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Frugal innovation in Germany: A qualitative analysis of potential socio-economic impacts

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ABSTRACT

Frugal innovation is gaining traction globally, not only in emerging economies, but also in the industrialized world. The root causes of frugality's acceptance as a societal value may however differ according to the social context, especially between the developing and the developed world. In this paper we present the results of a trend analysis in Germany that has been conducted as a part of a BMBF-supported project aiming to investigate "Potentials, Challenges and Societal Relevance of Frugal Innovations in the Context of Global Innovation Competition". The research was conducted in two steps. In a first step preliminary insights were generated by an extensive literature review and 3 focus groups with 30 experts discussing the relevance of frugal innovation for Germany. These insights were then verified in 20 semi-structured interviews with additional experts from cross-sections of the German society. The experts opined that frugal products and services (should) focus on the customers' core needs and reduce unnecessary complexity while adhering to high quality standards. They predicted a trend towards frugal solutions in Germany due to a complex interplay of various factors. One notable factor was a growing appreciation of moderation and voluntary simplicity by parts of the German society leading to "frugal choices". The second widespread consensus was that frugal innovations are necessary to secure long-term competitiveness of German companies in fast-growing, unsaturated markets in the emerging economies. Several challenges were pointed out concerning the actual implementation of frugal concepts in the product development process. An overwhelming reliance on high tech-driven and complexity-embracing innovation pathways by engineers in German firms was characterized as a powerful obstacle in implementing frugality.

KEYWORDS

Frugal Innovation, Germany, Affordability, Moderation, Emerging Markets, Voluntary Simplicity, Affordable Excellence, Frugality 3.0

1 Introduction

Frugal innovation is gaining traction globally, not only in emerging economies, but also in the industrialized world (see, e.g., Leadbeater, 2014; Radjou and Prabhu, 2015; Zweck et al, 2015; Kroll et al, 2016; Tsujimoto et al, 2016). A survey by the business consultancy firm Roland Berger Strategy Consultants (RBSC) in 2013 suggested that frugal products were “becoming ever more important for Western companies” (RBSC, 2013: 8). The report estimated that frugal products accounted for 12% of sales at the companies surveyed and that their share in sales was “expected to nearly double (to 22%) over the next five years”, i.e., by 2018. In an update issued in June 2015, RBSC (2015: 8) has re-emphasized this observation:

Frugal innovation is continuing to advance in emerging markets and has every chance of making the breakthrough in industrialized countries as well. The financial crisis, recession, stagnating household incomes, and high unemployment have opened the doors wide in a number of European countries, for example. [...] That is the situation today: many causes, but a single, clear trend. By 2018, frugal products will almost double in importance – as a share of both sales and profits – at the companies we surveyed.

The RBSC studies belong to those few – if not the only – studies so far that have attempted to estimate “hard figures” about the actual business of firms with frugal innovations. It is extremely hard – if not entirely impossible – to estimate the exact figures of actual business with frugal products and services. Any estimation owing to methodological limitations necessarily remains subject to debate. Several studies, nevertheless, do point towards the increasing relevance of frugal products and services in both emerging economies and the economically developed world (e.g., Kroll et al, 2016; Tiwari et al, 2017).

The root causes of frugality’s acceptance as a societal value may, however, differ according to the social context, especially between the developing and the developed world. A recent survey with Indian and German students has for example suggested that, other factors remaining constant, the choice of a frugal car by Indian students may be more often almost *singularly* driven by cost considerations, whereas many German students would be influenced in their choice also by factors such as environmental concerns and a deliberate rejection of status symbols (Tiwari, 2017).¹ Other reports, too, confirm growing interest of the young population in the western world in the “sharing economy” and its reduced emphasis on ownership of material things (see, e.g., GlobeScan, 2014; Minkmar, 2015; BrightSide, 2016). Press reports, such as those by Bös (2015) and Höfer (2016), also point to an increasing desire in certain sections of the German society (e.g., the elderly) for “simplified” products that help reduce unnecessary complexity in day-to-day life.

¹ This has led Tiwari (2017) to differentiate between three phases of frugality (1.0, 2.0 and 3.0).

It is, therefore, likely that the determinant factors of acceptance of frugal products and services in a given society, both on demand and supply sides, vary according to the specific social context and, as a result, may affect the society and the relevant “innovation systems”² differently. It is, however, not yet clear what factors play a critical role for the acceptance of frugal innovations in industrialized countries such as Germany. One such factor can be the “attractiveness of the value proposition”, partly but not exclusively reflected in brand image, which has been pointed out in some studies (Karamchandani et al, 2011; Tiwari and Herstatt, 2014; Chakravarti and Thomas, 2015). However, this factor still points to the customer perception of *individual utility* derived from a specific product or service. The survey by Tiwari (2017), on the other hand, points additionally to the *social motivation* (e.g., environmental concerns) in purchase decisions regarding frugal products. It is to understand such underlying mechanisms and their (long-run) implications that state institutions such as Germany’s Ministry of Education and Research (BMBF) and the European Commission have begun to place frugal innovation on their research agenda and to analyse the expected socio-economic impacts of frugal innovation (see, BMBF, 2014; European Commission, 2015).

In this paper, we present the results of a trend analysis in Germany that has been conducted as part of a BMBF-supported project that investigates the “Potentials, Challenges and Societal Relevance of Frugal Innovations in the Context of Global Innovation Competition”. The trend analysis was executed in two steps: The first step (WP1) was to generate initial insights regarding the relevance of frugal innovation in industrialized countries. This part was based on an analysis of the historical developments, a thorough literature and media review as well as a workshop with 30 relevant stakeholders from business, industry, science, and the civil society. Participants of the workshop were divided into 3 focus groups for the purpose of domain-related, in-depth discussions. These results, obtained as a part of Work Package (WP) 1 of the project, have already been reported in Tiwari, Fischer and Kalogerakis (2016).

In a second step (WP2), whose results are to be presented in this paper, preliminary insights generated in WP1 were channelized into identification of some key trends and the formulation of crucial open questions for the purpose of further investigation and validation through expert interviews. A total of 20 semi-structured interviews with experts from cross-sections of the society – science, business, politics, and the civil society – were conducted to examine these preliminary insights. A particular aim of this publication is to present and discuss the results of these interviews using the thick description method (Barzelay, 1993;

² Innovation systems can be categorized on national (Nelson, 1993; Dosi, 1999), regional (Freeman, 2002; Cooke, 2010) and sectoral (Malerba, 2002) levels. They have, however, come under strain due to blurred firm boundaries in the era of cross-border innovation activities (Patel and Pavitt, 2000; Howells, 2003). Some scholars have also spoken of a “global innovation system” (Spencer, 2003; Ernst, 2005), but this term has so far remained limited in use probably owing to its all-encompassing scope and the resultant difficulty of operationalization.

Ponterotto, 2006) and to make well-informed propositions concerning the trend of frugal innovation in the specific context of Germany. The overall argument is that there are clear indications for a growing relevance and demand for frugal solutions in Germany. Furthermore, potential benefits and challenges for German businesses that (begin to) innovate frugally are elaborated and policy recommendations are presented.

The remainder of this paper is organised as follows: The research approach is discussed in section 2, while the presentation and elaboration of the research results can be found in section 3. The results shall particularly focus on the understanding of frugal innovation by the selected group of experts and their opinion on its potential for the German industry and the challenges faced by firms in implementing frugal innovations. We also present some policy recommendations by the interviewed experts in this section. The paper concludes with a summarizing discussion in section 4.

