Toolset for Sustainable Business Modelling

Padmakshi Rana, Samuel W. Short, Steve Evans, Maria Holgado Granados and Katri Valkokari

1 Introduction

A sustainable business modelling (SBM) process and toolset needs to—embed sustainability ethos and initiatives into the business purpose and value network activities, integrate a broader multistakeholder view on generating environmental, social and economic value, identify and develop collaborations between the stakeholders to eliminate negative environmental and social impacts, and be appropriate for use by companies and practitioners. Some specific additional tools that explicitly address sustainability are required, for a business modelling process that delivers sustainability, more particularly addresses the impact on the environment and society (resource availability, climate change, waste and workplace environment). The following requirements were established based on the observations and gaps discussed in Chaps. "Business Models and Modelling: State of Art", "Sustainable Business Models: Theoretical Reflections", and "Practice Review of Business Models for Sustainability", for designing and developing the SBM process and toolset:

- Provide guidance on establishing the fundamental purpose of the company and network.

P. Rana (✉) · S.W. Short · S. Evans
Centre for Industrial Sustainability, Institute for Manufacturing, University of Cambridge, 17 Charles Babbage Road, Cambridge CB3 0FS, United Kingdom
e-mail: padmakshi.rana@cantab.net

M.H. Granados
EPSRC Centre for Industrial Sustainability, University of Cambridge, Cambridge, United Kingdom

K. Valkokari
VTT Technical Research Centre of Finland Ltd., P.O. Box 1300, 33101 Tampere, Finland

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- Uses a system- and company-level approach for interventions and changes (configuration and coordination of value creation, delivery and capture).
- A comprehensive framework for investigation and understanding of the value proposition of the company and network for all stakeholders (analysis of existing business model). Specifically, the approach needs to be able to identify negative outcomes for society and the environment.
- Assist in transforming the sustainable value proposition:
  - Provide guidance on how the business model might be amended/extended to enhance sustainability, i.e. ways to align the interests of the environment and society with the consumers and investors' interests.
- Provide options on the specific design of the business model (what) in order to deliver sustainable solutions, while supporting change within the companies.

Likewise, tool selection criteria were established, specifically for selection and development of the toolset:

- *Time required* this includes the period required for using the tool, which involves willingness and availability of the user to spend time on it. It also involves the time required for data collection and analysis. Hence, it has been classified into—a few hours, in between and more than 1 week.
- *Skills and knowledge required* there are tools that require a higher level of external facilitation and support in its use and application compared to others. It is considered preferable to identify, adapt and design tools and methods that involve ease of use. Therefore, three levels were identified in this criterion—standard skills, general knowledge and no specific need for field expertise, in between and highly specialised skills, multidisciplinary knowledge and field expertise. These consider the difficulty of implementing the tool (i.e. mathematical or statistical competence) and the depth of knowledge on specific contents.
- *Data required* this involves the quantity and difficulty in gathering data and is based on the following classification, which considers the nature, ease and accessibility to the information:
  - integrated in information sources, limited effort and number of people required for data collection (in the company and among immediate stakeholders)
  - in between
  - dispersed in information sources, effort required in data collection with the need to keep contact with different and distant stakeholders.
- *Value perspective* this criterion reflects the need for the tool to consider both tangible (monetary and performance indicators) and intangible (stakeholder involvement and customer satisfaction) values in order to capture benefits from economic, environmental and social sustainability.
- *Business ecosystem perspective* the tools are able to include a broader range of stakeholders across the industrial network.

- *Innovation and creativity* This includes tools that are capable of generating innovative ideas and stimulates creativity.
- *Availability of the tool* this criterion comprises of tools that are either already available and can be used as it is (on the shelf) or needs to be adapted for the SBM process.
- *Possible use of the tool* tools vary in their use—analysis, design and guidelines. Hence, the toolset considers all of these categories, given the nature of output of each step of the SBM process.

2 Use and Test Phase

The first stage process and toolset (Table 1) were developed, which were then refined and enhanced through trials with various organisations. The SBM process and toolset were developed and tested in individual sessions with the SustainValue project industrial partners in the manufacturing industry—Riversimple, CLAAS,

Table 1 First stage SBM process and toolset

Proposed steps	Proposed tools/methods	Expected outputs
Step 1—Purpose of the business	System SWOT analysis—SUSPRONET PESTLE/STEEPLED Sustainability continuum (Willard 2005)	Reason for being in the business, approach and drivers for sustainability, products and service bundles, industry-related needs, norms and opportunities
Step 2—Identify potential stakeholders and select sustainability factors	Value mapping tool GRI guidelines, SASB (industry-specific) Scenario management tool (Chap. "Methods and Tools for Sustainable Development of Products and Services")	Potential stakeholder types and what do they value, sustainability priorities
Step 3—Explore and develop new opportunities for sustainable value proposition	Value mapping tool Scenario management tool	Sustainable value proposition for a company and its stakeholders—value opportunities
Step 4—Concept generation and selection	Sustainable business model element archetypes (Short et al. 2012) Sustainability impact calculation tool (Chap. "Methods and Tools	Transformation/development of the new sustainable value proposition

(continued)

Table 1 (continued)

Proposed steps	Proposed tools/methods	Expected outputs
	for Sustainable Development of Products and Services")	
Step 5—Define and develop the value creation and delivery system and the value capture mechanism	Business model canvas (Osterwalder and Pigneur 2010) Life cycle cost estimation tool ("Methods and Tools for Sustainable Development of Products and Services")	Key activities, key resources, key partners, key channels, key mindset and the value exchanges and value capture for the stakeholders

Elcon and FIDIA—and with external organisations such as start-ups, small and medium enterprises (SMEs), MNCs (multinationals) and universities—teaching material and research institutes. The feedback and observations on the efficacy of the process and tools were captured by the facilitators and participants (who vary given that the tools in the portfolio are across the project and in some cases have been used by external facilitators). The process and toolset were not all tested in the organisations, and only a subset of the toolset was used with them.

