Frugal Innovation, Sustainability, and Sustainable Frugal Innovation: A conceptual clarification and empirical evidence

Paper for the AIMs conference Dakar June 2919

Sana Khan, Assistant Professor (ESDES, UCLy), Email: skhan@univ-catholyon.fr, ORCID Id 0000-0002-7633-8177

Patricia Laurens, Université Paris-Est, CNRS – LISIS – IFRIS, Noisy-le-Grand, France, Email: patricia.laurens@esiee.fr

Christian Le Bas, Full Professor of Economics (ESDES, UCLy), Email: clebas@univ-catholyon.fr, ORCID Id 0000-0002-6640-7255

Abstract

Sustainable development sets up a major challenge for economic activity, climate change, management of organization and society. It follows that the drivers and impacts of frugal innovations (FI) should be analyzed in relation to sustainability as a new socio-economic paradigm. In this study, we note that FI and sustainability are related to two sets of literature mainly studied in isolation until now (with some notable exceptions like Brem and Yven, 2013 and Rosca et al., 2017). Our objective is to realize a necessary conciliation between the two. In others words, our research question is to explore how and to what extent FI is linked to sustainability. We contribute to the literature dealing with FI in three ways. First, we show how FI can generate more sustainable development while FI is not inherently sustainable. Secondly, we draw conclusions regarding a possible taxonomy of FI which is based on two extreme poles i.e., FIs have no marked sustainable effects vs. FIs are fully sustainable. Finally, we carry out an empirical analysis of a sample studies of FIs published in different academic or scientific journals to discover the different between the two forms of FI.

Key words: frugal innovation, sustainability, sustainable oriented-innovation, affordable, low-cost

1. Introduction

Sustainable development has gained tremendous importance during the last couple of decades (Dyllick and Hockerts, 2002) due to its ability to save the planet, help the society, and boost the economy. The increasing problems of adverse climate change, depletion of natural resources, unequal distribution of wealth, wars, poor economic growth among others pushed key players in a society such as governments and industries to take initiatives. As a result, many sustainable innovations also referred to as eco-innovations (Rennings, 2000) have been designed and successfully diffused in the markets.

Frugal innovation (FI thereafter) is another type of innovation designed to facilitate the needs of individuals in the developing world or emerging markets (Basu et al., 2013). Although FI is

not an outcome of sustainability per se, to some extent it does aim to solve sustainability challenges in Bottom of the Pyramid (BOP) markets. The underlying formula of frugality is "to do more with less for more people" (Prahalad and Mashelkar, 2010, p. 2). Therefore, FI is basically an inclusive innovation which has well-defined properties (Tiwari et al., 2016). It demands a redesigning of the existing product so that the unnecessary costs can be avoided (Woolridge, 2010). In this case, the main functionalities are kept but frills or luxury features are removed from the product which otherwise makes it expensive.

Saying this, FI matches a new paradigm in the search for less functionality with a minimum quality meeting the needs of poor or less rich people. This clearly favors the idea that FI has an important social value (Tiwari et al., 2016) as well as an ecological value. This reflects that an association may exist between frugality and sustainability which has never been explored by existing researchers. Sustainable innovations and FIs have been studied in isolation until now with some exceptions (see for instance, Brem and Yven, 2013 and Rosca et al., 2017) as two streams of literature Therefore, this study aims to explore the association between frugal and sustainable innovations. To do so, this paper first reviews the existing literature on frugal as well as sustainable innovations. The review helps us to conclude that a possible taxonomy of FI exists which suggests that there are two extremes of FIs which are referred to as weakly sustainable frugal innovations (or only frugal innovations) and fully sustainable frugal innovations (or sustainable frugal innovations). We then systematically analyze the existing studies published in different academic journals to map the relationships of the two forms of FIs and academic disciplines.

The paper is structured in different sections. Sections 2 to 4 review the existing debate on sustainability, sustainable innovations, and the association between sustainable and frugal innovation. Section 5 then introduces two forms of FIs: weekly sustainable and fully sustainable FIs. Based on the results of the review, we then synthesize and conduct an empirical analysis of papers published in different scientific fields. Section 6 and 7 presents our findings and conclusion.

2. Sustainability and the emergence of a socio-economic paradigm

Natural resource depletion, biodiversity loss, and adverse climate change have been threatening our planet for many centuries. However, it has been more than three decades since the term sustainability or sustainable development became a mantra (Dyllick and Hockerts, 2002)[1].

Emergence of sustainability as a concept

The Limits to Growth report produced by *The Club of Rome* in 1972 proved that the contemporary course of economic development is not sustainable and predicted that many natural resources vital for humankind will be exhausted within one or two generations (Mebratu, 1998). The report gained popularity worldwide and pushed public policy researchers to find ways to improve the situation. This finally led to the publication of the famous Brundlandt Report by the UN World Commission on Environment and Development (WCED) in 1987. With her colleagues, Brundlandt, the chair of the Commission, introduced the concept of sustainable development to answer an overarching question "how can the aspirations of the world's nations for a better life be reconciled with limited natural resources and the dangers of environmental degradation?" The Commission defined sustainable development as: "[…] *development that meets the needs of the present without compromising the ability of future generations to meet their own needs*" (WCED, 1987). It is a starting point for almost all current debates on sustainability or sustainable development.