2 Research Approach

2.1 Initial Insights

Studies conducted during WP1 revealed that frugality has, for many centuries and across the globe, been perceived as a positive social value. However, in the western world of the 20th century, this positive connotation apparently changed into a rather negative association, “when aspiration for ‘ever-bigger and better’ solutions and the quest for unending growth in the face of saturated markets in the economically developed world led to practices like planned obsolescence” (Tiwari, Fischer, et al, 2016: 11 p.). Today, a change seems to be recurring. Two independent analyses of the social discourse regarding the perception of frugality and frugal innovation in the German media, suggested that certain groups of the German society have recently (re-)started to value frugal solutions (Bergmann and Tiwari, 2016; Fischer and Dauth, 2016). This result was also confirmed by the focus group analysis which was part of the workshop in WP1.

While participants of the workshop were unanimous in their positive assessment of frugality turning into a necessary and noteworthy trend in Germany, they also suggested that a major mind-shift might be required in the industrialized world in general, and in Germany in particular, to fully realize the potentials of frugal innovations. Challenges were seen “in innovation management and marketing, but also in cultural changes needed to adopt a frugal mind-set” (Tiwari, Fischer, et al, 2016: 20). Motivating engineers and managers responsible for product development to embrace a frugal mind-set and design frugal processes were seen as major tasks to be resolved (Tiwari, Fischer, et al, 2016).

The workshop was complemented by speeches from Mr. Bernd Mützelburg (former ambassador of Germany in India), Mr. Dirk Matter (Managing Director of the Dusseldorf office of the Indo-German Chamber of Commerce) and Mr. Wolfgang Hoeltgen (Director of

the German-Indian Business Center in Hannover and an entrepreneur) who spoke about opportunities and challenges for German companies regarding frugal innovation.³

All three experts regarded frugal innovation as a very important topic for German companies in today's global competition. A recurring topic was the need for the localization of products, i.e. product adjustments to regional markets, which was considered an essential element in frugal innovation. Careful need-assessments were, hence, regarded as very important to develop a competitive frugal design. It was suggested that German high-end products are becoming increasingly complex and are, as a result, often not the first choice for many customers in the rapidly growing emerging markets. They also cautioned that frugality must not be mixed up with "cheapness", but that it is rather concerned with providing a better cost-benefit ratio for the user/owner. In this context Mr. Mützelburg asked: "Can we preserve our jobs in the long term? Will we be able to be a successful economy in the world in the long term?" He perceived the topic of frugal innovation as "...really a key issue of the long-term viability of our German economy, the long term competitiveness." In a similar vein Mr. Matter saw a potential threat emanating from competitors from China, in particular for engineered goods and the automotive industry. Simple and effective products from China, in his opinion, are increasingly competing with German products at industrial fairs. He suggested that a frugal innovation strategy for German companies might be beneficial as a complementary approach to the high-tech strategy which is often associated with the pursuit of technical perfection. Both Mr. Matter and Mr. Hoeltgen emphasized that the German SME sector needs support to compete in the emerging markets of Asia. Mr. Hoeltgen also requested a development guide for engineers that can be used to teach German engineers how to develop frugal innovations.

As another result of WP1, it was also discovered that the relevance of frugality for Germany is often intrinsically linked to environmental sustainability goals and the establishment of a circular economy, so that frugal innovations can also be seen as "responsible innovations"⁴ (Tiwari, Fischer, et al, 2016: 22). Mr. Mützelburg and Mr. Hoeltgen also linked the issue of environmental sustainability with frugal innovation. Affordability, Mr. Hoeltgen believes, should be related to the question of what a society can afford, too. This would mean that "affordable excellence" ought not to be measured merely in terms of monetary affordability but should necessarily also deal with the question of societal and environmental affordability. And Mr. Mützelburg stated: "...we really need to minimize the use of resources and to maximize the output, the utility value for customers." In another interaction, Mr. Hoeltgen suggested defining frugal innovations as a "Meet the Need" paradigm to emphasize the optimum resource utilization aspect.

³ The three speeches in German language are available at the [You-Tube Channel TIM-TUHH](#).

⁴ For "responsible innovations" see, e.g., Bogner, Decker and Sotoudeh (2015) and von Schomberg (2015).

Altogether, insights from WP1 indicate that the value of frugality currently undergoes a renaissance as it can be positively linked with current social and environmental challenges. However, a number of open questions remain concerning the management of frugal innovation and the associated diffusion processes in different societies.

2.2 Methodology

Based on the insights of the first part of the trend analysis (WP1) an interview guideline was developed consisting of six main sections. The sections included the experts' perception (understanding) of frugal innovations and their perceived potential for the German society and industry. In addition, questions on probable management challenges in implementing frugal innovations and influencing contextual factors were discussed. Furthermore, the need of eventual political action was assessed and finally, the experts' views on any further open questions concerning this topic from a scientific research perspective were sought.

The aim was to discuss these topics with relevant stakeholders from academic and research institutions ("science"), business and civil society including the policy/politics perspective in Germany. Since the study is set in the specific German context, only interviewees living and working in Germany – though not necessarily all German nationals – were selected. Potential candidates for interviews were identified during our literature and media review and contacted by phone and/or by e-mail. Those consenting to interview were interviewed in person where feasible, otherwise by telephone. The interview length varied between one and two hours, on average taking about 90 minutes. All interviews were recorded with the explicit permission of the interviewees and transcribed for evaluation purposes. Interviewees generally emphasised that they were sharing their personal views and not speaking on behalf of their respective organisations. Based on the transcripts, a further content-analysis was conducted to aggregate important and recurring statements. All in all 20 interviews were conducted (Table 1).⁵

Background of Interviewees		
Science	Business	Civil Society and Politics
9	7	4

Table 1: Overview of conducted interviews

At the beginning, the interviewees were asked to describe their perception of frugal innovation and to state examples illustrating their understanding. It was ensured that a common understanding of frugal innovation formed the base of our discussion. If clarification was needed, we referred to our definition given in Tiwari, Fischer and Kalogerakis (2016: 16):⁶

⁵ A more detailed overview about the interviewed experts is in the appendix.

⁶ This definition also builds the base for our study throughout this paper.

Frugal innovations seek to create attractive value propositions for their targeted customer groups by focusing on core functionalities and thus minimizing the use of material and financial resources in the complete value chain. They substantially reduce the cost of usage and/or ownership while fulfilling or even exceeding prescribed quality standards.

3 Presentation of Results

3.1 Understanding of frugal innovations

It was discovered that the basic underlying “idea” of frugal innovation was intuitively clear to all respondents, even though the exact term was not necessarily known to everyone. Here some differences could be observed between experts from the field of business (almost all of whom knew the term) and those from the civil society (some of whom had not heard of the term before). Since business experts often deal with global trends and especially with developments in fast emerging economies, it might not come as a surprise that many had known the term primarily from resource-constrained settings such as India and Kenya. This is also in line with a recent bibliometric analysis showing that also in the academic literature frugal innovations are often associated with India (Tiwari, Kalogerakis, et al, 2016). Recent scholarly discourse has also suggested that emerging economies can act as “lead markets” for frugal products and technologies (Jänicke, 2014a; Quitzow et al, 2014; Tiwari and Herstatt, 2014).

