SUSTAINABILITY IN BUSINESS MODELS – A LITERATURE-REVIEW-BASED DESIGN-SCIENCE-ORIENTED RESEARCH AGENDA

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SUSTAINABILITY IN BUSINESS MODELS – A LITERATURE-REVIEW-BASED DESIGN-SCIENCE-ORIENTED RESEARCH AGENDA

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Abstract

Science and practice highlight the relevance of employing sustainability practices in consumption and production. A sustainable change requires the participation of society as well as companies and organizations. In addition, companies have to rethink their classical businesses and consider innovations for acting in an ecological, economic, and social way by enhancing and adapting their business models. Business models can be described in different ways such as textual (e.g. business plans) or in graphical frameworks (e.g. Business Model Canvas). Frameworks support the designing of business models and should provide the consideration of sustainability. This paper aims to answer how sustainability is represented in existing approaches for modelling business models. Therefore, we conduct a literature review including different databases, proceedings, and journals. We identify and categorise a total of 42 articles. As a first result of the synthesis, we determine a literature-based typology of extensions, adjustments and design principles for sustainable business models. In addition, we suggest a research agenda which (a) discusses further enhancements to design sustainable business models regarding modelling techniques, sustainability assessments and detail models as well as (b) highlights the importance of evaluating these approaches by recommending evaluation settings.

Keywords: Business Model Frameworks, Business Models, Sustainability, Typology of Design Principles, Graphical Representation of Sustainability.

1 Introduction

In recent years sustainability has been widely discussed by society, companies and governments (United Nations, 2014; Bundesregierung, 2014). Growing global population, increasing pollution and globalization are only some reasons which entail new challenges (United Nations, 2014). Due to these facts a rethinking or rather reorientation to a sustainable way of life is beginning. For example, saving energy, using renewable resources or producing fair-trade products (Waldmann, 2004; Standford, 2010). We are also trying to get a better work-life-balance and rethinking production places which have bad working conditions (Bundesministerium, 2005). Hence, the participation of society and companies is required. Companies have to integrate sustainable principles into their strategies to support sustainable development. However, current studies show that despite an awareness of sustainability, many managers do not include sustainability in their business models in a clearly and adequate...
way (Herzig and Schaltegger, 2009; Abdelkafi and Täuscher, 2015). The manufacturing sector in particular has a huge impact on aspects such as resources (33% energy-consumption), working conditions and emissions (38% CO₂) (Holgado Granados, 2014). In addition, according to Deloitte (2012), environmental and sustainability performance is an essential business issue that is increasingly impacting business decisions.

So far, some approaches for the creation of sustainable value exist. In order to achieve sustainable behaviour an entire business analysis is necessary (Abdelkafi and Täuscher, 2015). The key challenge is to create “economic success through […] a certain environmental or social activity” (Schaltegger et al., 2012, p. 98). In this context, business model frameworks can contribute. The increasing popularity of these models is correlated to several factors such as enabling new ways of value creation or using new technologies (Wüstenhagena and Böhneke, 2006). Frameworks should support the design of innovative businesses which include for example, cleaner products and cleaner processes (Lüdeke-Freund, 2010). Often, these models are defined as Business Models for Sustainability (BMIS). They respect environmental, social, and economical issues in a balanced way (Abdelkafi and Täuscher, 2015). Although some approaches consider sustainability common guidelines are still missing (Lüdeke-Freund, 2010). Especially IS has a large potential for the business model concept. For example, the integration of sustainability has a huge impact on informational infrastructures or on designing new tools (Osterwalder et al., 2005; Seidel et al. 2013). Hence, it is essential to develop new modelling techniques which support creating consistent, comparable and analysable models (Becker et al., 1995; Frank, 1999; Frank et al., 2014). Furthermore, the process of designing a business model should be supported by tools which for example, provide the collaborative but decentralized development of such models. In addition, analysis and enhancements for existing business models could be supported by tools. Consequently, the guiding research question of this paper is “How can design principles, applied to current sustainable business model frameworks, contribute to our understanding of such models, support the modelling process, and enable the building of IT-tools to support those models?”

Therefore, we conduct a literature review which provides a state of the art of existing approaches regarding sustainability in business models. Our paper continues as follows. First of all, we explain the theoretical background for sustainability and the corresponding role of business models (section 2). In section 3, we describe our methodology as well as the configuration-parameter of the literature review and the following classification of the review results. In section 4, we classify the results to a concept-matrix and outline the content of the results. We focus on graphical representations of business model frameworks which include sustainability. Furthermore, we analyse instances (business cases) to identify general principles regarding sustainable businesses. The result presents a typology which conceptualises existing approaches into design principles. Finally, we demonstrate enhancement perspectives and principles for designing sustainable business models. In addition, we highlight the importance of evaluating these concepts and give recommendations on what should be evaluated and how it can be evaluated (section 5). In the last section, we conclude with our findings and derive some implications.

2 Theoretical Background

2.1 Business Models

Business models have become popular in management theory and practice (Osterwalder et al., 2005; Shafer et al., 2005). Despite a wide range of definitions, there is still a lack of a generally accepted one (Osterwalder et al., 2005; Wüstenhagen et al., 2006). Simple approaches have used the term synonym for a revenue model (Mings and White, 2000). The key point consists of the creation of value (Amit and Zott, 2001; Chesbrough and Rosenbloom, 2002). According to Schneidewind et al. (2011), a business model describes the fundamental architecture of a company. It provides information about what the value stands for, who it consumes, how it can be produced and the finances. Initial definitions divided them into core strategy, strategic resources, customer interface, and value network (Wüstenha-
gen et al. 2006). In addition, Stähler (2001) identified three key elements: value proposition, value creation, and revenue model. According to Osterwalder et al. (2005), we define a business model as the plan of how an enterprise does business which (a) allows designing and realizing the business structure and systems as well as (b) gives basic information about values, resources, actors, and flows. Due to the growing amount of business model literature, there is also an increasing number of business model frameworks. Different frameworks use different concepts and abstraction levels for describing businesses (Wüstenhagen and Boehnke, 2006). Hence, the method of visualisation is essential (Nielsen, 2010). A generally accepted framework which allows people to talk about the “same thing” is required. The concept “must be simple, relevant and intuitively understandable, while not oversimplifying the complexities of how enterprises function” (Osterwalder and Pigneur, 2010, p. 15).

