility for the information and views expressed in the publication lies entirely with the author(s). Assistant Prof. Božidar Vlačić would also like to thank the scientific collaboration under the National Funds from FCT - Fundação para a Ciência e a Tecnologia project UIDB/00731/2020 and Spanish national funds project PID2019-106677GB-I00 of the Ministry of Science and Innovation of Spain.

Abstract

Frugal innovations are about achieving more value from using few resources. This concept has found application across multiple domains ranging from healthcare, transport, energy to manufacturing. This straddling of multidisciplinary domains fragments our academic understanding of the literature. This state-of-the-art literature review performed using multiple correspondence analyses on 199 articles along with a Delphi study with the prolific authors and practitioners of frugal innovation, integrates the multidisciplinary academic literature to offer a holistic picture of scholarly literature in the field, outlining its key theoretical approaches and provides a glimpse of the future. This study outlines the relevance of frugal innovations in combating the COVID-19 pandemic and the key areas for future research in frugal innovation, such as new product development, ease-of-use, the performance of frugal innovations, strategy, and sustainability, among others.

Keywords: Frugal innovation, Jugaad innovation, Gandhian innovation, Systematic literature review, Multiple Correspondence Analysis, Delphi study.

INTRODUCTION

The frugal innovation approach, which is about achieving more value using fewer resources, has been of significant scholarly (Hossain, 2020; Ernst et al., 2015) and practitioner interest (Bhatti, Prabhu & Harris, 2020; Radjou & Prabhu, 2015) over the last decade. Though the concept has its roots in resource-constrained contexts (Prabhu & Jain, 2015; Soni & Krishnan, 2014), it is currently being practiced and implemented by global multinationals (e.g., Sony, Renault, GE Healthcare) and in developed markets (Agarwal et al., 2020; Asakawa et al., 2019). Given that frugal innovation has captivated the attention of a large audience by its ability to reduce complexity and production costs, coupled with its relevance in tackling grand challenges (e.g., global warming, poverty, healthcare, and the COVID-19 pandemic) (Radjou, 2015; Nylund, Brem & Agarwal, 2021; Sahasranamam, 2020a; Steinfield & Holt, 2019), there is a need to take stock of the research on this phenomenon and set an agenda to advance the topic.

Frugal innovation – also known as Jugaad innovation and Gandhian innovation - represents "*a resource-scarce solution (i.e., product, service, process, or business model) that is designed and implemented despite financial, technological, material or other resource constraints, whereby the outcome is significantly cheaper than competitive offerings (if available) and is good enough to meet the basic needs of customers who would otherwise remain un(der)served*" (Hossain et al. 2016; p. 133). Although the first author to coin the term ‘frugal innovation’ remains unknown, scholars have acknowledged that the term's origin comes from ‘*frugal engineering*’, which was created in 2006 by the former CEO of the Renault-Nissan Alliance, Carlos Ghosn. Furthermore, recent research on frugal innovation highlights its philosophy-related constructs (such as Gandhian and Jugaad innovation in India and Bottom of the Pyramid (BoP) innovation) and processes (Agarwal et al., 2017; Tiwari & Kalogerakis, 2016; Pisoni et al., 2018; Hossain, 2018, Hossain, 2020). In addition, Weyrauch and Herstatt (2016) differentiated frugal innovation from other kinds of innovation based on three characteristics: substantial cost reduction, concentration on core functionalities, and optimized performance levels.

However, academic literature on the topic is fragmented due to its multidisciplinary application (Kuo, 2016; Busch et al., 2018; Miesler et al., 2020), mandating a review that incorporates literature from engineering, healthcare, transport, energy, manufacturing, and others. Because of this, there is a clear need for a comprehensive review of the management of frugal innovation to bring the fragmented strands of work within the field together (Snyder, 2019), facilitating an understanding of the key research themes in this area's theoretical and methodological foundations.

The purpose of this article is to provide an integrated understanding of the literature on frugal innovation. In line with this aim, we perform a multidisciplinary systematic literature review, including thematic and keyword analyses, to outline the intellectual structure of the frugal innovation domain (Paul & Rialp-Criado, 2020). This study adds to the scholarly literature on frugal innovation by (a) advancing theoretical understanding of frugal innovation; (b) providing an integrated map of literature on the topic through thematic and keyword analyses, integrating multidisciplinary literature on the topic to place it within the larger context of innovation and general management literature; (c) identifying the key theoretical and methodological bases for this literature, and (d) highlighting key research gaps to set an agenda for further research on this topic. We also contribute to literature review research methodology by integrating a quantitative approach (HOMALS) with a Delphi analysis to map the literature on the topic and reflect on future research trends from academic and practitioner standpoints. The comprehensive review offers value for practitioners in terms of understanding the challenges and opportunities of adopting frugal innovation practices.

The remainder of the article is structured as follows: in the next section, the bottom-up introduction of frugal innovation was introduced, in Section 3, we present the hybrid-narrative systematic literature review approach using multiple correspondence analysis and Delphi study; in Section 4, we graphically depict the research field of frugal innovation and discuss future research avenues regarding theory, research themes, geographical and industrial scope, and methodology; and, finally, in the last section, we provide our conclusions and outline implications for practice.

BOTTOM-UP INTRODUCTION OF FRUGAL INNOVATION

Frugal innovation overlaps with other similar terms such as constrained-based innovation, grassroots innovation, Gandhian innovation, Jugaad, catalytic innovation, and indigenous innovation (Brem & Wolfram, 2014; Hossain 2018; D'Angelo & Magnusson, 2020). The frugal philosophy although still in its beginning (Hossain, 2018), found its way in migrating from east to west due to vast benefits related to higher resource productivity, minimization of waste, and indirect ecological focus (Rosca and Bendul, 2016).

The term *frugal innovation* originally came from *frugal engineering*, which was created in 2006 by Carlos Ghosn. As the CEO of Renault-Nissan Alliance, Ghosn was impressed by Indian engineers, and during his leadership, Renault-Nissan became one of the world's leading producers of low-cost vehicles (Radjou et al., 2012). *Jugaad* and *Gandhian innovation* are specific concepts related to the geographical location of India, while Bottom of the Pyramid (BoP) implies people living with less than \$2.50 a day. Although BoP is a narrower term than frugal innovation, it is also the nearest (Hossain, 2018). In essence, *jugaad* is a Hindi word, meaning an innovative improvement that relies on creativity and skills (Radjou et al., 2012). Additionally, *jugaad* refers to improvisation and innovative solutions for everyday challenges by finding new applications for available resources. Moreover, *constrained-based innovation* is a broader term than frugal innovation, as it encompasses additional terms such as reverse innovation, blowback innovation, and trickle-up innovation (Agarwal et al., 2017). Accordingly, later noted terms are mostly used for explanation of the knowledge transfer from the east to the west (Hossain, 2018). For example, reverse innovation implies innovations originally established in developing countries and reversed as low-cost innovations in developed countries (von Zedtwitz et al., 2015). The evolution of the frugal innovation concept, as well as the meaning of related terminology including differences and similarities, are presented in Table 1.

INSERT TABLE 1 ABOUT HERE

RESEARCH DESIGN

As this research aims to synthesize an advance understanding of the frugal innovation research field through the provision of a fruitful research agenda, we have adopted a hybrid-narrative approach. A hybrid-narrative approach is an approach in which researchers “integrate a framework to provide directions for future research in a more narrative-oriented type of literature review” (Paul & Rialp-Criado, 2020, p. 2). Moreover, in line with the hybrid-narrative approach, we adopt the Theory, Context, and Methods (TCM) framework (Paul, Parthasarathy, & Gupta, 2017) as this systematic literature review cross-examines theoretical foundations, major research themes, geographical scope, industry, and methodological approaches (Vlačić et al., 2021).

The Sample of Articles and Data Collection

Following Hiebl's (2021) guidelines, the first step to take when outlining a research field is to select the related articles in the analysis. Two leading scientific databases were used for article and data selection – Scopus and Thomas Reuters Web of Science. In order to be included in the dataset, the manuscript had to contain the keywords such as frugal innovation or jugaad innovation or Gandhian innovation or Bottom of the Pyramid innovation in its title, abstract, and/or keywords. Accordingly, Jugaad innovation, Gandhian innovation, and Bottom of the Pyramid innovation are related terms, specifically when studying frugal innovation (Brem, 2017; Nair et al., 2015). Other related terms such as constrained-based innovation, grassroots innovation, and indigenous innovation were studied and addressed through the manuscript but were not part of selected keywords due to differences related to the geographical context and origin of frugal innovation.

Our focus was on frugal innovation and, therefore, articles only dealing with reverse innovation were excluded. Figure 1 provides further information on the process of article selection and employed methodological procedures.