More particularly, the interviewees stated that frugal innovations ought to focus on core functions and customer needs. Respondents across all domains saw frugal innovations as solutions that *must* enable the right amount of functionality and quality, and stressed the difference to concepts such as Jugaad which aim at cheap, make-do solutions and compromise on quality if needed. Especially some business experts argued that “low-costs” alone ought not to be sufficient for the long-term success of frugal innovations. There seems to be a general consensus on frugal solutions fitting to the actual needs of users and removing unnecessary complexity. In this regard, some experts also pointed out that frugal innovation may include high-tech solutions at lower costs and thereby reduce the need for economies of scale. The emphasis must however be on finding appropriate, effective and resource-efficient solutions. Product developers should not get bogged-down by dogmatic considerations and simplistic formulas such as “low-tech = bad” versus “high-tech = good”. The close connection between frugality-driven innovations and matters of environment and sustainability was also pointed out. Oliver Stengel, currently a research fellow at Hochschule Bochum (Bochum University of Applied Sciences) and author of an award-winning book (see, Stengel, 2011) on sufficiency, consumption-driven society and its ecological crisis stated:

Products should be designed in a way that they can be repaired easily and expanded modularly, so you can upgrade modules without the need to immediately buy a whole

new product or to manufacture it, too. One should make things in a way that they are easy to repair; and they are produced in a way that they have a kind of ‘timeless appearance’ – meaning that they are independent of fashions.

Some experts further emphasized that frugal innovations ought to go beyond being a mere outcome (good or service) and should rather be seen as a process that involves all steps in the corporate value chain. Especially in the B2C segment, so the argument, the majority of consumers do not care about specific development or production processes involved in the products they buy. However, from a company perspective frugal innovation should also be seen as “a certain philosophy or a certain process ... which is very goal-oriented involving a lot of discipline to create certain products or product types” (Business Expert 4).

Geographically, the examples known to the experts were often related to the Indian market – such as the Tata Nano, microfinance institutions in India, or harvesters sold by German firm Claas. Most interviews then, however, also reflected on frugal examples in Germany and Europe and listed discounters such as Aldi, budget airlines like Ryanair, or IKEA, Dacia Logan, Siemens Health Care; adjusted VW Polos or electro cardiograms from GE. Examples in the service industry included apart from budget airlines, shared economy (AirBnB, car sharing) or budget hotels like “motel one”.

3.2 Potentials for Germany

Although the number of frugal examples in the German market known to the interviewees was limited, almost all of them saw clear future potentials for frugal innovations in Germany – as a market and as place for frugal development and production. For both the B2C and the B2B market, frugal innovations were seen to possess potential across sectors, industry and level of technology.

Regarding the development of this trend for the next 5 to 10 years, three basic scenarios seem to be theoretically possible (as depicted in Figure 1):

- (1) Frugal innovation is merely a temporary phenomenon of interest and would develop into a niche phenomenon relevant for small segments of the German society;
- (2) Frugal innovation turns into a significant trend possessing relevance for distinct, but large sections of society
- (3) Frugal innovation develops into a mega-trend well known and appreciated throughout society cutting across social strata.

The analysis of opinions expressed in the interviews suggests that frugal innovations are considered a “highly relevant”, but not necessarily a “dominant” trend in Germany, which is further discussed and elaborated below.

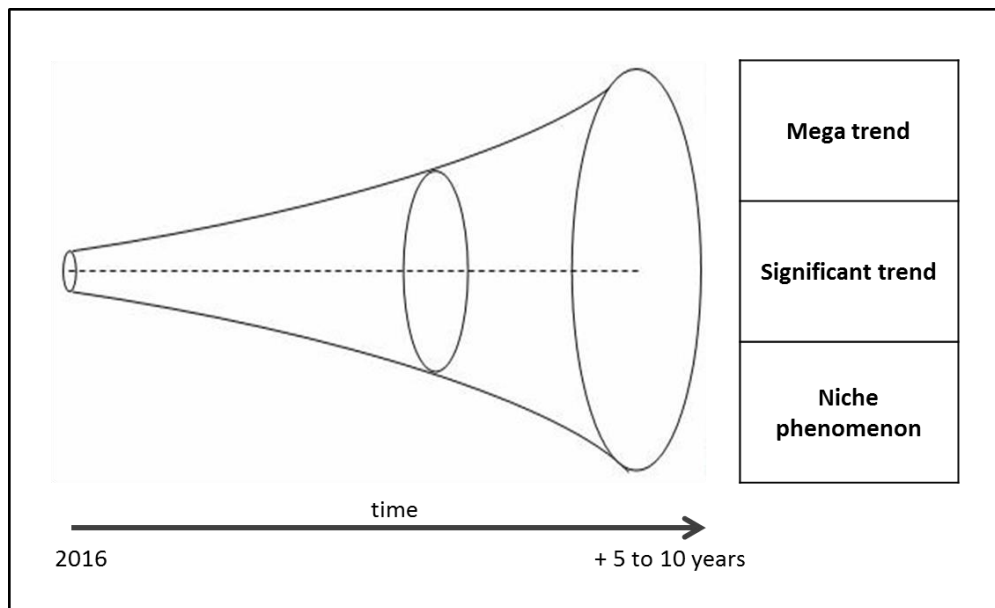


Figure 1: Three potential scenarios for the diffusion of frugal innovations in Germany

The likelihood of the three scenarios based on expert opinion is illustrated in Figure 2.

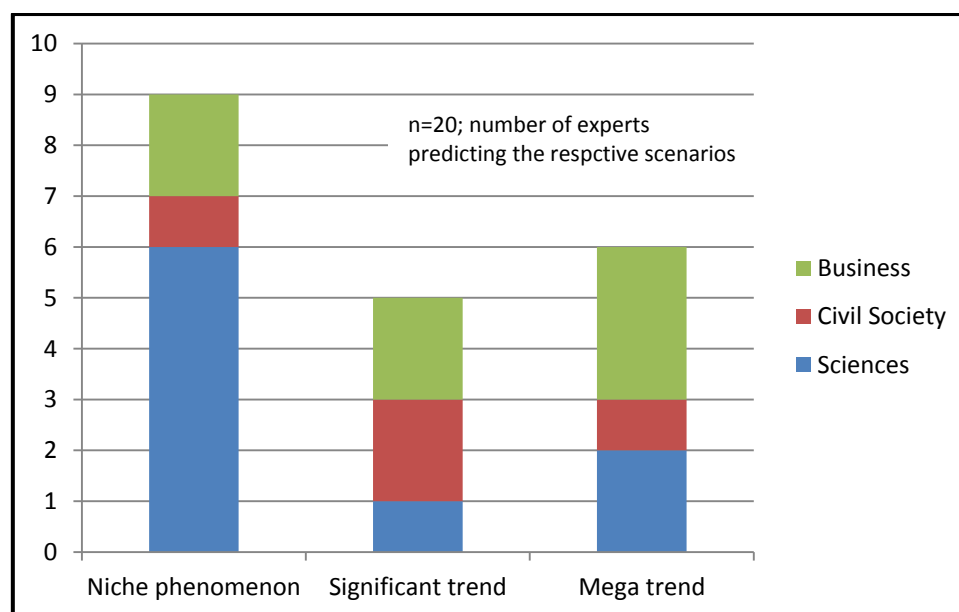


Figure 2: Evaluation of the three potential scenarios in expert opinion

Based on the answers of our interviewees it seems likely that frugal innovation will become a “relevant” trend in Germany, as altogether more than 50% of the interviewees predicted it to become either a significant or even a mega trend in the medium-run. Furthermore, the business experts within our sample are more optimistic than the scientists that we will be dealing with a mega trend of frugal innovation in the future.

As next, this general evaluation was complemented by some specific insights concerning the potential relevance of frugal innovations for private consumers (B2C) and business/institutional consumers (B2B).

For the German B2C market, drivers of frugal innovation seem to relate to particular social groups and their values. Although many German customers, in the opinion of some interviewees, continue to appreciate products with high technological complexity and sometimes use those as a status symbol, most interviewed experts considered frugal innovations as relevant for a variety of market segments in Germany. First, the German market may attract frugal products for reasons of **affordability**, which provides an analogy to the Indian market. This attribute was considered important for parts of the German society who face (strong) financial constraints, including new immigrants. Several times the concern was raised that future scenarios in Germany are plausible and probable which include an increasing social disparity and thereby foster the demand of frugal products and services.