Different kinds to visualise a business model are existing. First, textual description (usually utilized by reports such as business plans or brochures) include the most important points and provides details such as finances (Kanieshva, 2011; Springer Gabler, 2014). Second, graphical representations to illustrate how value is created and captured by grouping essential components and tracing relationships between them (e. g. Boulten et al., 2001; Wirtz, 2001; Kenieshva, 2011). A popular way is given by Osterwalder et al. (2005) who represents an entire business in a Business Model Canvas (BMC). This is divided into nine blocks: customers, value proposition, channels, customer relationship, revenue stream, key resources, key activities, key partnerships, and cost structure. These blocks cover the four main areas of a business: customer, offer, infrastructure and finances (Osterwalder and Pigneur, 2010).

Due to the fact that many graphical representations do not follow any modelling rules, it could be hard to read, to understand and to create them. A formal method of describing a modelling technique itself is stated by concepts like meta-models (e. g. Fettke et al., 2004). Fast changing market trends and situations require fast adjustments in businesses to consider current topics such as sustainability.

2.2 Sustainability

Based on global challenges such as climate changes and the need to act responsible, sustainability is a frequently used term which is also not defined in a generally accepted way. Sustainable Development (SD) first came up in 1987 from the World Commission of Environment and Development (WCED), which is also known as the Brundtland report. They define SD as “[…] the development which meets the needs of the present without compromising the ability of future generations to meet their own needs” (WCED, p. 43). Further definitions support this approach (e. g. Dunphy et al., 2000) or define SD as the aspects of business operations considering environmental, economic and social sustainability (Barlow, 2004). Despite some differences many of them argue that sustainability is one of the key factors regarding future competitiveness and business survival (e. g. Halgado Grandos, 2014).

2.2.1 Dimensions of Sustainability

The key issues of sustainability are usually addressed and divided into the three dimensions of economic, ecological, and social factors. They are also known as the Three Pillars of Sustainability. This model is used in local, regional, and national contexts of governance, business, and organizations (Pope and Morrison-Saunders, 2005). However, the analogy is often criticized because of the unequal consideration – if one pillar breaks, it does not impact the entire house (Dawe and Ryan, 2002).

Economic. Value creation, economic performance, and market presence.

Environmental. Energy/materials flows, emissions, waste, transport or human and nature co-exists.

Social. Work practices, working conditions, diversity and equal opportunities, social policy compliance, health, and human rights (Halgado Grandos, 2014).

According to Campbell (1996) these issues of sustainability result into three conflicts: (I) grow the economy, (II) distribute the growth fairly, and (III) in the process do not degrade the ecosystem. Decisions and ratings of current situations are required.
2.2.2 Strategies of Sustainability

For implementing sustainable consumption there are mainly three strategies (Huber, 1995).

Efficiency. This strategy is mostly seen as resource efficiency. It aims to reduce environmental damage. It tries to optimise the input-output ratios of production and consumption (Lüdeke-Freund, 2010). Current trends show that efficiency could enhance sustainability only at margins because there is no elementary change in the consumption.

Consistency. It tends to bring industry in line with circular approaches of the nature. The ideal is the metabolic cycle which does not generate waste because every output is reused (Lüdeke-Freund, 2010).

Sufficiency. Due to the fact that habits of consumers have to rethink (Lüdeke-Freund, 2010), sufficiency aims to change present patterns of consumption and production by a new lifestyle and attitudes in society. To address these issues, business models can contribute (e. g. Schaltegger and Wagner, 2008; Tukker et al., 2008).

Beside the mainly discussed strategies, there are further approaches. For example, Gronau (2003) suggested a new strategy which is called participation. This requires the involvement of stakeholders.

2.3 Business Models and Sustainability

The concept of BMfS emerged only a few years ago. Just like there is no general accepted definition of business models, there is a lack regarding the definition of BMfS, too (Abelfaki and Täuscher, 2015). Lüdeke-Freund (2010) described this concept as a model that creates competitive advantage through superior customer value and contributes to a sustainable development of companies and society. According to Schaltegger et al. (2012), it includes voluntary activities which solve social and/or environmental problems. By doing so, it creates positive business effects. They all address the creation of customer and social value as well as the integration of social, ecological and economic activities (Schaltegger et al., 2012).

Traditional business models often focus on economic values (Hvass, 2013). In addition, BMfS need the integration of further sustainable perspectives. While the economic view is already addressed in various sectors there are more factors which should be considered to design a sustainable business (Schneidewind et al. 2011). Only a few existing studies try to conceptualise elements and their relationships of sustainable businesses. There is research which identifies ideal types of BMfS, analyse potential BMfS in the context of industry, differ archetypes of BMfS, analyse the impact of archetypes such as product-service-systems, present case studies, and develop methodologies towards the innovation. Also some research focuses on “greening” models by considering collaborative innovation or sustainable value creation. To gain a general understanding of sustainable businesses and to provide a common framework it is necessary to complement existing approaches (Abelfaki and Täuscher, 2015).