INSERT FIGURE 1 ABOUT HERE

In the first stage, the authors read through the content of the identified articles to classify those without a clear focus on frugal innovation. After removing these articles, the final list consisted of 199 articles published between 2010 and 2021 with the following distribution: 2010-2013, 7%; 2014-2017, 28% and 2018 – 2021, 65% (the full list of articles is available in supplementary material). Academic interest in frugal innovation peaked in 2018 when around 20% of the observed articles were published. This peak can be partially explained by Brem's (2017) and Hossain's (2017) reviews, which served as a roadmap for future studies. Additionally, The European Journal of Development Research published the special issue on frugal innovation in 2018 (Leliveld & Knorringa, 2018). The ongoing interest in the field of frugal innovation is further illustrated in IEEE Transactions on Engineering Management's special issue on frugal innovation (Beise-Zee et al., 2021).

Over the past years, various authors have contributed to synthesizing and reviewing the frugal innovation field of research, as summarized in Table 2. However, most up to date reviews synthesize the research field up to 2019 (D'Angelo & Magnusson, 2020; Mortazavi et al., 2021), leaving around 45% of the research field to scatter and not accounting for ongoing changes caused by the COVID-19 pandemic and the relevance of frugal innovation in this turbulent and uncertain context. In short, this growing interest and increased relevance of frugal innovation call for a systematic organization of the frugal innovation field (Tranfield et al., 2003).

INSERT TABLE 2 ABOUT HERE

The Building of the Codebook

After building the database of publications to be analyzed, the next stage involved generating the codebook for the content analysis. Following the guidelines of Kiessling et al. (2021) and Vlačić et al. (2021), the authors created the final codebook, building upon previous literature reviews (see Table 2)

and a thorough analysis of 199 articles applying QDA Miner v.5 and Wordstat v.8 software. The codebook-building process involved indexing the keywords and phrases that served as representative descriptors of the included articles' content. The final codebook contained 788 keywords, categorized into 19 major categories. The major categories were divided into five themes: theoretical approaches, major research themes, geographical scope, industrial sector, and methodological approaches (the full list of keywords and categories is available in supplementary material – see Tables 1-5).

The Multiple Correspondence Analysis (MCA)

In order to analyze the intellectual structure of the frugal innovation research field, multiple correspondence analysis (MCA), based on homogeneity analysis by means of alternating least squares (HOMALS), was used (Dabić et al., 2020; Kiessling et al., 2021; González-Loureiro et al., 2015). MCA represents a quantitative technique for the exploration of qualitative data. This technique, using HOMALS analysis, enables researchers to synthesize and illustrate a research domain in the parsimonious Euclidean space, which is used to map diverse research fields, such as cross-border mergers and acquisitions (Kiessling et al., 2021), immigrant entrepreneurship (Dabić et al., 2020), service research (Furrer et al., 2020) and open innovation in manufacturing (Obradović et al., 2021), among others.

HOMALS procedure was used to estimate the coordinates of each descriptor on the map. The value of “0” was assigned to an article when neither its title, abstract, nor keywords contained a specific keyword and vice versa. The value of “1” was given to articles that did contain a specific keyword. The HOMALS was conducted using SPSS v26 software. For analysis to be valid, the overall keyword means had to be larger than 1 (Hair et al., 1998; Furrer et al., 2008). Following this, the overall mean was 1.31 per article.

Additional understandings of the frugal innovation research field could be achieved through dynamic perspective and the direction of change in the interrelations of the research themes over time (López-Duarte et al., 2016; Furrer et al., 2020). The evolution and shifts of the research interest over time are

developed by rendering the time in three different sub-periods: P1 (2010–2013), P2 (2014–2017), and P3 (2018–2021). As presented in Figure 3, a descriptor position relative to P1 enables the trajectory of research from this subperiod to date to be obtained. Accordingly, the “arrows represent the direction of evolution of each theme; their length signals the extent of changes in the themes” (Furrer et al., 2020; p.313). Finally, the greater the distance, the lesser the degree of association between the descriptors, indicating a potential research gap and fruitful future research avenues (see Figure 2 and Figure 3).

The Delphi Study

Through the Delphi approach and interaction with experts in the field (Flostrand et al., 2020), this study portrays the progress made to date in the frugal innovation research field and provides a glimpse of the future. As the future advancement of frugal innovation is dependent upon contributors generating new knowledge, combining expert view with an overview of the literature is a technique useful for expanding the frontiers of the field, as already observed in other research areas such as international business (Griffith et al., 2008), supply chain management (Melnik et al., 2009) and entrepreneurship (van Gelderen et al., 2021), among others.

In line with Rowe and Wright (1999), the study was performed with four key features: anonymity, iteration, controlled feedback, and the statistical aggregation of group response. Thus, the experts were contacted by e-mail and asked to position themselves regarding the future research on the topic, issues constraining the progress of research and practice on the topic and measurement of frugal innovation. The list of questions and summary of extracted quotes from our discussion with academic experts and practitioners are available in the supplementary material (see Table 6).

ILLUSTRATION OF THE FRUGAL INNOVATION RESEARCH DOMAIN AND KEY RESULTS

Illustration and synthesis of a research domain help researchers visualize underlying intellectual structures and further research opportunities. Our operationalization of the systematic literature review approach forms a low-dimensional illustration of the original high-dimensional space. As such, it allows

for further synthesis and advancement of the research domain (Snyder, 2019). Following the guidelines presented in López-Duarte et al. (2016), the first step in ascertaining a graphical depiction of the intellectual structure of frugal innovation is the labeling of the poles. The labeling process relies on the most extremely located descriptors and their frequency in each pole. Table 3 shows the labels and representative descriptors explaining the poles.

INSERT TABLE 3 ABOUT HERE

Building upon HOMALS analysis results, our study reveals that the horizontal axis in Figure 2 represents the studies dealing with “institutional voids” and “low-cost production”. Institutional voids refer to “situations where institutional arrangements that support markets are absent, weak, or fail to accomplish the role expected of them” (Mair & Marti, 2009, p. 419). Institutional theory, as a theoretical approach, and volatility, uncertainty, complexity, and ambiguity (i.e., VUCA) context (Millar et al., 2018), as a major research theme, are descriptors that represent the institutional void’s pole in the field of frugal innovation. Essentially, this pole outlines that under VUCA circumstances (Molina-Maturano et al., 2020) or low institutional support (David-West et al., 2019; Soni & Krishnan, 2014), frugal innovation represents a leading light in combating global challenges and driving sustainable growth (Brem, 2017; Rosca et al., 2018). The other horizontal axis pole is low-cost production represented by Transaction Cost Economics and New Product Development descriptors (Brem et al., 2020), which is a characteristic feature of frugal innovation, owing to its innovators' and his (hers) access to resources (Niroumand et al., 2020; Ojha, 2014; Zeschky et al., 2014).

INSERT FIGURE 2 ABOUT HERE

The vertical axis poles are labeled as “disruptive innovation” and “knowledge transfer”. Disruptive innovation refers to innovations that disrupt existing markets by creating value networks and new

markets (Christensen, 1997). The descriptors explaining disruptive innovation are innovation theory, ease of use, and performance (Cai et al., 2019; Rao, 2013; Winterhalter et al., 2017). Knowledge transfer can be considered "the process through which one unit (e.g., group, department, or division) is affected by the experience of another" (Argote & Ingram, 2000, p.151). Given the relevance and interconnectedness of the knowledge-based view and network theory (Altmann & Engberg, 2016), these descriptors are the main representatives of this pole.

Next, we present the evolution and shifts in the frugal innovation research field in Figure 3. The dynamic perspective reveals two main movements caused by the COVID-19 pandemic. Firstly, the VUCA descriptor was initially positioned closer to institutional voids, and disruptive innovation moved towards the opposite pole and outlined the importance of low-cost production and knowledge transfer. Accordingly, the researchers outlined the relevance of the frugal approach and knowledge transfer in combating the COVID-19 pandemic (Sarkar, 2021; Vescei et al., 2021). In line with this shift, the researchers acknowledged the relevance of knowledge transfer and networks in combating the pandemic across different industrial sectors, which caused the shift of Services and Manufacturing descriptors from low-cost production pole toward the knowledge transfer pole (Fischer et al., 2020; Corsini et al., 2021).

INSERT FIGURE 3 ABOUT HERE

While the recent years indicated rapid growth in academic contribution to the frugal innovation field, the vast majority of research themes remained closer to the center of the map, indicating scholars' continuing interest in themes such as strategy, performance, and new product development, among others. Considering the effects of the COVID-19 pandemic, the analysis of changes through periods provides a foundation for future research streams. These are presented in the following section, along with a detailed explanation of each descriptor.