An additional reason for demand for frugal solutions in Germany, in an apparent contrast to the Indian context, was “**frugality by choice**”. The answers of the interviewed experts suggest that there exist social groups in Germany which prefer frugal products although they are affluent enough not to base their purchasing decisions solely on cost factors. “Frugality by choice” can be motivated by a variety of factors as depicted in Figure 3.⁷

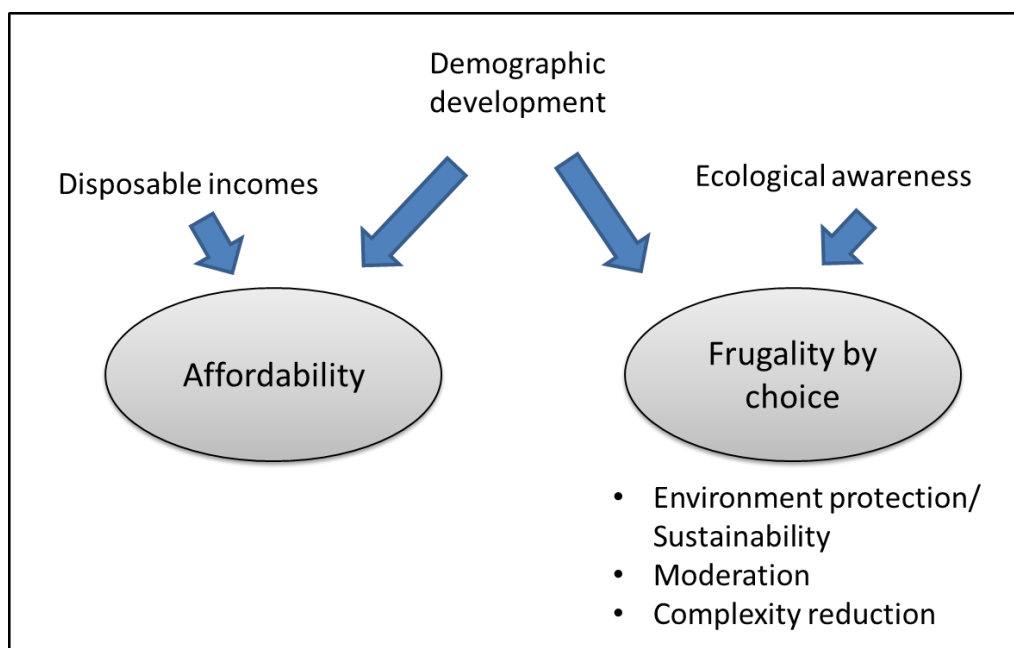


Figure 3: German market for frugal products

Environmental concern is one value considered particularly relevant for Germany. For example the expanding sharing economy was depicted as a frugal trend that is often motivated by **environmental concerns**. A rising environmental awareness in Germany is also connected to the problem of too much packaging waste. It was mentioned twice that

⁷ Also see results of an empirical survey involving students from Germany and other countries as reported by Tiwari (2017).

several “Unverpackt-Läden” were opened in Germany in the last two years offering food products without disposable individual packaging.⁸

Another value carried in frugal innovations is **moderation**. Parts of the German society seem to be longing for simplicity and are therefore trying to avoid overly complex products. This may on one hand be relevant for parts of the younger (hipster/minimalist) generations x and y. “Coolness” and “environment” may, thus, become important “selling factors” in Germany. In addition, older generations sometimes also wish to simplify their lives because they feel overstrained by the complexity inherent in their lives and the products surrounding them.

Our society is aging and the older people become, the more they try to separate themselves from things and to have things easier, because the rest is always a burden ... We need products that the aging population prefers. (Business Expert 3)

The **demographic development** in Germany is another important factor that has the potential to determine the strength of the frugal innovation trend. Elderly people may sometime be unable or unwilling to deal with complex high-tech products or may simply wish to sidestep avoidable (unnecessary) complexity (cf. Hanna, 2012). Hence, frugal solutions based on their actual needs and easy-to-use products will probably be highly valued by many from this section of the population. In addition, the demographic change might also increase poverty among senior citizens and simultaneously also increase the importance of an affordable health-care system in Germany. However, concerning this influence, there was no complete unanimity among the interviewed experts. Some experts cautioned that elderly people may be reluctant to change habits and to deviate from trodden paths. They rather see the frugal innovation trend being based on expectations and wishes of the younger generations.

The values carried by frugal innovations may in addition be promoted by political influence, particularly in education starting already in kindergarten. For example, most interviewees saw a strong appreciation of environmental sustainability in the German society which could be even further increased through **information and education**. Including the topic of frugal innovation into the debate about environmental sustainability and circular economy ought to lead to an increased awareness of frugal choices in Germany. Societal values and frugal products may further reinforce each other. In this context smart marketing and wording were seen as important criteria influencing the perception of frugal products and services in the German society. If the word “frugal” may not be known enough, a connection to complementary words such as “smart” or “sustainable” / “responsible” might be established to increase the demand for frugal products and services.

⁸ See for example the website original-unverpackt.de which also provides links to press-releases

3.3 Frugal innovations from a German business perspective

Most interviewees considered it a risk not to develop frugal products – particularly with respect to emerging markets in the developing world. These were attributed the most important future market for frugal products and services by all interviewees. Considering the growth of population and middle class, particularly in Asia, but also in Latin America and Africa, the interviewees cautioned against not innovating frugally.

However, German companies are faced with increasing pressures concerning cost and process efficiency in most industries. Hence, the majority of our experts see frugality as a value that will lead to **success in all industries** depending on the strategic orientation of the company.⁹ Prof. Dr. Alexander Gerybadze from University of Hohenheim and a former member of the Expert Commission for Research and Innovation to the German Federal Government says that:

“German companies would be well advised to pursue strategies that aim at cost-effective products and solutions appropriate for fast-growing markets in emerging countries. So far, many German companies prefer to sell products that are expensive. They should consider the dynamics of international markets, the concept of going down the learning curve. Managers should keep in mind that not everything is automatically better if it is expensive.”

One of the business experts even stated: “I think it should be relevant for all industries equally. I think this is an approach that will work for all companies” (Business Expert 4). Another interviewee emphasized the relevance of frugal innovation for all sectors by stating: “There is always room for improvement – always” (Business Expert 3). Many products are still based on old designs which could be simplified based on new technologies and materials available now. “...therefore a necessity exists to improve ten year old products – to make them simpler based on the knowledge of today” (Business Expert 3).

Some interviewees saw a special importance for the **German B2B market**. One interviewee argued that, for example, in the automotive industry suppliers are constantly forced to reduce their costs. And frugal components that German automotive suppliers had developed for the Indian market are sold also in Germany. Hence, frugal solutions are already finding their way into German automobiles – no matter if the end-customer demands frugal cars or not or whether the benefits of saving resources are passed on to him/her or not.

And at the end, such frugal innovation is a guarantor for Germany to remain at the technological peak. (Business Expert 5)

Prof. Dr. Martin Jänicke, who is a member of the Advisory Circle (“Beraterkreis”) of the BMBF funding programme *Innovation and Technology Analysis* (“Innovations- und Technikanalyse”) and is co-responsible for the theme of “New Global Innovation Pathways”

⁹ See, e.g., Besanko et al (2013)

says that frugal innovations might be even more attractive in the Business-to-Business (B2B) segment than for end-consumers. In his words:

To take an example from the medical industry: It may be interesting for a doctor to do a blood test with a micro frugal instrument without having to consult a specialized laboratory; for it saves time and costs. I can imagine that service providers may start taking recourse to such simple solutions. The costs are the key driving force for them. The normal customer may not necessarily be the most interesting target for frugal technologies. Patients might sometimes even perceive that cheap products are not good enough. But the experts with their in-depth understanding may be more open. Ultimately it is the hyper complexity of high-tech solutions which is acting as an enabler for frugal solutions.