Sustainability has three interconnected and mutually reinforcing dimensions: economic, environmental, and social (Robert et al., 2005; Strange and Bayley, 2008). As Basiago (1998) says, "the protection of natural systems represents not an overarching panacea for achieving economic vitality and social justice, but a necessary component of an entire system for achieving economic, social and environmental "sustainability", in which economic reforms and social reforms are as important [as environmental reforms]" (p. 155).

Triple bottom line: business and sustainability

It is important to point out that sustainability is conceptualized in two different ways – sustainability as a long-term maintenance of systems (Crane and Matten, 2016), and sustainability as a specific business goal (Elkington, 1999). The later referred to as the *triple*

[1] Khan and Le Bas (2019) provide a brief history of sustainability.

bottom line (TBL). Many firms are working actively for improving their sustainability performance (Brem and Yvens, 2006). Business strategy is becoming a key driver of sustainability performance. In this context it is relevant to retain three aspects of sustainability:

1. Economic sustainability refers to various strategies that facilitate resource use in an efficient and responsible way. Poverty and hunger eradication are acknowledged as the two main goals as far as economic sustainability is concerned (UN, 2005).
2. Social sustainability refers to practices and goals that enhance social capital and promote societal wellbeing. Khan (2016) after doing an extensive survey of literature provides a list of topics related to social sustainability: human health, basic needs, social coherence, decline of poverty, social justice, fair trade practices, human capital development, and protecting human rights, and so on.
3. Environmental (or ecological) sustainability refers to practices and decisions that benefit the natural order or reduce the ecological footprint. Following Ayres (2008) *Sustainability Economics* includes the problem of maintaining economic growth, while reducing pollution with a special attention to the linked problems of energy supply and climate change. Of course it is also important to mention the supply of other exhaustible resources. Various strategies are a reduction in greenhouse gas emissions, energy conservation, renewables consumption, and a reduction in pollution.

The three core elements of sustainability tend to define TBL approach which is acknowledged as the equivalent of corporate social responsibility in the business world (Hussain et al., 2018). Businesses have the responsibility of creating economic value along with social, societal and environmental values. Wellbeing and environmental actions should be added to the bottom line in order to satisfy different stakeholders. The fact that sustainability entered into the agenda of firm strategy has given birth to sustainability management system which is now required for translating sustainability strategy into coordinated practices (Benn et al., 2014). We now turn our attention to the definition of sustainability as a socio-economic paradigm.

Sustainability as a new socio-economic paradigm

Around the world, the sustainable use/reuse of natural resources has attracted huge attention from policy makers and civil societies. Along with the focus on environmental sustainability, social and economic sustainability has become popular in recent years. The last couple of decades have witnessed the evolution of concepts such as the circular economy (Geissdoerfer,

et al., 2017), resource efficiency (Tukker and Ekins, 2019), and sustainable resource management (see among others Bringezu and Bleischwitz, 2017). Nevertheless, it has been emphasized that environmental and social sustainable development is only possible after achieving economic development (Stern et al., 1996).

With the new industrial and technological revolutions underway – additive manufacturing, artificial intelligence, and big data – there are enormous possibilities and opportunities to make all industries and economies sustainable by transforming global production and making consumption sustainable. This is possible with the use of innovative technologies, circular business models, and the confluence of new production tools, along with the promotion of sustainable consumption patterns at the global level. Similarly, there has been a lot of improvement in the agriculture and energy sectors. Although these innovative and sustainable business models provide opportunities for low carbon emissions, their uptake in many economic sectors is very slow. This necessitates building new and radical solutions to help align future societal preferences for sustainability. Green or environmental innovations (or more simply eco-innovations) are implemented at a large scale as a consequence of a more drastic regulation or voluntary corporate measures (Mazzanti and Zoboli, 2006). It is about a new or significantly improved product or service, process, organizational method, or marketing method that creates environmental benefits compared to alternatives (Arundel and Kemp, 2009).

Societal preferences for sustainability are based on the interaction of social dynamics and resource dynamics. Recent changes in societal preferences and increased awareness about sustainability provides a clear link between economic, environmental, and social problems. Such links enable to set up visible sustainable development policies that deal with environmental problems, poverty, and intergenerational fairness issues. Among academic researchers have emerged a consensus about the interactions and interdependencies between natural resources, output, and ethical foundations for welfare functions and discounting principles (Bretschger and Smulders, 2007). Furthermore, the main premise of sustainable resource economics is that over time the decrease in per capita natural resources must be compensated by man-made inputs. For this reason, resource economics promotes sustainable innovation projects that help to reduce the use of non-renewable resources. Long-term ecological sustainability is the reduction in anthropogenic pressures on the environment. These pressures arise primarily from the extraction and processing of natural resources and using the environment as a sink for the disposal of waste effluents (Ayres, 2008).