OVERVIEW OF THEORETICAL UNDERPINNINGS AND AGENDA FOR FUTURE RESEARCH

This section discusses the theoretical foundations and major research themes used in the frugal innovation research domain. Additionally, Figure 4 shows the most used descriptors and their frequencies. In line with the results of the MCA analysis and the identified research gaps, we integrate streams of research through theoretical underpinnings and interaction with experts in the field to set future research agendas regarding the major research themes, geographical scope, industrial sector, and methodological approaches. Finally, we propose adopting other theoretical foundations that may serve as a platform/lens for future studies to use.

INSERT FIGURE 4 ABOUT HERE

Theoretical Foundations

Innovation Theory

Disruptive and open innovation approaches are the two major innovative underpinnings used in the frugal innovation literature. Disruptive innovation theory is used when examining aspects of frugality, such as price and simplicity (Hossain, 2018). Drawing on aspects of lower-cost and sustainable, frugal innovations, Rao (2013) highlights the disruptive potential of these innovations. Open innovation theory improves our understanding of frugal innovation by exploring the exchange of knowledge and ideas between emerging and developed countries. Dandonoli (2013) used open innovation to explain the collaboration between companies in developed and developing countries, concluding that this collaboration leads to a more sustainable environment. Gupta et al. (2016) studied the relationships within the Honey Bee Network in India to highlight the limitations of open innovation theory for frugal innovations in emerging markets. They argued that there is a knowledge and power asymmetry in

emerging countries and a deficiency of mutuality that reduces the number of opportunities through which innovators might seek ideas outside their organization.

Institutional Theory

Institutional theory has been used to understand the institutional contexts that shape the development of frugal innovation. For example, scholars have discussed the role of weak innovation infrastructures in shaping frugal innovation (Chatterjee & Sahasranamam, 2018; Nair et al., 2015) both as a constraint and a source of opportunity. As a constraint, weak innovation infrastructures involve unprotected intellectual property and a lack of support, hindering frugal innovation development (Gupta et al., 2016; Nair et al., 2015). However, weak institutional environments can also become sources of opportunity through which frugal innovators can develop new business opportunities and business models (Zeschky et al., 2014; Ananthram & Chan, 2019).

Resource-Based View and Knowledge-Based View

The resource-based view (RBV) and its extensions - capability-based view and knowledge-based view (KBV) - have been used to reveal how frugal innovators use their resources and capabilities in resource-constrained environments when developing their innovations, how they cope with resource constraints, and the role of environment on frugal innovation outcomes. For example, Cai et al. (2019) studied how emerging market firms deal with institutional, technological, and market constraints to develop frugal innovation. They highlight the importance of institutional leverage and bricolage in overcoming the constraints, leading to more affordable new products. In the context of low-income markets, to reduce their resource dependence, firms adopted approaches such as integrating with the local actor to co-create products and develop collaborations with non-traditional stakeholders (Schuster & Holtbrügge, 2014). Malik (2017) suggests that frugal innovation is a source for firms' unique and emerging operational market capabilities. Shibin et al. (2018) use RBV to develop a model of frugal innovation for supply chain sustainability in emerging markets. Lim, Han, and Ito (2013) use the Tata

Nano case study to discuss how frugal innovation capabilities help firms overcome internal and external resource deficiencies. Agarwal and colleagues (2020) demonstrate *jugaad* as a concept distinct from bricolage in the Indian context and identify key organizational practices that embody it, namely asset multiplication, leveraging human capital, building social embeddedness, and affordable quality. Shepherd et al. (2020) find that *jugaad* approaches do not offer a sustainable competitive advantage to firms; however, it impacts inclusive growth in terms of personal and others' well-being.

The KBV is used as a theoretical approach in frugal innovation literature to understand the role of knowledge as a resource and its utilization process (Dost et al., 2019). It has been used to examine both individual and firm-level learning aspects related to frugal innovation. Knowledge is a significant resource at an individual level, but there is often a shortage among low-income innovators. For instance, grassroots entrepreneurs often have low formal education and operate in communities with generally low education levels, restricting innovation development potential (Gupta et al., 2016; Pansera & Sarkar, 2016). At a firm level, Malik (2017) posits frugal innovation as an operational capability supporting the growth of emerging market multinationals in developed markets. Frugal innovation and the process of learning from other nations are also highlighted as approaches through which business can be conducted in the 21st century in emerging market contexts throughout Africa (Amankwah-Amoah et al., 2018). Shepherd et al. (2020) highlight iterative experiential learning as a feature of the *jugaad* process. Moreover, Chatterjee et al. (2021) noted that resource-constrained innovations are collaboratively driven by knowledge management especially in the context of Asian organizations.

Network Theory

Network theory discusses “mechanisms and processes that interact with network structures to yield certain outcomes for individuals and groups” (Borgatti & Halgin 2011, p. 1168). In a frugal innovation context, network theory embraces themes such as geography, education, and social class (Hossain, 2018). In Figure 2, network theory is located near the KBV, highlighting its use in conjunction with facilitating knowledge transfer, demonstrating high relevance during the COVID-19 pandemic.

Isaac et al. (2019) highlight the importance of embeddedness in internal and external networks to enhance knowledge transfer from subsidiaries in emerging markets to global markets. Western firms are encouraged to develop trust-based relationships with emerging market firms to develop frugal innovation (Altmann & Engberg, 2016). However, there are likely to be knowledge transfer difficulties in such relationships, which could be overcome through home-based R&D (Altmann & Engberg, 2016). Research has also emphasized the significance of network intermediates, such as the Honey Bee Network, which supports innovative ideas at a grassroots level (Gupta et al., 2016).

Transaction Cost Economics

The transactional cost economics (TCE) approach is another theoretical underpinning of the frugal innovation intellectual domain. Williamson (1979) promoted the idea of transaction costs by highlighting that organizations that can minimize the costs of their transactions will subsequently become more efficient. Howell et al. (2017) illustrated the influence of information technology (IT) in reducing transaction costs in business models for frugal innovation. Implementation of IT resulted in easier access to information, expansion of mobile phone utilization, and creation of easier payment methods with minimum transaction costs. The application of mobile phones brought opportunities for unbanked citizens by generating additional payment choices. Similarly, Altamirano and van Beers (2017) highlighted the role of frugal innovations, such as M-Pesa, in reducing transaction lengths and costs for farmers when ensuring market access and delivering public services. In the geographical context, economic, social, and environmental efficiency could be maximized by reducing costs of knowledge exchange between developing and developed countries.

Future Research Agenda Integrating Major Research Themes and Theoretical Foundations

Theme 1: Ease of Use

“Ease of use” is a term that explains how easy it is for consumers to use products. Frugal innovation is about producing affordable products that offer a seamless customer experience. Ease-of-

use becomes an important characteristic for frugal innovation to encourage its adoption among bottom-of-the-pyramid communities (David-West et al., 2019). Agrawal et al. (2018) studied healthcare innovation in India to point out the importance of affordable value innovations and ease of use functionality in frugal products. Pansera and Sarkar (2016) reflected how grassroots entrepreneurs operate with their available materials, assessing their impact on sustainable usage. Research has highlighted the relevance of frugal and sustainable innovations in developing products in cleantech (Kuo, 2016) and the water industry (Busch et al., 2018) that are user-friendly. Miesler et al. (2020) illustrate the value of easy-to-use point-of-care diagnostics such as lateral flow tests, smartphones, and handheld devices for the effective containment of infectious diseases.

Future Research Regarding Ease-of-Use

Firstly, firms are increasingly interested in frugal innovations in their approach to entering low-income markets, enhancing their need to become familiar with customers' needs in these markets. This has led to instances of collaboration between emerging and developed market firms. The use of case study-based research on such collaborations integrating research on frugal innovation and reverse knowledge transfer could help understand the adaption of developed market products to user needs in low-income markets. Secondly, emerging research discussed the role of universities in encouraging frugal innovation, advocating for its ease of use, and connecting them to markets (Fischer et al., 2020). Further research is needed to understand this in more depth, particularly the processes adopted by entrepreneurial universities in promoting frugal innovation. Finally, social networks and interactions influence the adoption and diffusion of innovations. There are opportunities to research frugal innovation in shared economy channels (products and services such as Airbnb and Uber). Research must be conducted regarding understanding how these features influence the adoption and usability of frugal innovations. In summary, future studies could address:

RQ1: How does collaboration between emerging and developed market firms affect the easier use of frugal innovation-based products?

RQ2: How can universities help consumers to understand frugal innovation better?

RQ3: How can social networks help to educate the user and encourage the adoption of frugal innovations?

Theme 2: New Product Development

This theme of research focuses on the unique characteristics of the frugal innovation development process. Annala, Sarin, and Green (2018) explored the water industry and argued that citizens have a crucial role as participants in the frugal innovation development process. Moreover, Maric et al., (2016) elaborated that frugal innovation holds great potential in combination with advanced manufacturing (i.e., 3D printing) as it allows (local) innovators to co-create and modify their products according to customers' needs. Rao (2019) explored how grassroots innovators implement science to produce new frugal products. Gupta and Thomke (2018) studied the product development process of medical devices in emerging countries. They concluded that the testing routine is different in emerging countries compared to developed ones regarding product development. Recently, Liu, Wang, and Feng (2019) presented a model for new product development stemming from frugal innovation recognized as the "multidimensional systematic innovation technique", where they highlight the need for firms to focus on their production and their relationships with suppliers if they want to meet customers' needs. Verma (2018) highlights challenges associated with developing new frugal medical products in emerging markets, such as quality assurance, supply chain challenges, and creating market demand.

