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Manifestations and Measures of Frugal Innovations

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Abstract

In the opinion of many researchers, frugal innovations are often connected with sustainable development. This statement is proved by literature analysis, where frugality and frugal innovations are presented as a determinant of sustainable development. However, in most of the cases the lack of empirical evidence of this situation can be noticed. The article includes a review of the literature describing frugal innovation. In the article, the definitions of frugal innovations are compared with some empirical propositions for frugality measuring in the companies. The aim of the paper is to describe the issue of frugal innovation, its definitions, manifestations and ways of measuring. The reason of conducting the study is a desire of verification how deep is the issue analysed in the literature. In order to achieve the aim of the paper, the following objectives have been set: (1) to discuss current definitions of frugal innovations; (2) to present the ways how frugal innovations can be manifested; (3) to describe current propositions of frugal innovation measures and to discuss if can they be used to measure frugal innovation efficiency in the companies. The analysis is based on literature review. First of all, there is presented the method of the study and detailed description of the research sampling process. Presentation of frugal innovation definitions is the second step of the study. The next step is to show the most common manifestations

of frugal innovations. Considerations about these two elements are the causes of identifying the measures, which helps to assess the efficiency of frugal innovations. The study confirms that there is still a huge demand for deeper investigation of the issue, because the current literature does not provide the comprehensive understanding of it.

Paper type: systematic literature review.

Keywords: frugal innovation, manifestations, measures.

1. Introduction

The idea of innovations and their different forms is broadly described and analysed in the academic literature. It is a very extended concept and there can be identified a lot of approaches to this topic. However, analysing the idea of innovations and its various types, there can be identified a gap within this field related to frugal innovations. The issue is rather new and interesting for numerous ranks of researchers. Therefore, the number of publications about the frugal innovation concept in last decade has been systematically growing. Frugal innovation as a concept is emerging, because the awareness of people about resources limitations and their scarcity is increasing. Companies try to solve this problem. However, they have to meet the needs of customers at the same time. Frugal innovations seem to be a corporate's answer to this situation. In the opinion of some researchers, frugal innovations are to be cheap, easy to use, tough and developed with a minimum amount of materials (Rao, 2013). Frugal innovations are driven by demand and low-cost competition, mainly in developing countries, where the markets are emerging and the companies are looking for new solutions, facing with the problem of resources' limitation at the same time. The solutions can be used in many sectors, such as water, energy, health-care, communications and transportation (Levänen, Hossain, Lytinen, Hyvärinen, Numminen and Halme, 2016). The cost advantage, which can be achieved in comparison with conventional innovations thanks to frugal solutions, is a reason why companies use frugal innovations more willingly and more often. Moreover, some of tested innovations in emerging markets are transferred to developed countries. These actions seem to be rational in times of global crisis to create long-term competitiveness of companies (Rossetto, Borini, Bernardes and Frankwick, 2017).

The understanding of frugal innovations is wide. In result, there can be found many definitions and approaches how frugal innovations can be manifested, classified and characterised. For example, Lis and Sudolska (2018) highlight the role of frugal innovations in corporate social responsibility of contemporary companies. Many of current researchers link the issue of sustainable development and frugal innovations (Ahuja and Chan, 2014; Arshad, Radić and Radić, 2018). That is also the perspective, which is undertaken by the authors of this article.

Recently, it has been observed a growing interest of academia in studying the frugal innovations idea. Frugal innovation is still a concept, which encourages deep studies including both conceptual and empirical approaches. Nevertheless, there can be identified a gap in developing a theoretical approach to frugal innovations. It means a research niche to be filled. Thus, creating a kind of theory summary of this topic should be considered as a valuable contribution. Authors believe that their work will be also very useful in developing this concept. The research exemplifies the most important factors creating the idea of frugal innovations and tries to form a kind of a theoretical guide of the topic, contributing to its evolution.

The aim of the paper is to describe the issue of frugal innovation, its definitions, manifestations and ways of measuring. The reason for conducting the study is a desire of verification how deep is the issue analysed in the literature. In order to achieve the aim of the paper, the following objectives have been set: (1) to discuss current definitions of frugal innovations; (2) to present the ways how frugal innovations can be manifested; (3) to describe current propositions of frugal innovation measures and to discuss if can they be used to measure frugal innovation efficiency in companies.

The structure of the article is as follows. This introduction precedes the methodological section, where the applied methodology of systematic literature review and the research sampling process are explained. The next parts of the article contain description of frugal innovations from three perspectives. First of all, some definitions of frugal innovations are presented. As a result of literature analysis, the authors develop and describe their own definition of frugal innovations. Secondly, the article includes the description of frugal innovations manifestations. Thirdly, selected measures of frugal innovations are discussed. This part of the article includes a description of frugal innovations measures

proposed by Levänen et al. (2016), and Rossetto et al. (2017), among others. In this part the lack of effective measures of frugal innovation in the literature and a need of more advanced researches conducting are underlined. The last part of the article is a conclusion section, which summarises all the most important and significant information described in the article.

