Sustainable innovation and frugal innovation: Exploring the relationships between Innovation and sustainability

*Innovation soutenable et innovation frugale : une exploration des relations entre
l'innovation et le développement durable*

Christian Le Bas

Electronic version

URL: <https://journals.openedition.org/rei/6617>

DOI: 10.4000/rei.6617

ISSN: 1773-0198

Publisher

De Boeck Supérieur

Printed version

Date of publication: 15 September 2017

Number of pages: 113-137

ISBN: 9782807391437

ISSN: 0154-3229

Electronic reference

Christian Le Bas, "Sustainable innovation and frugal innovation: Exploring the relationships between Innovation and sustainability", *Revue d'économie industrielle* [Online], 159 | 3e trimestre 2017, Online since 15 September 2019, connection on 02 June 2022. URL: <http://journals.openedition.org/rei/6617> ; DOI: <https://doi.org/10.4000/rei.6617>

SUSTAINABLE INNOVATION AND FRUGAL INNOVATION: EXPLORING THE RELATIONSHIPS BETWEEN INNOVATION AND SUSTAINABILITY¹

Christian Le Bas² (ESDES – Business School of UCLy)

Keywords: sustainable innovation, frugal innovation, environmental innovation, technological paradigm, responsibility.

Mots clés : Innovation soutenable, innovation frugale, innovation environnementale, paradigme technologique, responsabilité.

INTRODUCTION

Sustainable innovation is at the forefront of the academic environment and the business scene³. It has been the subject of tremendous interest in recent times. One example among many: recently a new book: *Grassroots Innovation Movements* (Routledge, 2016), has shed light on

---

¹ This paper is a byproduct of joint research projects carried out with Bernard Haudeville and Patricia Laurens. I have hugely benefited from exchanges with Laurence Nkakene Molou. Discussions at the *Innovation day* seminar abbé Grégoire (CNAM Paris, March 2017), in particular with Sophie Mignon, have improved this paper. Finally, I thank the two referees for their fruitful comments. I remain responsible for any errors and mistakes.

² clebas@univ-catholyon.fr

³ It is useful to recall that innovation is the unity of three partially overlapping processes (Pavitt, 2003): 1) The production of scientific and technological knowledge 2) The transformation of knowledge into working artefacts (products, processes, systems) 3) Responding to and creating market demand.

sustainable innovation. This examines why and how innovation is increasingly vital in order to meet global challenges like sustainable development. The main idea, too often neglected by the academic literature of technology and innovation, is that economic agents can develop innovating grassroots solutions, both for environmental sustainability and social justice. This corresponds to a new approach, recently developed under the label of *sustainable innovation*⁴ (thereafter SI), which targets the two types of aims: environmental and social (Brem and Wolfram, 2014; Ketata et al., 2014).

We need to briefly define sustainable innovation, and we will return to its characteristics in the literature in more detail in Section 1⁵. To some extent, SI sets up an environmental innovation⁶, the innovator undertaking both social and environmental actions. SI considers the needs of future generations that are a part of, but essential to, sustainable development, according to the seminal vision evoked by the Brundtland Report (1987)⁷. In a nutshell, it is a form of innovation that fits sustainable development perfectly. As Ayres (2008) argues, rightly, sustainable development is the reduction of anthropogenic pressures on the environment: “These pressures arise primarily from extraction and the processing of natural resources, and using the environment as a sink for the disposal of waste effluents...” (Ayres, 2008, p. 282). The concept of sustainable development has developed beyond the initial intergenerational framework to focus more on the goal of «socially inclusive and environmentally sustainable economic growth» (Sachs, 2015: 5). In the perspectives outlined

---

4 Sometimes labelled Sustainability Innovation (see for instance Schaltegger and Wagner, 2011).

5 See also the definitions provided by Le Bas in the presentation of this journal issue.

6 According to Kemp and Foxon (2007), environmental innovation matches the “production, assimilation or exploitation of product, production process, service or management or business methods that is novel to the organization (developing or adopting it) and which results, throughout its life cycle, in a reduction of environmental risk, pollution and other negative impacts of resource use (including energy use), compared to relevant alternatives”. Many studies consider technological, organizational and marketing innovations together.

7 The Brundtland (1987) Report said that “Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs”.

by the Brundtland (1987) Report, Passet (1979) described sustainability⁸ in terms of three spheres: the environment, the economy and society. It has also been expressed as economic, environmental and social development. The relationships between sustainability and innovation are straightforward. The basic idea derived from economic theory is that, in general, the market does not support sustainable innovation because of the numerous externalities it creates. As a consequence, an adequate policy is needed in order to solve the negative externalities problem (Swann, 2009). On the other hand, past innovations can also threaten the environment and therefore sustainability. Such adverse environmental effects may often be unexpected. Today, private firms carry out environmentally-friendly innovation projects on a voluntary basis. As a consequence, the need for public policy could appear to be less necessary. Frugal innovation (thereafter simply FI), the other kind of innovation at the core of this paper, is a prominent form of innovation very recently discussed in the literature dealing with innovation in relation to economic development (Basu et al., 2003; Brem and Ivens, 2013; Radjou et al., 2013; Fagbohoun, 2016; Haudeville and Le Bas, 2016b; Haudeville and Wolff, 2016; Le Bas, 2016a and 2016b, Tiwari et al, 2017a and 2017b). FI and SI have several implications for firm strategy and innovation management (Brem and Wolfram, 2014) in developed and less developed countries, in terms of economic growth for firms (Nunes and Breene, 2011; Zeschky, Winterhalter, Gassmann, 2014), and for economies in the North Developed World (Maric et al., 2016; Micaëlli, 2016; Zeschky et al., 2011).

There is a large literature addressing sustainable innovation, on the one hand, and frugal innovation, on the other. However, there is not much literature on how both types are related to each other, and to what extent the basic background of Innovation Economics is consistent in terms of accounting for each of these, and their relationships. Our paper contributes to the literature by giving an overview of research in both areas, and it provides a vision of the relationships between sustainable innovation and frugal innovation. To put it simply, we follow two intertwined goals: 1) showing how SI and FI can enrich the field of innovation studies, 2) analyzing the similarity, complementarity and difference between SI and FI by highlighting the condition for which FI might also be sustainable. The purpose

---

8 We consider sustainability as synonymous with Sustainable Development.

of this paper is to outline an analytical frame to position SI and FI in relation to the sustainability principle. We consider sustainability explicitly as a general framework that we want to enrich⁹. We explore the capacity of frugal innovation to feed sustainability. Consequently, one of our contributions is that FI exhibits important properties that match sustainability. Finally, we link SI and FI with a more general concept of responsible innovation.