Future Research Regarding New Product Development

Grassroots enterprises often face similar problems, and it is thus important for them to learn from others' experiences on new product development. Future research could use theories on memory systems and relational learning to better explore these considerations. While research on frugal innovation has looked into country-level institutional challenges, such as weak innovation infrastructures (Zhang & Mahadevia, 2014), limited attention has gone into micro-level institutional constraints in emerging market countries, emanating from class, caste, and gender aspects. Future research must look into micro-

level institutional constraints and explore their influence on the frugal innovation new product development process. In frugal innovation, end suppliers and customers have a prominent role in the product development process (Belkadi et al., 2018), which is more reliant on principles of open innovation. In responses to crises such as COVID-19, this approach has been beneficial in new product development (Sahasranamam & Soundararajan, 2021; Vesci et al., 2021). Future research on production network arrangements and their agility to dynamic environments for frugal new product development processes is needed. Therefore, future studies could ask:

RQ1: How can the characteristics of the micro-level institutional environment in emerging markets shape new frugal product development processes?

RQ2: How can relational learning help grassroots enterprises improve frugal innovation processes?

RQ3: How can suppliers and end-users influence the production network of frugal innovation?

RQ4: How can frugal new product innovators adapt in an agile manner to dynamic changes in the environment?

Theme 3: Performance

As shown in Figure 2, performance is located near the least developed countries, which suggests that it is often investigated within a low-income country context. Cai et al. (2019) acknowledged two kinds of frugal innovation - “cost innovation” and “affordable value innovation” - and concluded that both types of innovation positively affect performance. Hossain (2020) also studied performance in the context of grassroots innovators developing new products for commercial purposes. Weyrauch and Herstatt (2016) highlighted the importance of speed, power, and durability to satisfy customer requirements and increase performance. Albert (2019) showed how companies could improve their market performance by relying on available local resources. Echoing similar thoughts, Zeschky and colleagues (2011) proposed three features that companies should follow to succeed in a resource-

constrained environment: a simple and cheap manufacturing process, the use of available and local materials, and final products that are easy to use.

Future Research Trends Regarding Performance

A large body of literature addresses the performance implications of different types of innovation, such as radical, incremental, and process innovation (Valle & Vázquez-Bustelo, 2009), while the performance implications of frugal innovation remain veiled. This could partly be because of the lack of established scales and well-defined proxies for measuring frugal innovation, which offers potential for future research. An approach to measuring frugal innovation is through the lens of open innovation and its metrics regarding the depth and breadth of innovation (Laursen & Salter, 2006). In addition, research on the measurement of social impact could also provide useful metrics to measure frugal innovation (Maas & Liket, 2011).

In frugal innovation, performance is predominantly studied in terms of functionality (Rao, 2013), suggesting the relevance of commercialization. However, given that frugal innovation strives for cost-effectiveness and relies predominantly on locally available resources for development, its development may not be ideal for commercialization and sustained competitive advantage (Shepherd et al., 2020). Thus, one thread for future research on frugal innovation's performance could focus on identifying constraints to its commercialization and how it differs from an R&D lab's innovation commercialization. Another avenue for future research would be to undertake quantitative research focusing on inclusive growth-related performance outcomes of frugal innovations like well-being and social impact (Shepherd et al., 2020).

Shibin et al. (2018) highlighted the importance of sustainable supply chain management for frugal innovation when improving economic performance. Frugal innovators often choose local suppliers whom they can trust to deliver the product on time. Future research could extend this stream of research to understand better suppliers' roles in the performance of frugal innovations. Further research is required to understand the resourcing process of grassroots entrepreneurs better, how they navigate resource-

scarce environments, and the implication of these measures on firm performance. In summary, we suggest the following research questions:

RQ1: How can frugal innovation be measured?

RQ2: How can frugal innovation influence firm performance?

RQ3: How can a supplier network influence the commercialization and performance of frugal products?

RQ4: What resource bundles enable grassroots entrepreneurs to improve their performance?

RQ5: How can frugal innovators balance financial and inclusive growth outcomes in resource-constrained settings?

RQ6: What are the boundary conditions and approaches for the commercialization of frugal innovations?

Theme 4: Strategy

Extant research categorizes frugal innovators into three categories (Kumar & Puranam, 2012; Soni & Krishan, 2014; Hossain, 2017), and accordingly, their strategic approaches differ. The first type is “grassroots-level frugal innovators,” whose main motivation is to explain a problem with nearby accessible resources (Gupta, 2006). Soni and Krishnan (2014, p. 10) defined this category as: “*an individual or a group of people who attempt to solve a given problem adopting locally available ingenuity, and in doing so creates [sic.] a novel solution*”. Grassroots innovation usually comes from individuals or small communities (Pansera & Sarkar, 2016), and the vast majority of these innovations do not have proper support from formal institutions. Grassroots innovators usually have little formal education and develop products or services to meet local needs (Hossain, 2017). These innovators have a modest commercial focus when developing their innovations (Pansera & Sarkar, 2016).

The second type, called “domestic-corporate frugal innovators” (Soni & Krishnan, 2014), focuses on commercial success through frugal approaches rather than solving specific problems. Unlike the first category, where the innovators were mostly individuals or small communities, the main innovators here are local MNCs. In this case, the emerging market firms rely on networks and community support for

developing products (Hossain, 2017; Tiwari & Herstatt, 2013). For example, in India, Narayana Hrudyalaya developed a frugal service innovation for low-cost cardiac surgery.

The third type is "MNC-subsidary frugal innovators", which are large foreign MNCs that have developed R&D departments in the emerging markets. One example is General Electric's MAC 400: a portable ECG machine priced at USD 800 (Bhatti et al., 2017). This group's strategic approach is to use low-cost and good-quality talent in emerging markets to develop frugal innovation. Companies choose different strategies to develop frugal innovations based on motivation, type of industry, and resources.

Future Research Trends Regarding Strategy

Formal institutional contexts have undergone significant changes in emerging markets over the last two decades in the form of incremental pro-market reforms (Cuervo-Cazurra et al., 2019). Research on international business and strategy has examined the role of such institutional changes in emerging market firms and entrepreneurship (e.g., Sahasranamam & Nandakumar, 2020). However, limited research has focused on its effect on grassroots-level frugal innovators. Future research is required to fully understand the strategic responses of such innovators to formal institutional changes.

A common strategy employed by MNC-subsidary frugal innovators setting up R&D labs in emerging markets is using local workers to develop knowledge and technology infrastructures. More research needs to go into understanding the strategic practices of these MNC-subsidary in engaging with frugal local innovators and assimilating the knowledge. Another strategic approach of developed market multinational is a collaboration with local firms or NGOs when developing frugal innovations. Using a transaction cost perspective, future research could better understand how such collaborations function. In summary, future studies could aim to answer:

RQ1: How do formal institutional changes influence the strategy of grassroots-level frugal innovators?

RQ2: How can "MNCs-subsidary frugal innovators" use local capabilities to develop R&D departments in resource-constrained markets?

RQ3: How can western MNCs transform their frugal innovation strategies while working in partnership with local firms and NGOs?

Theme 5: Sustainability

Sustainability as a research theme has inspired researchers to investigate the connection between social, economic, ecological sustainability, and frugal innovation, often referring to United Nations Sustainable Development Goals. Building upon Gupta's notion that "frugality must blend affordability with circularity" (2006, p. 2), Levänen et al. (2016) conclude that frugal innovations in the water and energy sectors are more sustainable than the existing solutions. Numminen and Lund (2016) proposed a framework for describing energy frugality based on low-cost sustainable energy technologies. An example is fuel-efficient cook stoves, which offer fuel efficiency and health benefits and are ecologically sustainable as they are made of locally sourced materials. In essence, a research theme related to economic sustainability covers topics such as financial stability and economic value. Next, given the global pursuit of sustainability, frugal innovations are often seen in a relationship with lean engineering (Rosca and Bendul., 2016), as both paradigms portray ecological focus and lower resource usage (Brem and Ivens, 2013), enabling sustainable and better-quality value creation (Brem, 2017).

Future Research Regarding Sustainability

Within the Sustainability research theme, particular attention should be devoted to social aspects and topics such as social equity, education, working conditions, human rights, and many others. Until now, research on frugal innovation has not focused on social sustainability parameters in sufficient depth. For instance, MNC-subsidary frugal innovators, by localizing manufacturing plants and R&D departments, provide new jobs. However, more research needs to be undertaken to understand how training and social equity are enhanced by frugal innovation.