2. Method of study

To meet the purposes of the study, the systematic literature review methodology (Czakov, 2011) was applied. It can be observed an increased interest of this methodology among researchers, also including authors publishing their works in *Journal of Corporate Responsibility and Leadership* (Czerniachowicz, Lis and Wieczorek-Szymańska, 2017; Józefowicz, 2017). In order to design and structure the paper, it was used benchmarking of papers employing the systematic literature review methodology (Lis, 2017; Lis, Józefowicz, Tomanek and Gulak-Lipka, 2017; Sudolska and Lis, 2018). The research sampling process was divided into 4 steps and is exemplified in Table 1.

Table 1. Research sampling process

Stage	N
Records identified in Scopus database through topic search, subject to abstract analysis	202
Records identified in Scopus database through title search, subject to abstract analysis	91
Records identified through abstract analysis, subject to full-text analysis	12
Records identified through abstract analysis increased by snowball sampling, subject to full-text analysis	34

Source: own study based on Scopus database.

In order to study the issue of frugal innovations, the publications, indexed in the Scopus database, dealing with this subject were identified. As it can be seen in Table 1, the research sampling process was carried out in 4 steps:

- (1) the phrase ‘frugal innovation’ was searched in article titles, abstracts and keywords. It was found 202 publications;

- (2) the search was limited to the article titles. The sample was reduced to 91 items;
- (3) through abstract analysis, the number of publications subject to full-text analysis was reduced to 12 items;
- (4) the number of publications included in the sample (and subject to full-text analysis) was increased with snowball sampling up to 34 items.

The publications identified in the research sampling process were analysed and used in order to achieve the objectives of the study and to discuss the issue of frugal innovations.

3. Defining frugal innovations

This section is developed for achieving the first research goal, which is to discuss current definitions of frugal innovations. Growing interest in sustainable development, increased consumerism and fast growth of emerging markets with big numbers of low-income consumers push managers to change their approaches to managing innovations (Soni and Krishnan, 2014). Khan (2016) indicates frugal innovations as a future of management of innovation processes. The idea of frugal innovation goes a little bit beyond a nature of innovation. It relies on creating new concepts, but reducing costs through minimizing the use of resources. It is aimed at creating social and business values mostly in emerging markets. According to Soni and Krishnan (2014), the term ‘frugal innovation’ can be considered as relatively fresh in usage within academic and business environments. According to Simula, Hossain, and Halme (2015), the frugal innovation concept appeared very recently. Nevertheless, the idea of frugal is not new. The word ‘frugal’ comes from the mid-16th century Latin word – *frugalis*. Oxford Dictionary claims that frugal means savings in terms of money or food. Frugality was a very significant and inseparable condition of the ancient world (when it was a deficit in economic resources). Nowadays, it can be identified a very similar situation (mostly in emerging economies, at which frugal innovations are mostly aimed) and frugality is not less important. Thus, as it was already mentioned the phenomenon of frugal is not new. Good examples of frugal innovations from the past are the assembly line of Henry Ford or Japanese lean processes (Soni and Krishnan, 2014). At this point it might be interesting to look at different definitions of frugal

innovations. As studies on frugal innovations are in a relatively early stage, new definitions of this concept are still appearing (Hossain, Simula and Halme, 2016). The idea of frugal innovations is very broad. Thus, a lot of definitions and approaches to this topic can be found in the literature. Some of them are presented in Table 2.

Table 2. Definitions of frugal innovation

Author(s)	Definition
Van Beers, C., Knorringa, P., Leliveld, A. (2012)	“Frugal innovation is a process of stripping existing products of unnecessary or luxury attributes to bring it within reach of less affluent consumers. If the consumption of such goods could improve the wellbeing of poorer consumers, this would be an additional and important developmental impact of frugal innovations” (p. 67).
Bhatti, Y. (2012)	Frugal innovation is “innovation that redefines business models, reconfigures value chains and redesigns products to use resources in different ways to create more inclusive markets by serving users with affordability constraints, often in a scalable and sustainable manner” (as cited in: Ahuja, S., Chan, Y.E., 2014, p. 3).
Tiwari, R., Kalogerakis, K., Herstatt, C. (2014)	“Frugal innovations are new or significantly improved products (both goods and services), processes, or marketing and organisational methods that seek to minimise the use of material and financial resources in the complete value chain (development, manufacturing, distribution, consumption, and disposal) with the objective of significantly reducing the total cost of ownership and/or usage while fulfilling or even exceeding certain pre-defined criteria of acceptable quality standards” (p. 18).
Bound, K., Thornton, I. (2012)	“Frugal innovation responds to limitations in resources, whether financial, material or institutional, and turns these constraints into an advantage. Through minimizing the use of resources in development, production and delivery, or by leveraging them in new ways, frugal innovations result in dramatically lower-cost products and services” (p. 14).
Simula, H., Hossain, M., Halme, M. (2015)	An innovation that “meets the needs of customers with low purchasing power, typically located in low-income emerging markets, it is considered a frugal innovation” (p. 1568).