3. Sustainability and Innovation: Sustainability-Oriented Innovations

The search for sustainability (or a better sustainability performance) is becoming an important determinant of innovation. Many scholars suggest and find that innovations and mainly technological innovations contribute towardsthe sustainability of the socioeconomic system. The existing literature increasingly talks about a new type of innovation namely sustainable innovation (SI thereafter), innovation for sustainable development (see Mulder, 2007) or sustainability-oriented innovation (Adams et al., 2016). At the very start of the development of the SI concept, many referred to it as as green, environmental, or ecological innovation (see, for instance, Nidumolu et al., 2009). As a consequence, it is likely to envisage Environmental Innovation and SI as synonyms. Nidumolu et al. (2009) consider the nature, drivers, and strategic implications of this kind of SI. Hall and Vredenburg (2003), Ketata and McIntyre (2010) and Ketata et al. (2014) defines SI. SI is defined as related to environmental *and* social (or societal) issue including needs and visions of the firm's stakeholders (Gable and Shireman, 2004). This suggests that SI has some association with corporate social responsibility (CSR). To some extent, this approach also matches the principle of shared value as put forward by Porter and Kramer (2011). The shared value implies a firm creates economic value "in a way that also creates value for society by addressing its needs and challenges" (Porter and Kramer, 2011, p 4). The literature emphasized the knowledge to produce SI is more complex and learning activity is completed through more difficulties and failures (Hall and Vredenburg, 2003). One particular aspect of SI dynamics is its emergence. The initial development of SI can be facilitated by the *creation of technological niches* that allow experimentation through the co-evolution of technology, user practices, and regulatory structures (Kemp et al., 1998; Schot and Geels, 2008).

There are several determinants of this kind of innovation: consumer demand and needs are the demand-side drivers while technological push that fosters technological improvement and better technological efficiency and public regulations that enforce compliance are the supply-side drivers. Social activism in favor of environmental and social justice sets up another important factor (Yoon and Tello, 2009). The change towards corporate citizenship push sustainability issues into innovation process in multinational corporations in developed countries (Brem and Ivens, 2006).

Sustainable innovation (SI) sets up an emerging concept in the field of innovation. In a nutshell, it has the strategic implications of a set of innovations implemented by private and public enterprises that aim to restore or improve the sustainability of a socio economic system through its forms i.e.economic, environmental, andsocial. The conceptualization of SI originated from the work of Hall and Vredenburg (2003) and Ketata et al. (2014) aim to define sustainable innovation as related to environmental and social (or societal) issues. This tends to incorporate the demands of the firm's different stakeholders. The perspective is obviously broader than that considered by the Economics of Sustainability, according to Ayres's (2008) vision. For Ketata et al. (2014), "sustainable innovation adds a broader, systematic perspective to the meaning of 'sustainable' competitive advantage by incorporating the interests and needs of all parties involved; including not just shareholders" (p. 62).

4. Frugal Innovation has Positive Impacts on the Environment but is Not Inherently Sustainable

The recent literature offers several definitions for FI[2]. Basu *et al*. (2013) defined it as "a design innovation process in which the needs and the circumstances of citizens in the developing world are put first in order to develop appropriate, adaptable, affordable, and accessible services and products for emerging markets" (p. 130). Therefore, FI is related to new market segments linked to new needs (Tiwari et al., 2017a). Weyrauch and Herstatt (2017) retain three criteria for frugal innovation: substantial cost reduction, concentration on core functionalities, and optimized performance level. From the initial definitions of FI based on the innovation dynamics in emerging economies (India, in particular), it becomes clear that this type of innovation has general features that are valid for developed economies as well (Tiwari et al., 2016). Gupta and Wang (2009) argue that FI can also affect services and business models with low resources and environmental implications. Some others insights are put forth by recent pieces of the literature, for instance, frugal products are less sophisticated (Brem and Wolfram, 2014), they set up an offering specifically for low-income market segments (Nunes and Breene, 2011), and they are more inclusive because it satisfies more the needs of the poor (Tiwari et al., 2017b). Nevertheless, it could be relevant for products dedicated to less affluent people from the North (Zeschky et al., 2011). FI has important techno-economic properties such as low technological complexity, no clear relation with any science push effect, and a design based on eliminating

[2] For a compendium, see the recent work by Tiwari and Kalogerakis, 2016; Hossain, 2018; Pisoni et al., 2018.

unnecessary features of a product or a process (Le Bas, 2019). It appears clearly from these definitions that FI is an inclusive innovation that to some extent matches to social sustainability.

FI has positive impact on the environment

A lot of FI characteristics are related to ecological sustainability. In general, the frugal innovations are eco-friendly, has a low carbon footprint, and achives green marketing objectives. FI can be considered as an environmental innovation because (Le Bas, 2019):

1) It saves material and energy in manufacturing *and in the use* of goods (Brem and Ivens, 2013). As a consequence it contributes to the fair management of exhaustible resources and to sustainability by minimizing resource use (Jänicke, 2014; Sharma and Iyer, 2012).
2) The fact that FI decreases the level of technological complexity with a certain reliability has many consequences (Le Bas, 2019) such as a frugal product has fewer components, therefore we expect that these are easier to repair. Therefore, it boosts the possible recovery of end-of-life components and recycling. These properties correspond well to the circular economy principle.