We present our ideas as follows. Section 1 suggests an initial overview of sustainable innovation as emerging concepts in the field of innovation studies. Then we develop our own definition of frugal innovation as a new technological paradigm, matching poor resource constraints (Section 2). We show the novelty of the two kinds of innovation with respect to previous innovation generation models, as they are identified through the literature (Section 3). In Section 4, we discuss the assumption that frugal innovation could also be considered to be a sustainable innovation. Finally, in Section 5, we develop the idea that the two types of innovation (SI and FI) are part of a larger family of innovations: responsible innovation.

SECTION 1. SUSTAINABLE INNOVATION AS AN EMERGING CONCEPT IN THE FIELD OF INNOVATION STUDIES

SI establishes an important part of the renewal of *innovation studies* as an academic field in the Economics of Innovation¹⁰. We find a lot of definitions related to SI in the literature¹¹. As always, some of these are too broad, others too narrow. Many papers addressing the need of innovation for sustainable development do not really deal with SI (Hall and Vredenburg, 2003; Mulder, 2007). To define SI as innovation that enables sustainable development is obviously a very general definition that is a little misleading.

---

9 The current paper extends topics and analyses dealt with in a previous contribution (Le Bas, 2016b).

10 See also the contribution by Le Bas which opens this issue.

11 As noted by Ketata *et al.* (2014), authors dealing with SI do not suggest any definition.

A first set of papers considers SI as a green, or environmental, or ecological innovation. In this spirit, the paper by Nidumolu *et al.* (2009) on the *Sustainability Imperative* forms an important intellectual foundation. It pictures the nature, the drivers, and the strategic implications of SI, building on the definition of the Economics of Sustainability. As a consequence, Environmental Innovation and SI are used as synonyms.

A second definition of SI stems from the papers by Hall and Vredenburg (2003) and Ketata *et al.* (2014), that aim to define sustainable innovation as related to environmental and social (or societal) issues. This tends to incorporate the needs and visions of the firm's stakeholders (Gable and Shireman, 2004). The perspective is obviously broader than that considered by the Economics of Sustainability, according to Ayres's (2008) vision¹². As stated by Ketata *et al.* (2014, p. 62), "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". In this paper, we consider that it is the most relevant definition¹³. As a consequence, we take it as a conceptual reference, knowing that we cannot forget many contributions that acknowledge SI as a simple environmental innovation.

Considering this perspective has important consequences. In particular, the study of the activity of R&D and innovation is no longer sufficient. At the level of the firm, many different functional dimensions are significantly concerned, particularly, but not only, human resource management (see for instance Noci and Verganti, 1999). As noted by Ketata *et al.* (2014, p. 63) "This involves adequate communication with, and training of, employees as this domain needs to be integrated into their daily activities in order to avoid resistance and frustration" (see also Ketata and McIntyre, 2010). A final consequence is that the tools and methods of Innovation Management are no longer relevant because they are not totally applicable

12 The Economics of Sustainability includes the problem of maintaining economic growth, while reducing pollution and other environmental concerns, with special attention to the supply of other exhaustible resources and global warming (Ayres, 2008).

13 Schaltegger and Wagner (2011) define SI as innovation that contributes to solving societal and environmental problems through the realization of a successful business.

when this second type of SI is involved (Hall and Vredenburg, 2003). As a consequence, there is room for innovations in the methodology of knowledge production. In effect, the knowledge to produce SI is more complex and learning activity is achieved with more difficulties, mistakes and failures. What is at stake is the size of investment in sustainable activity, on the one hand, and the importance of risks related to SI activity, on the other. One particular aspect of SI dynamic is its emergence, and initial development 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).

Many firms consider SI to be a key to progress (Nidumolu *et al.*, 2009). As far as competition between firms in terms of innovations is concerned, one particular feature is that SI is costly but “by treating sustainability as a goal today, early movers will develop competencies that rivals will be hard-pressed to match” (Nidumolu *et al.*, 2009). To some extent the SI approach matches the principle of shared value, put forward by Porter and Kramer (2011), which implies that 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). As a consequence, the firm cannot continue to construct its behavior according to the criteria of optimizing short-term financial performance.

With respect to the drivers of this kind of innovation, we find, besides the classic determinants such as consumer demand and needs, or the technological push that develops improvements and better technological efficiency, public regulation enforcing compliance, in particular in the area of environmental protection. But we also notice new aspects which pull firm strategy towards sustainability, which deserves special attention: corporate social responsibility conduct (Porter and Kramer, 2006), or social activism in favor of environmental and social justice (Yoon and Tello, 2009).

Is it possible to construct a measure of the scale and scope of SI? In the perspective outlined by Nidumolu *et al.* (2009), which considers sustainable innovation as a kind of environmental innovation, we can mobilize data using patent statistics (see, among several others: Brunnermeier and Cohen 2003; Nameroff, Garant, and Albert 2004; Wagner 2007), or Community Innovation Survey questionnaires (see Kemp and Foxon,

2007). By contrast, in the perspective in which ecological and social aspects are taken into account together, *ad hoc* measures establish the only solution. For example, the quantitative analysis carried out by Katata *et al.* (2014) relies on three different outcomes: a reduction in resources/energy consumption (per unit of output), a reduction in environmental stress, and an improvement in health and safety. Then, with these ratings, and through principal component analysis, a sustainability scale base has been constructed.

SI is not the only kind of innovation that participates in the renewal of innovation studies. Today, frugal innovation (FI thereafter) is a form of technological innovation that has recently been studied by scholars (for an initial assessment see Le Bas, 2016b). Because SI and FI appear to be linked to each other it would seem to be important to look at their relationship, why they look like this, and why they are different. Consequently, we will address frugal innovation in the next section.

SECTION 2. FRUGAL INNOVATION AS A NEW TECHNOLOGICAL PARADIGM IN SITUATIONS OF RESOURCE CONSTRAINT

In the literature we find many analyses of frugal innovation (FI). A good example of FI is a tiny refrigerator, the ChotuKool fridge, sold by the Indian company Godrej. This looks more like a computer cooling system than a refrigerator (Bellman, 2009)¹⁴. According to Basu *et al.* (2013) “Frugal Innovation is 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”. A formula summarizes the core of FI as a process very well: “do more with less”¹⁵ (Radjou *et al.*, 2013, p. 45). It is thus of a certain importance to note that FI is not just a matter of exploiting cheap labor, it is a “matter of redesigning products and processes to

14 Kwid, the new car manufactured by Renault, and which is dedicated to the Indian market, establishes another example (see Midler *et al.*, 2017). The paper by Zeschky *et al.* (2014) provides many other examples.