Author(s)	Definition
Hossain, M., Simula, H., Halme, M. (2016)	Frugal innovation is “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 final 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” (p. 133).
Tiwari, R., Herstatt, C. (2012)	Frugal innovations are services and products that “seek to minimise the use of material and financial resources in the complete value chain (from development to disposal) with the objective of reducing the cost of ownership while fulfilling or even exceeding certain pre-defined criteria of acceptable quality standards” (as cited in: Belkadi, F., Buergin, J., Gupta, R.K., Zhang, Y., Bernard, A., Lanza, G., Colledani, M., Urgo, M., 2016, p. 590).
Radjou, N., Prabhu, J. (2014b)	“It is an ability to do more with less by creating more business and social value while minimizing the use of resources such as energy, capital and time” (as cited in: Khan, 2016, p. 29).
Knorriga, P., Peša, I., Leliveld, A., Van Beers, C. (2016)	“Frugal innovation is a new innovation manifestation that aims to bring products, services and systems within the reach of billions of poor and emerging middle-class consumers at the Middle and Base of the Pyramid” (p. 143).
Hossain, M. (2017)	“Frugal innovations are cheap, robust in harsh environments, easy to use and repair, new uses of existing technologies, and made of used and local materials” (p. 200).

Source: own study based on cited references.

As it can be seen in Table 2, there can be identified numerous definitions of frugal innovations. Despite of being quite new, the term ‘frugal innovation’ has generated a lot of approaches and definitions to that issue. There can be identified both some similarities and differences among presented definitions. However, for the purposes of this paper, it would be valuable to summarise some common points arising from them. Thus, analysing definitions presented above, it can be concluded that frugal innovations are:

- new solutions for products, services, processes or business models;
- aimed at low income customers in emerging markets;
- aimed at improving local societies wellbeing;
- innovations, which minimise the use of resources (material, financial, technological);
- low cost innovations;
- innovations that despite of resources limitations, keep or even exceed the quality standards.

The idea of frugal innovation is a very broad term and has some common characteristics with other innovation concepts and it overlaps with them. These are, e.g. cost innovation, good-enough innovation, the base of the pyramid innovation, inclusive innovation, resource-constrained innovation, grassroots innovation, disruptive innovation, jugaad and reverse innovation (Radjou and Prabhu, 2015; Zeschky, Winterhalter and Gassmann, 2014; Soni and Krishnan, 2014; Hossain et al., 2016). These concepts vary from each other, but they have some common points, e.g. the idea of ‘frugality’ and low cost exists in each of them. Probably the most similar concept to frugal innovation is reverse innovation. These are some frugal innovations that are developed and moved from low-income (or emerging) markets to wealthier markets (Hossain et al., 2016). The aim of presenting above concepts is just to exemplify that some similar innovation ideas are found in management theory and business practice. However, these issues will not be discussed thoroughly in this paper, because it focuses on frugal innovations. Thus, in the following section it will be discussed some various manifestations and approaches to frugal innovations. The number of cited definitions of frugal innovations proves that the issue is common and up-to-date in the area of management studies. The definitions include characteristics which can be assumed as essential from the perspective of frugal innovations. The researchers agree that the elements which define frugal innovations are: orientation on new solutions for products, services, business models and processes; desire of improving local societies wellbeing; low cost generating; aiming on low income customers in emerging markets; minimizing the use of tangible and intangible resources; improving the quality standards thanks to new solutions. As it can be observed frugal innovations can be increasingly important from the perspective of

resources scarcity and their impact on research and development area can be crucial in the next few decades. That is why increasing interest in the issue should be expected from both researchers and companies which are oriented to searching new solutions.

4. Manifestations of frugal innovations

Frugal innovations are a relatively new area being under investigation of the academia. Generally, frugal innovations are related mostly to emerging economies and are developed with low costs, restricted resources and a kind of flexibility, what differs from innovation management in developed economies. Nevertheless, nowadays it can be perceived as vital both for emerging and developed economies (Ahuja and Chan, 2014). It is, because developed countries' governments expect from companies meeting social needs and not engaging unnecessary spending (OECD, 2005). It is a great opportunity for frugal innovations. Hossain (2017) claims that "frugal innovations generate better business and social value than traditional innovations" (Hossain, 2017, p. 200). The idea of frugal innovation has been already analysed from different points of view, exemplified in various contexts and compared with numerous other concepts in order to draw some new, interesting conclusions. Therefore, this section will present some selected manifestations of frugal innovations found in the literature.