We content that on the one hand FI has a positive effect on the environment; as a consequence we can argue that it is an environmental innovation. On the other hand, many FIs are sustainable but certainly not all of them. In other words, being sustainable is often not the primary focus of FI. Pisoni et al. (2018) says: "by providing a better value proposition for less affluent customers with a more efficient use of resources, a frugal approach to innovation could generate social and environmental benefits in advanced economies" (p. 122). But FI is not sustainable at its core (Rosca *et al.,* 2017). For assessing the *true* contribution of frugality to sustainable growth and development, we need a holistic concept that can integrate the three dimensions of sustainability (Rosca et al., 2017). With this perspective,) we put forward the evidence showing FIs does fulfill the social, ecological, and economic dimensions:

Social: FI includes poor people in the consumption norms and therefore it follows the social sustainability principles at least partially. There are a lot of FIs that have no effect on the important dimensions of social sustainability as gender equality, better health, and access to basic resources (water, for instance).

Ecological: A lot of frugal products have in general no environmental aims. For example, the Tata Ace mini-truck for the Indian market was invented to meet local needs rather than to meet

green objectives (Tiwari and Herstatt, 2014). Nevertheless, frugality has at least some potentially important ecological consequences.

Economic: FI though improving the way of life of poor (less rich) people does not address structural roots of poverty as discussed in depth by Nahi (2016). For instance, it lets the structure of income repartition unchanged. Frugality, while having positive effects in many contexts, does not necessarily drive development as pointed out by Pansera (see, for instance, Pansera, 2013 and 2018). Moreover, it has been noted that frugal innovation could merely exacerbate inequality and as a consequence cannot enhance inclusive sustainable development (Knorringa et al. 2016).

5. Fully Sustainable Frugal Innovation (FSFI) versus Weakly Sustainable Frugal Innovation (WSFI)

By reviewing more than 100 scholarly articles, Adams et al. (2016) stress one important deficiency of the knowledge base concerning the relations between innovation and sustainability. Previous work tend to treat sustainability as a dichotomous construct/ concept (sustainable or unsustainable), rather than embedding sustainability oriented innovation as a dynamic, complex and unfolding process that is achieved over time. As a consequence, at one point of time an innovation can bring more in terms of sustainability with respect to the current alternatives but can still be weakly sustainable. This approach enables us to build up our main assumption. Because all frugal innovations have no clear environmental benefits or have not enough social or economic positive consequences as far as sustainability is concerned we follow the analysis by Adams et al. (2016) and define a new category of FI, that is the sustainable frugal innovation (SFI). SFIs are frugal innovations acting for sustainability (see also Rosca et al., 2017). SFI has two clear impacts that reinforcing the sustainability of an economy i.e. it has environmental benefits on the one hand and performs inclusive actions for low income people on the other.

As a consequence, we explicitly distinguish between fully sustainable frugal innovation (FSFI) versus weakly sustainable frugal innovation (WSFI) or simply frugal innovation. It must be noted that because FIs tend to have an inclusive consequence on the consumption is sustainable but often very part way. In the following section, we took one step further and carried out an empirical analysis to study frugal innovation or WSFI and FSFI that is the frugal innovation having clear and marked sustainable properties.

6. Data Collection and Analysis

The objective of our analysis is to understand and map the relationships of FIs and academic work published in different scientific disciplines. To do so, we synthesize existing work published in scientific journals.

Data collection

In order to find a sample of studies on frugal innovations, we search for the academic (scientific) publications provided by the Web of science. We briefly explain our inclusion criteria in this section. It is not an easy task to gather data on frugal innovations. Many innovations of this kind are under the radar (Kaplinsky, 2011) and escape statistical tracking. Some of them are patented and the data related to the patent system give us only a few cases to study. One exception is the work of Tiwari et al. (2017) dealing with frugal innovations through German patenting. There is some information on case studies of frugal innovations in business newspapers but it is not directly usable because the information is scattered. We knew from our literature search that there are academic papers available which deals with frugality and case studies of frugal innovation are also available. We searched for the existing literature of the past ten years on the Web of Science. For the search, we used different keywords like *'innovation* and *'frugal'* or *'innovation'* and *'affordable'*. We selected all the papers which have these terms or their synonyms in their title and keywords section. In the second step, we selected the studies only from the academic journals of Management and/or Social Sciences. After deleting all other articles which did not fit the criteria, we were able to retrieve 200 papers approximately for our analysis.

In the next step, we read the abstract (if it exists because in a few cases there were no abstracts) of each paper. After reading the abstracts, we chose only those articles which study the *true* frugal innovation. For instance, we found innovations which were related to *fast and frugal heuristics* or to the frugal functioning of chips to limit their warming. These types of innovation studies were deleted from the final dataset.