Having clarified potentials of frugal innovations for German companies, we are now interested in challenges that these companies might encounter when aiming to develop frugal innovations. Our results indicate that **business structures and practices within Germany** are not really favouring frugal solutions at the moment. An overview of our argumentation and challenges that German companies might face is given in Figure 4.

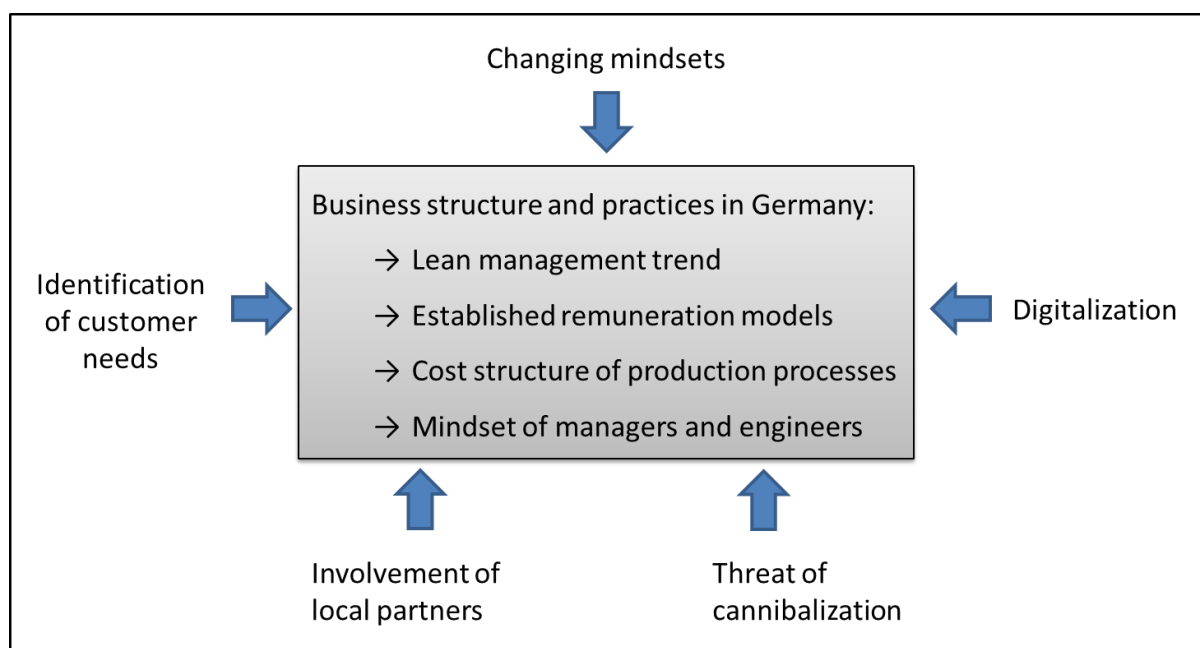


Figure 4: Challenges from a business perspective

From the scientific side it was argued that in a competition-oriented economy the development of frugal products might not be the first choice for companies. Instead of really radically changing their product designs towards frugal solutions, companies will rather tend to cut costs by **lean-management** that for example reduces personnel or warehousing costs. Furthermore, **established remuneration models** may cause barriers of acceptance on account of path dependency. Taking the example of medical equipment, hospitals

accustomed to leasing high-tech gadgets might rather choose fancy solutions that appeal to the medical doctors due to increased affordability of leased equipment.¹⁰

You cannot even find medical gadgets from Poland [in German hospitals], although these are much cheaper. (Business Expert 1)

Also, the concern was raised that **production processes** for frugal solutions are too expensive in Germany. Hence, companies following a frugal strategy might be forced to relocate their production to other countries. The same person bringing up this concern however relativized this point as well. As frugal solutions can be very successful by incorporating high-tech components and are often based on radical innovations, German production sites for frugal products are possible depending on the market segment targeted at. Quality is an essential element of frugal innovations as was discussed above. The production of innovative high-quality frugal products including high-tech components should be possible in Germany.

Digitalization was seen by some experts as one way in which processes are already being managed more efficiently – more frugally. As it allowed for smother and more efficient innovation processes, digitalisation saved time and resources. Besides, digitalisation contributes opportunities in designing human-machine interfaces which are more intuitive in the application and thus reduce complexity for the user.

Looking at the innovation process to develop frugal solutions, a main topic brought up by the interviewees was a **new mind-set needed by engineers** working for German companies. Most interviewees shared the opinion that German engineering culture rather appreciates complex high-tech solutions. According to Prof. Gerybadze, German engineers often tend to emphasize technical product characteristics and, in case of doubt, would rather add an additional feature than delete it. Experts also opined that engineers generally expect to be rewarded for the development of new complex solutions. Besides, engineers in German colleges and universities are not necessarily taught to deliberately focus on reducing costs. Hence, in order to successfully develop frugal solutions a new mind-set would need to spread. From the management perspective, it is seen as a great cultural challenge for a German company to teach engineers to develop frugal solutions, if this means to dispense with technical features that could theoretically be realized. One solution for larger companies might be country exchanges for their engineers. SMEs were attributed higher difficulties in that matter due to their financial restrictions. Start-ups however were considered to employ innovative staff that may be more open for new technological solutions.

¹⁰ This can be seen as a case of an interesting “rebound effect” (Hertwich, 2005; Sorrell and Dimitropoulos, 2008) as the lower costs of leased equipment lead to a certain “wastage” of resources as the saved resources are directed towards acquisition of items that are more “fancy” but not really needed. Rebound effects are known to “sometimes have reduced the general effect of energy-efficiency increases” (Jänicke, 2014b: 241).

This raises the question whether German companies can develop frugal solutions on their own or whether they need **partnerships in developing countries**. Although it might be beneficial to have partnerships, business experts mostly shared the opinion that German companies can develop frugal innovations themselves if they are taught how to do so. A shared opinion existed that it should be possible to create a kind of manual for frugal innovation which will enable German companies to develop frugal innovations themselves. If such a guideline is also incorporated into engineering education, German engineers will be able to leave their complex high-tech technological trajectories and to develop instead frugal innovations based on the actual customer needs in a good-enough quality. It was further stressed that the mental openness and interest in considering alternative or new ways of innovating and working might be essential for the success of such projects.

Especially experts with a business background stressed the importance of figuring out the **actual customer needs** right from the beginning of a new development project. Knowledge about customer or user needs is seen as an essential prerequisite to successfully develop frugal solutions. Based on the opinion of the interviewees, most of the companies are still lacking sufficient processes at the front end of product or service development to get a clear picture of actual user needs including their prioritization. A first step towards this direction is to engage development engineers in a communication process with the customer or end-user. If this important step is solely in the responsibility of marketing and sales staff, it is likely that important insights are being missed, because normal customers usually cannot communicate their real needs clearly (Sheth and Ram, 1987; Herstatt and von Hippel, 1992). Often the customer is not aware of the causes of his problems or does not know which information is important to provide in order to receive a solution that better fits his needs. Hence, a thorough communication process and customer needs analyses complemented by observations of use/ application processes seems to be essential for frugal innovation processes. Then, based on the gathered information concerning customer needs a company has to decide strategically which customer needs it wants to fulfil in its frugal product.

