

Doing more with less:

Towards a conceptual framework for frugal business model innovation

Albert Kraaij

Sander Limonard

The Hague University of Applied Sciences

a.kraaij@hhs.nl

a.j.p.limonard@hhs.nl

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1. Introduction: frugality as a new lens for business model innovation

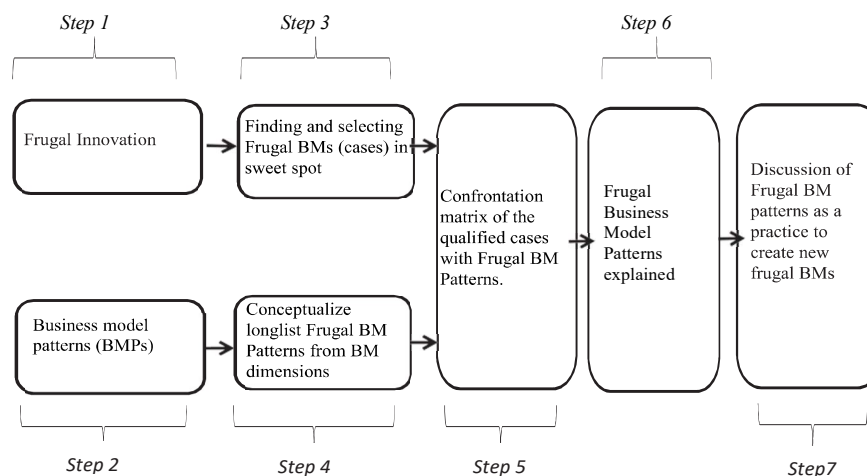
Pressure on natural resources, unsustainable production and consumption, inequality and a growing global population lie at the base of the big challenges that we, as a society, face today (Kopnina, 2017). In this chapter, we chose to investigate how businesses can take responsibility in dealing with these challenges by means of frugal business model innovation (BMI). It is increasingly apparent that business-as-usual is not an option for a sustainable future (Bocken et al 2014). What we need is a fundamental shift in the purpose of businesses and almost every aspect of how it is conducted (Jackson 2009; Bocken et al 2014). Frugal innovation could provide one of the solutions.

The notion of “frugal innovation” was first introduced in the context of emerging markets, giving non-affluent customers opportunities to consume affordable products and services suited to their needs (Weyrauch and Herstatt 2017). The value provided with frugal innovation started as inherently social because the goal was to give the poorest of the poor access to products and services to empower them. However, the discourse on frugal innovation has recently been extended towards developed countries focusing on using less resources (Tiwari and Bergmann 2018). Frugality or working with a frugal mindset could also mean using resources to their full potential. In this chapter, we will apply this mindset in developing business models (BMs). Business modelling with a frugal mindset opens up a path that provides significant value while minimizing the use of resources such as energy, capital and time (Radjou and Prabhu 2015). By applying this mindset, we hope to show that frugality provides a promising perspective to make the transition to more sustainable BMs.

We explore the usefulness of looking through this lens by taking it as the starting point in identifying business model patterns or BMPs (Bocken and Baldassarre 2019). In short, frugality could be explained as “doing more with less” (Radjou and Prabhu 2015), and as such could be used to explore BMs that combine the creation of economic, ecologic and social value at the same time (Bocken et al 2014; Schenkel et al 2015). In this chapter, we also propose a set of BMPs specifically

directed towards the creation of frugal BMs. We have structured our study and this chapter according to the seven steps as depicted below.

Figure 1 Process of developing a typology of frugal BMPs.



First, we performed a literature review of two concepts: frugal innovation (step 1) and business model patterns (step 2). In the third step of the process we compiled a non-exhaustive list of 99 cases of frugal BMs, based on certain selection criteria, to be investigated further (step 3). In parallel, we identified a list of frugal BMPs (step 4) from existing literature on BMPs based on the originating point in the BM. The result was a list of 11 possible BMPs that could be relevant for creating a frugal BM. Then these findings from step 3 and step 4 were combined and the subsequent cases were used to explore to what extent the patterns matched the actual choices made in the successful frugal BMP (step 5). This analysis resulted in a framework of 9 BMPs with examples (step 6), which became the basis for a discussion of the limitations and practical implications of this study as well as the conclusion and suggested avenues for future research (step 7).

2. Literature review

In order to achieve the necessary BMI we aim to ‘marry’ two bodies of literature, frugal innovation and business model patterns, into the proposed conceptual framework that adds frugal innovation to the realm of the sustainable business literature.

2.1 Frugal innovation (step 1)

The frugal innovation concept is subject to discussion, however the core was first captured by Prahalad and Mashelkar (2010). The origin of the concept lies in increasing the accessibility and affordability of products and services for the billions of poor and emerging middle-class consumers at the Middle and Bottom of the Pyramid (Bhatti 2012). An innovation could be coined as frugal if it provides a solution that is already on the market but uses less resources and is designed and implemented despite financial, technological, material or other resource constraints (Hossain et al 2016). Leadbeater (2014) describes it as “providing better solutions for more people by using fewer resources by doing things completely differently”. Frugal innovations often reach out to unserved customer groups while ensuring “affordable excellence” (Tiwari and Herstatt 2012). Frugal innovations tend to be based on reinterpreting, reconfiguring and (re)combining existing practices. Therefore, scholars with a background in the more technical dimensions of innovation might label these activities as adaptations rather than innovations (Knorrinda et al 2016). As the body of literature on frugal innovation and business practices continues to expand, the definition of the term itself continues to evolve.