Firstly, it might be interesting to look at frugal innovation conceptualization presented by Ahuja and Chan (2014). They refer to the definition of frugal innovation provided by Bhatti (2012), who defines frugal innovation as "innovation that redefines business models, reconfigures value chains and redesigns products to use resources in different ways to create more inclusive markets by serving users with affordability constraints, often in a scalable and sustainable manner" (as cited in: Ahuja and Chan, 2014, p. 3). According to this explanation, authors exemplify frugal innovations as a mixture of social, business and technology innovation, what is presented in Figure 1.

Ahuja and Chan (2014) exemplify frugal innovation as a combination of three other kinds of innovations: social, business and technology. Social innovation is a solution, which creates values

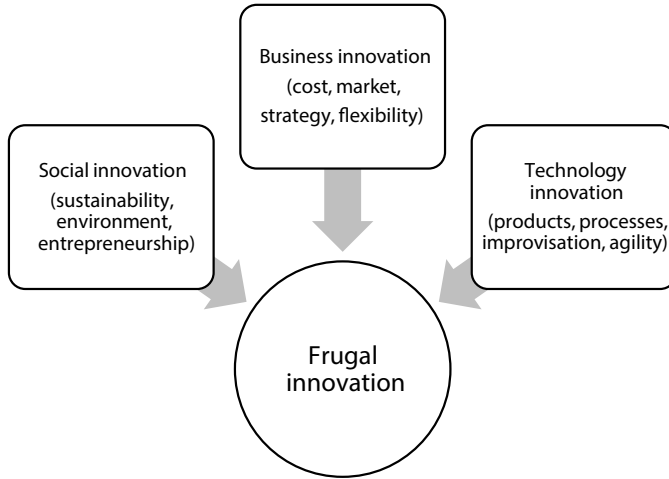


Figure 1. Frugal innovation conceptualisation

Source: Ahuja, S., Chan, Y.E. (2014), “The Enabling Role of IT in Frugal Innovation”, *Proceedings of the 35th International Conference on Information Systems: Building a Better World Through Information Systems*, Auckland, New Zealand, 14–17 December 2014.

for societies and solves some social problems and is in accordance with concepts of sustainability and entrepreneurship (The Center for Social Innovation at Stanford University, 2014). “Business innovation is related to redefining new business models and reinventing value chains” (Ahuja and Chan, 2014, p. 4). On the other hand, technology innovation is connected with strengthening goods and services by technology development (Ahuja and Chan, 2014). In this kind of innovation, it is also important to find an appropriate fit between market expectations and products’ technical features (Heeks, 2012). Moreover, Ahuja and Chan (2014) focus in their study mostly on the role of IT in enabling frugal innovations. They observe that former researches indicate that IT capabilities support frugal innovations significantly. Conducting their own study, they conclude that IT is very important in enabling frugal innovations and lowering costs and it can be also beneficial for firms in different areas.

Recently, it can be observed an increased interest, among scientific communities, in innovations’ influence on economic development and their role in meeting Sustainable Development Goals,

“which will frame the post 2015 agenda and policies of the United Nations member states over the next 15 years” (Pansera and Sarkar, 2016, p. 1). Some researchers claim that the ideas of frugality and sustainability are interrelated (Khan, 2016; Levänen et al., 2016). According to Rao (2013) “frugal innovations have a lot to offer for sustainable development” (Rao, 2013, p. 66). Levänen et al. (2016) indicate frugality as a characteristic of sustainability. Khan (2016), in his study, analyses eight frugal innovation cases in the context of social sustainability. He finds that almost each case of frugal innovation includes significant elements of social sustainability. Moreover, he observes that frugal innovations address such social sustainability topics like e.g.: human well-being, basic needs and quality of life, social justice, social inclusion, poverty reduction, learning capacity and many others (what is presented in Figure 2, which exemplifies connection between frugal innovation and social sustainability).

The researcher also notes that all cases being under study find some answers for important problems of societies. Khan (2016) pays attention also to the importance of innovators’ awareness of connection between social sustainability and frugal innovations. It can help strengthen the innovation market position and its impact from a larger perspective. In result, it can generate more benefits for companies through developing innovation. Moreover, social sustainability is crucial for sustainable development and “it is possible to realise social sustainability goals via the application of frugal innovation” (Khan, 2016, p. 21). Levänen et al. (2016) also observe that frugal innovations support sustainable development in many ways.