The summary of lessons learnt from the various trial sessions (Table 2) was used to improve and enhance the process and toolset. The sessions and subsequent research meetings among the SustainValue partners and external academics on the observations and feedback of participants and facilitators lead to addition and removal of tools.

Table 2 Trial sessions

Organisation	Type	Number and duration of workshops, participants and location	Overall workshop objectives for participants, tool developers and facilitators	SBM process and toolset used
Riversimple	Start-up (automotive)	2 workshops, UK Workshop 1–2 h, 2 participants—founder and engineer Workshop 2—1.30 h, 7 participants—stakeholder representatives—custodians)	Stakeholder interactions and relationships, missing stakeholders Approach to sustainable business modelling Tool improvement and validation	SBM process (whole process) Value mapping tool Sustainable business model archetypes
CLAAS	MNC (agriculture)	1 workshop, 2 h, 2 participants—service engineer and product manager, Germany	Stakeholder identification, value forms across the network, sustainable	Value mapping tool Sustainable business

(continued)

Table 2 (continued)

Organisation	Type	Number and duration of workshops, participants and location	Overall workshop objectives for participants, tool developers and facilitators	SBM process and toolset used
			business model exploration Future developments with regard to potential changes in the agricultural business environment Tool improvement and validation	model archetypes Scenario management tool SIC tool
Elcon and VTT	SME (electronics, power systems) and research institute	2 workshops, 2 days, 5 participants—2 board members, 1 employee, 2 researchers, Finland	Sustainable business model development—new offering Life cycle cost perspective for customers to select a sustainable solution Tool improvement and validation	SBM process (whole process) Sustainability continuum Value mapping tool Sustainable business model archetypes Business model canvas LCC estimation tool
FIDIA	MNC (milling)	1 workshop, Italy	Supporting FIDIA's potential transition towards a sustainable business model	Sustainability continuum (Step 1) Business model canvas (Step 5)
Furniture	SME	1 workshop, 2 h, participant—managing director, UK	Tool improvement and validation	Value mapping tool Business model archetypes
Food	MNC	1 workshop, 2 h, participant—head of sustainability and communications, UK	Tool improvement and validation	Value mapping tool Business model archetypes
Consumer products	MNC	1 workshop, 2 h, participants—sustainable development manager—products, quality and		

(continued)

Table 2 (continued)

Organisation	Type	Number and duration of workshops, participants and location	Overall workshop objectives for participants, tool developers and facilitators	SBM process and toolset used
		technology and the energy team representative		
Software/hardware products—4, manufacturing—1	5 start-ups	5 individual workshops, 1 h with 2 participants in each session, UK	Business model development Tool improvement and validation	Value mapping tool (Steps 1–3) Strategic road mapping tool with value mapping tool
Finnish furniture industry	SME network	3 workshops, Finland: Workshop 1–8 participants—representatives of network companies Workshop 2–6 participants—company representatives Workshop 3—12 participants—researchers from varied backgrounds	Network-level codevelopment of sustainability Stakeholder identification and interactions	Value mapping tool (Steps 1–3)
Genoa University University of Cambridge	Engineering students	1 workshop, 2 groups of 5 to explore two separate company cases, Italy 2 workshops, 3 h each, Cambridge: • Undergraduate—6 groups of 5, each with individual cases • Graduate—8 groups of 5, each with individual cases	Exploring various forms of value across the network to assist sustainable business modelling Tool improvement	Value mapping tool Sustainable business model archetypes
SustainValue partners workshop	Industry, academia and research institutes	1 workshop, 1.30 h, 3 groups of 4–5 participants—industry and academia, UK	Tool demonstration and improvement	Value mapping tool (Steps 1–3)
Consultants on an executive course	Consulting	1 workshop, 45 min, 20 participants, UK	Tool improvement and validation	Value mapping tool—new design and improved process
	Mix of industry and		Tool improvement and validation	Value mapping tool

(continued)

Table 2 (continued)

Organisation	Type	Number and duration of workshops, participants and location	Overall workshop objectives for participants, tool developers and facilitators	SBM process and toolset used
World[a] Federation of Sporting Goods Industry	sporting goods associations	2 workshops, 2 h each, over 50 participants, Taiwan Workshop 2 with sustainability professionals, innovation specialists, manufacturing/sourcing experts		—new design and improved process Sustainable business model archetypes

[a]Event hosted by Chinese National Federation of Industries Taiwan External Trade Development Council and Taiwan Sporting Goods Manufacturers Association

3 Sustainable Business Modelling Process

SBM process is a five-step approach that considers a network-centric perspective to deliver sustainability. The SBM process accompanied by a portfolio of tools provides companies with assistance in the analysis and design of sustainable business models for network-level change. This approach introduces the sustainability dimensions (environmental, social and economic) and objectives, language around shared-value creation across the industrial network and harmonising stakeholder objectives through the identification of conflicting interests between them. The specific difference is that the analysis of market needs is not just narrowly focused on customers, but equally on the needs and impacts on the society and the environment—that is, conceptualising a three-dimensional value proposition (economic, social and environment) for the company. The process is iterative, in that as changes occur in one step, it impacts not only on the following step but also on the preceding ones and occurs over a period of time. Companies can be at various stages of the SBM process, so using the process and toolset will rely on the preference of the participants (Fig. 1).