Soni and Krishnan (2014) see emerging countries as the "transaction arenas" where supply and demand are hard to find. Thus, there exists a prominent role for intermediaries such as incubators and

innovation support organizations like Honey Bee Network (Gupta, 2006) in connecting frugal innovator developers with their customers. Future research needs to look into the role of the sustainability practices of such intermediaries of frugal innovation. There is also immense scope for frugal innovations to contribute to the circular economy, net-zero agenda, and other grand challenges (Albert, 2019), which are important avenues for future research around frugal innovation and sustainability. There is also a need for research to understand the conditions that make frugal innovations sustainable. Therefore, future research could focus on:

RQ1: Under what circumstances is frugal innovation sustainable?

RQ2: What are the institutional conditions needed for supporting the creation and maintenance of frugal innovations for tackling grand challenges like poverty and climate change?

RQ3: How can collaboration between MNCs and local actors improve social sustainability?

RQ4: What category of funders are supporting the development of frugal innovations focused on sustainability?

RQ5: What are the sustainability practices of frugal innovation intermediaries?

Future Research Agenda regarding Geographical Scope

To synthesize the research field, geographical scope is illustrated in line with the United Nations and the International Monetary Fund categorization of economies: advanced economies, emerging economies, and least developed economies. Regarding frugal innovation in advanced economies, the USA and Germany have been the most frequently researched countries. There is limited research on services related to frugal innovation focused on advanced economy contexts. Similarly, a limited amount of research has focused on frugal innovations from least developed countries. Future research needs to focus on frugal innovations in less developed economies, drawing comparisons with frugal innovations from emerging economics to characterize similarities and differences. There is also a need for research focused on less developed countries to understand how frugal innovation practices support inclusive growth, economic development, and new business activities in these contexts. Overall, the most studied

country is India, and concepts and practices such as “jugaad” and “Gandhian innovations” have emerged from these studies.

Another area for future research is the cross-national adoption of frugal innovation. This would facilitate an understanding of how differences in institutional contexts between countries can influence frugal innovations. This could offer useful lessons when it comes to scaling up frugal innovations. For example, emerging market multinationals from India now have an increased presence and influence in developed and less developed economies. This enhances the potential for transferring frugal innovation practices from home to other countries. Future research is needed to enable us to understand this phenomenon better. Given the high costs associated with doing business in different contexts, particularly across countries, the research could focus on how frugal innovators manage such costs using theoretical lenses, such as TCE. In summary, future research should focus on questions like:

RQ1: How can less developed countries use frugal innovation to their advantage?

RQ2: How do institutional contexts influence the development of frugal innovation and set boundary conditions?

RQ3: How does the increasing presence of emerging market multinationals in developed and less developed countries influence frugal innovation practices in those contexts?

RQ4: What approaches are adopted by frugal innovators to manage the transaction costs of doing business in multiple contexts?

Future Research Agenda regarding Industrial Sector

Extant research has focused on service industry sectors, such as transportation (automobile industry, bicycle), energy (energy frugality, electricity, husk power systems, solar energy), water (water filters, water pumps), and healthcare (hospitals, patient care) sectors. However, there is a need for further studies in the manufacturing industry in terms of frugal innovation. Mourtzis et al. (2019) is an example of this fruitful avenue. Their study explores the implementation of frugal innovation in manufacturing networks and proposes the framework that explains how frugal innovation can be boosted in

manufacturing through ICT tools, offering significant potential for future research focusing on frugal innovations in the manufacturing industry. There is a necessity to know organizational learning around frugal innovation in manufacturing, the adaptation of manufacturing supply chains to the frugal innovation process, and managerial abilities to support frugal innovations. From Figure 2 and Figure 3, we also note that the initial manufacturing position close to the low-cost production axes shifted toward knowledge transfer, indicating scope for future research to explore its relevance in the context of hi-tech manufacturing. Within the service sector, the focus has so far predominantly been on resourcing for frugal innovation. At the same time, aspects related to scaling and impact (Steinfeld & Holt, 2019) needs more attention in future research. Researchers could also focus on the institutional systems supporting the development of frugal innovations in essential service sectors, such as energy and water, in different countries. In summary, the research questions are:

RQ1: How can the institutional contexts of emerging countries support frugal innovation in essential sectors, such as water and energy accessibility?

RQ2: What organizational learning approaches are needed for frugal innovation in the manufacturing sector?

RQ3: How can collaborations between manufacturing firms in emerging and developed countries support frugal innovations?

RQ4: What capabilities are needed to support frugal innovation in large manufacturing organizations and high technology manufacturing?

RQ5: How can the manufacturing supply chain be made more efficient through frugal innovation?

RQ6: What support structures are needed for scaling up frugal innovations in the services sector?

Future Research Agenda regarding Methodological Approach

Frugal innovation is a relatively new topic in academia and qualitative research, particularly the case study approach is the commonly used methodology (Gaur & Sahdev, 2015; Liu et al., 2019; Reinhardt, Gurtner, & Griffin, 2018; da Fonseca, 2016). While quantitative methods have been used

(Shibin et al., 2018; Isaac et al., 2019), the lack of established measurement approaches for frugal innovation is a major factor limiting the scope of quantitative studies (Rossetto & Borini, 2017). This, therefore, present a promising topic in future research. Scholars could focus on building longitudinal multi-year databases that track frugal innovation over the years. Future research may also draw on methodologies such as randomized control trials and quasi-experimental approaches to understand user adoption and consumer behavior elements when it comes to frugal innovation. Additionally, it would be valuable for researchers from different industries to transfer knowledge on frugal innovation among each other and to contribute to the creation of various measurement frameworks (Neely, 2005). Next, frugal innovation requires a multilevel study to understand the essence of the concept. Most of the publications studied the opportunities and challenges of individuals, but future studies should focus more on community, organization, and government levels of analysis. Finally, considering different levels of analysis – micro, meso, and macro will contribute to a better understanding of the connection between the east and the west, and differences in norms, networks, roles, and leadership skills.

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Future research agenda identified through Delphi study

Through the discussion with scholars and practitioners, we summarize additional areas for future research interest on the identified emerging trends in frugal innovation, the role of frugal innovation in combating the COVID-19 pandemic, and areas where they seek more research.

Based on these discussions, and in line with performed review, it is acknowledged that frugal innovations play a significant role during a crisis such as the COVID-19 pandemic in shaping the rapid development of products like ventilators, sanitizer dispensers, and oxygen dispensers. For example, frugal innovators in India develop leg-operated water taps, automated sanitizer dispensers, and walking sample collection kiosks to meet the needs of the pandemic such as breaking the contact chain and large-scale testing (Sahasranamam, 2020b). Similarly, maker spaces like Isinnova (in Italy) and Makers'

Asylum (in India) were able to use digital fabrication to develop do-it-yourself kits that helped to frugally create products needed in COVID-19 response (Corsini et al., 2021). Maker spaces and remote work requirements have also led to decentralization of manufacturing, leading to greater use of local resources and frugal practices making use of what is available in respective communities. Another effective frugal approach for the containment of infectious diseases is the use of point-of-care tests that are performed at the patients' bedside to reduce waiting times (Miesler et al., 2020). More research is needed to understand such emerging frugal practices in response to crisis events. This could also offer insights into the scope for frugal innovation in rapid prototyping and revival of the economy. COVID-19 pandemic has also reshaped specific sectors like transportation, logistics, healthcare, and e-commerce in fundamental ways. For instance, sharing economy, which was seen as a future of transportation and housing in urban areas pre-COVID, suddenly became an unlikely preference considering the social distancing norms. The revival of the many such sectors will need frugal innovation approaches to adapt and provide value. Frugal innovations are also likely to influence the lifestyle and work arrangements in a post-COVID world. All this offers immense scope for future research on the topic.

Currently, most research on frugal innovation is product-oriented; hence, more research on the use of frugality regarding process and business model innovations is warranted. This will help broaden our perspective on value creation (for users and other stakeholders) and value capture (who is benefitting from it, its value). A related stream of future research would be to understand the process by which frugal innovators develop their products. A gender perspective is also missing in the literature, making a case for further research on female frugal innovators. There is also needed to go beyond the heroic innovator focus on the literature to explore collective or group processes around frugal innovation. This could particularly benefit from considering an innovation ecosystem lens to understand the enabling conditions and collective processes that support the development of frugal innovations (Sahasranamam & Soundararajan, 2021). Emerging technologies like A.I., blockchain, and digital transformation of

businesses are opening newer avenues for frugal innovation, which needs further examination (Ahuja & Chan, 2019).