15 Or the “Search for the just necessary” as suggested by Midler *et al.* (2017).

cut out unnecessary costs” (Woolridge, 2010). FI is related to new market segments linked to new needs (Eagar et al., 2011). The question remains of knowing if the focus of frugal innovation in the emerging markets is only for designing products and services especially for poor people (Nunes and Breene, 2011), or whether it can be applied in western economies as well¹⁶.

We have shown that FI can be pictured as a *new emerging technological paradigm* (Haudeville and Le Bas, 2016b). According to Dosi (1982): “A ‘technological paradigm’ contextually defines the needs that are meant to be fulfilled, the scientific principles utilized for the task, and the material technology to be used. In other words, a technological paradigm can be defined as a ‘pattern’ of solutions of selected techno-economic problems, based on highly selected principles derived from natural sciences... jointly with specific rules aimed to acquire new knowledge and safeguard it, whenever possible, against rapid diffusion to the competitors”. We argue that FI fits this concept of a technological paradigm well. As a research program, driving the work of technologists and researchers, it establishes the matrix of technological solutions that are generated and implemented in order to improve many types of technologies. In a nutshell, this new paradigm appears as a *new knowledge technology of technical change* (using the terms of Arora and Gambardella, 1994). This means that the mode of reasoning behind frugality establishes a powerful knowledge tool for creating new technological knowledge. The search for fewer product functionalities is an important feature of FI. A frugal product retains essential functionalities. A low level of technological complexity is one of the remarkable consequences of FI. Measuring the complexity of a technological system by the number of internal components, FI explicitly aims to decrease these. As a consequence, the cost of the technological system in this process is lower.

It is sometimes argued that FI corresponds to *jugaad* innovation. We can now consider *jugaad* innovation as another concept found recently in the field of innovation studies. Radjou et al. (2013, p. 45) consider the six principles related to *jugaad* innovation: “1. Find opportunities in a context of adversity and transform constraints into opportunities 2. Do more with

¹⁶ Another definition, FI matches products that typically do not have sophisticated technological features but meet customers’ basic needs at low cost (Zeschky et al. 2011).

less 3. Think and act with agility 4. Aim for simplicity, 5. Involve the marginal population, and 6. Follow your heart” (Radjou et al., 2013, p. 45). Of course, part of *jugaad* relies on FI.

The “do more with less”, popularized by Radjou et al. (2013), provides a good picture of FI as a new technological paradigm. To some extent it can be viewed as a capacity, under resource constraints, to overcome seemingly insurmountable problems. The “do more with less” should not be confused with the “creating something with nothing” that is at the heart of *bricolage*. The last idea was analyzed by the Baker and Nelson (2005) study. It offers a new theoretical perspective for figuring out the consequences of the existence for firms (and individual economic agents) of a poor natural resources environment¹⁷. It sets up a capability to produce something (a specific product, for example) with nothing at all. Obviously, here, the term *nothing* is a little exaggerated, in the sense that we cannot produce anything from nothing. *Bricolage* has been introduced as a construct that describes how individuals improvise “by recombining existing, but individually less useful, resources to create value through creative reconstruction” (George et al., 2012). Interestingly, FI and *Bricolage* are organizational activities sharing the characteristics of the model of innovation matching poor resource situations (George et al., 2012). The latter is based on three processes: *reframing constraints*, *enacting new models*, and *bridging access*. A firm needs to consider all these three processes as starting conditions for viable inclusive innovation, as all three conditions are normally necessary (but not sufficient) to support innovation. According to George et al. (2012):

“*Reframing constraints* refers to organizational actions that take context as an assumed input and find new ways to perceive these constraints to create opportunities. ... *enacting new models* refers to fundamental reconceptualizations of organizational design and business models by reconciling constraints faced by disenfranchised communities...

Bridging Access refers to organizational processes that identify, locate, and create access to disenfranchised individuals and communities. Bridging

---

17 There may be a difference between FI and *bricolage*. FI fits well with an economic environment that is persistently poor in resources, while *bricolage* highlights more the case of a firm that is poorly endowed with resources.

access involves “implementing new forms of partnerships and networks that connect hitherto disconnected individuals with opportunities” (George *et al.*, 2012, pp. 675-676). Each enters into a positive, self-reinforcing virtuous circle for social engagement and innovation.

FI as a new knowledge technology for producing technological change seems to be more diffused in less developed countries, or in large emerging economies like India (see in particular Tiwari and Herstatt, 2017a). It is used more and more in developed economies for designing low-cost new products (the case of the Logan, manufactured by Renault, is an archetype). It seems to us that SI fits more with the case of Western firms which follow a strategy in favor of sustainable development, including significant collaborations of any kind with stakeholders.

Table 1. Types of innovations related to frugal innovation (inspired by Brem and Wolfram, 2013)

Type of Innovation	Definition	References
Jugaad	Providing a technological or organizational solution for poor people at the BoP as a solution for fighting poverty	Radjou <i>et al.</i> (2011)
Frugal engineering	FI that improves process-oriented technologies with lower development costs	Kumar (2008) Reddy (2011) Midler <i>et al.</i> (2017)
Gandhian innovation	This is a form of Jugaad innovation that aims to integrate <i>local</i> competences, and searches for collaboration to improve the social wealth of BoP	Prahalad and Mashelkar (2010)
Grassroots innovation	A bottom-up technological development approach based on civilians as inventors. Creative people are connected through social or business networks	Seyfang and Smith (2007)
Catalytic innovation	According to Christensen (2006, p 96), the characteristics of this type of innovation are: “First, they push social change in a systematic way by using economies of scale and replication. Second, they fulfill needs that are served badly or not at all. Third, they offer low-cost solutions with performance that is reduced but still sufficient for customer satisfaction. Fourth, they explore unusual resources such as volunteer manpower, donations, and intellectual capital that were not considered attractive by the competition. Fifth, they are underestimated or ignored by present competitors”.	Christensen <i>et al.</i> (2006)

The recent literature deals with types of innovation that are very close to FI or Jugaad innovation: Frugal engineering, Gandhian innovation, Grassroots innovation, and Catalytic innovation. Here we draw on the paper by Brem and Wolfram (2014), which reviewed these kinds of concepts of innovation in a very relevant way. In Table 1, we provide more details on their own definition. They borrow important characteristics from each other, and as a consequence it may be that we confuse some of them.