Step 1—Setting the scene

This step is about understanding the purpose of the business and potential stakeholders in the value network. Understanding the purpose involves developing the rationale of the business and its value. This is followed by identifying the stakeholders in the value network/s that will assist in exploring new sustainable value proposition/s. The discussion on developing the purpose and identifying stakeholders, with whom engagement needs to be established, is supported by exploring the company's position (current and future), drivers and priorities for sustainability, along with anticipated threats and opportunities.

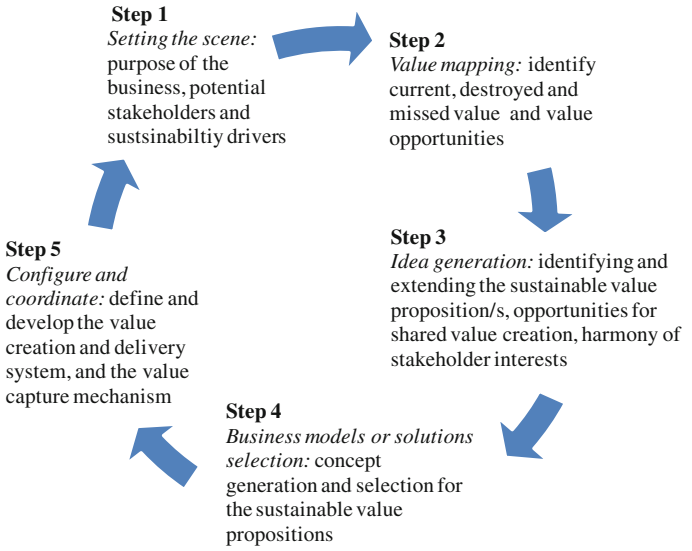

Fig. 1 Sustainable business modelling process (adapted from Rana et al. 2013; Holgado et al. 2013)

Step 2—Value mapping

This step emphasises on understanding the positive and negative aspects of the value proposition of the business and its value network. It is concerned with identifying and mapping various forms of value (current, destroyed and missed) from a multistakeholder perspective across the network to contribute towards the development of the new and/or extended sustainable value proposition/s.

Step 3—Idea generation

Based on the stakeholders established and the value mapping exercise in Steps 1 and 2, analysing the relationships and value (social, environmental and economic) exchanges between the stakeholders to eliminate negative environmental and social impacts (waste, carbon emissions, forced labour) across the network is undertaken in this step. The step focuses on identifying conflicts between stakeholders across the network and working on covalue creation (stimulating innovation and ideas) through the harmony of stakeholder interests, to develop new and/or extended opportunities for sustainable value creation.

Step 4—Business models or solutions selection

This step involves the selection of one or a combination of feasible business models, concepts or solutions for the transformation of the new sustainable value proposition or propositions (Step 3) so as to seek ways/paths to capture opportunities for value creation, while minimising negative value and maximising positive value in the network. Business models or concepts that actively seek to address

sustainability are considered. This could be initiatives that encourage sufficiency—consumer awareness and education, demand management and product longevity and durability and encouraging sustainable production—closed loop (waste at the end of the use phase of a product to be used to create new value), cradle to cradle (e.g. designing waste streams that have minimal impact on the environment), reuse and remanufacture.

Step 5—Configure and coordinate

This step is about defining and developing the value creation and delivery system and the value capture mechanism for the selected sustainable value proposition and business model to generate network-level change. It involves the analysis, design and transformation of the value creation and delivery systems and the value capture for the selection/s from Step 4. It includes the identification and potential development of the value delivery and capture system (key activities, channels, resources) for pursuing options to deliver sustainability, while analysing the cost incurred through the life cycle to assist in evaluating the options. This step builds on Steps 2 and 3 on the understanding of stakeholder value and value exchanges in the network.

4 Toolset

Each step of the SBM process is accompanied by the selection of tools that will assist companies in understanding and delivering sustainability (Table 3). The selection of the tools in each step of the SBM process will depend on the user with regard to the type of the organisation, scope of operations, resource availability (human and financial), scale and size and the position on sustainability. Each tool can be used in isolation depending on the objective for use. However, they are more effective in generating results—delivering sustainability, if they are used in combination, which is exemplified in the overview of some of the tools in the following sections.

4.1 Primary Tools

The following tools were either developed or identified specifically to support the SBM process so are presented as primary tools. They assist companies in designing and developing a sustainable business model that includes a network-centric perspective for sustainable value creation.