3 Research Methodology

To identify (state of the art), examine and classify existing modelling approaches which represent sustainability in business models, we conduct a theoretical literature review (Pare et al. 2015). A literature review is more than an easy way of collecting some publications of a particular domain (e. g. Levy and Ellis, 2006). To get relevant findings it is necessary to develop synthesis out of the literature reviews than just to analyse it. Synthesis, on the one hand should address a specific research domain, and on the other hand should summarise essential knowledge of the chosen research domain (Cooper, 1988). It aims to understand the big picture of a particular domain to reduce irrelevant research agenda and to use the existing body of knowledge in an effective way (vom Brocke et al., 2009).

Although reviewing literature is essential for academic projects, (a) scholars tend to be unaware of the need for structuring such reviews, (b) guides for conducting reviews are often adopted from other research fields and do not entirely meet the specific needs of IS researches, and (c) guides often do not pay attention to the role of literature search processes (Webster and Watson, 2002; Okoli and Schae-
brom, 2010; Boell and Cecez-Kecmanovic, 2015). An important factor is the rigor of the search process because searching for literature is complicated in emerging fields such as IS and essential for the quality of such reviews. For this reason, the researcher has to document literature findings, the selection of keywords and the evaluation of the results (vom Brocke et al., 2009). Due to the methodological rigor of literature reviews in IS, we follow the five steps by vom Brocke et al. (2009): (I) definition of review scope (section 1), (II) conceptualization of topic (section 2), (III) literature review (section 4), (IV) literature analysis and synthesis (section 5), and (V) research agenda (section 6).

4 Literature Review

Identification of Keywords. A key factor of adequate searching is the identification of keywords in the vocabulary of the analysed domain. The keywords have to be documented precisely to support the traceability for other scholars (vom Brocke et al., 2009). Initially, we used relevant search items to identify suitable items for our literature review. We analysed them and highlight the quantity of usage according to Web of Science, Google Scholar and AIS Electronic Library (AISeL) (Table 1) to ensure the selection of more popular articles. Due to the wide range and interdisciplinarity of articles regarding sustainability, we analysed general search engines for identifying the items as well as an IS library.

<table>
<thead>
<tr>
<th>Item</th>
<th>Web of Science</th>
<th>Google Scholar</th>
<th>AISeL</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>„sustainability“*</td>
<td>64.662</td>
<td>2.600.000</td>
<td>8.075</td>
<td>-</td>
</tr>
<tr>
<td>„sustainable“</td>
<td>118.208</td>
<td>3.040.000</td>
<td>2.311</td>
<td>-</td>
</tr>
<tr>
<td>„green“</td>
<td>438.004</td>
<td>5.020.000</td>
<td>2.747</td>
<td>Authors named “green”; should be used in combination with other terms</td>
</tr>
<tr>
<td>“green business model“*</td>
<td>4</td>
<td>235</td>
<td>3</td>
<td>Ecological models</td>
</tr>
<tr>
<td>business model*</td>
<td>48.211</td>
<td>2.760.000</td>
<td>24.039</td>
<td>Only one the items could appear</td>
</tr>
<tr>
<td>„business model“*</td>
<td>3.325</td>
<td>420.000</td>
<td>858</td>
<td>Only with words in the same order</td>
</tr>
<tr>
<td>„business model“*</td>
<td>5.831</td>
<td>438.000</td>
<td>4.212</td>
<td>*placeholder for any unknown terms</td>
</tr>
<tr>
<td>“business concept“*</td>
<td>193</td>
<td>19.400</td>
<td>208</td>
<td>Synonym</td>
</tr>
<tr>
<td>“business plan“*</td>
<td>/</td>
<td>6.200</td>
<td>945</td>
<td>Strategy view, calculation</td>
</tr>
<tr>
<td>“business model concept“*</td>
<td>40</td>
<td>2.540</td>
<td>116</td>
<td>Frameworks, Templates, Concepts, etc.</td>
</tr>
<tr>
<td>“business model framework“</td>
<td>30</td>
<td>1.850</td>
<td>87</td>
<td>Frameworks, Descriptions, etc.</td>
</tr>
<tr>
<td>“graphical business model representation“*</td>
<td>/</td>
<td>2</td>
<td>/</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 1. Identification of search items.

We excluded items which are not suitable regarding our research question. We focus on frameworks which support users to develop and create their own business model. We include: English language, frameworks, and business cases. We exclude: simulation (mostly business plans), non-research articles which were purely descriptive, and articles that did not match the inclusion criteria. Finally, we determined our keywords which are quoted in Table 1 – represented by the grey coloured rows.

Selection of Sources. First, we choose AISeL which allows searching in relevant IS journals and IS conferences. We focus on the major IS conferences (ECIS, ICIS, and WI). Second, because the research field of sustainability is relatively new and there is a wide range of articles, we choose Google Scholar to include interdisciplinary articles, too. Hence, our selection should address domain-specific IS articles (depth search) as well as interdisciplinary articles (breadth search). Finally, we derived a search phrase for each source (Table 2).

<table>
<thead>
<tr>
<th>Google Scholar</th>
<th>(“business model concept“* OR “business model framework“* OR “graphical business representation“ OR “green business model“<em>) AND (“sustainability“</em>)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AISeL</td>
<td>“business model“* AND “sustainability“ NOT “simulation“</td>
</tr>
</tbody>
</table>

Table 2. Definition of search phrases.
5 Literature Analysis and Synthesis

5.1 Classification of Results

In total we found 1,684 articles (Google Scholar: 1,540; AISeL 144). Furthermore, we added exclusion criteria and got a total of 1,323 results. We evaluated these results by analysing titles, abstracts and keywords. Non-relevant articles were eliminated. The remaining articles (143) were verified by reading the full text to identify articles which suit our research questions. Finally, we removed duplicates and added articles of other sources (forward/backward search). In total, we found 42 relevant articles regarding our research question (Figure 1).

![Image]

Figure 1. Search results.

In the next step, we classify our literature results (Table 3) by using a concept matrix which is divided into the following four dimensions.