3. THE NEWNESS OF SI AND FI

SI and FI are new kinds of innovations. They are concerned by the objectives pursued by the innovator. As a consequence, they do not fit the well-known taxonomy product/process/organizational/marketing (Swann, 2009). The newness of these types of innovations is exemplified by the fact that they do not match any of the five models of innovation generation known in the literature on innovation (Rothwell, 1992 and 1994, Hobday, 2005; Tidd, 2006)¹⁸. Each innovation generation enables us to figure out the dominant directions of change in the innovation process in a particular time period. The first generation model matches the well-known technology push (1950s to mid-1960s). Innovation is designed as a linear sequential process from R&D (and maybe Design Activity) to market, which accepts the results of the technological research process. The second generation is based on market pull (mid-1960s-1970s). This is always a linear sequential process, but now the market is the source of ideas and provides direction to new R&D projects. To some extent, in this framework, the R&D function has a *reactive* role. Then a third generation appears, labelled as “coupling models of innovation” (mid 1970s-1980s). The sequence of innovation is now completed by feedback loops within the value chain from the later stages (the marketing department, the aftersales department, the market) to the earlier stages (R&D). It involves the firm placing an emphasis on the R&D/marketing interfaces. Later, the fourth generation integrated model (early 1980s-1990) is characterized by working in parallel with integrated development teams, a strong upstream supplier, linkages and partnerships. The fifth generation systems integration and networking model

¹⁸ Haudeville and Le Bas (2016b) also developed this idea.

(Post-1990-?) is greatly supported by the huge progress of information technology. In this context, strategic aims are related to corporate flexibility, speed of development, quality and other non-price factors.

The trouble with this picture of several generations of innovation is that it is unable to take into account the new innovation imperatives in favor of environmental concerns, for example. Both SI and FI introduce a radical change in the previous models of innovation. Because SI explicitly takes into account the environmental targets, it enlarges the scope of innovation drivers, limited in the first two generations, to technology push and market pull. Otherwise SI is based on a strong involvement of firm stakeholders, it modifies the schema underlying the last two generation models, implying only the collaboration of the firm's economic partners. Of course, this characteristic is less evident for FI. FI, by seeking to increase the purchasing power of poor people, is not framed within the model of innovation generation. Its capacity to boost inclusive growth establishes a new innovation consequence. The recent book by Midler *et al.* (2017) on the design and manufacturing engineering of the Kwid as a frugal Indian car shows that Renault has clearly experimented with a new type of innovation management, far removed from the five generations model that we have outlined.

It is also important to frame SI and FI in terms of the knowledge base and capacity. The question at stake is, is the knowledge base accumulated by the firm to produce SI or FI different? This question is crucial in terms of management on how to develop SI and FI capability. With respect to SI, Ketata *et al.* (2014) have suggested that the merits of internal R&D may be limited as an important technological driver. The technological competences for sustainable innovation appear outside a firm's traditional fields of technological expertise (Shrivastava, 1995). This is due to the fact that technologies (often with general purposes) that have a positive environmental impact are very often created outside the firm. As a consequence, a firm needs external competences in order to implement them. A motivated and well-trained workforce may give firms broader interfaces to deal with a multitude of potential stakeholders in the environment (Ketata *et al.*, 2014). A lack of training can provoke employee tensions (Ketata and McIntyre, 2010). For FI it is another story. Frugality can be thought of as a generic knowledge technology of technical change. In other words, it is an intangible technology (a paradigm) for producing frugal goods. It can be operational at diverse

stages of development, from handcrafted manufacturing in less developed countries, to a technological product in industrial economies of the developed North. If we look at how frugality is implemented in the developed world, we observe that internal (to the firm) technological capacity in R&D and design are crucially important. Midler *et al.* (2017), outlining Renault-Nissan's experience with the Kwid project, demonstrate that *Innovative design* and capacity in frugal engineering are at the forefront. By way of a conclusion, from the point of view of the knowledge base, the firm must master different blocks of competences according to whether this implements SI or FI. Nevertheless, FI and SI share similarities. They have important macro impacts that act in the same direction: driving the economy on an inclusive growth path. For this reason, they have been considered as a new engine for the green growth of firms and nations (Mazzucato and Jacobs, 2016; Le Bas 2016b). Finally, SI and FI are relevant for a better understanding of technological development in less developed countries (see the literature reviewed by Haudeville and Le Bas, 2006a).

Table 2. Sustainable innovation and Frugal innovation in perspective

	Objectives	Key features	Typical firm conduct	Type of knowledge base required	Consequences in terms of growth regime
Sustainable Innovation	Innovation matching sustainable development	Fighting against global warming and explicitly taking into account environmental and social concerns	Firm displays an environmental and social strategy (close to the <i>shared value perspective</i> in Porter and Kramer, 2011).	Importance of absorptive capacity management of HR	Firm growth, more green growth and giving satisfaction to stakeholders
Frugal Innovation	New technological paradigm aiming to provide low price goods	Cost saving in the production and use of innovation. Lower technological complexity	Products less expensive for new market segments	Importance of design and engineering competences	Firm growth is higher and more inclusive (better satisfaction of the needs of poor people)

Table partly adapted from Le Bas (2016b).

Table 2 provides a tentative comparison between SI and FI, summarizing the results we have obtained up to here. We compare SI and FI as far as firm objectives, key figures, firm conduct, knowledge base required, and macroeconomic growth scheme are concerned. To sum up, our basic assumption would be that SI and FI tend to build up a new (the sixth) innovation generation model, for which the firm drives technological innovation projects which have new goals (with respect to the previous ones): environmental, social and inclusive aims. Such an idea helps to progress the conceptualization of the two types of innovation.

A final point deserves particular attention. SI and FI are different but not opposed. This is likely to produce frugal goods (or organization) sustainably. Moreover, in some cases, FI may be sustainable as well.

SECTION 4. FRUGAL INNOVATION HAS PROPERTIES OF SUSTAINABILITY

Here we take into account the two aspects that define sustainability: social and environmental consequences. With respect to this approach, it now appears explicitly that there are elements of sustainable development in FI.

This idea draws on the fact that FI aims to solve sustainability challenges in Bottom of the Pyramid (BOP) markets. FI is often implemented in order to improve the standard of life of poor social groups. More of the poor's needs are now satisfied. FI and SI are both interested in triggering an economic development that is more inclusive (Le Bas, 2016b). It is the primary target of FI to increase the purchasing power of the poor, in particular in developing countries. By contrast, the approach underlying SI considers it an important target to include workers and other stakeholders in a firm's objectives.