Radjou and Prabhu (2015) describe frugal innovation as “an innovative fix; an improvised solution born from ingenuity and cleverness”. This cleverness and ingenuity could also be put to work to deal with the current social and ecological crises. If we want to maintain our standard of living whilst finding an ecological balance we need to find clever ways to create economic, social, and ecological value while wisely optimizing the use of all available resources. Unlike the “do more with more” system of consumerism (Akenji 2014), which uses ever more resources to create even more products, the frugal lens invites us to do better with less by making the most of all existing resources and to maximize the value for all stakeholders (Radjou and Prabhu 2020). Frugal Innovation holds the promise to provide a broader range of solutions than just serving the Bottom of the Pyramid Market.

In this chapter, we build on the extended definition put forward by Tiwari and Bergman (2018) who define frugal innovation as a “resource scarce solution” (i.e., product, service, process or BM) that is designed and implemented despite financial, technological, material or other resource

constraints, whereby the final outcome is significantly cheaper than competitive offerings (if available) and is good enough to meet the basic needs of customers who would otherwise remain un(der)served.

2.2 Frugal innovation in the circular economy

The existing literature on frugal innovation focuses mainly on issues surrounding the design and manufacturing of frugal products. Nevertheless, it notes that other lenses on frugal innovation may also be just as important. For example exploring how frugal BMs can make products and services more affordable (Kroll et al 2016). Several studies show that businesses struggle to take full advantage of new frugal technologies because they are not able to develop adequate BMs (Abdelkafi et al 2013; Wischmann et al 2015). On the other hand, successful cases of frugal innovation seem not only dependent on specific locally adapted products, but also on innovative BMs (Bhatti and Ventresca 2012a). Overall however, the world of frugal innovation, whether in the narrow definition of serving the poor or the wider definition we adopt here, tends to overlook the importance of developing viable BMs.

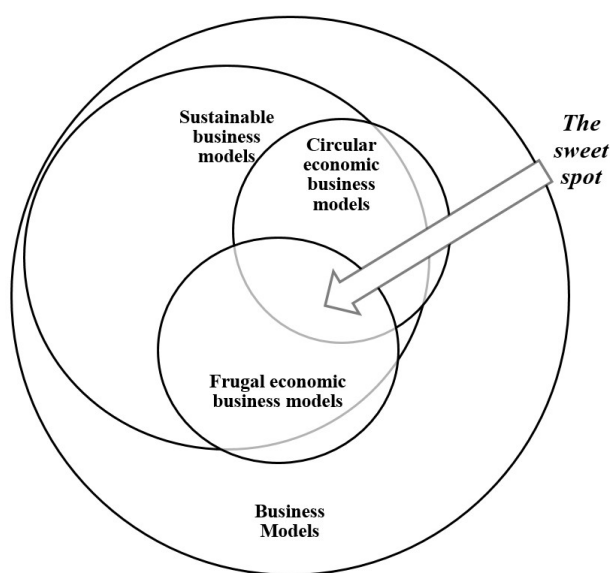
The notion of frugality could also provide a new perspective on how to deal with the traditional trade-off between people and planet that is apparent in the body of literature on developing sustainable BMs (Arnold 2018). Circular BMs tend to have a clear focus on the planet or ecological value (Bocken et al 2014) whilst frugal BMs tend to concentrate more on creating social value by focusing on provision of products and services to low-income markets (Geissdoerfer et al 2018). In line with the consumerism perspective that is widespread in developed countries, various authors have highlighted the potentially lucrative markets associated with the Bottom of the Pyramid (Yunus et al 2010). As an alternative, the frugal lens invites practitioners to devote their effort to developing products and services that provide only the necessary value, resulting in solutions that are simultaneously affordable and resource efficient.

Some authors have pointed out that the majority of successful frugal innovations create multiple types of value (Rosca, 2017). E.g., an energy-efficient waste-burning cookstove can improve well-

being by reducing smoke inhalation (social), reduces the need for cutting down trees (ecological) and decreases time spend collecting firewood (social). This particular example of a sustainable BM can thus be perceived as both circular and frugal.

The creation of both ecological and social value by means of the same BM is what we like to label as “the sweetspot” where circular and frugal overlap. Frugal means “doing more with less”. That in itself can be seen as no different from conventional eco-efficiencies which Cradle to Cradle criticizes. But frugal innovations can be techno-knowledge solutions that complement or substitute nature-based solutions, ecological adaptation and resilience (D’Amato 2017). Whereas eco-efficiency focuses on ‘doing less bad’, frugality can be viewed as a lens that supports fundamental rethinking of current systems, which is coined as eco-effectiveness. Frugal innovation can therefore be seen as a first step towards the ‘circular economy’ as it supports the elimination of undesirable substances and ultimately calls for a reinvention of products by reconsidering how they may optimally fulfill the needs for which they are actually intended while simultaneously being supportive of ecological and social systems (Braungart et al 2007). In line with Geisdorfer et al (2017), who visualized the different sustainable BM model subcategories, we visualised this sweet spot in figure 2 and it is the starting point for our data collection.

Figure 2. Imperfect overlap of sustainable BM subcategories; “the sweet spot”



2.3 Business model patterns (step 2)

BMs require intentional design if they are to deliver aspired sustainability impacts (Bocken 2019). Practitioners often build on trial-and-error experimentation, seeking incremental modifications, to optimize their current BMs but not always very successfully (Martins et al 2015). One reason for BMI failure is a lack of supporting frameworks and tools (Weking et al 2018) and this is where BMPs come into play. BMPs could be used as an effective tool to capture and organise the knowledge about the creation of sustainable BMs and to creatively develop or adapt solutions, for example to envision new or improved BMs by recombining existing patterns (Lüdeke-Freund et al 2018). “It is about reusing solutions that are documented generally and abstractly in order to make them accessible and applicable to others” (Amshoff et al 2015).