As it was already mentioned, frugal innovations can be beneficial both for companies and societies and can be considered as a significant element of social sustainability and as a result of sustainable development (Khan, 2016). However, it is a complicated process and requires to be conducted very carefully. It entails some important conditions and also problems. According to Altmann and Engberg (2016), “the transferability of knowledge played a key role in the development trajectory of each project” (Altmann and Engberg, 2016, p. 52). They also suggest that frugal innovations depend on portability of two very significant types of knowledge: technical knowledge and knowledge about relevant markets. On the other hand, Belkadi, Buergin, Gupta, Zhang, Bernard, Lanza, Colledani and Urgo (2016) indicate a few main directions for frugal

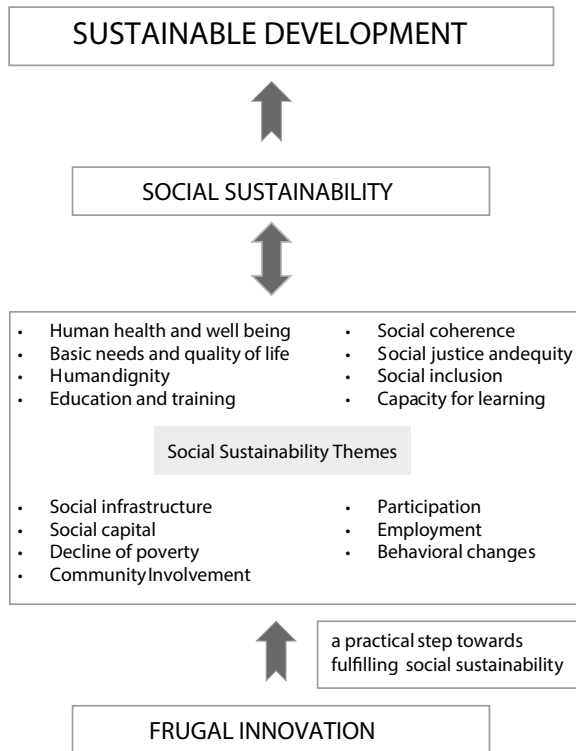


Figure 2. Connection between frugal innovation and social sustainability

Source: Khan, R. (2016), “How Frugal Innovation Promotes Social Sustainability”, *Sustainability*, Vol. 8, Issue 10, art. 1034, p. 20.

innovations to being developed for particular markets with optimal and desired costs and quality. These are (Belkadi et al., 2016, p. 590):

- (1) “Develop new products from scratch in local R&D centres;
- (2) Develop frugal products as an adaptation of existing solution for local markets, by:
 - Replacing current materials with cheaper but functional ones;
 - Removing non-essential product and service features from current products and services;
- (3) Re-design the production network by increasing the proportion of regional suppliers;

- (4) Modify current production processes and strategies to reduce manufacturing and logistic costs”.

These directions mentioned above raise also some problems and questions, which companies need to deal with realizing frugal innovations projects (Belkadi et al., 2016), e.g.:

“how to identify the right product modules, features or functions to be removed, modified or even renewed? How to integrate the customers into the modifications and/or development process? How to adapt the current production to the modified product features for the new regional markets? How to re-design the supplier network for this adaptation? How to reuse the knowledge of regional product development in the future?” (Belkadi et al., 2016, p. 590).

As it can be seen, managers have to deal with numerous matters while developing frugal innovations. An appropriate approach to issues mentioned above can give them some advantages and benefits. As it is presented in the section, the scope of ways how to manifest the frugal innovation solutions in the companies is very broad. Basically, they should support sustainable development. Doubtless, these solutions gain in importance and are necessary to develop both a company and the environment, where it conducts its business. However, it is connected also with some challenges and tasks which companies have to face with. The success of frugal innovations can be also measured by some factors, what is analysed in the following section.

5. Measures of frugal innovations

This section describes the common propositions of frugal innovation measures which are used by companies. The companies have to be frugal with all of the resources they use conducting a business. It means they have to create such methods of management, which can help them to save time – the most valuable resource from the perspective of business. Moreover, the managers should focus on effective using of human resources and CEOs have to simplify the organisational structures of their organisations. However, none of the strategy, business model or any other activity conducted in an

organisation can be assessed without designing a specific measure, which helps to specify the indicators responsible for effective implementation. As ‘traditional innovation’ is to be measured to decide if it meets expected effects, frugal innovations’ efficiency should be described by proper measures as well. However, frugal innovations differ from ‘traditional innovations’, and their inventors consider a term ‘innovation’ in other way. Goals and motivations of the companies creating frugal innovations are completely different and their inventions have to provide high-quality solutions and deliver a significant value to customers at relatively low cost (Radjou and Prabhu, 2014b). There are many cases where authors of research publications point out the problems with measuring frugal innovation’s efficiency. Although, some literature reviews present indicators for measuring frugal innovations, they seem to be insufficient (Arshad et al., 2018; Levänen et al., 2016; Khan, 2016).