**Specification.** Specification describes whether the article presents a framework (Type) which supports the development of sustainable business models or an example (Instance) like a sustainable business case. Here, we focus on frameworks which support the designing of new business models. Furthermore, it also includes frameworks which address characteristics of sustainability. In addition, business cases were analysed to determine sustainability characteristics and requirements which could have an impact on graphical frameworks and should be considered.

**Sustainability.** According to the common Three Pillar Model of Sustainability (section 2), we distinguish this dimension into economic, ecological, and social sections. However, in our sense sustainability consider all dimensions in an equal way.

**Representation.** Representation addresses the visualisation of sustainability in business models. We divided it into textual and graphical sectors. These sectors do not exclude the appearance of the other one. It is not disjunctive because graphical representations often include textual elements.

**Evaluation.** To demonstrate that new approaches are useful they have to be evaluated. Hence, we analysed the support regarding the construction (modelling) and the interpretation (reading) of sustainable business models.

Some results deal with the behaviour or influence perspective on sustainable business models by analysing potential, individual factors, drivers, and barriers which have an impact on acting sustainable or creating a sustainable business (e.g. Backer et al., 2010; Evangelistia et al., 2011; Nair and Paulose, 2014). These articles are not considered in our literature review because we aim to identify criteria of sustainable business models and frameworks and not criteria such as impacting or success factors.
<table>
<thead>
<tr>
<th>Reference</th>
<th>Specification</th>
<th>Sustainability</th>
<th>Representation</th>
<th>E</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Macllanes (2005)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>Dynamic BM; Stages: technical issues (1), environmental factors (2), traditional factors (3), sustainable factors (4)</td>
</tr>
<tr>
<td>Osterwalder et al. (2005)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>Role of BM in IS; Profitable and sustainable revenue streams; Sustainable strategy requires: &quot;amount of internal diversity&quot; (p. 16), &quot;stock of potential strategies to be set off in the face of change&quot; (p. 16)</td>
</tr>
<tr>
<td>El-Gayar et al. (2006)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>Framework for IS supporting environmental management and sustainable development; Factors: extern (initiatives, regulation/standards, consumer opinion, supply chain), intern (management consider &quot;double bottom line&quot; (p. 762))</td>
</tr>
<tr>
<td>Peinel et al. (2009)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>Domain specific technique for eGovernment; transparency to assess sustainability; (e) validated in European projects</td>
</tr>
<tr>
<td>Umbeck et al. (2009)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>Framework for sustainable innovation; Criteria: competitive advantage, sustainability, unique sale point</td>
</tr>
<tr>
<td>Baker et al. (2010)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>ICIS Panel Report; Sustainable Innovation; Green IT; Sustainable IT. Requirements: social/normative frameworks</td>
</tr>
<tr>
<td>Lüdeke-Freund (2010)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>Conceptual framework of BM eco-innovation; Factors: population, pollution, consumption and reproduction, renewable resources; Barriers for sufficiency: psychological, behavioural, definition of limits; Barriers of efficiency: hindering innovation, lack of knowledge, missing demand</td>
</tr>
<tr>
<td>Watson et al. (2010)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>Server rooms and data centres; products and processes to ensure energy efficiency; Criteria: awareness of Green IT, motivation and coaching of employees; (e) evaluated with a design science approach</td>
</tr>
<tr>
<td>Boehm et al. (2011)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>Case study on logistic services; Drivers on greening: customer, competitor, legislation, managerial, employee; Barriers: costs, availability of alternative solutions, lack of customer interests, availability of IT for CO2 declaration</td>
</tr>
<tr>
<td>Evangelista et al. (2011)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>Indicators for sustainability benchmarking; Information-Sharing; (e) prototypical evaluation in industry</td>
</tr>
<tr>
<td>Kerschbaum et al. (2011)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>Mobile-Learning; sustainable market success; Criteria: anytime, anywhere learning; (e) evaluated with a quantitative analysis against the modified Technology Acceptance Model (TAM)</td>
</tr>
<tr>
<td>Maske et al. (2011)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>Conceptualization report for greening businesses; Green BM innovation; Concepts: modification (adjustments), re-design (changes), alternative (substitute), creation (new building blocks)</td>
</tr>
<tr>
<td>Henriksen et al. (2012)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>Sustainability-driven BM for &quot;waste as a resource&quot;, &quot;profit as a by-product&quot;, &quot;consumer as a sponsor&quot; (p. 60)</td>
</tr>
<tr>
<td>Kanscheva (2012)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>Hierarchical BM using a sustainability conceptual focus; Organizes the business concept around a value proposition</td>
</tr>
<tr>
<td>Lambert et al. (2012)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>Report of how companies work with Green BM Innovation; Level of maturity: (1) regulation driven, (2) compliance driven, (3) production driven, (4) new-redesign, (5) business model focus to make value capture from differentiation, (6) synthesize BM, new technologies, regulations, trend; (e) evaluated with case studies</td>
</tr>
<tr>
<td>Nilsson-Andersen et al. (2012)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>Renewable Energy; Customer-side BM (e. g. photovoltaic), Utility-side BM (e. g. technologies on offshore farms); Capturing value from energy transformation</td>
</tr>
<tr>