The usefulness of these patterns seems to depend on the context in which they are applied, although Gassmann et al (2014a) claim that 90% of all BMIs are a combination of already existing BMs. Therefore a promising approach that supports BMI, is learning from BMPs that are actual recurring phenomena that have proven to be successful in the past in different industries or contexts (Amshoff 2015; Weking et al 2018a).

Remane et. al (2017) add more detail to the concept of patterns by highlighting that they are solutions to a problem within a single building block of a BM. Any pattern originates from a certain building block of the BM and then triggers change in other building blocks (Osterwalder and Pigneur 2020). If this one change in a building block and the associated configuration of choices in all the building blocks turn out to be a recurring pattern, it can be called a BMP. By looking through our extended notion of frugality to the body of literature on BMPs, we aim to provide a new way of identifying and understanding BMs that could inspire practitioners to create sustainable BMs (Lüdeke-Freund et al 2018).

3. Method

After we established how frugality can be used as a lens to look at BMs (step 1) and learned about how BMPs could be identified using this lens (step 2) we proceeded by selecting and coding relevant cases (step 3) and established a first set of 11 frugal BMPs (step 4).

3.1 Data collection: Selection of frugal BM cases (step 3)

To explore frugal innovations in BMs, a list of 99 frugal innovation cases were identified through purposeful sampling. We did this by searching for keywords as Frugal Innovation or synonyms such as the Indian concept for frugal “Jugaad”, “resource-constrained innovation”, “grassroots innovations” or “Bottom of the Pyramid”. Main academic search engines (such as Google Scholar, EBSCO, Sage and Science Direct), but also non-academic search engines like Google search were used to retrieve frugal innovation case studies. Sources of data collection were academic literature in the form of scientific case studies on frugal innovations in journals and books, grey literature (e.g. The Economist, The Guardian), reports of business organisations, foundations, development organisations and NGOs (e.g. European Union) as well as awards for Frugal Innovations (e.g. The Gandhian Young Technological Innovation Award).

Next, we analyzed and coded all 99 cases and selected those that passed the criteria as shown in Table 1. The goal of this first order coding was to find frugal innovations that create economic, social and ecologic value (the sweet spot). As the first indicator of succes, we used the fact that based on the frugal innovation, a business was launched. The second indicator was continuity because the fact that a product or service is provided for a prolonged period of time proves, to a certain extent, that the BM works. Third, social and ecological value can be determined if a contribution to at least one of the Social Development Goals (SDG’s) in the social domain and at least one of the SDGs in the ecological domain can be assumed. In the table below the selection of relevant cases is presented:

Table 1 Frugal Innovation (FI) selection using three criteria

<i>Criteria</i>		<i>Number of Cases</i>
	Total # FIs (cases) derived from the literature	99
<i>I</i>	# of FIs that were translated into an actual BM meaning the product or service that has actually been launched.	78
<i>II</i>	# of FIs which are a proven commercial success, meaning selling enough products or services to create continuity. The companies were still in existence at the time of the data-analysis with a minimum period of one year (continuity).	74
<i>III</i>	# of FIs which are within the <i>sweetspot</i> of SBM, creating both social and ecological value. This was determined on a validated estimation of the positive sustainability effect of the frugal business model on at least one social SDG's and at least one ecological SDG.	78
	Cases that match all relevant criteria (I – III)	61

The final dataset set consisted of 61 cases of frugal innovation which we call Frugal BMs. All frugal BMs have a positive social and ecological effect and can be called a success in the marketplace. These frugal BMs range from product innovations (e.g. food stoves and clothing) to service innovations (e.g. trading platforms) and are located in different geographical areas (e.g. Europe, North America, Asia and Africa) and different industries (e.g. agriculture, health, food, transport).

3.2 Identifying frugal BM patterns (step 4)

We identified a first set of frugal BMPs by looking at the existing body of literature on BMPs through our extended frugality lens. Popular notions of BMPs (Osterwalder and Pigneur 2010; Osterwalder and Pigneur 2020), were all included as well as literature on successful BM configurations based on critical success factors and trade-offs in BM design (Ballon et al 2008; Rosca 2017) as well as critical design issues or design options (Bouwman et al 2008; Posthumus et al 2012; Lüdeke-Freund et al 2019). We tap into this body of literature to establish a first set of patterns that can be used as an intervention in creating new BMs.

In Table 2, the first set of frugal BMPs is described. We decided to formulate the BMP as the one intervention or design choice that determines the design in all the other building blocks. This is in line with the work of Posthumus et.al (2012) and Bouwman et.al. (2008) on identifying critical success factors and design issues. Critical success factors can be identified as a limited set of design parameters that need to be addressed when designing a frugal BM i.e. the decisions that need to be made to ‘make or break’ the viability of a BM (Posthumus et al 2012). A critical design issue is

defined as a design variable that is perceived to be of eminent importance to the viability and sustainability of the BM under study (Bouwman 2008). This longlist was cross-checked with existing libraries on BMPs to see if a frugal BMP was already mentioned.

Table 2 First set of frugal BM patterns.