Rossetto et al. (2017) claim that “despite the growing number of published articles on frugal innovation, there are still a lack of instruments that allow the measurement and quantification of this phenomenon in order to allow more precise and quantifiable studies to be carried out” (Rossetto et al., 2017, p. 1). Consequently, the number of academic publications which describe the methods and tools for frugal innovation measuring is rather poor. The authors of articles underline that there is still a gap in describing the measurement methods of frugal innovations and its impact on sustainable development of the organisations. The reason of this situation is the fact that “measuring and quantifying social sustainability has been quite challenging, as the indicators are less developed, because this concept is intangible and qualitative in nature and there is no widely accepted scientific basis for analysis” (Khan, 2016, p. 9). However, this argument does not discourage researchers and they try to identify and develop indicators, which describe sustainability of the companies.

Similarly, enterprises try to develop measurement tools, which can help them assess innovations and their outcomes. One of the examples is a French company Danone, which in cooperation with SAP (a German software provider), developed a tool called ‘Danprint’. This tool helps to track and evaluate the level of carbon emission (carbon footprint) of all subseries of the company to control life cycle of its products. Thanks to that the company can minimise its negative influence on air condition by cutting

the carbon footprint by 50% by 2020 and reduce CO₂ emissions, and increase its sales volume at the same time. Many companies such as Tarkett and Kingfisher make their products of renewable or recycled materials and use only a renewable source of energy as well (Radjou and Prabhu, 2014a). As it was said, frugal innovations can be treated as complements to sustainable development strategy. Most of the cited frugal innovations definitions present this phenomenon as a significant support of sustainable development. Frugal innovations may influence achieving Sustainable Development Goals (SDGs) in a substantial way. The quantity of studies highlighting the link between both issues seems to confirm this statement (Arshad et al., 2018). The definitions mentioned in previous sections give rise to treat frugal innovations and sustainable development as congenial issues. It means the indicators used to measure sustainable development should be sufficient to check efficiency of frugal innovations.

In the literature, there can be found the lists of indicators, which describe sustainable development of a company. Some of them are collected by Khan (2016):

“McElroy, Jorna and Engelen have proposed a social footprint method to quantitatively measure and report on the social sustainability of their operations. Another set of standards was proposed by Thomsen and King after evaluating the best business practices of sustainable businesses that could act as a starting point to assess social sustainability. These are workplace practices, work-life balance, retirement benefits, healthcare benefits, safe workspaces, stable housing, support services for children, support for employees in their non-work lives, training and support for the larger community. In recent years, impact investing has become quite popular among business leaders, government, social organisations and philanthropists who are interested in assessing social sustainability of businesses/projects in order to solve some of society’s most pressing issues” (Khan, 2016, p. 8).

The proposition by Levänen et al. (2016) can be helpful in identifying the crucial indicators of frugal innovations, which influence on meeting the Sustainable Development Goals. The authors refer to issues of frugal innovation and sustainable development, because in their opinion there is a gap in specifying the real relationships between those two issues. Their research and analysis is to give an answer whether frugal innovations have a significant influence on sustainable development.

The authors underline the role of nine most important indicators which determine sustainable development of a company and present them as the list of questions, which are divided into 3 separate sections. As they claim this approach should help to implement sustainable development tools. Moreover, the authors try to convince that proposed “indicators seem well-suited to assess the impacts of frugal innovations (in terms of water and energy sectors)”. A company has to answer these questions if it wants to analyse and measure the effects of implemented innovations (Levänen et al., 2016, pp. 2–3; 11). The full idea of the concept is presented in Table 3.

Table 3. Indicators for the analysis of sustainability of frugal innovations by Levänen, Hossain, Lyytinen, Hyvärinen, Numminen and Halme (2016)

Ecological sustainability indicators
1. Is the frugal innovation more energy efficient than the existing solutions?
2. Is the frugal innovation more material efficient, e.g., recyclable or reusable, than the existing solution?
3. Is the frugal innovation more climate neutral than the existing solution?
Social sustainability indicators
4. Does the frugal innovation help to fulfil basic necessities, such as water, food or shelter?
5. Does the frugal innovation enable better health or improve access to education?
6. Does the frugal innovation increase the inclusion of marginalised people in society and/or equality between its members?
Economic sustainability indicators
7. Does the use of the frugal innovation release the time resources of the users for other purposes?
8. Does the use of the frugal innovation increase the income of the user or save them money?
9. Does the frugal innovation create new jobs and/or new enterprises?

Source: Levänen, J., Hossain, M., Lyytinen, T., Hyvärinen, A., Numminen, S., Halme, M. (2016), “Implications of Frugal Innovations on Sustainable Development: Evaluating Water and Energy Innovations”, *Sustainability*, Vol. 8, Issue 1, art. 4, p. 3.

The model described by Levänen et al. (2016) shows three basic dimensions which determine sustainability of a company: ecological, social and economic. All of these areas include three questions, which is to indicate whether frugality has a direct influence on sustainability in

a company. For example, the ecological sustainability can be improved by saving and developing the efficiency of energy by frugal innovations; social sustainability can be developed by frugal innovation by enabling better health or raising the access to education, and economic sustainability can be achieved by creating new jobs and/or new enterprises by frugal innovations (Levänen et al., 2016).