Table 3 SBM Toolset

SBM process	Toolset
Step 1—Setting the scene	*Primary* Value mapping tool *Support* System SWOT analysis (Tukker and Tischner 2006) PESTLE/STEEPLED Sustainability continuum (Willard 2005)
Step 2—Value mapping	*Primary* Value mapping tool *Support* GRI guidelines, SASB (industry-specific) Scenario management tool
Step 3—Idea generation	*Primary* Value mapping tool Sustainable business model archetypes (Bocken et al. 2014) *Support* Scenario management tool
Step 4—Business model/s or solution/s selection	*Primary* Sustainable business model archetypes *Support* Sustainability impact calculation tool
Step 5—Configure and coordinate	*Primary* Business model canvas (Osterwalder and Pigneur 2010) Strategic roadmapping tool—emergence roadmapping method (Phaal et al. 2012) *Support* Life cycle cost estimation tool Sustainability performance framework

4.1.1 Value Mapping Tool

Value mapping tool (adapted from Bocken et al. 2013) supports Steps 1 (setting the scene), 2 (value mapping) and 3 (idea generation) of the SBM process. It assists in understanding and mapping various forms of value (positive and negative aspects of the business and its value network) and identifying conflicts between stakeholder interests, while analysing value exchanges from a multistakeholder perspective to create positive value creation for the network. It assists in stimulating innovation, generating ideas and creating new sustainable value propositions. The value mapping tool is proposed to help companies understand and create new sustainable value propositions to support business model design for sustainability. The tool was specifically designed to focus on understanding and transforming the value proposition from a stakeholder perspective for sustainability. The novel design aspects of the tool include the following (Bocken et al. 2013):

- Four representations of value to facilitate a systematic value assessment, representing the forms of value. Identifying them separately encourages a more thorough exploration of the current business model and assists in identifying areas requiring change or improvement.

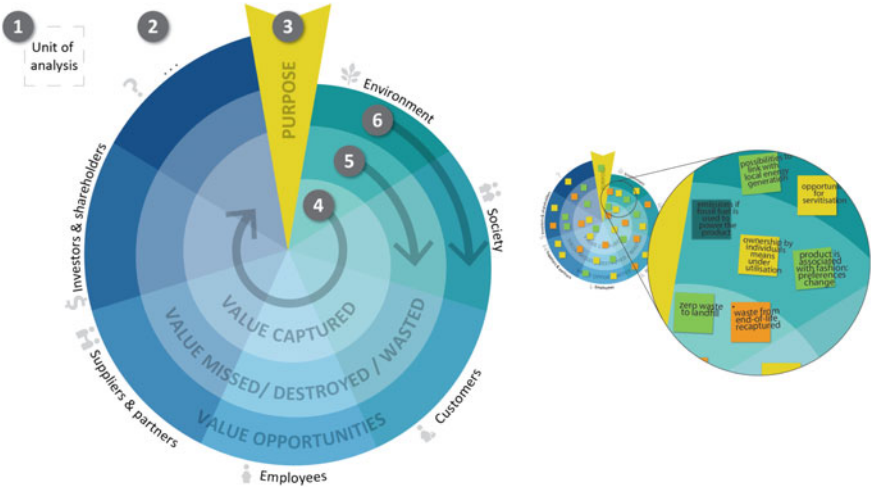

Fig. 2 Value mapping tool

- Stakeholder segments to facilitate a multiple stakeholder view of value. Current business modelling processes and tools focus on the customer value proposition. The proposed tool seeks to expand the range of stakeholders or recipients of value, including the environment and society. Each segment represents a stakeholder group.
- A network-centric rather than firm-centric perspective to encourage the optimisation of value in a network (i.e. considering all actors involved in the design, production and distribution of a product or service). The company is represented as "employees and shareholders" to facilitate a network perspective (Fig. 2).

Tool Rationale and Aim

The objective of the tool is to transform destroyed and missed value into positive new value creation and explore value opportunities for radical new sustainable value creation. The value mapping tool is based on the value transformation rationale illustrated in Fig. 3. The Riversimple industrial case elaborated in Chap. "An Industrial Case: Riversimple" provides examples of current, destroyed and missed value and value opportunities in the company.

The value mapping tool has three specific aims, which are as follows:

- Understand the positive and negative aspects of the value proposition of the business and its value network.
- Identify conflicting stakeholder interests, so pathways for generating harmony of interests can be developed to reduce negative outcomes.

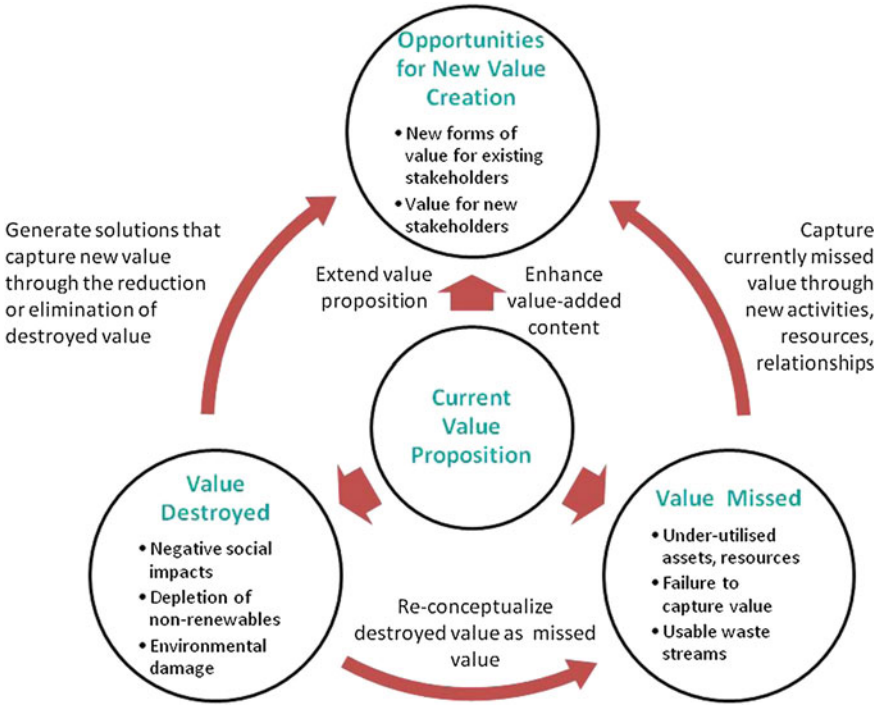

Fig. 3 Value transformation (Short et al. 2013)