Nowadays, there is a strong demand for innovation to be socially acceptable. FI copes with this concern through improving a set of technologies to increase the purchasing power of poor people. Tiwari and Kalogerakis (2016) note that the present-day understanding of frugal innovation is shaped primarily by discourses on "bottom of the pyramid". Their bibliometric

analysis clearly shows that frugal innovations are associated with sustainability and development (Tiwari and Kalogerakis, 2016). Because it allows an increase in the supply of low price products, FI has positive social consequences. But it must be underlined that these positive effects are generated through the market (the supply of low price goods), and presuppose an effective demand¹⁹. By contrast, SI aims to match a firm's objectives with those of stakeholders and society. The effects are more direct and do not affect, at least directly, the purchasing power of poor people.

We now want to show that FI can deal with environmental concerns. As far as environmental goals are concerned, we recall that environmental innovation lies at the heart of SI. In a nutshell, SI is basically an environmental innovation. By contrast, a *frugal innovator does not put forward environmental concerns as a crucial driver*. Its first goal is not to generate positive feedback for the environment. Nevertheless, as we have documented elsewhere, FI has some properties of environmental innovation (Le Bas, 2016b). In effect, FI is basically a new technological paradigm aiming to produce goods that are not too expensive, with a minimum quality, and which are just necessary, using cheap, local inputs. Because it saves material and energy in manufacturing it contributes to the fair management of exhaustible resources. If we now consider the lower technological complexity at the core of any FI, we can illustrate a few green underlying properties: the ability to repair in the case of failure, the recovery of end-of-life components, and probable recycling (Le Bas, 2016a). To some extent, FI fits well with the model of a circular economy that sets up an important property for sustainability (Ayres, 2008). Authors acknowledge the environmental benefits linked to FI. For instance, Gupta and Wang (2009) consider frugal innovation as the development of simple and ecological products/services with little environmental intervention. Howard (2011) sees FI as having a low carbon footprint. Basu *et al.* (2013) consider FI as a means to create sustainable solutions. As a consequence, *FI may be considered as a new technological paradigm that participates with the sustainable development approach*. To some extent, frugality might be considered as a first step towards sustainability. It remains true that FI is basically a new technological paradigm in an economic context that is poor in resources.

---

19 Frugal innovation is basically focused on the investigation of poor classes in (emerging) markets as target groups (Zeschky *et al.*, 2011).

As a very first conclusion we do not argue that FI *always* and everywhere has clear environmental benefits. We have given evidence showing FI *often* has positive impacts on the environment. In that sense FI is “weakly sustainable”²⁰.

5. SUSTAINABLE INNOVATION AND FRUGAL INNOVATION AS RESPONSIBLE INNOVATION

When companies pursue sustainability, it is usual to demonstrate that they are socially responsible (Nidumolu *et al.*, 2009). FI is also at the heart of the responsibility challenge. We assume that SI and FI have characteristics of Responsible Innovation (RI thereafter). We need to give more details on the notion of responsibility at the core of the analysis.

A deep-seated attention to moral values and societal concerns has emerged in the studies on applied technology, innovation and engineering (Van den Hoven, 2013, 2014). Broadly defined, responsible innovation refers to the analysis of the moral acceptability of innovation. As far as procedural notion is concerned, RI thereafter refers to a process of new technology creation that requires certain norms “like accountability, inclusiveness, due care and transparency” (Van den Hoven, undated)²¹.

---

20 In the previous section, we noted the existence of diverse kinds of frugal innovation (see Table 1). We are now able to explore whether or not their characteristics are related to sustainability. Still following Brem and Wolfram (2014), amazingly, they found that sustainability shapes the most important attributes of Gandhian innovation and grassroots innovation, while for jugaad innovation, frugal engineering has neither social nor ecological efforts as central attributes. Grassroots innovation establishes a concept based on both social and ecological concerns. It is clearly defined as sustainable innovation. It acknowledges inventor social integrity, aims to include poor people, and is primarily designed to reduce or eliminate drudgery. Two properties are also important: 1) communication between local people plays an important role in encouraging it 2) it is created by local people with their available resources (Gupta 2008, p. 58). As an important conclusion, ecological understanding constitutes an important factor in grassroots innovation.

21 For von Schomberg (2011), a responsible innovation matches “A transparent, interactive process by which societal actors and innovators become mutually responsive to each other with a view to the (ethical) acceptability, sustainability and societal

We now have to consider in depth the concept of responsibility that lies behind RI. An innovator is also a citizen. He (she) must remain individual, working for the wellbeing of society. Responsibility in that context of innovation means that he (she) has to take into account all the actors and acknowledge their different roles. The innovator should consider all the people that the innovation may reach: customers (current or potential), workers, people living in the city, actors in the diverse networks in which the innovator is involved, and so on. It is really more difficult to define what is firm responsibility. Here we follow Pavie *et al.* (2014): “The first difficulty of a firm’s responsibility is to know where its responsibility lies. Who is responsible for what, how and where? If we understand where a person’s responsibility lies towards himself and his environment, it is important to understand where said responsibility lies within a company. Is it at the level of employees? Management, shareholders and boards (executive, board of overseers, etc.)? To a certain extent, this extends the scope of responsibility to include boards of directors, the press and the public. In that sense, all these actors become interlocutors to whom the firm must answer. Responsibility is thus no longer individual, it becomes shared and versatile”. Nevertheless, the manager as an individual and the corporation as a whole are the principal stakeholders.

We here consider four visions for responsibility in relation to business and innovation activity:

1. The notion of responsibility is linked to the notion of being accountable for one’s actions. This latter notion is important as it introduces the notion of the obligation to “answer to”. In English, the notions of responsibility and accountability are close, if not identical.
2. Another notion of responsibility aims to think of this as conforming to regulation. This is important because it enables one to separate the notion of this and of corporate social responsibility (CSR). To be and to act in conformity with the law is important because the many economic agents in many countries defraud or break the law. The law is the basic reference for all economic and social behaviors.

---

desirability of the innovation process and its marketable products (in order to allow a proper embedding of scientific and technological advances in our society).”

3. Corporate social responsibility establishes another vision of firm responsibility. There are many notions of CSR. Each scholar uses his own definition. In this context, the definition by the European Commission matters:

“Corporate social responsibility (CSR) is a concept whereby companies integrate social and environmental concerns in their business operations and in their interaction with their stakeholders on a voluntary basis. It is about enterprises deciding to go beyond minimum legal requirements and obligations stemming from collective agreements in order to address societal needs. Through CSR, enterprises of all sizes, in cooperation with their stakeholders, can help to reconcile economic, social and environmental ambitions. As such, CSR has become an increasingly important concept both globally and within the EU, and is part of the debate about globalization, competitiveness and sustainability. In Europe, the promotion of CSR reflects the need to defend common values and increase the sense of solidarity and cohesion²².”