The majority of frugal innovation research is focused on its technology and innovation aspects, with limited context-specific theory development. This offers scope for international business researchers to compare the role of local contexts across countries for frugal innovations. For example, frugal innovation is quite different within emerging markets and developed countries (Hyypiä & Khan, 2018; Zeschky et al., 2011). Similarly, the nature of the education system in the country influences the engagement in frugal innovation, which needs deeper cross-country examination. For instance, an academic expert whom we interviewed mentioned, "*our collaboration with our industrial consortia has taught us that often the challenge lies in the engineering department. Swiss and German engineers are educated to be perfectionists, improvisation is not part of the curriculum. Solutions are then also in the education of engineering disciplines*". Scholars could also draw on sociology and economic geography literature to investigate how frugal innovations influence larger social transformation beyond the mere product/service delivery motives.

As discussed, the measurement of frugal innovation performance is a significant research gap on the topic. When discussing this with academics and practitioners, we obtained a mixed set of responses. Some academics and practitioners recommended incorporating aspects such as social impact, well-being, and sustainability in operationalizing frugal innovation performance. This complements the view of Shepherd et al. (2020), where they identify well-being as a key parameter of jugaad innovation outcome. At the same time, others recommended drawing from the literature on modularity (Mikkola & Gassman, 2003) and resource-constrained innovation (Agarwal et al., 2017) to develop contextualized measures of frugal innovation performance. Another viewpoint was to consider frugal innovation on an ex-post concept to define or describe a product or service, thereby not requiring to measure it.

IMPLICATIONS FOR PRACTICE

Our review is of value to practitioners to understand the challenges and opportunities associated with frugal innovation. Essentially, our review offers a synthesis of available knowledge base on frugal innovation and outlines foundations as well as empirical evidence related to new product development, strategy, and sustainability. For instance, it is important to recognize that frugal innovation is not about the cheapest products; rather, it needs to exhibit affordability, quality, ease-of-use, and sustainability. Through a Delphi study, which incorporates practitioners' opinions, we identify immense scope for frugal innovations in responding to crisis and in the post-COVID-19 revival of the economy. We also identified the importance of practitioners and policy makers to move beyond product aspects to engage in making a systems-level change to facilitate the scaling-up of frugal innovations. We characterize the key features of frugal innovations and managers could benefit from this to explore frugal innovation in more depth and identify its scope for adapting their practices and business models accordingly.

CONCLUSION

Frugal innovation produces satisfactory offerings under resource constraints, directly targeting user requirements based on three tenets: simplicity, affordability, and environmental sustainability. In this context, it was found that innovation theory, institutional theory, RBV and KBV, network theory, and TCE were widely used in prior studies. Future research could build on these and draw on international business theories, sociology, and strategy literature to understand frugal innovations. Researchers are encouraged to develop methods for measuring frugal innovation. These developments will help develop frugal innovation from a stand-alone concept into a more widespread concept at a system-level incorporating complex interaction with the surrounding environment, society, firms, and technologies (e.g., from frugal practices to frugal cities).

Despite the contributions, our review has some limitations. Essentially, although systematic literature reviews adhere to rigorous scientific methods, the data collection process does entail a certain level of publication bias (Kepes et al., 2012); as we focused on articles and reviews published in peer-

reviewed journals written in the English language, excluding other language publications. Moreover, while the employed methodological approach minimizes the subjectivity bias and offers a more objective account than bibliometric and structured reviews (Furrer et al., 2020), the development of a codebook does entail a certain level of author subjectivity. Next, as this review was focused on frugal innovation rather than the umbrella approach of combining frugal innovation with terms such as constrained-based innovation, grassroots innovation, and indigenous innovation in the data collection process, researchers interested in this domain can perform additional reviews based on their topics of interest. However, despite these limitations, the review provides an integrated map of the research domain and outlines the trajectory of the frugal research field, offering recommendations for future research streams which we hope will attract further attention among scholars and practitioners.

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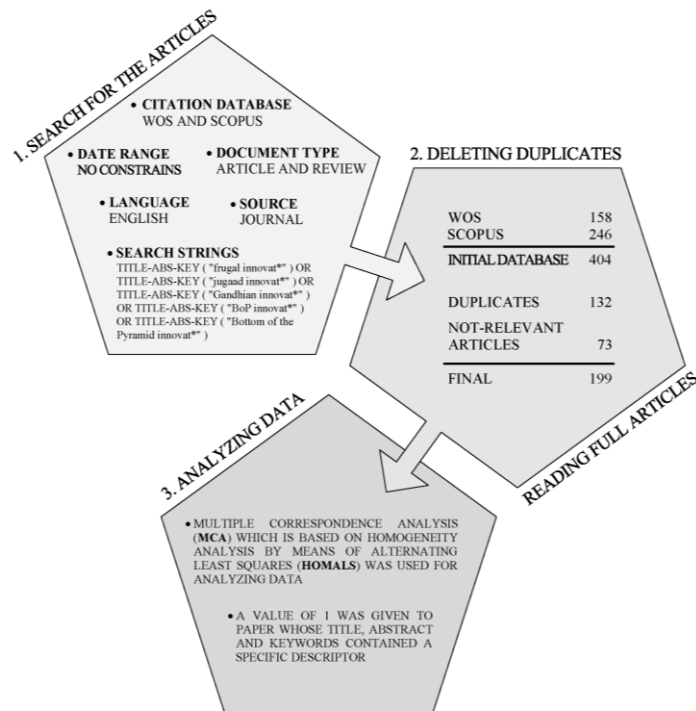