- Explore new opportunities for further positive sustainable value creation through increased value-added, business extension and capturing currently missed value such as underutilised capacity.

Using the Tool

The process begins by defining the unit of analysis. The focus is on the value proposition for the overall network, rather than the company, to support a network perspective. Stakeholder types are identified and placed in each segment of the tool. Generic stakeholder types are provided, but the participants are free to populate the tool with specific stakeholders to facilitate the analysis. Hence, blank stakeholder segments are provided for potential addition of specific new stakeholder types during the process. Society and the environment are included as stakeholders. A facilitated brainstorming that includes a set of questions is then used to populate each stakeholder segment in turn with the various forms of value generated for that stakeholder. This follows a logical progression from the core value proposition by the current business model, outwards to values further removed from the core offering. The use of the value mapping tool follows the steps below:

- Step 1—Setting the scene:
  - Decide the unit of analysis (product/service, business unit, company or an industry).
  - Add or modify any missing stakeholders.
  - Identify the purpose of the unit of analysis and its network (yellow star).
- Step 2—Map the value (follow the spiral, clockwise):
  - Current value captured for each stakeholder.
  - Value missed (underutilised, failing to capture or recognise value) and destroyed for each stakeholder.
  - Identify causal relationships between forms of positive value creation and destroyed value.
- Step 3—Generating solutions for shared sustainable value creation:
  - Eliminate value destroyed—where is the conflict between stakeholders? How might it be resolved?
  - Look for ways to utilise value missed.
  - Explore new value opportunities—extending the value proposition, shifting to higher value-added activities.
- Step 4—Revisit the purpose.

Applicability of the Tool

This tool is conceived to provide a structured approach for entrepreneurs and business managers to gain a more complete understanding of the value proposition of the company and to explore opportunities for transforming the value proposition towards more sustainable solutions. The tool is envisaged to have applicability to all business modelling activities, from exploring opportunities for new start-ups, to assisting in redesigning business models for established large corporations. The use of the tool and the design of any workshops to use the tool should be adapted to the size and complexity of the business. For more complex businesses, it may be desirable to focus on specific business units or product lines to ensure the process is manageable. To maximise the potential of the tool, representatives or suitable proxies for each major stakeholder group should participate in the process to solicit broad perspectives on value.

4.1.2 Sustainable Business Model Archetypes

The sustainable business model archetypes (Short et al. 2012; Bocken et al. 2014) support Step 4 (network-level change). The archetypes describe groupings of

mechanisms and solutions that might contribute to building up the business model for sustainability. They assist companies in transforming new sustainable value propositions, while designing sustainable business models, and were specifically identified and developed for this purpose. The archetypes are used in combination with the value mapping tool to illustrate the value forms and support business transformations.

The trial sessions demonstrated the value of such an approach in stimulating innovative thinking and supporting business model transformation for sustainability. The archetypes were further refined to integrate broader examples of business model innovations from practice, while enhancing and clarifying the description of the individual archetypes. The title was changed from sustainable business model element archetypes to sustainable business model archetypes as mentioned in Sect. 2 of Chap. "Sustainable Business Models: Theoretical Reflections".

As Bocken et al. (2014) state, "the archetypes have the potential to embed sustainability into business purpose and processes, increase the ambition of innovations, accelerate their introduction and reduce risks of implementation through providing exemplars from practice". The archetypes do not only reduce social and environmental negatives but also assist in redesigning and reconceiving the business model to deliver sustainability (Fig. 4).

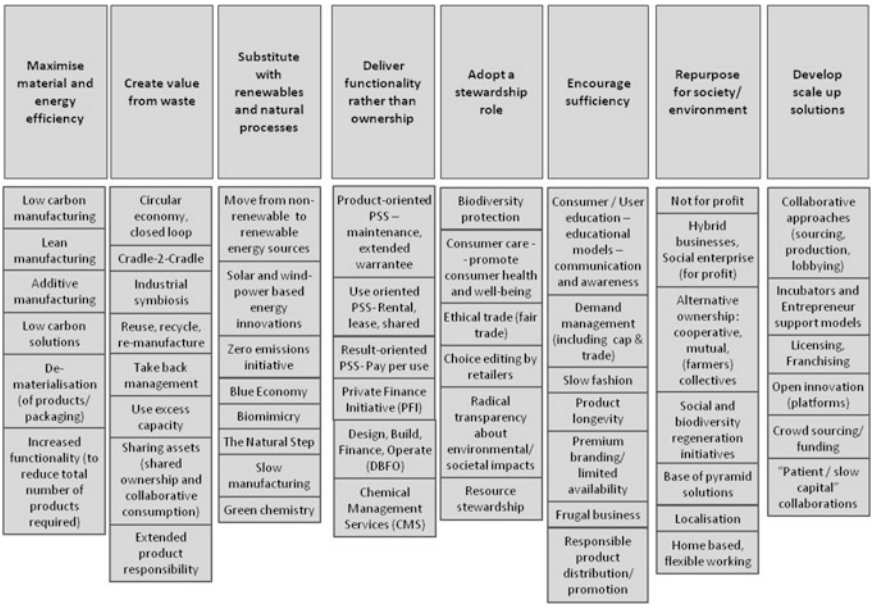

Fig. 4 Sustainable business model archetypes (Bocken et al. 2014)