<i>Major BM dimensions (Lüdeke-Freund, 2018)</i>	<i>Proposed frugal BM pattern</i>	<i>Original source in literature</i>
Value proposition	DEBUNDLING; How can the value proposition be split up / subdivided into partial offers? DISMISS (Sufficiency): Makes using certain products or services redundant by abandoning its function or by offering the same function with a radically different product using less resources.	(Osterwalder 2010; Bouwman, 2008); Bundling (Bocken, 2016); Sufficiency
Target customers	DELEGATE to customers ; Outsource certain activities to users or consumers.	(Osterwalder 2020); Delegator, (Gasman, 2014); Self-service
Value delivery processes (Channels)	DOMESTICATE : Use local networks to market, sell, distribute and provide customer support and maintenance services for sustainable products.	(Osterwalder, 2020); Opportunity Builder, (Dybdahl, 2019); Localism, (Postumus, 2012); Local service delivery
Partners and stakeholders	DELEGATE to key partners ; What activities can we outsource to key partners?	(Osterwalder, 2020); Delegator
Value creation processes of Activities	DECREASE harmful activities ; Modify the companies activities or allow the customer to modify their activities in a durable, sustainable way such that they do not hurt society nor the planet or that customers can lead a better life.	(Osterwalder, 2020); Sustainability Master
Value creation processes of Resources	DIMINISH RESOURCES (SIMPLIFY) : Remove or reduce features, resources or waste streams.	(Osterwalder, 2020); Efficiency disruptor (Gassmann, O., 2014); No Frills
	DECOMPOSE : Remove resources from the commercial value proposition and replace those with ones the user/consumer already has at his/her disposal.	(Osterwalder, 2020); Resource dodger, (Gassmann, O., 2014); Trash-to-cash, (Lüdeke Freund, 2018); Organic feedstock
	DIVERSIFY : Implement efficiencies by introducing and operating a business model in different markets to create economies of scale in delivering a value proposition.	(Osterwalder, 2020); Repurposer, (Lüdeke Freund, 2018); Cascading and repurposing
Revenues	DEMOCRATIZE : Find innovative ways to democratize access to products or services by redesigning the revenue model to increase the affordability of technological, sustainable and/or social solutions.	(Osterwalder, 2020); Democratizers (Gassman, 2014); pay-per-use, rent instead of buy, affiliation or Robin Hood
Costs	DECONTEXTUALIZE : Standardize production processes in order to create economies of learning in creating a value proposition.	(Gassman, 2014); Mass customization or Target the poor.

While creating these conceptualized patterns, it emerged that most of the conceptualized patterns started with a “D”. Since the inspiration behind these patterns came from literature on circular BMPs where these patterns are often referred to as the (nine) R-framework (Potting et al 2017) we decided to take a similar semantical approach.

3.3 Analysis: Confrontation matrix of the 61 cases with 11 Frugal BM Patterns (step 5)

We analyzed and coded the 61 cases of successful frugal innovations through the lens of the 11 conceptualized frugal BMPs and show the result in the confrontation matrix in the findings section below. For this second order coding we created a “base case” BM for each selected case, which is an actual existing BM that can be seen as the industry standard or industry recipe (Matthyssens et al 2006). This base case BM is the non-frugal version of the successful frugal BM. In a confrontation matrix we matched the dynamics of this non-frugal BM versus the dynamics of the frugal BM against the proposed list of frugal BM Patterns. Essential in this step was the originating point of the frugal innovation. When this dynamic showed similarities to one or more of the proposed frugal BMPs we assigned this to the principal proposed frugal BMP. This second order coding exercise was performed using Excel. The result of this coding is the confrontation matrix in table 4.

4. Findings

The analysis of the confrontation of 61 frugal cases through the conceptual lens of 11 frugal BMPs resulted in a shortened list of the 9-D framework (step 5 in figure 1). For the BMP “Debundling” we did not find any cases that could be connected to this pattern, which is the reason we eliminated this pattern. The BMP “delegate to key partners” was only confirmed in one of the cases, but could be combined with “delegate to customers” into “delegate to customers and key partners”. Below we will describe the 9 final frugal BMPs in more detail and illustrate the mechanisms at work in these patterns by means of illustrative case descriptions (step 6).

Table 3. Confrontation matrix; Conceptualized frugal BMPs and selected successful Frugal BMs (cases).