<td>Richter (2012)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>Conceptualize &quot;Sustainable Business Models&quot;; Taxonomy for challenges of Green BM; Focus environmental issues</td>
</tr>
<tr>
<td>Sommer (2012)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>Conceptual framework for lean and green business organizations; Analysis of existing frameworks</td>
</tr>
<tr>
<td>Boons et al. (2013)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>Conceptual framework for closed loop systems in the fashion sector; Three perspectives: front end (return management),</td>
</tr>
<tr>
<td>Duarte et al. (2013)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>Model by Osterwalder (2004)</td>
</tr>
<tr>
<td>Reference</td>
<td>Specification</td>
<td>Sustainability</td>
<td>Representation</td>
<td>E</td>
<td>Description</td>
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<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Kamath et al. (2013)</td>
<td>X</td>
<td>X X X X X X</td>
<td>X X</td>
<td>X</td>
<td>back end (remanufacture development), engine (remanufacture operational issues); (e) case studies</td>
</tr>
<tr>
<td>Pampanelli (2015)</td>
<td>X</td>
<td>X X X X X X</td>
<td>X X</td>
<td>X</td>
<td>Social BM framework; Modification of Osterwalder (2010); Adding social costs and social benefits</td>
</tr>
<tr>
<td>Abuzetina et al. (2014)</td>
<td>X</td>
<td>X X X X X</td>
<td>X X</td>
<td>X</td>
<td>Green BM in construction sector; Criteria: whole-life, closed loops, natural resources; (e) qualitative interviews</td>
</tr>
<tr>
<td>Dewan et al. (2014)</td>
<td>X</td>
<td>X X X X X X</td>
<td>X X</td>
<td>X</td>
<td>Approach, how environmental value requirements can be identified and efficiently fulfilled; (e) case study</td>
</tr>
<tr>
<td>Nair et al. (2014)</td>
<td>X</td>
<td>X X X X X X</td>
<td>X X</td>
<td>X</td>
<td>Green BM of sustainable energy; Chances: lay the foundations for the sixth wave of innovation; Requirements: enabling technological systems, customized BM, market-adoption strategy, favourable government policy</td>
</tr>
<tr>
<td>Sanderson (2014)</td>
<td>X</td>
<td>X X X X X X</td>
<td>X X</td>
<td>X</td>
<td>Study: Green IS and electric vehicles; Impact: demographics, government, car attributes, mobility patterns, individual characteristics (p. 4); Green IS for eco-friendly technologies; environmentally aware; lower energy consumption</td>
</tr>
<tr>
<td>Bocken et al. (2015a)</td>
<td>X</td>
<td>X X X X X X</td>
<td>X X</td>
<td>X</td>
<td>Sufficiency as a driver of BMI for sustainability; Criteria: energy efficiency, value from waste, renewable processes, adopt stewardship role, encourage sufficiency, re-purpose for society/environment; (e) a case study approach</td>
</tr>
<tr>
<td>Chasin et al. (2015)</td>
<td>X</td>
<td>X X X X X</td>
<td>X X</td>
<td>X</td>
<td>Electric vehicle charging infrastructure domain; “Accordingly, the commercial law demands sustainable behaviour, the aim of making a profit […]” (p. 341)</td>
</tr>
<tr>
<td>Doehrmann et al. (2015)</td>
<td>X</td>
<td>X X X X X X</td>
<td>X X</td>
<td>X</td>
<td>Framework of social ventures; On base of real-life case studies; Adjustments of Osterwalder and Pigneur (2010); Adding social mission (1) the one-sided, (2) the two-sided, (3) market-oriented, (4) commercially utilized</td>
</tr>
<tr>
<td>Hanelt et al. (2015a)</td>
<td>X</td>
<td>X X X X X</td>
<td>X X</td>
<td>X</td>
<td>Electric vehicle; environmental sustainability; Criteria: substitution potential, coverage, eco-friendly, resource efficient, flexible, modern; IS support sustainable mobility, for example with mobile apps</td>
</tr>
<tr>
<td>Hanelt et al. (2015b)</td>
<td>X</td>
<td>X X X X X</td>
<td>X X</td>
<td>X</td>
<td>Taxonomy; IS in business model innovation; Embedding sustainability into the core of business models</td>
</tr>
<tr>
<td>Hildebrandt et al. (2015)</td>
<td>X</td>
<td>X X X X X X</td>
<td>X X</td>
<td>X</td>
<td>Services for sustainable mobility (car sharing); Support by IS: information, automation/transformation; Criteria: flexibility, spontaneity, reliable access, real-time information, advanced reservations, automated payment</td>
</tr>
<tr>
<td>Joyce et al. (2015)</td>
<td>X</td>
<td>X X X X X X</td>
<td>X X</td>
<td>X</td>
<td>The Triple Layered Business Model Canvas; Social Stakeholder, Environmental Life Cycle, Economic</td>
</tr>
<tr>
<td>Matzner et al. (2015)</td>
<td>X</td>
<td>X X X X X</td>
<td>X X</td>
<td>X</td>
<td>Sharing services; Influence: perceived economic benefits, perceived demand, openness, perceived value-for-money, availability; Variable: degree to which an individual performs an environmentally conscious and responsible</td>
</tr>
<tr>
<td>Rauter et al. (2015)</td>
<td>X</td>
<td>X X X X X</td>
<td>X X</td>
<td>X</td>
<td>Study to investigate business models for sustainability; Drivers: legal regulations, leadership, organisational culture, coherence between corporate strategy and the business model for sustainability</td>
</tr>
<tr>
<td>Sach (2015)</td>
<td>X</td>
<td>X X X X X</td>
<td>X X</td>
<td>X</td>
<td>Sharing economy; Criteria: IT for societal value creation, acceptance, innovativeness, IT for analysis, innovation as competitive advantage, novel digital technologies</td>
</tr>
<tr>
<td>Upward et al. (2015)</td>
<td>X</td>
<td>X X X X X</td>
<td>X X</td>
<td>X</td>
<td>Ontology for Strongly Sustainable Business Models</td>
</tr>
</tbody>
</table>

Table 3. Classification and description of the literature review results.
5.2 Graphical Representation of Sustainability in Business Models

Frameworks should support the construction of new business models with considering sustainability aspects. Existing approaches address sustainability in the following ways:

**Adding new blocks to existing frameworks.** To consider environmental and social aspects Kan-shieva (2012) added two additional boxes below the Business Model Canvas. These boxes reflect ecological and/or social costs as well as ecological and/or social benefits which are provided for nature and society. Sanderse (2014) also added a box for the impacts of a business. Henriksen et al. (2012, p. 33) added “Growth Strategy” and “Comparative Strategy”. In addition, the original four-pillar template by Osterwalder (2004) is extended with a fifth pillar for “Non-Market Aspects” to figure out the value that is created with and for society and environment (Lüdeke-Freund, 2009, p. 43). They also included environmental aspects into the framework (Lüdeke-Freund, 2010).