Tool Rationale and Aim

With the exception of some recent literature (e.g. Boons and Lüdeke-Freund 2013 who propose a classification by social, technical and organisational sustainable business model innovations), few authors have sought to unify the various examples in the literature and practice in a useful categorisation. The lack of a common source of information in this area makes it difficult for practitioners to understand the scope of business model innovation for sustainability. This then limits practical experimentation and implementation of sustainability solutions in industry and restricts the potential for exploitation of synergies between different types of innovations, so further limiting the potential benefits. Hence, the sustainable business model archetypes were developed to describe groupings of mechanisms and solutions that might contribute to building up the business model for sustainability and identify gaps for future research agenda. The main aims of the sustainable business model archetypes are to:

- Provide a means of categorising and explaining business model innovations for sustainability.
- Define generic mechanisms for actively assisting the business model innovation process for sustainability.
- Provide exemplars that explain and communicate business model innovations to businesses to derisk the business model innovation process (e.g. through education and workshops).

Using the Tool

The set of archetypes is envisaged to provide assistance in two main ways:

- Assisting in developing the value proposition, by providing a structure for identifying and exploring opportunities for transforming currently negative outcomes of the business model, or exploring new ways to create positive sustainable value.
- Designing and developing the business model structure by providing guidance in mechanisms to realise a desired value proposition.

The archetypes and the examples are not generally entire business model innovations in their own right, but rather elements that constitute part of a business model design. The sustainable business model should be developed using a combination of several of the various archetypes for shaping the business transformation. “Although each can be applied in isolation, different archetypes may be combined and real sustainability almost certainly demands combinations of archetypes (e.g. deliver functionality rather than ownership, while maximising material and energy efficiency)” (Bocken et al. 2014). The archetypes can be used as exemplars in a workshop setting with industry. For example, it can be used with

the value mapping tool as prompts in illustrating the value forms (value destroyed and missed, value opportunities).

Applicability of the Tool

The sustainable business model archetypes are conceived to provide a structured approach for entrepreneurs, business managers and practitioners to investigate mechanisms for creating and delivering new sustainable value propositions and to explore opportunities for transforming the value proposition towards more sustainable solutions. Companies when brainstorming to develop new sustainable business model ideas may draw inspiration from each of the archetypes, a creativity process that has been well received, during exploratory industry workshops conducted by the authors.

4.1.3 Business Model Canvas

The business model canvas (Osterwalder and Pigneur 2010) supports Step 5 (coordinate and configure) of the SBM process in the coordination and configuration of the value network. The canvas (also mentioned in Sect. 4 of Chap. "Business Models and Business Modelling: State of Art") attempts to capture all the dominant components of the business model (value proposition, creation, delivery and capture) and is made up of nine building blocks:

- 'value proposition—describes the bundle of products and services that create value for a specific customer segment
- customer segments—defines the different groups of people or organisations and enterprise aims to reach and serve
- channels—describes how a company communicates with and reaches its customer segments to deliver a value proposition
- customer relationships—describes the types of relationships a company establishes with specific customer segments
- revenue streams—represents the cash a company generates from each customer segment (costs must be subtracted from revenues to create earnings)
- key resources—describes the most important assets required to make a business model work
- key activities—describes the most important things a company must do to make its business model work
- key partnerships—describes the network of suppliers and partners that make the business model work
- cost structure—describes all costs incurred to operate a business model'

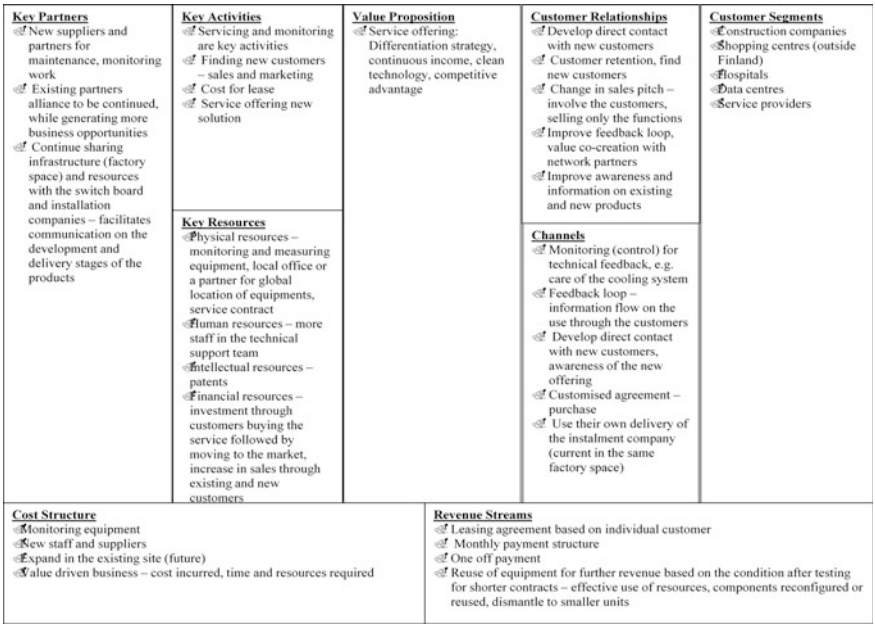

Fig. 5 Business model canvas—Elcon case example (Uusitalo et al. 2015)