If each firm has its own way to implement CSR guidelines, each looks like the other, in that they respect the current legislation but go a (many) step(s) beyond. In a nutshell, CSR does more, or does better, than what is recognized as legal (that remains the norm). According to Crane *et al.* (2008), empirical research has been unable to agree on the answer to the one question that has dominated CSR research, which is whether CSR is good for business or not. Consequently, it is sometimes argued that CSR is best understood, not as a concept, a construct, or a theory, but as a field of scholarship. This view is a little exaggerated. The works produced by Porter provide a solution to this apparent paradox. Porter and Kramer (2006, 2011) envisage two types of CSR: strategic CSR (also called proactive), and responsive CSR (also called reactive CSR). Strategic CSR requires an alignment between CSR and the firm's development strategy, which then creates a virtuous circle that allows innovation activities to develop. In contrast, responsive CSR matches the

---

²² A special issue on *Corporate Social Responsibility and Sustainability* has been published by the *Journal of Business Ethics* (Volume 130, Issue 4). The main objective is to develop research on corporate social responsibility (CSR) and provide implications to corporations for their sustainable development. CSR is not just a strategy of risk management, it is also a practice with foresight for sustainable success and ultimate benefits.

most basic definition of CSR “acting as a good corporate citizen, attuned to the evolving social concerns of stakeholders, and mitigating existing or anticipated adverse effects from business activities” (Porter and Kramer, 2006). Bocquet *et al.* (2013) emphasize the relevance of this taxonomy by emphasizing that firms with a strategic CSR profile are more likely to innovate in both products and processes. In contrast, adopting responsive CSR practices significantly alters a firm’s capacity to innovate, through the creation of barriers to innovation. The two types of CSR profiles matter in explaining a firm’s innovation behavior. Thus it is argued that it is not the existence of CSR as a behavior implemented by firms that matters in terms of accounting for firm innovative performance, *but the type of CSR*. As a consequence, it may be that we have the beginning of an explanation to the CSR paradox noted by Crane *et al.* (2008).

How should we conclude? Responsibility through CSR that goes beyond the legal norms, chiefly when it is strategic, offers a framework for a win-win game for the stakeholders. It allows an increase in firm efficiency and economic development (Bocquet *et al.*, 2013). In return, economic growth can become more inclusive and push sustainable solutions. CSR might be the institutional framework pulling responsible innovation.

4. A final perspective on responsibility is related to the ethics of science and technology research. The democratic governance of science and innovation activity is a major challenge, not only for scholars and researchers, but also for decision makers, or simply citizens. It is a huge chapter that we do not wish to open in this paper. Suffice to say that in general, in such a framework, responsible innovation is designed in order to address social and ethical concerns. Researchers and the public must be well informed and well organized in order to take fair decisions (the issue of governance is at stake here). In this perspective, Stilgoe *et al.* (2013) have suggested a framework. It is based on the fact that responsible innovation has to fill four dimensions with general application and relevance: anticipation, reflexivity, inclusion and responsiveness. Although the framework for responsible innovation was designed for use by the UK Research Councils and the scientific communities they support, we argue that it has a very general scope that can be applied to R&D and innovation activity in many contexts.

To sum up, because of its concern for inclusive growth and development and environmental improvement SI is, without any doubt, responsible²³. For example, SI fits particularly well with the CSR perspectives outlined by the CSR approach. The case of FI is more complicated. This type of innovation is deployed in order to fulfill the needs of those with low incomes. As a consequence, it is partly related to RI because it targets inclusion. It does not always have environmental benefits, although it does not aim at environmental degradation. As a consequence, it is not possible to argue that FI is always and everywhere RI. We can say the same for Gandhian, grassroots and catalytic innovations that are close to FI (see Brem and Wolfram, 2014).

CONCLUSION

In this conceptual paper we contribute to the analysis of recent forms of innovation by jointly assessing the characteristics, determinants and consequences of SI and FI in relation to sustainability principles. We have shown how SI and FI tend to enrich the field of *Innovation Studies*. They also establish the features of a new model of innovation that fits well with the current socio-economic challenges that economic players face, mainly based on environmental progress and social concerns (sustainability). Of course, we show that SI is fully at the core of sustainability, FI less so, because the environmental concerns are not at the heart of this kind of innovation. Consequently, we argue that FI is “weakly sustainable”.

The main limitation of our study is that we have built a conceptual analysis based on a literature survey and our own expertise in that field. We did not conduct a new empirical analysis. A number of research agendas deserve particular attention. A better understanding of SI appears to be necessary: knowing its determinants, its consequences, its relationships with corporate social responsibility. The variety of its forms should be a fascinating topic, in particular the relationship between the Developed World (the North) and less developed areas (the South). With respect to FI,

---

23 In the framework of the World Forum for a Responsible Economy the question of sustainability is at the core of discussions and debates.

an assessment of its consequences on sectoral growth and macroeconomic dynamic would be welcome²⁴.

Our analysis suggests at least two lines of research on SI and FI. First, knowing that the two kinds of innovations have high social benefits with a low private rate of return, public policy matters in this context. What could be a public policy in favor of FI? It is a question of a new research agenda. Second, up to now we have no evidence regarding the level of diffusion of FI in the North and the South. As a consequence, surveys with, for instance, the format of the Community Innovation Survey, will be welcome.

REFERENCES

- ARORA, A., GAMBARDILLA, A. (1994), "The Changing Technology of Technical Change: General and Abstract Knowledge and the Division of Innovative Labour", *Research Policy*, 23(5), 523-532.
- AYRES, R., (2008), "Sustainability economics: Where do we stand?", *Ecological Economics*, 67(2), 281-310.
- BAKER, T., NELSON, R. (2005), "Creating something from nothing: resource construction through entrepreneurial bricolage", *Administrative Science Quarterly*, 50, 329-366.
- BASU, R., BANERJEE, P., SWEENEY, E. (2013), "Frugal Innovation: Core Competencies to Address Global Sustainability", *Journal of Management for Global Sustainability*, 1(2), 63-82.
- BELLMAN, E. (2009), "Indian Firms Shift Focus to the Poor", *The Wall Street Journal*, October 20, A.1.
- BOCQUET, R., LE BAS, C., MOTHE, C., POUSSING, N. (2013), "Are firms with different CSR profiles equally innovative? An empirical analysis with survey data", *European Management Journal*, 31(6), 642-654.
- BREM A., WOLFRAM, P. (2014), "Research and development from the bottom up", Introduction of "Terminologies for new product development in emerging markets", *Journal of Innovation and Entrepreneurship*, 3(9), 1-22, <http://www.innovation-entrepreneurship.com/content/3/1/9>.
- BREM, A., 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.
- Brundtland Commission (1987), *Report of the World Commission on Environment and Development: Our Common Future*. Oxford: Oxford University Press.