<i>Longlist of 11 proposed Frugal BM patterns</i>	<i>Explanation of the patterns</i>	<i>FRUGAL BMs</i>	<i>Frugal BMs or cases assigned to a proposed pattern</i>
DEBUNDLING;	How can the value proposition be split up into partial offers?;	0	Not found
DELEGATE to customers;	Outsource certain activities to users or consumers;	6	Foldscope (USA / Stanford , Foldable microscope); Prakash Lab 1 (USA / Stanford , Standardized imaging oral cavity); Prakash Lab 2 (USA / Stanford , hand-powered blood centrifuge); Bernard Kiwia, Cycle solutions (Tanzania , Bicycle phone charger); CGnet Swara (India, Local interactive newsplatform); Dhonsi mechanizations (India, Tractor driven machine for bio-waste)
DOMESTICATE;	Use local networks to market, sell, distribute and provide customer support and maintenance services for sustainable products;	4	ClickMedix (USA, App Healthcare); Alborz Darou Pharmaceutical Company; Tehran, Iran (Global , Polypill Low-cost prevention of cardiovascular disease); NINAYO (Tanzania , Online trading platform for agriculture in East Africa); GNESD/ Toyola (Ghana , Charcoal stove)
DELEGATE to key partners;	Outsource certain activities to business partners;	1	Peek Vision (Global, Smartphone eye-scan used by schools).
DIMINISH RESOURCES (SIMPLIFY):	Remove or reduce features, resources or waste streams;	15	KaIoS (Ivory Coast, Data communications); MittiCool (Global, Platform); General Electric2 (USA, Healthcare low cost ECG); Jodo Gyan (Africa, eRanger ambulance); Philips (Global, Ultrasound device'); Haier (China , Mini Magical Child); Moladi (South America, Housing from reusable lightweight plastic); Envigreen bags (India , Biodegradable bags); Dahiya Raj Singh (India, Biomass gasifier); Kromkrommer (NL, Soup created from "vegetable food waste"); Vodafone 150 (London, Cheap phone); Nokia 1100. (Developing countries , Cheap phone); Siemens (Germany, SMART Line HMI panel); Siemens (China, Digital R-Ray, Multix Select DR machine,)
DECOMPOSE;	Remove resources from the commercial value proposition and replace those with ones the user/consumer has at disposal,	4	Mansukhbhai Jagani (India , Bullet santi Multiutility farm vehicle); Mike Norman/eRanger (India , Rubber prosthetic); aQysta (Nederland/Malawi , Barsha Water Pump); Wonderbag (Africa , Slowcooker without power); Illuminum Greenhouses (East Africa, Kenya , Cheap greenhouses kits)
DIVERSIFY;	Implement efficiencies by introducing and operating a business model in different markets to create economies of scale in delivering the value proposition;	5	Lifestraw.com (Kenya, Vietnam, Waterfilter); Danone, Shokti (Bangladesh, Nutricious Yoghurt); Berkely-Darfur Stove (Darfur and Ethiopia, Energy-efficient wood-burning cookstove); Siemens (USA, Baby warmer (Lullaby);
DECREASE harmful activities;	Modify the companies activities or allow the customer to modify their activities in a durable, sustainable way such that they do not hurt society nor the planet or that customers can lead a better life;	9	Changemakers (Egypt, Environmentally-friendly building materials); Frontier Markets (Global , Solar powered torches and lights); Banka Biolo (India , Biological Sanitation Value Chain); Petit Pli (London , Clothes that grow); A Muruganatham's (India , Low-cost sanitary napkins); D. Renganathan (India, Mechanical tree climber); SunSaluter (Usa, India, Solar panels that rotate towards the sun); Tata chemicals (India, Waterpurifier); Patagonia (USA, Outdoor clothes);
DEMOCRATIZE;	Find innovative ways to democratize access to products or services by redesigning the revenue model to increase the affordability of technological, sustainable and/or social solutions;	7	Flexitron (India, E-Charkha spinmachine); OLPC (Miami, Cheap educational laptop); ZOLA Off grid electric (sub-Saharan Africa, Power with panels); Nidec Youmma (Brasil, pay-as-you-go solar-powered fridge).
DECONTEXTUALIZE;	Standardize production processes in order to create economies of learning in creating the value proposition;	6	General Electric1 (India , MittiCool Clay Refrigerator(50 liter)); "Microlife Vital Signs Alert (Global , Handheld device to measure blood pressure); GE Healthcare (USA , Vscan, pocket-sized ultrasound tool); Aravind (India , Eye care system); Frugal digital (India, Medical alarmclock that measures patients health); Dr. Devi Shetty (India, Affordable healthcare).
DISMISS (Sufficiency).	Make using certain products or services redundant by abandoning its function or by offering the same function with a radically different product using less resources.	4	Instock (NL, Foodwaste Restaurant Chain); Karma (France, Sweden, United Kingdom, Food waste reduction app); Vitsoe (Germany, Lifelong furniture manufacturer), Brunello Cucinelli (Italy, Brunello Cucinelli Clothes).
		61	

DELEGATE to consumers and partners

The essence of this pattern is that the company outsources activities that are part of their value chain to the client or partner (e.g. a low cost, human-powered blood centrifuge). The frugal innovation is that customers can exchange the value of time, which some customers frequently have plenty of, for the value of money which in most cases is a scarcer good. This is particularly suitable for process steps that add relatively little perceived value for the customer, but incur high costs, like assembling furniture. This can also increase efficiency, since in some cases the customer can execute a value-adding step more quickly and in a more target-oriented manner than the company.

In our list of 61 frugal BMs that met the relevant criteria we found evidence of this pattern in 6 cases. This pattern is visible in both products and services. The industries vary from healthcare (e.g. Foldscope, an ultra-affordable foldable paper microscope), agriculture (e.g. self-tooth mapping with mobile phone that brings standardized, multi-modal imaging of the oral cavity into the hands of rural health workers around the world), entertainment (see below) and the transportation industry (e.g. a bicycle phone charger).

A great frugal example is CGnet Swara from India. This interactive news platform created a voice portal that enables ordinary citizens to report and discuss issues of local interest: the listeners (customers) actually create their own news. This BM crafts news value without spending resources on e.g. hiring reporters or travel expenses. In a vast country like India with its pollution problems avoiding additional travel is welcome from a sustainability point of view.

DOMESTICATE

This pattern is labelled Domesticate (or localize) because it pivots around the use of local networks to market, sell, distribute and provide customer support and maintenance services. This means changing the value delivery processes to enable acquiring a large group of customers that could not, at reasonable costs, be reached before. It is not the value of the product or service itself that has changed utilizing this pattern, but the way the value is delivered to the customer. New markets can be opened up offering the value proposition to new customers, but also in using new channels resulting in expensive or too powerful actors in the value chain to be cut out. By lowering the price, more

customers can capture the value and in the process new jobs will be created to create that value. This pattern can only be applied successfully if a thorough understanding of the value chain and its networks exists.

The industries in the dataset range from healthcare (e.g. Polypill low-cost prevention of cardiovascular disease), to agriculture (e.g. NINAYO an online trading platform for agriculture aiming at cutting-out the middlemen), to manufacturing (e.g. The Toyola Coalpot). The Toyola Coalpot is an environmentally friendly cooking device that is not only manufactured but also sold and serviced by local, unemployed artisans. These artisans are trained in the skills needed to manufacture efficient stoves but also trained in selling and repairing the stove within their own villages. Since frugal means doing more with less, this is a good example of exactly the value a frugal lens can contribute.