Figure 1: Methodology procedure

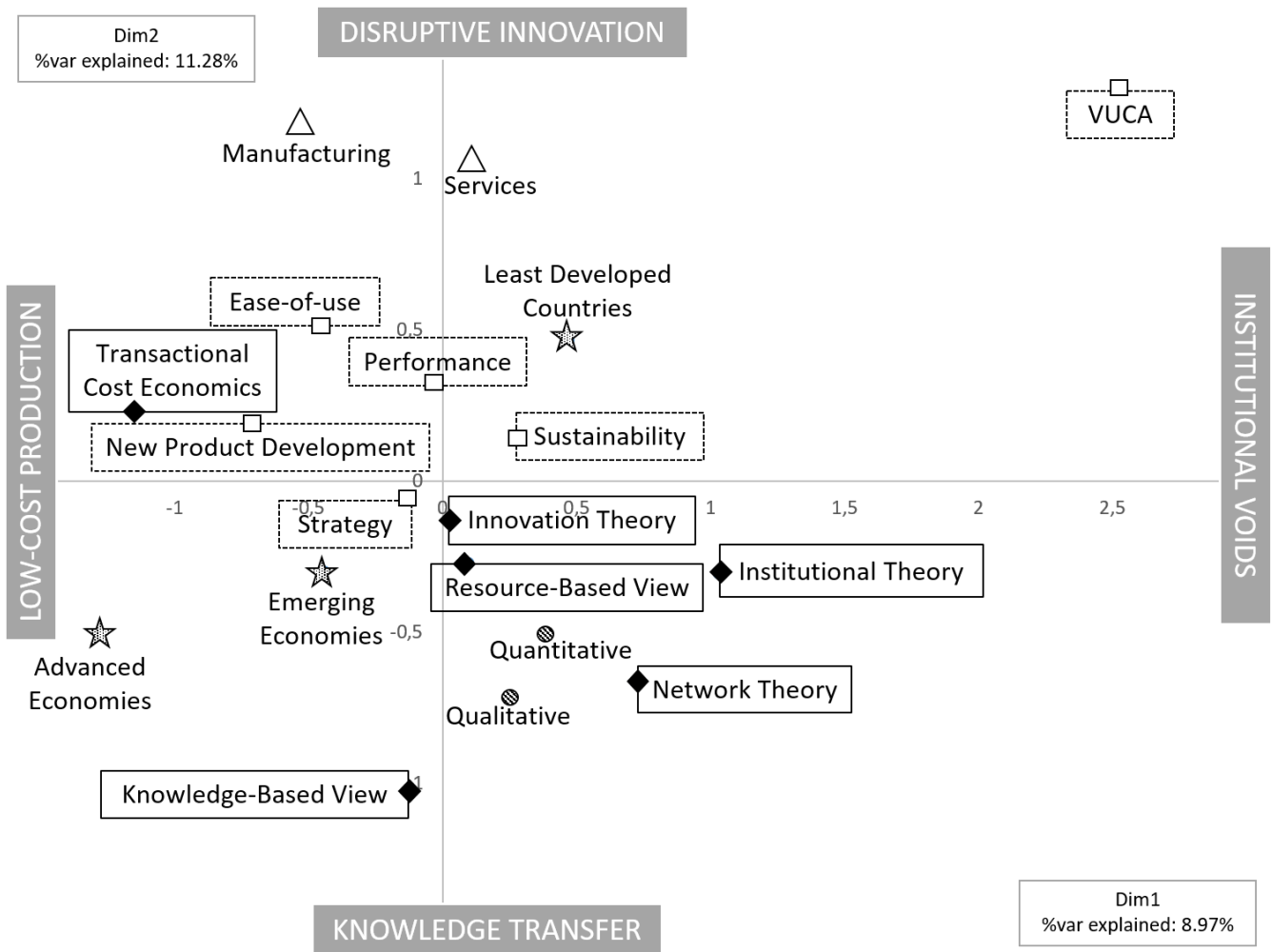


Figure 2: Graphical representation of Frugal Innovation research field

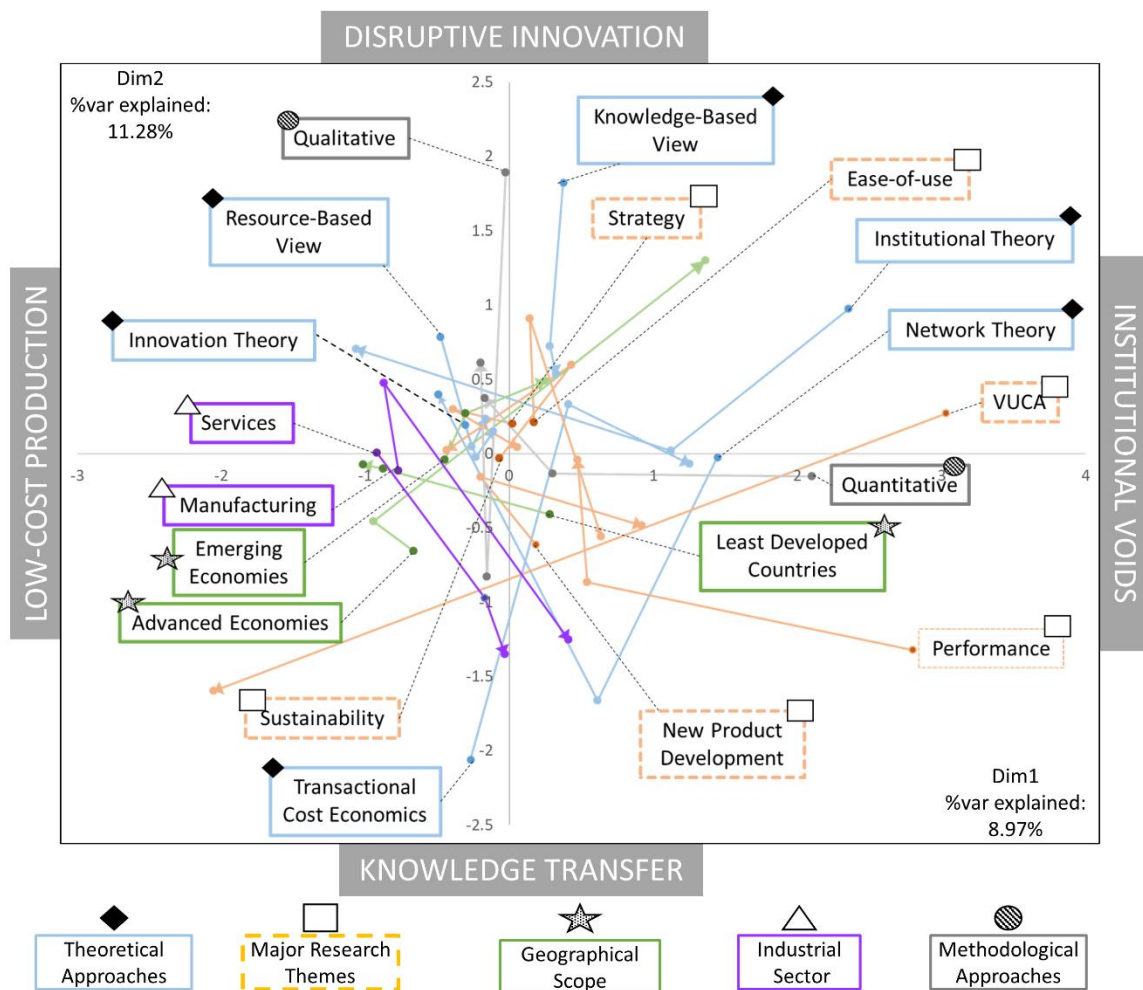
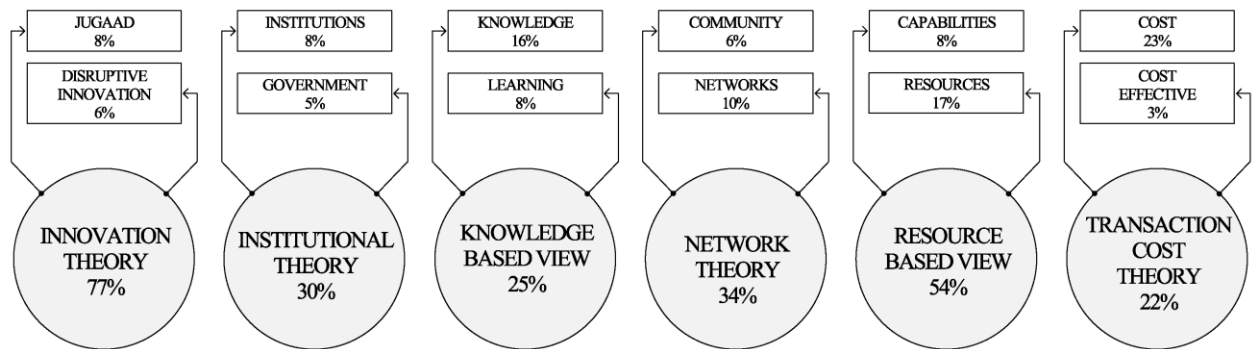


Figure 3: Graphical representation of Frugal Innovation field evolution over time
 Note: The start of the arrow indicates the descriptor position in P1, the bend of the arrow indicates the P2, and the point of the arrow indicates the P3. As the VUCA descriptor, emerges for the first time in 2014 the positioning is only available for subperiods P2 and P3.



THEORETICAL FOUNDATIONS

RESEARCH THEMES

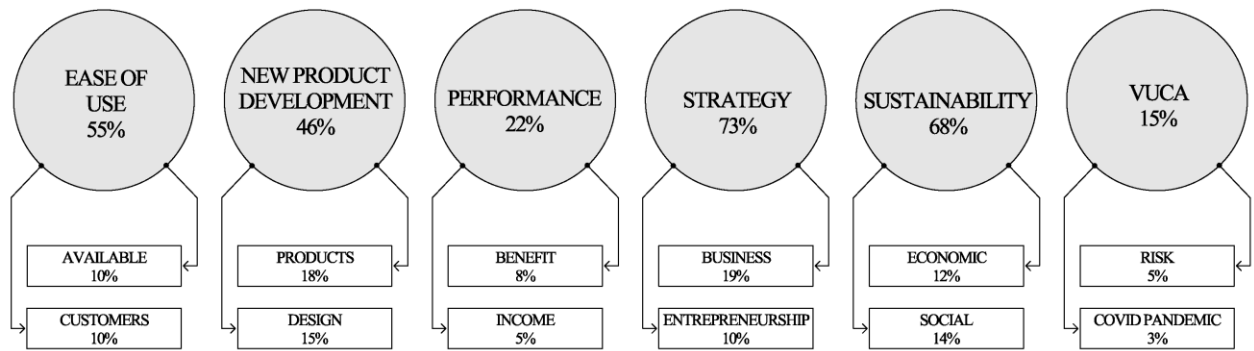


Figure 4: The most used descriptors and their frequencies.

Note: given that scholars grounded their research on more than one descriptor, the sum of the individual category, e.g., theoretical foundations, can be larger than 100%. For example, a paper that studied innovation theory used disruptive innovation and Jugaad as keywords.