Analytical strategy

We used the Cortext Platform (www.cortext.net) developed at LISIS (Laboratoire Interdisciplinaire Sciences Innovations Sociétés) to analyze our dataset. Cortext Platform

proposes a full ecosystem of modeling and exploratory tools for analyzing text corpora. We performed an automatic extraction of multi-terms (combinations of 2 or 3 words encapsulated in a multi-term) on the lexical fields of the publications (title, abstract, and author keywords). The most frequent multi-terms were then used to map a network of co-occurrence of multi-terms in publications. Each node was a multi-term and two multi-terms appearing in the same document were linked. The size of the nodes accounted for the occurrence of the multi-term in the corpus, the size of the edge between two nodes for the number of documents where the two multi-terms were present. Based on the overall multi-term proximity, a clustering of the terms was carried out. We then labeled each cluster with the main Research Categories of the journals to which the publications belonged including the multi-terms. We run this exercise for the two corpora i.e. papers dealing with frugal innovations versus frugal sustainable innovations. We searched for the main differences between the two corpus.

5. Results

Descriptive statistics

The analysis resulted in 56 technological innovations over the period 2008-2019. There were 32 studies on frugal sustainable innovations (58%) and 24 on frugal innovations (42%). An interesting observation was that only during the last two years there were 51% studies on frugality which shows that frugality is rather a recent phenomenon. As far as the temporal evolution is concerned we could not detect any clear cut trend between the two samples.

Table 1. Distribution of innovations according to the disciplines of academic journals

Journal Disciplines	Frugal	Frugal Sustainable	Total
Basic **Biology**	1,5	0	1,5
Medical Research	9,665	5,5	15,165
Applied **Biology - Ecology**	0	5,5	5,5
Chemistry	1,25	1	2,25
Physics	0	0	0
Sciences tf the Universe	0,5	8,5	9
Engineering	6,082	8,665	14,747
Mathematics	0	0	0
Human Sciences	0,5	1	1,5
Sociales Sciences	4	1,833	5,833
Total	***23,497***	***31,998***	***55,495***

In order to find the information on the technological fields of frugal inventions, we distinguished between the two types of innovations according to their journal disciplines. Table 1 shows the difference between the two (we operate with the fractional counting if a journal is relevant for two or more scientific disciplines). Two interesting findings were revealed. Frugal innovations are more concentrated than sustainable frugal innovations in the fields of Medical Research and Engineering. The number of frugal sustainable innovation studies in these two disciplines reflect the importance of frugal sustainable innovations. Nevertheless, two other fields also reveal their importance i.e. Applied Biology and Ecology and Universe Sciences.

Mapping of frugal innovations and sustainable frugal innovations in academic disciplines

Figure 1 and figure 2 map the number and the relationships between the multi-terms together with the clusters that appear. If we compare the number of clusters in both figures, we can see that there are a larger number of clusters in figure 2. This shows the greater importance of frugal sustainable innovations compared to frugal innovations. . Moreover, it also reflects that the sample of frugal sustainable innovations is more diversified in terms of different academic disciplines (also see table 1). Frugal innovation information (multi-terms) is focused on two big clusters (figure 1) of Surgery and Engineering. Besides, two other medium-sized clusters related to the fields of Medical Research i.e. Urology & Nephrology, Education & Educational

Research, Materials Science, Dermatology General & Internal Medicine, and Operations Research & Management appear.

As far as frugal sustainable innovations are concerned, information is more fragmented (figure 2). There is a big cluster of Operations Research & Management Science, Neurosciences & Neurology, and Surgery. We also found many medium-sized clusters diversified around many thematic like Agriculture, Food, Construction, Material Science, and Biophysics. Nevertheless, a novel and an interesting insight was revealed from the mapping in figure 2 i.e. the presence of the *Developing Countries* node at the crossing of the 7 clusters which is linked to another consistent node *Energy System* present at the edge of the Energy & Fuels Engineering cluster. Finally, we revealed two important findings as we expected that frugal sustainable innovations are more closely linked to the growth of developing countries on the one hand and to the clean energy on the other.

6. Conclusion

Our study clarifies and reveals the relationship between frugality and sustainability from the conceptual as well as empirical standpoint. Our analysis in the previous section indicates that the conceptual debate and analysis of frugality can be improved by making some changes. For instance, frugality and sustainability link is an interesting area for research but it will be even more useful to may exploit and study the three types of sustainability- social, ecological, and economic). This will enable future researchers to get a rich taxonomy of frugal sustainable innovation and to improve the empirical work on the complex relationship between frugality and sustainability.

With respect to the empirical analysis, in particular, many improvements are possible. For instance, future researchers can be more specific in the selection of their keywords and the combination of different keywords. An important aspect would be to assess if the choice to study frugality in various academic or scientific publications is relevant to understand the scale and scope of frugal innovations in relation to sustainability and to assure if our study covers a very large proportion of existing research. It is further important to study the features of the different types of innovation in order to efficiently manage organizational change for corporate sustainability (Benn et al., 2018). The same idea holds for *reverse innovation* (Martin, 2018).