Another example is ClickMedix. For people living in remote parts of the world or people not able to visit a doctor, accessing healthcare can mean travelling a considerable distance, which is especially problematic when there are medical emergencies (for example, when showing signs of COVID-19). With ClickMedix, an app that enables health workers to screen, diagnose and refer patients for treatment, villagers can avoid the lengthy travel time and associated costs. The app works by taking local health professionals through a validated questionnaire, guiding them to ask patients appropriate questions and then directing them to the relevant treatment or referral options. The app can be used to screen patients for a number of conditions, including HIV, malaria, tuberculosis, diabetes, heart disease and cancer (The Guardian 2018).

DIMINISH resources (simplify)

Stripping the product or service to the core is the essence of this BMP. Diminish or simplify resources can be described as the means to remove or reduce features, resources, required activities and/or waste streams. A certain product or service in the base case situation is simplified using frugal innovations, which means that redundant features are removed while the basic value of the product or service remains intact. This implies that the product typically needs to be developed as a standardized, low-price version of a product or service that is traditionally customized and higher priced. This no-frills value creation focuses on what is necessary to deliver the core value proposition of a product or

service, typically as basic as possible. Cost savings are shared with the customer, which creates value for a customer base with lower purchasing power.

This pattern is recognized in 15 cases making it the most recurring pattern in our dataset. Not surprisingly this pattern has not been identified in companies that offer services but only in product-oriented companies. It occurs in a large range of industries such as telecommunication (e.g. extreme cheap no frills mobile phones created by Vodafone and Nokia), the food industry (e.g. cheap biodegradable non-plastic bags), the energy industry (e.g. simple biomass gasifier), the manufacturing industry (e.g. low cost box-type solar cooker that can be fitted into a window like an air conditioner) and the healthcare industry (e.g. simplified, portable CT-scanner).

Companies using this particular BMP should develop a product or service that only focusses on the core value. The ecological value is that less resources are required while the social value is that the product or service is available for customers with less purchasing power. However there is a risk that this particular frugal innovation might even increase overall resource consumption or pollution, like the Nano car in India which is a very simple motor vehicle is very cheap, but also highly polluting. Fortunately this is not the case with most other frugal innovations.

A remarkable example of this type of value creation is the Indian company MittiCool's which produces clay refrigerators. The MittiCool clay refrigerator does not require electricity, is made of locally available material and can keep vegetables and milk fresh for three full days avoiding food waste. The refrigerator is very simple and can therefore be produced and sold at low cost. It is also eco-friendly due to being non-electrical compared to the base case, a regular electrical refrigerator.

DECOMPOSE

Using resources already at the disposal of clients is the core of this BMP. Decompose can be described as the removal of resources from the commercial value proposition and replacing them with resources the user/consumer already can access or uses. The original product or service that was offered needs to be stripped of certain resources to make it more attractive for the customer because he/she already has the possession of this particular resource. The resource costs for the company are partially eliminated, whilst the customers waste disposal might be reduced, hence "the sweet spot".

In the agriculture industry we found two examples like Aluminum Green, a company that constructs simple and affordable modern greenhouse kits for smallholder farmers by letting them use locally available materials. An example from the energy industry is an innovation called the Barsha pump, a water wheel propelled pump that utilizes the energy from the flow of rivers and canals to pump water without requiring any fuel or electricity to be operated. In the food industry an example is an environmentally conscious slow cooker that is designed to heat and cook food in existing local pottery without the use of electricity.

The dimension for the BM where this frugal innovation originates is the resources value creation processes. Using resources already at the disposal of the customer has a positive consequence for the customer and therefore its perceived value. It also reduces costs making it more accessible for customers and allowing re-using or repurposing existing resources.

The best frugal example that describes this pattern is the Bullet Santi, brainchild of Mansukhbhai Jagani, an Indian farmer who used his own motorcycle and modified it into a multi-utility farm vehicle ('Santi' means plough in Gujarati). He allowed other farmers to turn the motorcycle they already own into an affordable tractor substitute for their agricultural activities. No additional resources (ecological value) was acquired to help generate an income of this farmer (social value).

DIVERSIFY

The pattern of diversification pivots around the following question: can we use the companies' solutions to solve a problem outside the current market they serve? This pattern offers the possibility to find innovative ways to tap into new markets demand by the power of combining or "repurposing" existing technologies that previously served different ends in other markets. It can create access to products, services and/or technologies for underserved markets that were previously only accessible to a limited number of customers. Diversify means to implement efficiencies by introducing and operating a BM in different markets to create economies of scale in delivering the value proposition.

We identified 5 successful Diversify cases within the sweet spot of frugal innovation both in products as well as services. The industries in the dataset range from data communications (e.g. M-Pesa/Safaricom that repurposed its existing telecom network to create a much needed safe and reliable

money transfer system for Africans), healthcare (e.g. an inexpensive frugal baby warmer), to food (e.g. Shokti +, a yoghurt enriched with micro-nutrients to combat malnutrition, which is also a source of income for the inhabitants of surrounding villages).

The Berkeley-Darfur Stove is an interesting manufacturing example of this pattern. Students from Berkeley University came up with an innovation; a safe, energy-efficient wood-burning cook stove originally designed for the US market. However, the social and ecological value of this innovation could be much higher in other parts of the world. This stove can directly improve health by reducing smoke inhalation. It can also alleviate poverty by reducing the amount of time needed to gather wood every day (social value) and also reduce harmful emissions (ecological value). But to be successful in another market more than just a technical innovation was required. What was missing was manufacturing/logistical expertise and also local knowledge (assembly, distribution, training and evaluation). To this end a partnership was created. An Indian company manufactured and transported the stoves. An Ethiopian company brought in the necessary local knowledge. These three partners have combined or diversified their knowledge and already distributed more than 25,000 of these Berkeley-Darfur Stoves in Darfur and Ethiopia.

DECREASE harmful activities

Decreasing harmful activities means modifying the company's activities or allowing the customer to modify their activities in a frugal and durable way to prevent social or ecological costs. These activities can be scrutinized on their social and ecological effects and restorative actions can be undertaken, creating social and ecological value in the process.