The canvas places emphasis on defining concrete processes and operational activities to produce and deliver the value proposition. The preceding steps of the SBM process will explore and develop the sustainable value proposition/s with the selection of one or a combination of business models and/or solutions that will deliver sustainability. The canvas will then assist in the coordination and configuration of the key activities, key resources, key partners and channels and the value exchanges and value capture for the stakeholders across the network, while defining the revenue model of the company based on the sustainable value proposition. Figure 5 illustrates the use of the canvas with the company Elcon. The canvas was not specifically designed for sustainability, but as it addresses the key components of a business model, it is considered helpful to configure the value network for the selected sustainable value proposition/s and associated business model/solution.

Using the Tool

Using the canvas in combination with the value mapping tool and sustainable business model archetypes (tool and approach especially designed for sustainability) in a workshop setting explicitly includes multistakeholder perspective on cocreation of sustainable value. The canvas was used in combination with the value mapping tool and the archetypes, during the use and test phase with an industrial partner, while exploring their new sustainable value proposition—service offering,

which falls under the "deliver functionality rather than ownership" archetype. The new sustainable value proposition, along with input on the environment, society and customers from the value mapping tool, was plotted on the canvas, hence continuing the emphasis on sustainability being at the core of configuring and coordinating the delivery and capture of the new value proposition. Figure 5 is an example of the Elcon industrial case, aligned to deliver functionality rather than ownership archetype (product service systems—use-oriented).

Applicability of the Tool

This tool is already available (on the shelf) and extensively used by the developers and external facilitators. It is applicable to entrepreneurs, intrapreneurs, consultants, practitioners in start-ups, SMEs and multinationals among others who seek to create value, develop innovative business ideas and transform businesses (Osterwlader and Pigneur 2010).

4.1.4 Strategic Roadmapping Tool

Phaal et al. (2004) view roadmaps and the roadmapping process as a powerful approach that supports "business strategy and planning beyond its product and technology planning origins" and "brings together people from different parts of the business, providing an opportunity for sharing information and perspectives and providing a vehicle for holistic consideration of problems, opportunities and new ideas". Such roadmaps plot the identified additions to the value proposition and business model elements on a timeline from the current date to a projected end point (which could be considered as the long-term sustainability vision). The steps along the path should build incrementally upon each other, although some activities may of course be undertaken in parallel. An appropriate time frame would depend on the industry, company size and other factors. In some cases, it might be just a few months or years, others perhaps a generational planning horizon.

The emergence roadmapping method (ERM), below, developed by Phaal et al. (2012), in particular, is considered a helpful method to support Step 5 (configure and coordinate) of the SBM process. Although this roadmapping method is primarily for early-stage ventures, it is considered useful to support the transformation and implementation of new and innovative sustainable value proposition/s as "it is applicable to both the overall pattern of industrial emergence and the particular innovative efforts of companies within an industry" (Phaal et al. 2012). It "provides a structured process for [value] opportunities to be explored further, to clarify the strategic direction and to agree on technical and business development actions necessary to move forward" (Phaal et al. 2012) (Fig. 6).

The ERM was used in combination with the value mapping tool as part of "design strategy workshop for early-stage ventures" with five different start-up companies at different stages of development, run by the facilitators at the Institute

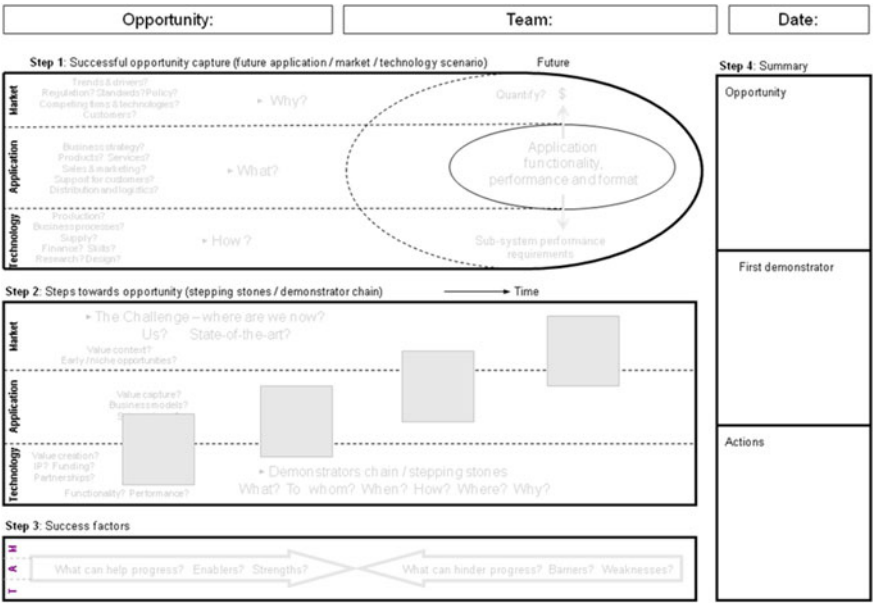

Fig. 6 Emergence roadmapping method (Phaal et al. 2012)

for Manufacturing, Education and Consultancy Services (IfM ECS). The output from the value mapping tool (new sustainable value propositions), in particular the new value opportunities, was plotted on the roadmap to develop routes towards the opportunities. Figure 7 illustrates the ERM agenda and process generated by Phaal et al. (2012). This tool is already available (on the shelf) and used by the developers in industry.