Based on these insights, the **involvement of local partners** gains importance if frugal solutions are developed for emerging economies where customer needs often differ greatly from the home market (Ambos and Ambos, 2007; Schanz et al, 2011). Many examples of successful frugal innovations described in literature involve an intense front-end phase of product development. Local partnerships were considered as highly important for a successful frugal product development. Several interviewees argued that mixed teams of local and German developers (engineers, designers, innovators) were ideal. Others argued that research and development ought to happen in the respective market in the first place. Some interviewees with business backgrounds suggested a partnership with Indian start-ups, because these start-ups usually act very fast and only have low R&D costs. However, as partnerships can also be problematic and companies can often have reservations to go in this direction, it is suggested to invite foreign engineers. Including foreign engineers with local knowledge for a limited project time, can also deliver valuable insights for their

development project freeing companies from the need of a long-term involvement with foreign companies. Other interviewees suggested business collaborations with local research centres. Altogether, practitioners state that, although a partnership is often suggested for frugal innovation processes in management research, such a partnership is not mandatory for success. Yet, the engagement with the local market and its customer needs were considered essential.

Finally, it was discussed whether companies ought to develop frugal solutions even if they are market leaders in a premium segment. Mostly it was agreed that such coexistence is possible, as positive effects will outweigh a **threat of cannibalization**. One researcher even argued such a double strategy as mandatory for long term success, because there is a strong possibility that products based on highly complex technology will sooner or later be challenged by frugal alternatives.¹¹ Hence, by creating knowledge and processes concerning the development of frugal solutions, a company that is usually active in the high-end sector will be better positioned against future attacks. Furthermore and as a side-topic, many interviewees argued that it is important to communicate the quality of frugal products and services to potential customers and to the society as a whole. Frugality should not stand for cheapness and inferiority, but rather for the right quality to fulfil actual user needs. It became obvious that it is still unclear to many interviewees in which way frugality of a product should be communicated to customers. However, especially in the B2B sector it is assumed that an effort is needed to communicate the special value of frugal products to the customers in order to eliminate quality concerns that might exist.

3.4 Policy involvement

A shared opinion was that politicians or policy actors are very often not aware of the frugal innovation topic yet. However, at least from the business side this was not seen as problematic. These interviewees qualified frugal innovation as a company topic not requiring policy involvement. Concerning financial support, only three business men said that tax benefits would be helpful for companies seeking partners in foreign countries to expand their markets with frugal products. One German business consultant working in India argued that free trade agreements would foster the spread of frugal innovations just like any type of product or service. In this regard policy makers could have a positive impact for German companies. Although it was agreed upon that policy regulations can impede innovations in

¹¹ Contractor (2013) provides an interesting account of how multinationals companies (MNCs) from emerging economies are succeeding globally with a “frugal mind-set”. In his opinion, “a frugality that translates into not only lower corporate headquarters overheads, but also a more rigorous and cautious analysis of expenditures in foreign subsidiaries” provides such MNCs with significant competitive advantage also in the sphere of innovative products and services. On the other hand, Buse and Tiwari (2014) have shown that many German mid-sized firms (Mittelstand) take recourse to premium, global products and tend to ignore the demand for localized solutions in markets such as India and China.

general, this was not seen as a special concern regarding frugal innovations. Some regulations might even foster the demand of frugal products. For example, regulations promoting environmental sustainability are expected to have a potential positive impact on the acceptance of frugal innovations.

Some scientific experts criticised the singular focus of German research policies on high-tech strategies – strategies they called “not frugal at all”. In this context one interviewee suggested to check all research projects from the last five to ten years, if robust products and services could be developed out of the results. However, this awareness is still missing in policy institution. On the contrary, in government institutions there seems to be a fear that frugal solutions could lead to a contraction of the GDP apart from negatively affecting employment.

A few experts also pointed to a missing discourse on the relationship between sustainability and frugality, i.e., the sustainable use of resources and production development. Although environmental sustainability is currently a big topic in Germany, the connection of frugality and sustainability is not drawn yet. Concerns exist that a sufficiency strategy, even though it might concern only the most ecologically harmful sectors, will lead to a decreasing GDP. However, it was also questioned if frugal products really contribute to the global reduction of environmental pollution. For example, shampoo sachets sold at the Base of the Pyramid seem to rather have a negative ecological effect. In general, rebound effects can have negative effects in connection with frugal products. Hence, it seems to be of crucial importance from a socio-ecological perspective to discuss frugal innovation in the context of sustainability.

The gist of the current policy environment may be probably well summarized in the words of Prof. Gerybadze who stated:

“The whole research selection and funding process in Germany actually aims at frontier science and is skewed towards highest possible technological performance. Government support/funding programmes and selection committees concentrate on novelty and technical sophistication. Thus, they encourage projects that may extend the scientific frontier, but which are not necessarily targeted for rapid commercialization. The outcome of funded projects is, in many cases, too complex and sophisticated, and would require tedious add-on work in order to be commercialized. As a result, research and innovation policy often drives-out frugal Innovation.”

Most interviewees would, probably not surprisingly, appreciate an increased public communication on the topic of frugal innovation. They believe that a mind-shift in the German society towards a stronger appreciation of values such as frugality and sustainability will have strong positive effects. Frugal innovations could help foster such a mind-shift. At the same time, a stronger education of such related values as moderation and sustainability in education was considered important by several interviewees. Finally, if frugal innovations

are not evaluated and discussed as poor-people topic, but as a positive choice, there will be a strong effect on the demand for frugal choices.

4 Summarizing Discussion

Summarizing we can say that the experts interviewed for this study generally agreed that frugal products and services (should) focus on the customers' core needs and aim to "simplify life" by reducing "unnecessary complexity". This is in line with the published research from a variety of disciplines such as ecology, healthcare, consumer psychology and ethics (Hanna, 2012; Paech, 2012; Reynders and Baekelandt, 2015).

Within the frugal innovation research itself, there has been an increasing focus on these aspects moving away from a mere "low-cost" paradigm targeted at "the poor" to a "substantially lower-cost" approach, which can be targeted at any group of (price-sensitive) customers (Tiwari, Fischer, et al, 2016; Weyrauch and Herstatt, 2016). Such attractive simple solutions may also include high-tech components and may therefore be relevant for all market segments. On one hand, the experts saw a trend towards frugal solutions in Germany as a result of the demographic development, increasing social disparity (due to factors such as migration or an expanding low-wage sector), and globally increasing environmental problems. Frugal innovations were further considered to enhance the quality of life and to respond to a growing appreciation of moderation and voluntary simplicity (cf. Elgin, 1981; Heinberg, 2011) by parts of the German society that were termed as "frugal choices".

There was also a widespread consensus that frugal innovations are necessary to secure long-term competitiveness of German companies in fast-growing, unsaturated markets in the emerging economies, as has been suggested by some scholars (Zeschky et al, 2011; Buse and Tiwari, 2014; Schamari, 2014). The expert interviewees therefore suggested that German companies should consider introducing frugal solutions in the emerging economies as well as the German market in order to cater to the needs of evolving market segments. Especially in the B2B segment which is characterised by a lesser concern for brand image market success can be expected for affordable excellence. In contrast, some experts raised the concern that mainstream customers in Germany might have high expectations with respect to the complexity of products and services – frugal products might remain limited to a niche market in the end-consumer segment (B2C) in Germany.

Several challenges were pointed out concerning the actual implementation of frugal concepts in the product development process by German companies. The preference for high-tech, technology- and complexity-oriented solutions by engineers in German firms were considered an obstacle, as it could result in missing the core needs and functions. As a

solution, mixed teams between German and foreign employees stemming from developing countries as India were recommended. This is especially important for German companies with substantial shares of overseas business in the developing world as well as for the German *Mittelstand*.