---

24 It might be that SI sets up a real sub system of innovation across sectors and countries (on the notion of sub system see Mignon et al., 2014).

- BRUNNERMEIER, S. B., COHEN, M. A. (2003), "Determinants of Environmental Innovation in US Manufacturing Industries", *Journal of Environmental Economics and Management*, 45(2), 278-293.
- CRANE, A., MATTEN, D., MCWILLIAMS, A., MOON J., SIEGEL D. (2008), "Corporate Social Responsibility Agenda", in *The Oxford Handbook of Corporate Social Responsibility*, Oxford University Press.
- CHRISTENSEN, C. M. (2006), "The ongoing process of building a theory of disruption", *Journal of Product Innovation Management*, 23(1), 39-55.
- DOSI, G. (1982), "Technological Paradigms and Technological Trajectories: A Suggested Interpretation of the Determinant and Direction of Technological Change", *Research Policy*, 11(3), 147-162.
- EAGAR, R., VAN OENE, F., BOULTON, C., ROOS, D., DEKEYSER, C. (2011), *The Future of Innovation Management: The Next Ten Years*, Prism 1.
- FAGBOHOUN, S. (2016), « Innovation frugale, effectuation et Fablabs : des pratiques à croiser pour penser l'innovation différemment », *Innovations*, 51, 27-46.
- GABLE, C., SHIREMAN, B. (2004), "The stakeholder imperative", *Environmental Quality Management*, 14(2), 1-8.
- GEORGE, G., MCGAHAN, A. M., PRABHU, J. (2012), "Innovation for Inclusive Growth: Towards a Theoretical Framework and a Research Agenda", *Journal of Management Studies*, 49(4), 661-683.
- GUPTA, V. (2008), "An inquiry into the characteristics of entrepreneurship in India", *Journal of International Business Research*, Special Issue 1, 7(S1), 53-69.
- GUPTA, A. K., WANG, H. (2009), *Getting China and India right: Strategies for leveraging the world's fastest growing economies for global advantage*, Josey-Bass Wiley.
- HALL, J., VREDENBURG, H. (2003), "The Challenges of Innovating for Sustainable Development", *MIT Sloan Management Review*, 45(1), 61-68.
- HAUDEVILLE, B., LE BAS, C. (2016a), « L'innovation frugale : une nouvelle opportunité pour les économies en développement ? », *Mondes en développement*, 173, 11-28.
- HAUDEVILLE, B., LE BAS, C. (2016b), « L'innovation frugale, paradigme technologique récent ou nouveau modèle d'innovation ? », *Innovations*, 51, 10-25.
- HAUDEVILLE, B., WOLFF, D. (2016), "How could standardization support the production and diffusion of frugal innovations?", *Journal of Innovation Economics and Management*, 21, 27-37.
- HALL, J., VREDENBURG, H. (2003), "The challenges of innovating for sustainable development", *MIT Sloan Management Review*, 45(1), 61-68.
- HOBDAI, M. (2005), "Firm-Level Innovation Models: Perspectives on Research in Developed and Developing Countries", *Technology Analysis & Strategic Management*, 17(2), 121-146.
- HOVEN, M. J. et al. (Eds.) (2014), *Responsible Innovation*, Dordrecht: Springer, pp. 3-13.
- HOWARD, M. (2011), "Will frugal innovation challenge the west?", *Market Leader Quarter*, 53(3).
- KEMP, R., FOXON, T. (2007), "Typology of eco-innovation. European Project 'Measuring eco-innovation'" (Call FP6-2005-SSP-5A, Area B, 1.6, Task 1).
- KEMP, R., SCHOT, J. W., HOOGMA, R. (1998), "Regime shifts to sustainability through processes of niche formation: the approach of strategic niche management", *Technology Analysis & Strategic Management*, 10, 175-195.

- KETATA, I., SOFKA, W., GRIMPE, C. (2014), "The Role of Internal Capabilities and Firms' Environment for Sustainable Innovation: Evidence for Germany", *R&D Management*, 45(1), 60-75.
- KETATA, I., MCINTYRE, J. (2010), "The challenge of implementing a sustainable development innovation in multinational companies", The Academy of Management Conference, August 2010, Montréal, Canada.
- KUMAR, N. (2008), "Internationalization of Indian enterprises: patterns, strategies, ownership advantages, and implications", *Asian Economic Policy Review*, 3, 242-261.
- LE BAS, C. (2016a), "Milestones towards the Economics of Frugal Innovation", *Journal of Innovation Economics and Management*, 21, 3-6.
- LE BAS, C., (2016b), "Frugal innovation, Sustainable innovation, Reverse innovation. Why they look alike? Why they are different?", *Journal of Innovation Economics and Management*, 21, 9-21.
- MARIC, J., RODHAIN, F., BARLETTE, Y., (2016), "Frugal innovations and 3D printing: insights from the field", *Journal of Innovation Economics and Management*, 21, 57-76.
- MAZZUCATO, M., JACOBS, M. (2016), *Rethinking Capitalism: Economics and Policy for Sustainable and Inclusive Growth*, John Wiley & Sons Inc.
- MICAËLLI, J.-P. (2016), « Comprendre l'innovation frugale : le diptyque proposé par Navi Radjou et ses co-auteurs », *Innovations*, 51, 95-104.
- MIDLER, C., JULLIEN, B., LUNG, Y. (2017), *Innover à l'envers : repenser la stratégie et la conception dans un monde frugal*, Paris, Dunod, coll. « Stratégie d'entreprise ».
- MIGNON, S., TEMPLE, L., TEMRI, L., TOUZARD, J.-M. (2014), « Éditorial », *Innovations*, 43(1), 5-11.
- MULDER, K. F. (2007), "Innovation for sustainable development: from environmental design to transition management", *Sustain Sci*, 2, 253-263.
- NAMEROFF, T. J., GARANT, J., ALBERT, M. B. (2004), "Adoption of Green Chemistry: An Analysis Based on US Patents", *Research Policy*, 33(6-7), 959-974.
- NIDUMOLU, R., PEAHALAD, C. K., RANGASWAMI, M. R. (2009), "Why Sustainability Is Now the Key Driver of Innovation", *Harvard Business Review*, 87(9), 57-64.
- NOCI, G., VERGANTI, R. (1999), "Managing 'green' product innovation in small firms", *R&D Management*, 29(1), 3-15.
- NUNES, P. F., BREENE, T. S. (2011), *Jumping the S-Curve: How to Beat the Growth Cycle, Get on Top, and Stay There*, Harvard, Harvard Business Review Press.
- PASSET, R. (1979), *L'Économie et le vivant*, Paris : Payot.
- PAVIE, X., SCHOLTEN, V., CARTHY, D. (2014), *Responsible Innovation: From Concept to Practice*, World Scientific.
- PAVITT, K. (2003), "The Process of Innovation", SPRU WP Paper No. 89, 47 p.
- PORTER, M. E., KRAMER, M. R. (2006), "Strategy and society", *Harvard Business Review*, December, pp. 77-92.
- PORTER, M. E., KRAMER, M. R. (2011), "The big idea. Creating value. How to reinvent capitalism – and unleash a wave of innovation and growth", *Harvard Business Review*, January-February.
- PRAHALAD, C. K., MASHELKAR, R. A. (2010), "Innovation's Holy Grail", *Harvard Business Review*, 88(7-8), 132-141.
- RADJOU, N., PRABHU, J., AHUJA, S. (2011), "Use jugaad to innovate faster, cheaper, better", *Harvard Business Review*. Retrieved from http://blogs.hbr.org/cs/2011/12/think_like_an_indian_entrepre.html. Accessed 12.03.2012.