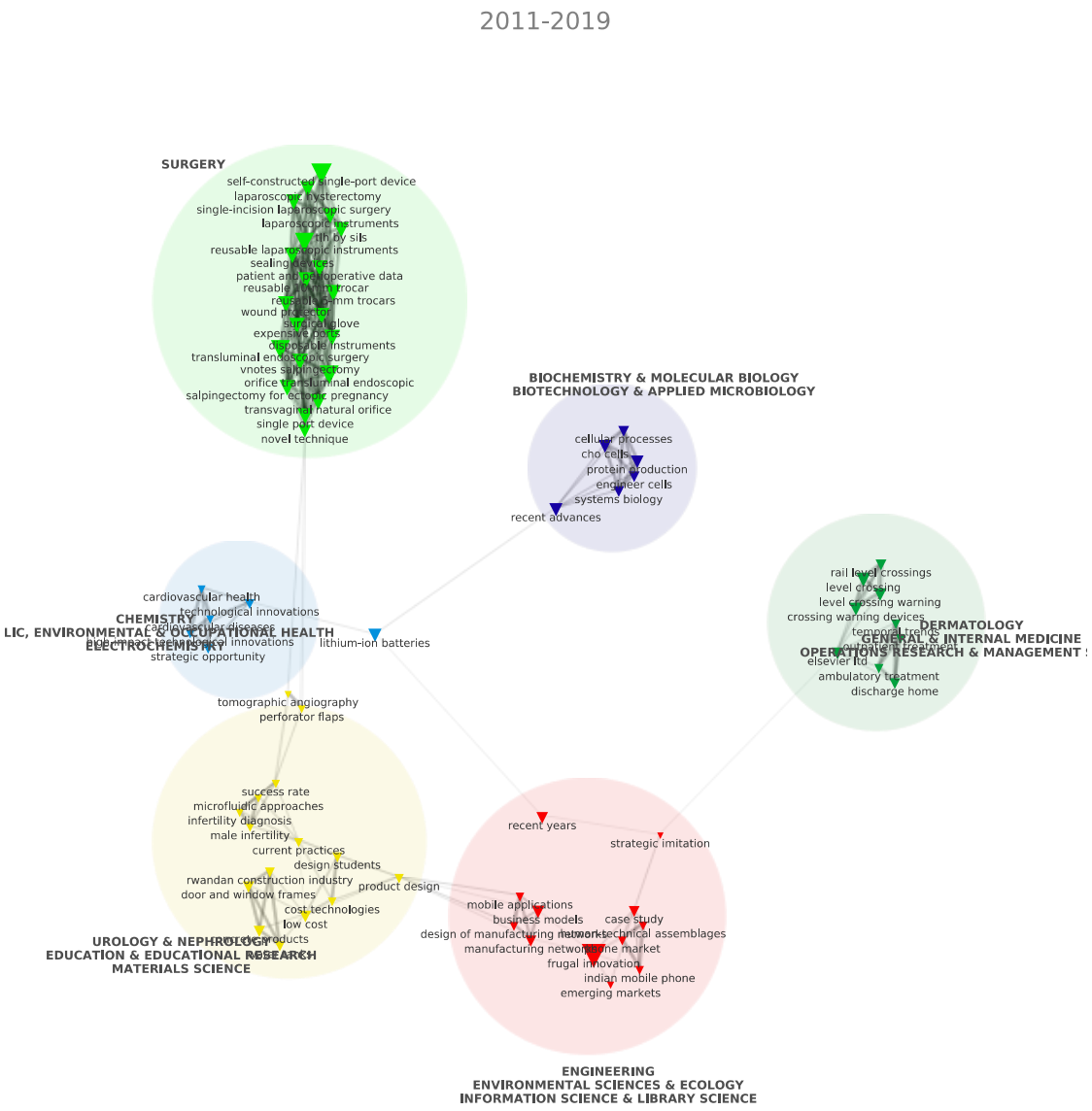

Figure 1: Frugal innovations (WSFIs) and academic disciplines

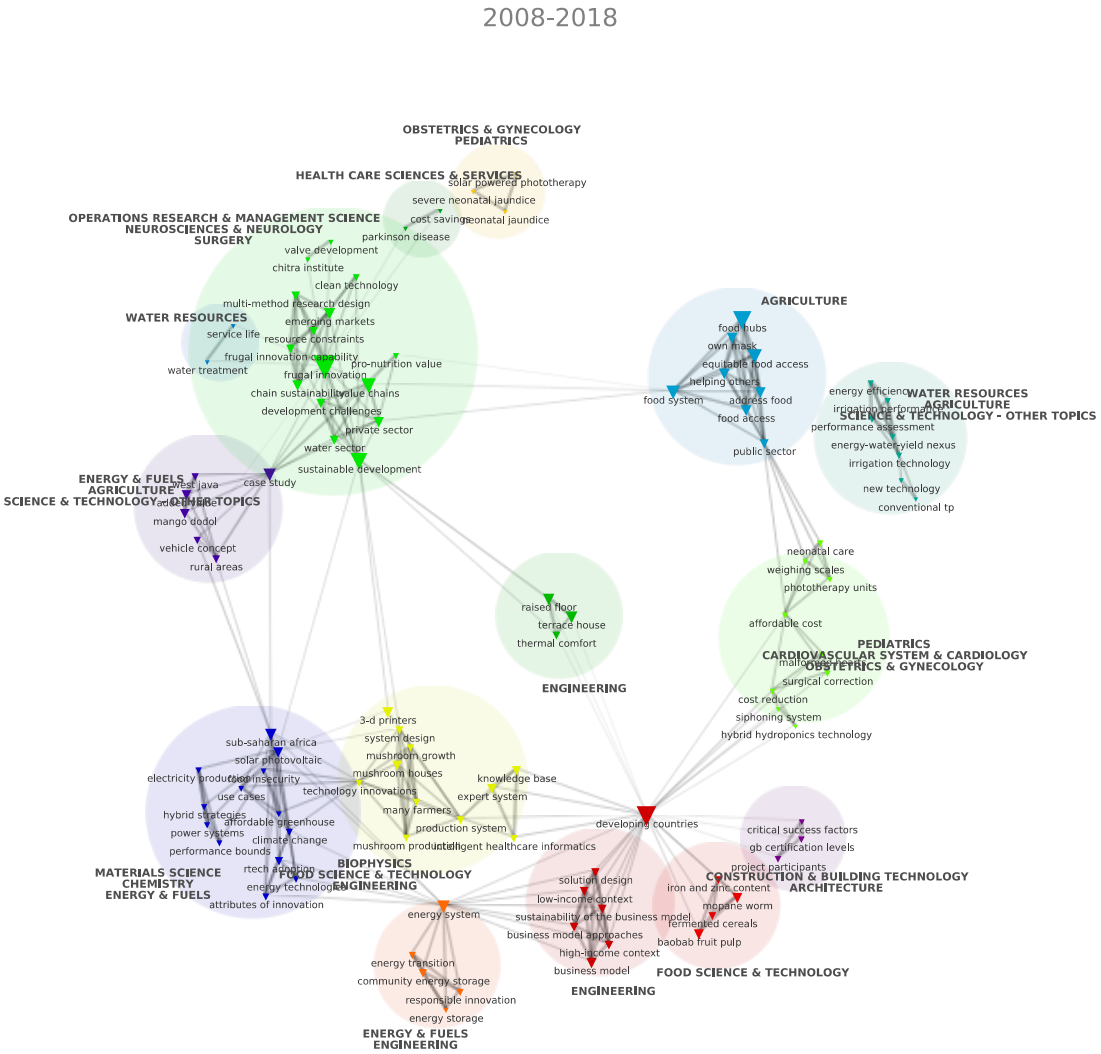

Figure 2: Sustainable frugal innovations (FSFIs) and academic disciplines

References

Adams, R., Jeanrenaud, S., Bessant, J., Denyer, D., & Overy, P. (2016). Sustainability-oriented innovation: A systematic review. *International Journal of Management Reviews*, *18*(2), 180-205.

Arundel, A., & Kemp, R. (2009). Measuring eco-innovation. UNU-MERIT Working Paper Series (Working Paper No. 017).

Ayres, R. U. (2008). Sustainability economics: Where do we stand? *Ecological Economics*, *67*(2), 281-310.

Basiago, A. D. (1998). Economic, social, and environmental sustainability in development theory and urban planning practice. *Environmentalist*, *19*(2), 145-161.

Basu, R. R., Banerjee, P. M. and Sweeny, E. G. (2013). Frugal Innovation: Core competencies to address global sustainability. *Journal of Management for Global Sustainability, 1*(2), 63-82.

Benn, S., Edwards, M., & Williams, T. (2014). *Organizational change for corporate sustainability*. Oxon: Routledge.

Benn, S., Edwards, M., & Williams, T. (2018). *Organizational change for corporate sustainability*. Routledge.

Brem, A. and Ivens, B. (2013). Do frugal and reverse innovation foster sustainability? Introduction of a conceptual framework. *Journal of Technology Management for Growing Economies*, *4*(2), 31-50.