This pattern was recognised in several industries; in construction (e.g. environmentally-friendly building materials using abundant local building ingredients (e.g. clay, stone) along with treated waste products), in the computer industry (social platform offering a range of products empowering local women), in manufacturing (e.g. a line of clothes that grow with your child using expansion fabrics allowing each item of clothing to grow up to seven sizes, which is not only sustainable by reducing waste, but can also save families money on new clothes), in agriculture (e.g. a mechanical tree climber which can be used safely for scaling palm and coconut trees), in energy (e.g. solar panels that optimize

energy collection by rotating to face the sun during the day) and in health care (e.g. a sanitary pad-making machine which dispenses ecological sanitary napkins for one-fifth the price of a branded one).

The outdoor clothing brand Patagonia is an example of this BMP as the company pledges to 'build useful things that last, to repair what breaks and to recycle what comes to the end of its useful life'. Patagonia's customers are asked to pledge to only buy what is needed and will last, make repairs and reuse and recycle anything else and consider second hand products. Another inspiring example of this BMP is Banka BioLoo a women led organisation engaged in developing environmentally friendly products and services such as bioloos. The bioloos treat human waste with bacterial cultures, which means off-site disposal and treatment of excrement is not required. As a result, transport of human waste is eliminated, reducing pollution. Because the bioloos are found in 20 states across India, more people can safely use the toilet in different locations ranging from trains and schools to communities and hospitals.

DEMOCRATIZE

The purpose behind this BMP is to decrease the cost of ownership for the customer and to find innovative ways to democratize access to products or services by redesigning the revenue model to increase the affordability of technological, sustainable or social solutions. The main BM dimension is the value capture or revenues: by decreasing the cost of ownership, more customers can afford this product or service. One approach to achieve this, The Robin Hood, is to charge wealthy customers more than poorer customers for a product or service. This approach facilitates the idea of 'separation between revenue and customer' as this third party (the wealthy customer) might see value in the offering for philanthropical reasons. The other approach is to pay-per-use, which means that the customer only pays on the basis of what (s)he effectively consumes. As such, companies are able to attract customers who are not able to pay the full amount.

Two possible innovative ways of achieving this are The Robin Hood and pay-per-use. One approach is to charge wealthy customers, The Robin Hood, more than poorer customers for a product or service. The other way is to pay-per-use. In this approach, the actual use of a service or product is

metered. The customer pays on the basis of what he or she effectively consumes. The company is able to attract customers who are not able to pay the full amount.

This pattern recurs in several industries; in education (e.g. One-laptop-per-child seeks to empower the world's disadvantaged children with education, distributing rugged, low-cost and low-power laptops to kids across the developing world partially paid for by schools in the developed world), in the food industry (e.g. Chotukool India, a mobile food & beverage cooler for small shop owners) and in manufacturing (e.g. a spin machine that also produces electricity).

A well-known example of pay-per-use is M-Kopa, a Kenyan based company that offers cheap solar solutions with an innovative payment scheme. M-Kopa offers a home solar solution in a box, which includes a solar rooftop panel, three LED light bulbs, a solar radio and a cell phone charger. The whole kit costs \$200, which is too expensive for most Kenyans, and this is where mobile phones make it more affordable. After making an initial deposit of \$30, you or your neighbors pay off the balance by making a small daily micro-payment with your mobile phone.

Another example is the Youmma, a pay-as-you go-solar-powered fridge (CNN Business 2020). The cooling system of the small 100-liter fridge has been designed for off-grid use. That means it can be powered by a smaller solar panel and a smaller battery, reducing costs. Next to the technical innovation, the company also offers an innovative revenue model. Customers pay for the fridge in daily micro-installments via cell phone. If a user doesn't pay, the fridge stops working until payment has been received. The solar fridge is helping African entrepreneurs to earn a living off-grid without making a big initial investment. It also helps to reduce the waste of a valuable resource; food.

These examples are more than just technological innovations: the pay-as-you-go-system has basically democratized access to products or services by redesigning the revenue model to increase the affordability of a technological innovation.

DECONTEXTUALIZE

Reducing the total cost of ownership for the customer is the essence of this BMP; not only reducing the initial investment, but also reducing the maintenance and repair costs. Decontextualize is defined as creating a mass customized commodity by standardizing production processes in order to

create economies of learning in creating the value proposition. Economies of learning are a combination of economies of scale and economies of scope, both derived from the know-how picked up through experience. Economies of scale depend on producing more quantity or a wider portfolio. Economies of scope means becoming a true specialist in a certain field by producing a greater cumulative amount of the same product.

We identified this pattern in healthcare (e.g. The Jaipur Foot, also known as the Jaipur Leg, is a rubber-based prosthetic leg for people with below-knee amputations. It is inexpensive and widely acceptable as a prosthesis). An example from the manufacturing industry is a smart kettle called GETI, that generates power from woodstoves to light up houses and charge phones.

This BMP originates in the BM dimension cost structure and can only be successful by using frugal innovations that radically change the configuration and therefore minimize activities and resource usage. Customers with lower purchasing power benefit from these affordable less-resource products.

An example of this pattern and economies of learnings is the Aravind Eye Care System. This is a company that innovated into an eye-care specialist which provides affordable healthcare in India. Especially rural habitats did not have hospitals where they could go to when needed. Aravind started a mobile-hospital with only 11 beds, manned by 4 medical officers, which offered services as ‘eye-camps’, where they visited these rural areas to examine the needs of the inhabitants saving them long trips to hospitals in the large cities.