As a key success factor a good understanding of actual customer needs was pointed out. Although one could expect that companies already excel in this important step of the innovation process, insights from the experts show that lots of room for improvement still exists in this regard. Especially German companies trying to reach emerging markets in Asia need a way to get local knowledge in order to successfully meet market demands. Some examples of large companies investing in product development with and for emerging markets exist. However, most SMEs face unsolved challenges to retrieve relevant local knowledge and competent local partners.

Finally, Policy makers ought to foster information campaigns to raise awareness in the German society as well as in the German business sector, especially in the “Mittelstand”, so that German companies do not get behind in this global trend. And, as pointed out before, a scientific as well as public debate concerning the interplay between frugality and sustainability is promising to deliver positive effects for society.

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BIBLIOGRAPHY

- Ambos, B. and T. C. Ambos (2007): Outside the Triad: An Examination of International R&D Investments within Peripheral Economies, in: G. R. G. Benito and R. Narula, *Multinationals on the Periphery*, Hampshire, Palgrave Macmillan: 188-205.
- Barzelay, M. (1993): "The Single Case Study as Intellectually Ambitious Inquiry," *Journal of Public Administration Research and Theory* 3(3): 305-318.
- Bergmann, S. and R. Tiwari (2016): Visibility and Acceptance of Frugal Innovation in German-speaking Countries, *Scientific Symposium on Potentials of Frugal Innovation in Industrial Countries*, Leipzig, Fraunhofer Center for International Management and Knowledge Economy.
- Besanko, D., D. Dranove, M. Shanley, and S. Schaefer (2013): *Economics of Strategy*, Singapore, Wiley.
- BMBF (2014): Bekanntmachung: Richtlinien zur Förderung von Forschungsvorhaben im Rahmen der Innovations- und Technikanalyse, Berlin, Bundesministerium für Bildung und Forschung (German Federal Ministry of Education and Research), BAnz AT 26.08.2014 B.

- Bogner, A., M. Decker, and M. Sotoudeh, Eds. (2015): *Responsible Innovation: Neue Impulse für die Technikfolgenabschätzung*, Baden-Baden, Nomos.
- Bös, N. (2015): Autos für Asien, Handys für Opa, *Frankfurter Allgemeine Zeitung*, Frankfurt am Main, 31.10/1.11 (Beruf und Chance: C1).
- BrightSide (2016, n.d.): "Why young people don't buy cars and apartments anymore," Retrieved September 27, 2016, from <https://brightside.me/inspiration-psychology/why-young-people-dont-buy-cars-and-apartments-anymore-238710/>.
- Buse, S. and R. Tiwari (2014): Global Innovation Strategies of German Hidden Champions in Key Emerging Markets, XXV ISPIM Conference, June 8-11, Dublin.
- Chakravarti, A. and M. Thomas (2015): *Why People (Don't) BUY: The GO and STOP Signals*, Houndmills, Palgrave Macmillan.
- Contractor, F. J. (2013): "'Punching above their weight': The sources of competitive advantage for emerging market multinationals," *International Journal of Emerging Markets* 8(4): 304 - 328.
- Cooke, P. (2010): "Regional innovation systems: Development opportunities from the 'green turn'," *Technology Analysis & Strategic Management* 22(7): 831-844.
- Dosi, G. (1999): Some notes on national systems of innovation and production, and their implications for economic analysis, in: D. Archibugi, J. Howells and J. Michie, *Innovation policy in a global economy*, Cambridge, Cambridge University Press: 35-48.
- Elgin, D. (1981): *Voluntary Simplicity: Towards a Way of Life that is Outwardly Simple, Inwardly Rich*, New York, Harper.
- Ernst, D. (2005): "Pathways to innovation in Asia's leading electronics-exporting countries: a framework for exploring drivers and policy implications," *International Journal of Technology Management* 29(1/2): 6-20.
- European Commission (2015): Call for Tenders: Study on frugal innovation and re-engineering of traditional techniques, Brussels, Directorate-General for Research & Innovation, 2015/S 086-154254.
- Fischer, L. and T. Dauth (2016): Frugal Innovation and Frugality in German Public Discourse, *R&D Management Conference*, Cambridge, UK.
- Freeman, C. (2002): "Continental, national and sub-national innovation systems - complementarity and economic growth," *Research Policy* 31: 191-211.
- GlobeScan (2014, October 11): "'Generation Fairtrade': UK Teens Care About Ethics, Want Businesses To Act More Responsibly," Retrieved April 29, 2016, from <http://www.globescan.com/news-and-analysis/press-releases/press-releases-2014/99-press-releases-2014/331-generation-fairtrade-uk-teens-care-about-ethics-want-businesses-to-act-more-responsibly.html>.
- Hanna, P. (2012): "The Evolution of Simplicity and Meaning," *Journal of Product Innovation Management* 29(3): 352-354.
- Heinberg, R. (2011): *The End of Growth: Adapting to Our New Economic Reality*, Gabriola Island, New Society Publishers.
- Herstatt, C. and E. von Hippel (1992): "From experience: Developing new product concepts via the lead user method: A case study in a 'low-tech' field," *Journal of Product Innovation Management* 9(3): 213-221.
- Hertwich, E. G. (2005): "Consumption and the Rebound Effect: An Industrial Ecology Perspective," *Journal of Industrial Ecology* 9(1-2): 85-98.
- Höfer, K. M. (2016, August 23): "'Frugale Innovationen': Bitte nicht immer so kompliziert," Retrieved September 28, 2016, from http://www.deutschlandradiokultur.de/frugale-innovationen-bitte-nicht-immer-so-kompliziert.976.de.html?dram:article_id=363871.
- Howells, J. (2003): Systems of innovation in a global economy, in: J. Michie, *The handbook of globalisation*, Cheltenham, Edward Elgar: 81-89.
- Jänicke, M. (2014a): Entwicklungsländer als Vorreiter der Nachhaltigkeit? Frugale Technik, *Ökologisches Wirtschaften*, 29 (1): 30-36.