To integrate social value and environmental value Lambert et al. (2012) adjusted the Hierarchy Business Model and added further blocks. The framework “is proposed as a new tool for sustainability management and research” as well as it “enables the depiction of a business and its sustainability” (Lambert et al., 2012, p. 9). Bocken et al. (2015a) added new key stakeholders to their value mapping tool to consider social and environmental aspects.

Beside the adjustments of existing business models, Umbeck et al. (2009, p. 61) developed a reference model which includes further relevant elements that protect sustainability.

**Dividing blocks of existing frameworks.** Sanderse (2014, p. 46) divided the customer block into “ultimate beneficiaries” and “customer/donor segments” to differ target groups and fundraising groups especially regarding business models for International Non-Governmental Organizations. Kamath et al. (2013) created a social enterprise model which is based on the Business Model Canvas. They divided the cost structure and revenue streams respectively into a financial and social view. They consider “what are the social costs for your social business model?” and “what is the way your social business model impacts social benefits?” (Kamath et al., 2013, p. 278).

**Modifying the block-content of existing frameworks.** To support a business model for social enterprises, Kamath et al. (2013) modified the customer side by given a focus on the beneficiaries rather than on the customers. They use the term beneficiary “to denote all those who will be sustainably benefitted by the model” (Kamath et al., 2013, p. 279). In addition Sanderse (2014) named the revenue stream “income” which includes income or funding streams such as donations, merchandises/sales or investments. Costs are termed as “expenditure”. On the beneficiaries side the relationship block includes a “program delivery method” to describe “the method which the organization uses to achieve its mission or programme activities” (Sanderse, 2014, p. 6).

**Modifying the structure of existing frameworks.** Gardetti et al. (2015) enhanced the original BMC by putting customers in the first place because customers are the heart of any business model. They moved the associated blocks for customer relationships and revenue stream to the left side.

**Linking elements (items or blocks) of existing frameworks.** “A great innovative potential is also placed in the interaction zones” (Henriksen et al., 2014, p. 46). The authors recommend to consider the interactions because changes in a particular block may have implications for related blocks. In a similar way Dohrmann et al. (2015, p 146) developed an approach for monetizing social value creation by adding an item for the value proposition which is called “Social Mission”. This item is linked to other elements in the canvas to illustrate relations and dependencies which should be respected.

**Adding views on existing frameworks.** Joyce et al. (2015) developed a Triple Layered BMC which include extra layers for social stakeholder and environmental life cycles. Sanderse (2014) added a value proposition which is called “mission” to support the consideration of a fundamental purpose of an organization during the designing of new businesses. Henriksen et al. (2012) developed a Green Business Model Innovation Concept which emphasis on the reduction of the environmental impact. This impact can vary according to the method by which the change in the targeted blocks takes place.
They added views for “creation” (entirely new), “alternatives” (fulfil the same function or operate as substitutes), “re-design” (re-design materialized), and “modification” (small and progressive adjustments) in each block (Henriksen et al., 2012, p. 46).

In total, we found various graphical approaches which are based on the BMC by Osterwalder (2010). Beside the mentioned results, Peinel et al. (2009) developed a domain-specific modelling technique to support the economical sustainability of eGovernment business models.

5.3 Principles of Sustainable Business Models

In addition, we review the business cases and textual results to identify essential characteristics and criteria that are discussed in the articles. These findings contribute information about which principles could be used in checklists for the design of sustainable business models. To structure the findings, we categorised them according to the common three pillars of sustainability.

**Social principles.** Bocken et al. (2015a) identified aspects which impact society, employees, partners, customers, and investors: leasing and affordable for everyone. According to Boons et al. (2013) sustainable innovation requires measureable social value, responsibility (among the supply chain), consumption as well as costs and benefits (social). They discussed social effects such as working conditions. Dewan et al. (2014) identified social principles such as safety of the product, health (fresh food, life-saving medicine, use of tobacco), employment (education, health, loans, and investments), ethics, and creating local jobs. Sommer (2012) determined business types for social sustainability for example, do-good-models (fair trade, sustainable fishing) and health models (organic food).

**Ecological principles.** Sustainable production can include following principles: pollution control, clean production, eco-efficiency, life-cycle-thinking, closed-loop production, waste management, recycling, noise control, using renewable energy, environmental monitoring and nature protection (e.g. Henriksen et al., 2012; Nilsson-Andersen et al., 2012; Duarte et al., 2013; Abuzeina et al., 2014). Regarding processes and activities of companies we determined: using natural resources, supplier selection, reserve logistics, delivery options (considering emissions, waste, noise, energy and heat), reducing waste, reuse products, reducing CO₂ impacts, apply deposits to ensure take-back, and pollution prevention (e.g. El-Gayer et al., 2006; Duarte et al., 2013; Hvass, 2013; Pampanelli, 2013; Dewan et al., 2014) In the case of electric vehicles, Hanelt et al. (2015a) identified quietness and substitution potentials. To achieve sustainable mobility, flexibility, availability, and advanced reservation these factors are useful (Hildebrandt et al., 2015).