- RADJOU, N., PRABHU, J., AHUJA, S. (2013), *L'Innovation jugaad : redevenons ingénieux !*, Paris : Éditions Diatino.
- REDDY, M. (2011), "Indo-US trade: co-creating value", *The Indian Journal of Management*, 4(1), 1-2.
- ROTHWELL, R. (1994), "Towards the Fifth-generation Innovation Process", *International Marketing Review*, 11(1), 7-31.
- ROTHWELL, R., (1992), "Developments towards the fifth generation model of innovation, Technology", *Analysis and Strategic Management*, 4(1), 73-75.
- SACHS, J. D. (2015). *The Age of Sustainable Development*, New York: Columbia University Press.
- SCHALTEGGER, S., WAGNER, M. (2011), "Sustainable entrepreneurship and sustainability innovation: categories and interactions", *Business Strategy and the Environment*, 20(4), 222-237.
- SCHOT, J., GEELS, F. W. (2008), "Strategic niche management and sustainable innovation journeys: theory, fitrateg, research agenda, and policy", *Technology Analysis & Strategic Management*, 20(5), 537-554.
- SEYFANG, G., SMITH, A. (2007), "Grassroots innovations for sustainable development: towards a new research and policy agenda", *Environmental Politics*, 16(4), 584-603.
- SHRIVASTAVA, P. (1995), "Environmental technologies and competitive advantage", *Strategic Management Journal*, 16, 183-200.
- STILGOE, J., OWEN, R., MACNAGHTEN, P. (2013), "Developing a framework for responsible innovation", *Research Policy*, 42(9), 1568-1580.
- SWANN, G. M. P. (2009), *The Economics of Innovation: An introduction*, Cheltenham: Edward Elgar.
- TIDD, J. (2006), *From Knowledge Management to Strategic Competence: Measuring Technological, Market and Organisational Innovation*, 2nd ed., vol. 3, London: World Scientific Publishing.
- TIWARI, R., HERSTATT, C. (2017), *Lead Market India: Key Elements and Corporate Perspectives for Frugal Innovations*, Cham: Springer.
- TIWARI, R., KALOGERAKIS, K., (2016), "A Bibliometric Analysis of Academic Papers on Frugal Innovation", Working Paper, August. Technische Universität Hamburg, Hamburg.
- TIWARI, R., FISCHER, L., KALOGERAKIS, K. (2017a), "Frugal innovation in Germany: A qualitative analysis of potential socio-economic impacts", Working paper No. 96. Hamburg, Institute for Technology and Innovation Management, Hamburg University of Technology.
- TIWARI, R., FISCHER, L., KALOGERAKIS, K. (2017b), "Frugal Innovation: An Assessment of Scholarly Discourse, Trends and Potential Societal Implications", in *Lead Market India* (pp. 13-35), Cham: Springer.
- VAN DEN HOVEN, J. (2014), "Responsible Innovation: A New Look at Technology and Ethics", in J. Van den Hoven, N. Doorn, T. Swierstra, B. J. Koops, H. Romijn (Eds.), *Responsible innovation 1: innovative solutions for global issues*. Dordrecht: Springer.
- VAN DEN HOVEN, J. (2013), "Value sensitive design and responsible innovation", in R. Owen, J. Bessant, M. Heintz (Eds.), *Responsible innovation* (pp. 75-84), Chichester: Wiley.

- VAN DEN HOVEN, J. (undated), "Responsible Innovation in brief", http://www.tbm.tudelft.nl/fileadmin/Faculteit/TBM/Over_de_Faculteit/Decaan/Responsible_Innovation_in_brief.pdf.
- WAGNER, M. (2007), "The Link between Environmental Innovation, Patents, and Environmental Management", DRUID, Working Papers No. 07-14, Danish Research Unit for Industrial Dynamics. Copenhagen, Denmark.
- VON SCHOMBERG, R. (2011), "Prospects for technology assessment in a framework of responsible research and innovation", in M. Dusseldorp, R. Beecroft (Eds.), *Technikfolgen Abschätzen Lehren: Bildungspotenziale Transdisziplinärer Methoden*, Wiesbaden: VS Verlag für Sozialwissenschaften.
- WOOLRIDGE, A. (2010), "The Charms of Frugal Innovation, Special report", *The Economist*, 5 April.
- YOON, E., TELLO, S., (2009), "Drivers of Sustainable Innovation: Exploratory Views and Corporate Strategies", *Seoul Journal of Business*, 15(2).
- ZESCHKY, M. B., WINTERHALTER, B., GASSMANN, O. (2011), "Frugal Innovation in Emerging Markets", *Research-Technology Management*, 54(4), 38-45.
- ZESCHKY, M. B., WINTERHALTER, B., GASSMANN, O. (2014), "From Cost to Frugal And Reverse Innovation: Mapping the Field and Implications for Global Competitiveness", *Research-Technology Management*, 57(4), 20-27.
- ZESCHKY, M. B., WINTERHALTER, B., GASSMANN, O. (2011), "Frugal Innovation in Emerging Markets", *Research-Technology Management*, 54(4), 38-45.