As a result of the research, authors find empirical and conceptual connections between two issues: frugality and sustainability. Moreover, frugal innovations have a positive influence on all three mentioned dimensions: ecological, social and economic. Frugal innovations can for example save money in two ways: “(1) they offer less expensive electricity; and (2) they create income by employing local people and enabling new entrepreneurship” (Levänen et al., 2016, p. 11). Similarly, frugal innovations improve quality of water and air by minimizing the pollutions. However, the research shows that there are still some challenges for innovators of frugal solutions. These challenges are: “(1) the proper integration of material efficiency into product or service systems; (2) the patient promotion of inclusive employment; and (3) the promotion of inclusive and sustainable local industrialization” (Levänen et al., 2016, p. 11). Explaining the reason of this situation they indicate that “our analysis suggests that while there are similarities between frugality and sustainability, it is still problematic to straightforwardly equate the two at the conceptual level” (Levänen et al., 2016, p. 11). The final conclusion by the authors is:

“(...) it is not clear how to measure the sustainability of different frugal innovations (...). Whether conventional innovations and frugal innovations should be measured by the same parameters and scales is an important issue to consider. Third, it is unclear how the material efficiency of local solutions should be measured (...). Development funding often emphasises sustainable development, but the extent to which such funding contributes to sustainability is not always clear. Consequently, we need better tools to analyse the relations between frugal innovations and sustainable development” (Levänen et al., 2016, p. 11).

Rossetto et al. (2017) also point out the lack of a scale to measure frugal innovations in the literature. That is why, the authors prepare their own proposition how to measure frugal innovations. Moreover, they claim that precious measuring of the processes and other phenomena

is an essence of a science and without measuring it is impossible to make verifications and analysis of such issues. In their research it can be found some benefits that a company can obtain thanks to a described model, such as possibility to verify the level of frugality that a company has achieved. In result, an organisation can monitor and optimise resources' consumption. However, they point out that in the literature there are many publications, which refer to measuring sustainable consumption by consumers. This situation and lack of alternative ways for frugal innovation measuring is a basic motivation for them to build such a measure that the companies can use to monitor their frugality. Rossetto et al. (2017) specify three dimensions, which directly refer to frugal innovations. These three areas include: “(1) Concentration in the Core Functionalities and Performance; (2) Substantial Cost Reduction; (3) Creation a Frugal Ecosystem” (Rossetto et al., 2017, pp. 2–4). Their thoughts and analysis of the issues are briefly presented in Table 4.

Table 4. Definitions of the dimensions of frugal innovation by Rossetto, Borini, Bernardes and Franckwick (2017)

Dimension	Definition
Concentration on Core Functionalities and Performance	“This dimension brings together the items that seek to measure the attractiveness of the offered value proposition, seeking to associate the central functions of the offer with the performance, preferentially fulfilling or even exceeding the prescribed quality standards”.
Substantial Cost Reduction	“This dimension brings together the items that seek to measure the effort to reduce the use of material, financial and organizational resources in order to achieve a substantial reduction of use and / or property costs to transfer this economy to the final consumer”.
Create a Frugal Ecosystem	“This dimension brings together the items that seek to measure the company’s effort in its search for Sustainability, Sustainable development, the development of a relationship throughout the value chain in order to create a frugal ecosystem, that is, with a view to creating an Environment that promotes frugal innovation”.

Source: Rossetto, D.E., Borini, F.M., Bernardes, R.C., Frankwick, G.L. (2017), “A New Scale For Measuring Frugal Innovation: The First Stage of Development of a Measurement Tool”, *VI SINGEP – International Symposium on Project Management, Innovation, and Sustainability*, Vol. 6, p. 7.

Basing on the literature review, the authors defined a collection of items, which build the dimensions that they proposed. As a result, they verify 66 items in total: 26 items, which create dimension 1 (Concentration on Core Functionalities and Performance); 23 elements for dimension 2 (Substantial Cost Reduction) and 17 items, which define dimension 3 (Create a Frugal Ecosystem). The next step was to consult the items with experts. As the result, the list of items was reduced and only 30 were considered in the survey. Finally, after analysis of the companies, it was possible to define nine the most significant items (3 for every dimension), which are the most significant for measuring frugal innovations (Rossetto et al., 2017, pp. 8–12). The results are presented in Table 5.

Table 5. Scale for measuring frugal innovation by Rossetto, Borini, Bernardes and Franckwick (2017)

Concentration on Core Functionalities and Performance
1. The core functionality of the product/service rather than additional functionality.
2. Ease of use of the product/service.
3. The question of durability of the product/service (does not spoil easy).
Substantial Cost Reduction
4. Solutions that offer 'good and cheap' products/services
5. Significant cost reduction in the operational process.
6. The significant reduction of the final price of the product/service.
Create a Frugal Ecosystem
7. Environmental sustainability in the operational process.
8. Partnerships with local companies in the operational process.
9. Efficient and effective solutions to customers' social/environmental needs.