DISMISS (Sufficiency)

Dismiss is the ultimate frugal pattern in the sense that its value and strength lies in that it allows its customers to adopt a more frugal and therefore more sustainable consumer lifestyle. It can be described as making the use of products or services redundant by abandoning its initial function or by offering the same function with a radically different product. This BMP seeks to moderate overall resource consumption by curbing demand through education and consumer engagement. It makes products that last longer and avoid built-in obsolescence, focusing on satisfying ‘needs’ rather than promoting ‘wants’, as well as focusing on conscious sales and marketing techniques, or innovative

technology solutions (Bocken and Short 2016). BMs build on this BMP limit overconsumption and associated unnecessary resource use and are still successful in the market place. This frugal BMP finds its origin in the BM dimension value proposition and its value lies in that it creates the possibility for the customer to change its behaviour and to live a frugal live. Banking on this willingness is seen as an opportunity rather than a hindrance for business success.

Examples of this pattern can be found in the food industry (e.g. Instock, a restaurant in the Netherlands which serves food that otherwise would have been wasted) and in manufacturing (e.g. Vitsoe, a furniture manufacturer extends product life and encourages reuse by going against the industry norm of designing and manufacturing products intended to have a limited useful life). A primal example of banking on the willingness of consumers to limit unnecessary resource consumption is the Karma app that connects surplus food from restaurants, cafes and grocery stores to consumers for a lower price. As a result, users eat great food for less and businesses receive an additional revenue stream whilst reducing food waste.

5. Discussion and conclusion (step 7)

5.1 Conclusion

The goal of this study was to enhance the general discussion on how to transition to more sustainable BM's by adding the lens of frugality as a promising perspective (the sweet spot). Frugal innovation has grown into a well established field of research and this chapter aims to add value by connecting it to the circular economy discourse. Frugal innovations can simultaneously create social value and eco-effectiveness and can thus be perceived as a first step towards the 'circular economy'. We conceptualized a list of frugal BMPs and confronted these with succesful cases of frugal BMs within the sweet spot mentioned above. This answered the question: "What are the frugal BMPs that can help design successful sustainable BMs?" and resulted in the proposed 9-D framework.

The work of Prahalad and Mashelkar (2010), Radjou and Prabhu (2015) and Knorringer et al (2016) paved the way for this chapter by addressing the need for more attention to finding the right BM for frugal innovations. Moreover, they address the need for more insight into how these BMs take shape. Can frugality as a lens be used to describe how frugal BMI takes place? Does it allow us to describe new mechanisms in creating social and ecological value at the same time by applying a frugal mindset?

Looking at the patterns that were identified and validated with a first dataset, we feel safe to say that this perspective indeed sheds light on the ingenuity and cleverness of frugal innovators in developing BMs that would otherwise not be as explicit. The work on BMPs by Posthumus et al (2012), Gassmann et al (2014), Rosca (2017), Geisdorfer et al (2018), Lüdeke-Freund et al (2018) and Osterwalder and Pigneur (2020) provided a broad but insightful basis to identify a first set of frugal BMPs, resulting in the 9-D framework. The frugal perspective allows to describe previously hidden mechanisms behind the creation of social and ecological value and how practitioners can move beyond a trade-off between the two and to aim for the sweet spot. We can conclude that the frugal lens and development of this framework deserves further exploration.

5.2 Practical implications

So far, this chapter has captured the ‘what’ of frugal BM Innovation. The question can be raised *how* practitioners can actually design new frugal BMs. In her contribution to this book and in her previous work, Nancy Bocken has answered this question by describing that experimentation with (sustainable) BMs is needed to understand which propositions work in practice and what the impacts on the environment could be. BM experimentation can be based on different practices (Bocken et al, 2019) and can kickstart transformations within business (Bocken 2021). We suggest to add the 9D framework of frugal BMPs to enrich BM experimentation hopefully resulting in novel sustainable BMs.

5.3 Limitations of this study

This research is a first step based on a new perspective in the field of sustainable BM design and should be considered work in progress. The used dataset has certain limitations both in quantity and in quality. We recognize that our set of frugal cases is not exhaustive, and we acknowledge that many more frugal BMs exist with clues to other patterns that still need to be detected. Applying more stringent criteria on the availability of quantitative and qualitative information, and especially on the dynamics of creating the BM and quantifying the actual created values, should increase the sample quality. A revised set of selected cases of successful frugal BMs can then be used to further validate the presented 9-D framework. Additional research on critical success factors and critical design issues is necessary to validate BMPs as the methods that are used to identify these vary considerably and regularly lack methodological rigour.

5.4. Directions for future research

Based on the outcomes of this study we propose the following directions for future research. First, a more in-depth analysis of the mechanisms behind creating successful frugal BM's is needed. Such research should have a strong qualitative component and could be directed to build a library of patterns that can be used in creating frugal BMs. Furthermore, non-described BMPs can be found or knowledge of already described BMPs can be enriched. Since there are no explicitly tested hypotheses yet, we based this chapter on an in-depth theoretical approach. Also for this purpose a common vocabulary needs to be created regarding parameters for BMI, such as critical success factors and critical design issues. The aim here is to help mature this field by creating a shared vocabulary and heuristic that enables researchers to build a consistent body of knowledge that can be tested and verified (Eisenhardt 1989).

Secondly, the presented 9D-framework needs to be tested and experimented within education and training programs for practitioners in combination with BM experimentation. The data collected from these sessions will be used for further validation of the framework. Finally, we were unable to find closure in the discussion on how to measure the sustainability effect of new frugal BMs. After experimentation with the presented framework, some form of sustainability measurement will be necessary in order to validate if the new proposed frugal BM will be achieving both the financial and

sustainability goals set by the organisation (Bocken et al 2019). A parallel trajectory has already started to address this gap by creating a specific tool to this end.

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