Sommer (2012) present types of business models with green potential: low pollution, low waste, dematerialization, smart models (smart metering, virtual power plants), performance contracting (energy), renewable, eco-consulting (green logic), and base-of-the-pyramid models (solar). Richter (2012) determined customer aspects (e.g. photovoltaic, solar thermal hot water, and micro wind turbines) and utility aspects (e.g. offshore wind farms, large scale photovoltaic, and biomass power plants). Furthermore, sustainable benchmarks are suggested by Kerschbaum et al. (2011): energy (consumption, costs, emissions), water (consumption, costs, effluent), materials (consumption, costs), waste (hazardous, recycled, disposal costs), and production (costs, sales).

In general, we determine principles regarding environmental awareness, sustainable consumption, sharing; motivation and coaching, and integrating Green IS (energy informatics) in curricula (Watson et al., 2010; Boehm et al., 2011; Hvass, 2013; Pampanelli, 2013; Bocken et al., 2014).

**Economic principles.** A case study by Sach (2015) includes a ranking of elements which should be considered in the enterprise logic. The following extract exemplifies that economic elements still play a key role: (1) innovation, (2) social acceptance, (3) competitive advantage, and (18) sustainability. Sustainability is categorized as an indirect influence which has the prior state “add on” (Hanelt et al., 2015b, p. 10). A successful sustainable strategy requires a “stock of potential strategies to be set off in the face of change” (Osterwalder et al., 2005, p. 16).
According to Boehm et al. (2011), different criteria have to be considered regarding efficiency which also includes economic issues (faster and more efficient). Regarding closed loop systems and end-of-life issues financial characteristics such as costs of system, cost of collection, and cost of sorting have to be respected in business models (Hvass, 2013, p. 115).

### 5.4 Typology of Design Principles for Sustainable Business Models

The identified graphical extensions and adjustments (section 5.1) as well as the textual findings (section 5.2) are classified in a typology for designing sustainable business models (Table 4). A typology is derived in a deductive manner and gives a qualitative-based, conceptual classification (Bailey, 1994). We determine graphical approaches which support considering sustainability aspects during the (a) construction of business models, (b) extension of business model frameworks, and (c) modelling techniques. Here, the term principle addresses an approach which could be used to enhance a business model. The principles 2-7 can be applied to enhance existing approaches regarding sustainable factors such as the guiding ideas which are described in principle 1. For example, adding new blocks (5) to a framework to visualize environmental impacts such as reserve logistic (1). Furthermore, these principles could be used to develop new tools which support the modelling of sustainable business models.

<table>
<thead>
<tr>
<th></th>
<th>(1) Design principles and approaches for developing sustainable business models</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Ecological:</strong> resource management (renewables), reuse management (take-back), reserve logistic, life-cycle-thinking, closed-loop-production, waste management, recycling management, heat control, noise control, air control, water control, cleaner production, eco-efficiency, reduce emission, photovoltaic, solar, offshore wind, alternative opportunities, value from waste, substitution</td>
</tr>
<tr>
<td></td>
<td><strong>Social:</strong> sharing, leasing, affordable for everyone, health, fresh food, education of employees, loans, investments, ethics, creating local jobs</td>
</tr>
<tr>
<td></td>
<td><strong>Economic:</strong> maximize financial savings, ensure regulations, differentiation strategy</td>
</tr>
<tr>
<td></td>
<td>(2) Modifying the block-content of existing frameworks</td>
</tr>
<tr>
<td></td>
<td>According to the initial structure of the business model framework the content of several building blocks have been modified. For example, customers are renamed to beneficiaries to address all persons who will be benefitted in a social business model (Kamath et al., 2013), or revenue stream is changed to funding stream to consider donations and other investments (Sanderse, 2014).</td>
</tr>
<tr>
<td></td>
<td>(3) Dividing blocks of existing frameworks</td>
</tr>
<tr>
<td></td>
<td>According to the initial structure of the business model framework several blocks are divided into specific parts. For example, Sanderse (2014) divided the customer block into ultimate beneficiaries and customer/donor segment to specify this block more detailed.</td>
</tr>
<tr>
<td></td>
<td>(4) Modifying the structure of existing frameworks</td>
</tr>
<tr>
<td></td>
<td>According to the initial order and the content of the blocks the structure/order could be modified. For example, Gardetti et al. (2015) put customers in the first place, because they should be the heart of a business. In addition, sustainability aspects could put in the first place.</td>
</tr>
<tr>
<td></td>
<td>(5) Adding new blocks to existing frameworks</td>
</tr>
<tr>
<td></td>
<td>Additional boxes are added to existing frameworks to consider sustainability aspects such as environmental or biophysical sticks. For example, the Four Pillar Model (Lüdeke-Freund, 2009), Flourishing Business Model Canvas (Upward et al. 2015), Value Mapping Tool (Bocken et al., 2015a).</td>
</tr>
<tr>
<td></td>
<td>(6) Linking elements (items or blocks) of existing frameworks</td>
</tr>
<tr>
<td></td>
<td>There are potentials in the interaction between the elements, because changes in a specific element could have an impact on other elements. For example, using a particular resource impacts the environment. We identified three types of links: (a) item to item, (b) item to block, (c) block to block.</td>
</tr>
<tr>
<td></td>
<td>(7) Adding views with principles on existing frameworks</td>
</tr>
<tr>
<td></td>
<td>There are different ways of adding a view such as environmental sustainability on a business model: (a) on the entire business model, (b) on single blocks, and (c) on the entire business model and on single blocks. The design principles (1) could be used to develop sustainability relevant views.</td>
</tr>
</tbody>
</table>

Table 4. Typology of design principles for sustainable business models.
6 Research Agenda

6.1 Enhancement Perspectives of Sustainable Business Models

We identified different graphical approaches which address sustainability in business models. These approaches give information regarding the design of models and frameworks. However, the degree of completeness is not explored. Further IS literature could contain more approaches to enhance modelling techniques and models. For example, domain-specific modelling techniques which have gained a lot of attention in the IS community, could be used with business models (Becker et al., 2007a).