Bretschger, L. and Smulders, S. (2007). Introduction to sustainable resource use and economic dynamics. *Environmental & Resource Economics*, *36*(1), 1-13.

Bringezu, S., & Bleischwitz, R. (2017). *Sustainable resource management: global trends, visions and policies*. Routledge.

Crane, A. and Matten, D. (2016). *Business ethics: Managing corporate citizenship and sustainability in the age of globalization*. Oxford: Oxford University Press.

Dyllick, T. and Hockerts, K. (2002). Beyond the business case for corporate sustainability. *Business Strategy and the Environment*, *11*(2), 130-141.

Elkington, J. (1999, January). *The link between accountability and sustainability–theory put into practice*. Conference on the Practice of Social Reporting for Business, ISEA (Vol. 19), Commonwealth Conference Center, London.

Geissdoerfer, M., Savaget, P., Bocken, N. M. and Hultink, E. J. (2017). The Circular Economy–A new sustainability paradigm? *Journal of cleaner production*, *143*(1), 757-768.

Hussain, N., Rigoni, U. and Orij, R. P. (2018). Corporate governance and sustainability performance: Analysis of triple bottom line performance. *Journal of Business Ethics*, *149*(2), 411-432.

Jänicke, M. (2014). Entwicklungsländer als Vorreiter der Nachhaltigkeit? Frugale Technik. *Ökologisches Wirtschaften, 29*(1), 30-36.