- Jänicke, M. (2014b): Innovations for a Sustainable Resource Use - Reflections and Proposals, in: M. Angrick, A. Burger and H. Lehmann, *Factor X: Policy, Strategies and Instruments for a Sustainable Resource Use*, Dordrecht, Springer: 235-246.
- Karamchandani, A., M. Kubzansky, and N. Lalwani (2011): "Is the Bottom Of the Pyramid Really for You," *Harvard Business Review* 89(3): 107-111.
- Kroll, H., M. Gabriel, A. Braun, E. Muller, et al, Eds. (2016): *A Conceptual Analysis of Foundations, Trends and Relevant Potentials in the Field of Frugal Innovation (for Europe)*, Interim Report for the Project "Study on frugal innovation and reengineering of traditional techniques" Commissioned to Fraunhofer ISI and Nesta, Directorate-General for Research and Innovation, European Commission, Luxembourg, Publications Office of the European Union.
- Leadbeater, C. (2014): *The Frugal Innovator: Creating Change on a Shoestring Budget*, Hampshire, Palgrave Macmillan.
- Malerba, F. (2002): "Sectoral systems of innovation and production," *Research Policy* 31: 247-264.
- Minkmar, N. (2015): Viel zu viel Zeug, *Der Spiegel Wissen*, Hamburg, Spiegel Verlag, 05/2015 (Oktober): 82-85.
- Nelson, R. R., Ed. (1993): *National Innovation Systems: A Comparative Analysis*, Oxford, Oxford University Press.
- Paech, N. (2012): *Befreiung vom Überfluss: Auf dem Weg in die Postwachstumsökonomie*, Munich, Oekom Verlag (7th edition, 2014).
- Patel, P. and K. Pavitt (2000): National systems of innovation under strain: the internationalisation of corporate R&D, in: R. Barrell, G. Mason and M. O'Mahony, *Productivity, innovation, and economic performance*, Cambridge, Cambridge University Press: 217-235.
- Ponterotto, J. G. (2006): "Brief Note on the Origins, Evolution, and Meaning of the Qualitative Research Concept "Thick Description"," *The Qualitative Report* 11(3): 538-549.
- Quitow, R., R. Walz, J. Köhler, and K. Rennings (2014): "The concept of "Lead Markets" revisited: Contribution to environmental innovation theory," *Environmental Innovation and Societal Transitions* 10: 4-19.
- Radjou, N. and J. Prabhu (2015): *Frugal Innovation: How to do more with less*, London, The Economist.
- RBSC (2013): *COO Insights: Frugal Innovation*, Munich, Roland Berger Strategy Consultants GmbH.
- RBSC (2015): *"Think Act Beyond Mainstream: Simply the Best - Frugal products are not just for emerging markets: How to profit from servicing new customer needs"*, Munich, Roland Berger Strategy Consultants GmbH.
- Reynders, A. and J. Baekelandt (2015): "Low-cost total laparoscopic hysterectomy by single-incision laparoscopic surgery using only reusable standard laparoscopic instruments," *Gynecological Surgery* 12(2): 101-105.
- Schamari, U. W. (2014, Feb. 21): "Maschinenbau - besser nicht mehr ganz so gut," *VDI Nachrichten*, Retrieved 27.07.2015, from <http://www.vdi-nachrichten.com/Technik-Gesellschaft/Maschinenbau-besser-so-gut>.
- Schanz, C., S. Hüsiger, M. Dowling, and A. Gerybadze (2011): "'Low cost-high tech' innovations for China: why setting up a separate R&D unit is not always the best approach," *R&D Management* 41(3): 307-317.
- Sheth, J. N. and S. Ram (1987): *Bringing Innovation to Market: How to Break Corporate and Customer Barriers*, New York, John Wiley & Sons.
- Sorrell, S. and J. Dimitropoulos (2008): "The rebound effect: Microeconomic definitions, limitations and extensions," *Ecological Economics* 65: 636-649.
- Spencer, J. (2003): "Firms' knowledge-sharing strategies in the global innovation system: empirical evidence from the flat panel display industry," *Strategic Management Journal* 24(3): 217-233.
- Stengel, O. (2011): *Suffizienz: Die Konsumgesellschaft in der ökologischen Krise*, München, oekom.

- Tiwari, R. (2017): Frugality in Indian Context: What Makes India a Lead Market for Affordable Excellence?, in: C. Herstatt and R. Tiwari, Lead Market India: Key Elements and Corporate Perspectives for Frugal Innovations, Heidelberg, Springer.
- Tiwari, R., L. Fischer, and K. Kalogerakis (2016): "Frugal Innovation in Scholarly and Social Discourse: An Assessment of Trends and Potential Societal Implications", Joint working paper of Fraunhofer MOEZ Leipzig and Hamburg University of Technology in the BMBF-ITA project, Leipzig/Hamburg.
- Tiwari, R., L. Fischer, and K. Kalogerakis (2017): Frugal Innovation: An Assessment of Scholarly Discourse, Trends and Potential Societal Implications, in: C. Herstatt and R. Tiwari, Lead Market India: Key Elements and Corporate Perspectives for Frugal Innovations, Heidelberg, Springer.
- Tiwari, R. and C. Herstatt (2014): Aiming Big with Small Cars: Emergence of a Lead Market in India, Heidelberg, Springer.
- Tiwari, R., K. Kalogerakis, and C. Herstatt (2016): Frugal Innovations in the mirror of scholarly discourse: Tracing theoretical basis and antecedents, R&D Management Conference, Cambridge, UK.
- Tsujimoto, M., R. Tiwari, and C. Herstatt (2016): Comparative Case Analysis of Frugal Innovation in Japan, Scientific Symposium on Potentials of Frugal Innovation in Industrial Countries, Leipzig, Fraunhofer Center for International Management and Knowledge Economy.
- von Schomberg, R. (2015): Responsible Innovation: The New Paradigm for Science, Technology and Innovation Policy, in: A. Bogner, M. Decker and M. Sotoudeh, Responsible Innovation: Neue Impulse für die Technikfolgenabschätzung, Baden-Baden, Nomos: 47-70.
- Weyrauch, T. and C. Herstatt (2016): Frugal innovation – What is it? Criteria for frugal innovation, R&D Management Conference, Cambridge, July 3-6.
- Zeschky, M., B. Widenmayer, and O. Gassmann (2011): "Frugal Innovations in Emerging Markets," Research Technology Management 54(4): 38-45.
- Zweck, A., D. Holtmannspötter, M. Braun, M. Hirt, et al (2015): "Gesellschaftliche Veränderungen 2030: Ergebnisband 1 zur Suchphase von BMBF-Foresight Zyklus II", Zukünftige Technologien Nr. 100, Düsseldorf, Innovationsbegleitung und Innovationsberatung der VDI Technologiezentrum GmbH.

APPENDIX

List of interviewed experts:

No.	Name	Position	Organisation (Industry)	Conducted by
1	Prof. Dr. Alexander Gerybadze	Professor of International Management and Innovation	University of Hohenheim	TUHH
2	Prof. Dr. Martin Jänicke	Senior Fellow	Institute for Advanced Sustainability Studies	TUHH
3	Dr. Oliver Stengel	Research Fellow	Bochum University of Applied Sciences	TUHH
4	<i>Science Expert 4</i>	Anonymized	Anonymized	Fraunhofer IMW
5	<i>Science Expert 5</i>	Anonymized	Anonymized	Fraunhofer IMW
6	<i>Science Expert 6</i>	Anonymized	Anonymized	Fraunhofer IMW
7	<i>Science Expert 7</i>	Anonymized	Anonymized	Fraunhofer IMW
8	<i>Science Expert 8</i>	Anonymized	Anonymized	Fraunhofer IMW
9	<i>Science Expert 9</i>	Anonymized	Anonymized	Fraunhofer IMW
10	<i>Business Expert 1</i>	Director	Management Consultancy (Healthcare)	TUHH
11	<i>Business Expert 2</i>	Editor, Business & Economics	A large publisher of academic/research works	TUHH
12	<i>Business Expert 3</i>	Entrepreneur	IT solutions and consultancy in Indo-German projects	TUHH
13	<i>Business Expert 4</i>	Director Global Engineering	Large Company (Mechanical Engineering)	TUHH
14	<i>Business Expert 5</i>	Anonymized	Anonymized	Fraunhofer IMW
15	<i>Business Expert 6</i>	Anonymized	Anonymized	Fraunhofer IMW
16	<i>Business Expert 7</i>	Anonymized	Anonymized	Fraunhofer IMW
17	<i>Civil Society Expert 1</i>	Journalist with a reputed magazine	Author of an article on material superfluity in the society	TUHH
18	<i>Civil Society Expert 2</i>	Journalist with a reputed magazine	Reported on a business model that prima facie appears to be frugal	TUHH
19	<i>Civil Society Expert 3</i>	Anonymized	Anonymized	Fraunhofer IMW
20	<i>Civil Society Expert 4</i>	Anonymized	Anonymized	Fraunhofer IMW

Note: The views expressed by the interviewed experts explicitly represent their personal opinion and should not be construed as official viewpoints of the institutions/firms they are associated with. The interviews conducted by project partner Fraunhofer IMW have been reported as “anonymized” due to data privacy concerns raised by it.