**Domain-Specific/Block-Oriented Modelling Technique.** A commonly used domain-specific modelling technique is **PICTURE** (Becker et al., 2007b). It provides building blocks for a particular domain which can be used to design new models more efficiently. This technique is evaluated during a project and it complies with the predefined requirements. Due to the increasing number of visual representations guidance is required. Based on the generally accepted modelling principles by Becker et al. (2005) it is possible to ensure the quality of information models. Standardized building blocks include some benefits which can be related to comparability, comprehensibility, clarity, and reusability (Becker et al., 2009). First of all, our determined principles (section 5.2) could be used to support the identification of potential blocks. They enable to consider sustainable thinking during the design of models.

**Sustainability Assessment.** In addition, we suggest a graphical assessment of sustainable and unsustainable aspects in business models. New elements which could be oriented towards metaphors such as the three colours of a traffic light seem to be helpful. We identified different elements of a business model to which a sustainability assessment may refer: (a) entire business model, (b) single building blocks, and (c) entire business model and single building blocks.

In case of integrating different enhancements, we propose the combination of a domain-specific modelling technique with a sustainability assessment. In this way we create assessed building blocks of a domain-specific modelling technique to support the selection process during the designing of new sustainable business models. This approach enables the designer to consider which blocks should be placed into the model by taking sustainability into account.

**Detail Model.** The identified principles which should be respected in a sustainable or green business model, are also relevant for other types of models and modelling techniques. Here, we focus on a particular block to enable detailed descriptions of the contents. For example, process models could be used in particular blocks such as “key activities” to provide more details about the sequence of activities. Furthermore, a detailed description allows a more detailed sustainability assessment.

<table>
<thead>
<tr>
<th>Table 5. Extension of the typology for sustainable business models.</th>
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<tbody>
<tr>
<td><strong>(1) Domain-Specific/Block-Oriented Modelling Technique</strong></td>
</tr>
<tr>
<td>This approach provides additional building blocks for a particular domain such as sustainability. Standardizations of elements and concepts support the designing process of new business models in an efficient way.</td>
</tr>
<tr>
<td><strong>(2) Sustainability Assessment</strong></td>
</tr>
<tr>
<td>Graphical assessment of sustainable or unsustainable aspects in business models. New elements which are oriented towards the metaphor of a traffic light seem to be helpful. Different types: (a) entire business model, (b) single building blocks, (c) entire business model and single building blocks. Furthermore, we could assess building blocks of a domain-specific modellng technique.</td>
</tr>
<tr>
<td><strong>(3) Detail Model</strong></td>
</tr>
<tr>
<td>Integration of a detail model which provides a specific view of a business model block. This concept offers detailed descriptions of blocks such as “key activities” by other models, for example process models or data models.</td>
</tr>
</tbody>
</table>
6.2 Evaluation Perspectives of Sustainable Business Models

However, it is important to evaluate the concepts which address sustainability in business model frameworks to clarify which approaches can be combined, used in particular domains, and support efficient reading and constructing of these models. It is challenging to decide which approaches are suitable for designing sustainable business models. Due to the diversity of existing methods a generally framework is required. Hence, we suggest to evaluate following aspects in a first step:

**Evaluation inside single types of the typology (intra).** First, we suggest the evaluation of possibilities to combine aspects from a single type of the typology. Is it possible to combine every aspect with each other or does one aspect exclude the others? For example, does adding a view on a single building block exclude the possibility to add a view on the entire model?

**Evaluation between all types of the typology (inter).** Second, we recommend validating the approaches among each other. Are there potentials to combine different approaches? For example, is it allowable to add additional boxes and modify the content of existing boxes at the same time? Is it allowable to use a domain-specific modelling technique while integrating sustainability assessments? To answer these questions the combination of each type with the other types has to be analysed.

**Evaluation of domain-specific applicability.** Third, we motivate to evaluate the applicability of the typology types to prove in which domains/use cases specific ones are applicable. In which cases it make sense to choose a specific type? For example, dividing the revenue stream into blocks regarding financial and social benefits is often used in social business models.

Results of an evaluation may show that the established approaches are completely adequate for modelling sustainable businesses and there is no need for enhancement. For example, the BMC is one of the best ways to consider sustainability because existing enhancements are hard to understand and hard to use. There exist different frameworks for conducting an evaluation (e. g. Gemino and Wand, 2004; Schalles, 2013). In general, there is a model-development and a model-interpretation perspective which focuses on efficiency and effectiveness. Here, we suggest to evaluate the mentioned enhancements for sustainable business models to identify how suitable a model is compared to other models.

6.3 Limitations

This literature review, including the search parameter such as items and phrases, is based on methodological recommendations by vom Brocke et al. (2009). We choose this methodology because it is – in our opinion – adequate for conducting a traceable and expandable literature review. However, the selection of key words, literature sources, inclusion and exclusion criteria, and classification is conducted by own decisions and choices which have limitations. First, we could have added more key words for example, “social sustainability” or “ecological sustainability”. Secondly, we could have added more sources for example, “ScienceDirect”. An extended search may enable the identification of more relevant literature. This selection is limited to the specified proceedings, journals, and search engines.

7 Conclusions

The present article develops a literature-based design-science-oriented typology of principles which support the new- and re-design of sustainable business models and indicates further enhancements regarding the graphical representation. Altogether, our extended typology gives an orientation of approaches which can be applied to ensure sustainability in new models and describes requirements which should be supported, for example by tools. There is already a range of enhancements which are, unfortunately, often used separately. In our opinion the combination of these approaches could aid to support the consideration of sustainability in such models. Hence, there is a need for evaluation.

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Nilsson-Andersen, P., and J. Bang Andersen (2012). Green business model innovation in the tourism and experience economy-Cases from Austria, Portugal, Denmark, Finland, Mexico, Norway, Sweden, Iceland, Russia and South Korea.