Source: Rossetto, D.E., Borini, F.M., Bernardes, R.C., Frankwick, G.L. (2017), "A New Scale For Measuring Frugal Innovation: The First Stage of Development of a Measurement Tool", *VI SINGEP – International Symposium on Project Management, Innovation, and Sustainability*, Vol. 6, p. 12.

As it can be seen, the dimension of Concentration on Core Functionalities and Performance can be achieved for example by evaluating how easy is the use of a product or service. Substantial Cost Reduction is noticed if a company has significant cost reduction in the operational process thanks to frugal innovations. Moreover, a company Creates

a Frugal Ecosystem if it establishes efficient and effective solutions to customers' social or environmental needs. The authors recommend this model both to identify and measure the level of frugality of the innovations in a particular company. Moreover, in comparison to the previous model, this approach can be used in any company, regardless of its size, industry or a type of a product it manufactures. As a summary, they suggest to companies to focus strongly on developing a Frugal Ecosystem, which influences frugal innovation processes, create relationships with partners, customers, suppliers and shareholders and develop a product or service. It can help to create an environment, which gives business development opportunities for a company and generates benefits for all its stakeholders (Rossetto et al., 2017).

Measuring efficiency is crucial from the perspective of evaluating the processes which are performed in companies. Some indicators presented in the section describe the areas which can be the elements of analysis if a company aims to develop in sustainable way. As it was proposed by Levänen et al. (2016) these areas concern ecological sustainability indicators, social sustainability indicators and economic sustainability indicators. However, the task for managers is to find the elements that can be improved in the company, to develop solutions, implement them and measure. However, measuring the efficiency of new solutions is not so obvious. Although, there can be found some propositions for measuring frugal innovations, it can be said that the issue is still a challenging task for academic researchers. It means, there can be recognised a huge requisition for studying the issue. This is the only way for creating better indicators, which can be used to measure the efficiency of frugal innovations in the companies (Khan, 2016). As it is underlined by Ahuja and Chan (2014):

“very few econometric measures for firm performance that appropriately and comprehensively capture frugal innovation are available. The literature on frugal innovation must be broader and deeper before relevant linkages to economic measures, financial performance, and productivity can be drawn more easily (...) A firm can simultaneously engage in social, technology, and business innovations and this is what makes frugal innovation very interesting as a phenomenon and very challenging as a research topic. It is only via thorough scientific and empirical investigation that we will be able to carve out a space for frugal innovation research and establish its boundaries” (Ahuja and Chan, 2014, p. 13).

Finding the effective tools which help to assess efficiency of frugal solutions is the basic element which has to be created and developed. It should help frugal innovations to be commonly used, because it contains the base for evaluating the need of frugal innovations solutions in companies.

6 Conclusions

The literature review presented in the article confirms that frugal innovation is a broad concept, which requires more thorough studies and researches. It confirms also that the relations between sustainability and frugality of a company are significantly strong. Frugal innovations can be manifested in many ways and in many areas. For example, social innovation can be manifested by sustainability; business innovation can be presented by lowering cost or improving flexibility; and technology innovation can be a source of improvements in processes in a company. However, the biggest challenge connected with frugal innovations is their measurement and development of such tools, which can, in a proper way, present the effectiveness and level of frugal innovations. Reducing cost and saving of materials can be insufficient in creating frugal innovations. They should also be valuable for customers and bring benefits for a company and its stakeholders. It can be achieved only if companies know how to evaluate frugality of innovations.

A significant limitation is a problem with measuring frugality of innovations and their effectiveness. However, some researchers try to develop the measures, which can be used by companies. As it was discussed, the complexity of frugal innovations is related with designing some tools which fit to the size of a company or the type of business it conducts. In other words, it can be difficult to build an universal measuring tool that all companies can use regardless of the type of business or a manufactured product/service. However, there can be found a proposition of Rossetto et al. (2017), who claim that their model can be used in every kind of company. For sure, this statement should be verified, so it can be recommended to companies, which want to check their level and effectiveness of frugal innovations.

Other limitation is a low number of articles, which verify the effectiveness of presented models. These propositions require to be tested and should not be treated as the optimal way of verifying frugality of the

company. The concept of frugal innovation still needs to be extended and knowledge about this phenomenon used properly. There are still many areas, which can be explored in relation to frugal innovations and researchers have opportunities to explore them and consequently fill existing gaps. Developing the issue and finding new solutions for evaluating and measuring frugal innovation efficiency should be the breakthrough from the perspective of defining and manifesting the frugal innovations. New researches and scientific publications related to frugal innovations must be treated as the only way for developing the issue. The cooperation between companies and research institutions is strongly desired here as the source of new knowledge about implementing and measuring frugal innovations.

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