Kaplinsky, R. (2011). Schumacher meets Schumpeter: Appropriate technology below the radar. *Research Policy*, *40*(2), 193-203.

Kemp, R., Schot, J. and Hoogma, R. (1998). Regime shifts to sustainability through processes of niche formation: the approach of strategic niche management. *Technology analysis & strategic management*, *10*(2), 175-198.

Khan, R. (2016). How frugal innovation promotes social sustainability. *Sustainability*, *8*(10), 1034.

Knorringa, P., Peša, I., Leliveld, A., & Van Beers, C. (2016). Frugal innovation and development: Aides or adversaries?. *The European Journal of Development Research*, *28*(2), 143-153.

Le Bas C., (2018). Frugal Innovation as Environmental Innovation. *International Journal of Technology Management*, forthcoming

Martin, L. (2018). Drivers of Reverse Innovation. In *2018 IEEE International Conference on Engineering, Technology and Innovation (ICE/ITMC)* (pp. 1-7). IEEE.

Mazzanti, M., & Zoboli, R. (2006). Examining the factors influencing environmental innovations. SSRN Paper Series (https://www.econstor.eu/bitstream/10419/73938/1/NDL2006-020.pdf).

Mebratu, D. (1998). Sustainability and sustainable development: historical and conceptual review. *Environmental Impact Assessment Review*, *18*(6), 493-520.

Nunes, P. F. and Breene, T. (2011). *Jumping the S-curve: How to beat the growth cycle, get on top, and stay there*. Harvard: Harvard Business Press.

Pansera, M. (2013). Frugality, grassroots and inclusiveness: New challenges for mainstream innovation theories. *African Journal of Science, Technology, Innovation and Development*, *5*(6), 469–478.

Pansera, M. (2018). Frugal or Fair? The Unfulfilled Promises of Frugal Innovation. *Technology Innovation Management Review*, *8*(4).

Pisoni, A., Michelini, L. and Martignoni, G. (2018). Frugal approach to innovation: State of the art and future perspectives. *Journal of Cleaner Production*, *171*, 107-126.

Porter, M. E. and Kramer, M. R. (2011). The big idea: Creating shared value. *Harvard Business Review*, *89*(1/2), 62-77.

Prahalad, C. K. and Mashelkar, R. A. (2010). Innovation's Holy Grail. *Harvard Business Review*, *88*(7/), 132-141.

Rennings, K. 2000. Redefining innovation: Eco-innovation research and the contribution from ecological economics. *Ecological Economics, 32* (2), 319–32.

Robert, K. W., Parris, T. M. and Leiserowitz, A. A. (2005). What is sustainable development? Goals, indicators, values, and practice. *Environment: science and policy for sustainable development*, *47*(3), 8-21.

Schot, J. and Steinmueller, W. E. (2018). Three frames for innovation policy: R&D, systems of innovation and transformative change. *Research Policy, 47*(9), 1554-1567.

Schot, J., & Geels, F. W. (2008). Strategic niche management and sustainable innovation journeys: theory, findings, research agenda, and policy. *Technology analysis & strategic management*, *20*(5), 537-554.

Sharma, A. and Iyer, G. R. (2012). Resource-constrained product development: Implications for green marketing and green supply chains. *Industrial Marketing Management*, *41*(4), 599-608.

Stern, D. I., Common, M. S. and Barbier, E. B. (1996). Economic growth and environmental degradation: The environmental Kuznets curve and sustainable development. *World Development*, *24*(7), 1151-1160.

Strange, T. and Bayley, A. (2008). *Sustainable development: Linking economy, society and environment*. Paris: Organisation for Economic Cooperation and Development (OECD).
Strong, C. (1996). Features contributing to the growth of ethical consumerism-a preliminary investigation. *Marketing Intelligence & Planning*, *14*(5), 5-13.

Tiwari, R. and Herstatt, C. (2014). *Aiming big with small cars: Emergence of a lead market in India*. Heidelberg: Springer.

Tiwari, R. and K. Kalogerakis (2017, July). *Assessing Innovation Capabilities in India's Auto Component Industry*. R&D Management Conference, Leuven, Belgium.

Tiwari, R., Fischer, L. and Kalogerakis, K. (2017). *Frugal innovation in Germany: A qualitative analysis of potential socio-economic impacts*. Hamburg University of Technology (TUHH), Institute for Technology and Innovation Management, Working Paper, n° 96.

Tiwari, R., Kalogerakis, K. and Herstatt, C. (2016). *Frugal innovations in the mirror of scholarly discourse: Tracing theoretical basis and antecedents*. R&D Management Conference, Cambridge, UK.

Tukker, A. and Ekins, P. (2019). Concepts fostering resource efficiency: a trade-off between ambitions and viability. *Ecological Economics*, *155*(C), 36-45.

WCED (1987). *Our Common Future: World Commission on Environment and Development*. New York: Oxford University Press.

Weyrauch, T. and Herstatt, C. (2016). What is frugal innovation? Three defining criteria. *Journal of frugal innovation*, *2*(1), 1-17.

Woolridge, A. (2010), The Charms of Frugal Innovation. Special report, *The Economist*, 5 April.