Table 1: The evolution of Frugal innovation

Author	Term	Definition
Agarwal et al., 2016, p. 4	Catalytic innovation	<i>“Subset of disruptive innovations with high emphasis on social change, scalability and sustainability”</i>
Brem & Wolfram, 2014, p. 19	Gandhian innovation	<i>“An approach that takes advantage from the adaption of existing technologies by integrating them into local context or/and establishing local expertise by spillovers through collaborations in order to increase social wealth of people from the BoP”</i>
Govindarajan & Kopalle, 2006, p.12	Disruptive innovation	<i>“Powerful means for broadening and developing new markets and providing new functionality, which, in turn, disrupt existing market linkages.”</i>
Hossain et al. 2016; p. 133	Frugal innovation	<i>"a resource-scarce solution (i.e., product, service, process, or business model) that is designed and implemented despite financial, technological, material or other resource constraints, whereby the outcome is significantly cheaper than competitive offerings (if available) and is good enough to meet the basic needs of customers who would otherwise remain un(der)served"</i>
Prabhu & Jain, 2015, p. 847	Jugaad capability	<i>“the art of overcoming harsh constraints by improving an effective solution using limited resources”</i>
Radjou et al., 2012, p.4	Jugaad	<i>“a unique way of thinking and acting in response to challenges; it is the gutsy art of spotting opportunities in the most adverse circumstances and resourcefully improvising solutions using simple means”</i>
Sharma & Iyer, 2012, p. 600	Resource-constrained product development	<i>“the process of developing new products that use minimal resources and are affordable to a broader market”</i>
Von Zedtwitz et al., 2014, p. 3	Indigenous innovation	<i>“A process of making use of technologies transferred from the advanced economies to develop superior technologies at home”</i>

Table 2: Notable references for the development and construction of frugal innovation research field

Author	Title	Type of review (according to Paul & Rialp-Criado, 2020)	Methodology (according to Furrer et al., 2020)	Sample size	Time Span	Database	Source	Overview and findings
Brem, 2017	Frugal innovation- past, present, and future.	Structured review	Expert-based survey	n.a.	n.a.	n.a.	n.a.	Frugal innovations are leapfrogging on advanced technologies and developing resource-efficient and sustainable solutions. Hence, it is expected that frugal innovations enable sustainable growth of the business and nation.
Agarwal et al., 2017	A systematic literature review of constraint-based innovations: State of the art and future perspectives	Hybrid-narratives	Content analysis	117	2002 - 2015	EBSCOhost, Science Direct, Wiley Online Library, Google Scholar.	Journals, Book chapters, Conference Proceedings, Business magazines	Focusing on resource constraints, this study provides an overview of the innovation research field from scarcity and constraint-based perspective. This study reveals the dearth of research regarding user adoption and technological advancements of constraint-based innovations.

Author	Title	Type of review (according to Paul & Rialp-Criado, 2020)	Methodology (according to Furrer et al., 2020)	Sample	Time Spar	Database	Source	Overview and findings
Hossain, 2017	Mapping the frugal innovation phenomenon	Structured review	Content analysis	62	n.a.	Scopus, EBSCO, Google Scholar, Web of Science, SSRN	Journals, Book chapters, Working papers	The boundary of frugal is not well established, thus a clear concept is necessary. Moreover, a thematic analysis of the literature could be an appropriate approach to explore various themes that are present in the literature.
Hossain, 2018	Frugal innovation: A review and research agenda	Structured review	Content analysis	101	not available	ABI/INFORM Complete; EBSCO; Emeralds; IEEE Explore; InderSciences; Sage Premier; ScienceDirect; Scopus; Taylor & Francis; Web of Science; Wiley	Journals	Even though research on frugal innovation is still in an embryonic stage, the presence of numerous definitions hinders the understanding of the concept. As for practitioners, there is a necessity for substantial change in mindset, organization culture, and business environment to embrace a frugal innovation approach.

Author	Title	Type of review (according to Paul & Rialp-Criado, 2020)	Methodology (according to Furrer et al., 2020)	Sample size	Time Span	Database	Source	Overview and findings
Pisoni et al., 2018	Frugal approach to innovation: State of the art and future perspectives	Structured review	Qualitative – Expert-based survey	113	2005-2017	Scopus, Google Scholar, EBSCOhost	Articles published in peer-reviewed journals	Building on insights from qualitative systematic literature review and experts survey, the authors depict main FI research topics, such as origins and definitions, ecosystem, innovation process, implementation, and diffusion.
D'Angelo & Magnusson, 2020	A Bibliometric Map of Intellectual Communities in Frugal Innovation Literature	Bibliometric review	Citation study	58	Until October 2018	SSCI - Web of Science Core Collection	Articles published in the best peer-reviewed journals in social science	In light of growing interest in the frugal innovation research field, this review outlines the most active and influential communities, the most seminal works, and the most active scholars. Building on insights from 58 articles the authors present four main clusters such as strategic challenges, inclusive development, sustainability, and industrial application.

Author	Title	Type of review (according to Paul & Rialp-Criado, 2020)	Methodology (according to Furrer et al., 2020)	Sample size	Time Span	Database	Source	Overview and findings
Mortazavi et al., 2021	Mapping inclusive innovation: A bibliometric study and literature review	Bibliometric review	Citation study	293	2001-2019	Web of Science	Journals	Building on insights from relevant journal articles on inclusive innovation. The authors outline five inclusive innovation-related dimensions: innovation as a tool for affordability, innovation as a tool for inclusion, building of capabilities and innovation, innovation constraints associated with social empowerment, and innovation as an inclusive system.

Abbreviations: n.a. = information not available

Note: Considering Bradford's (1934) and Garfield's (1990) suggestions that papers published in the top journals of a field are more likely to push the boundaries of the research field, in this manuscript, we primarily use papers published in top journals. Other articles are acknowledged throughout the manuscript but, due to word limits, are not presented in Table 1 within the reviewed manuscript.

Table 3: Descriptors representing the poles of the axes

Poles	Labels	Descriptors	Exemplar References
Axis X Upper	Institutional voids	Institutional theory, VUCA, Sustainability	Brem, 2017; David-West et al., 2019; Molina-Maturano et al., 2020; Soni & Krishnan, 2014;
Axis X Lower	Low-cost production	New Product Development, Transactional Cost Economics	Brem et al., 2020;.Niroumand et al. 2020; Ojha, 2014; Zeschky et al., 2014,
Axis Y Upper	Disruptive innovation	Ease of use, Performance, Innovation Theory	Busch et al., 2018; Cai et al., 2019; Rao, 2013;
Axis Y Lower	Knowledge transfer	Knowledge-Based View, Network Theory	Argote & Ingram, 2000; Altmann & Engberg, 2016; Isaac et al., 2019

Table 4: Overview of future research avenues positioned at the intersection of theoretical foundations and research trends

		Research Trends					Geographical scope	Industrial sector
		<i>Ease of Use</i>	<i>New Product Development</i>	<i>Performance</i>	<i>Strategy</i>	<i>Sustainability</i>		
Theoretical foundations	<i>Innovation Theory</i>	How does collaboration between emerging and developed market firms affect the easier use of frugal innovation-based products?		How can frugal innovation be measured?		Under what circumstances is frugal innovation sustainable?	How can less developed countries use frugal innovation to their advantage?	
	<i>Institutional Theory</i>		How can the characteristics of the micro-level institutional environment in emerging markets shape new frugal product development processes?		How do formal institutional changes influence the strategy of grassroots-level frugal innovators?	What are the institutional conditions needed for supporting the creation and maintenance of frugal innovations for tackling grand challenges like poverty and climate change?	How do institutional contexts influence the development of frugal innovation and set boundary conditions?	How can the institutional contexts of emerging countries support frugal innovation in essential sectors, such as water and energy accessibility?

	Research Trends					Geographical scope	Industrial sector
	<i>Ease of Use</i>	<i>New Product Development</i>	<i>Performance</i>	<i>Strategy</i>	<i>Sustainability</i>		
<i>Knowledge-Based View</i>	How can universities help consumers to understand frugal innovation better?	How can relational learning help grassroots enterprises improve frugal innovation processes?	How can frugal innovation influence firm performance?			How does the increasing presence of emerging market multinationals in developed and less developed countries influence frugal innovation practices in those contexts?	What organizational learning approaches are needed for frugal innovation in the manufacturing sector?
<i>Network Theory</i>	How can social networks help to educate the user and encourage the adoption of frugal innovations?	How can suppliers and end-users influence the production network of frugal innovation?	How can a supplier network influence the commercialization and performance of frugal products??		How can collaboration between MNCs and local actors improve social sustainability?		How can collaborations between manufacturing firms in emerging and developed countries support frugal innovations?
<i>Resource-Based View</i>		How can frugal new product innovators adapt in an agile manner to dynamic changes in the environment?	<p>What resource bundles enable grassroots entrepreneurs to improve their performance?</p> <p>How can frugal innovators balance financial and inclusive growth outcomes in resource-</p>	How can “MNCs- subsidiary frugal innovators” use local capabilities to develop R&D departments in resource-constrained markets?	What category of funders are supporting the development of frugal innovations focused on sustainability?		<p>What capabilities are needed to support frugal innovation in large manufacturing organizations and high technology manufacturing?</p> <p>How can the manufacturing supply chain be made more efficient through frugal innovation?</p>

		Research Trends				Geographical scope	Industrial sector
		<i>Ease of Use</i>	<i>New Product Development</i>	<i>Performance</i>	<i>Strategy</i>		
				constrained settings?			What support structures are needed for scaling up frugal innovations in the services sector?
<i>Transaction-Cost Economics</i>				What are the boundary conditions and approaches for the commercialization of frugal innovations?	How can western MNCs transform their frugal innovation strategies while working in partnership with local firms and NGOs?	What are the sustainability practices of frugal innovation intermediaries?	What approaches are adopted by frugal innovators to manage the transaction costs of doing business in multiple contexts?