4.2 Support Tools

The tools below are used in combination with the primary tools to provide additional information and assistance in-depth analysis of the outcome.

Tools such as system SWOT analysis (Tukker and Tischner 2006), PESTLE/STEEPLED, Global Reporting Initiative (GRI) and Sustainability Accounting Standards Board (SASB) and corporate sustainability continuum (Willard 2005), assist companies in identifying industry-related requirements, norms and opportunities including the company's position (current and future), drivers and priorities for sustainability. These tools were identified to support Step 1 of the SBM process and are used in combination with the value mapping tool (based on the preference of the user). These tools and guidelines are already available (on the shelf) and have been used extensively in industry.

Timing	Activity	Description
10 min	Introductions	The workshop begins with facilitator and participant introductions.
20 min	Context presentation	The sponsor of the workshop or a nominated participant sets out the background for the workshop, including a summary of any pertinent technical and commercial information.
10 min	Aims and workshop approach	The lead facilitator presents the aims for the workshop and describes the approach, explaining how the structure and checklist provided by the template guides the group activities. The digital camera case is used to illustrate the nature of technology-intensive industrial emergence and the concept of the demonstrator chain.
60 min	Step 1: Clarify the future-opportunity scenario	Participants brainstorm ideas with a goal to articulate the future target-opportunity scenario in terms of market and application.
60 min	Step 2: Specify demonstrator milestones	Demonstrator milestones ("stepping stones") that will assist in moving towards achieving the goal are identified and described.
45 min	Step 3: Identify enablers and barriers to progress	External and internal enablers of and barriers to progress are identified, associated with the various demonstrator milestones and development activities.
15 min	Step 4: Summarize opportunity and way forward	Participants develop a short "elevator pitch" of the opportunity scenario defined in Step 1 and the first demonstrator to be achieved and priority actions to be taken from Steps 2 and 3.
20 min	Discussion and close	Workshop progress is reviewed, including key lessons and actions.

Fig. 7 Emergence roadmapping agenda and process (Phaal et al. 2012)

4.2.1 System SWOT analysis

It is part of the output of SUSPRONET project (Tukker and Tischner 2006). The generic SWOT analysis tool (strengths, weaknesses and opportunities and threats of companies) was adapted to include sustainability dimensions and technology and legislation aspects. This tool assists companies in identifying the current and future strengths, weaknesses, opportunities and threats of the business (business model) for sustainability. Such information will help towards developing initiatives and mechanisms for addressing and embedding sustainability in the business purpose and operations (Fig. 8).

SWOT	Current Situation		Future Situation	
	Strengths	Weaknesses	Opportunities	Threats
A. Environmental Dimension • materials efficiency (including water) • energy efficiency • toxics/ environmental risks • waste minimisation, re-use, recycling • transport and mobility efficiency • life cycle aspects, longevity, cyclic economy (technical/natural cycles) • bio-compatibility, nature conservation				
B. Socio-cultural dimension • fulfilment of needs/ consumption patterns (high or moderate) • health and safety issues • living conditions/ quality of life • employment/ working condition • equity and justice/ relation to stakeholders (media, NGOs etc.) • respect for cultural diversity				
C. Economic dimension ***for the company/ies*** • market position, competitiveness • profitability, added value for companies • long term business development, risk • partnership/ co-operation/ chain value captured • macro economic effect/ market influence ***for the customers*** • profitability, affordability, added value for customers (tangible/ intangible)				
D. Technology, Feasibility				
E. Legislation, Regulation, Public Infrastructure				

Fig. 8 System SWOT analysis (Tukker and Tischner 2006)

4.2.2 PESTLE and STEEPLED

They constitute extensions of the PEST analysis (Political, Economic, Social, and Technological Analysis). PESTLE includes legal and environmental factors, and STEEPLED adds education and demographic factors. They are considered as macroenvironmental factors that an organisation has to take into consideration when studying its business environment. The extension of the tool is considered as they assist companies in understanding the micro- and macrolevel factors influencing the current and future business environment. It is considered as a useful strategic tool and could potentially provide additional support to the value mapping and scenario management tool in understanding the current and future factors influencing the business environment.

4.2.3 GRI and SASB guidelines

They (serving as more as checklists) are considered helpful in providing guidance for identifying sustainability factors and priority areas. The GRI framework provides companies with guidelines for sustainability reporting based on the social, environmental and economic dimensions. SASB propose sector-specific sets of indices to reflect the different materiality issues of different sectors and emphasise on the link between business model, corporate strategy and sustainability issues (SASB website).

4.2.4 Corporate sustainability continuum

It (Willard 2005) represents the progress of a company on the path towards sustainability. It will support companies in reviewing their current and future path towards sustainability (Fig. 9).

4.2.5 Scenario Management Tool

The scenario management tool supports Steps 1, 2 and 3 of the SBM process. The tool is illustrated and explained further in Chap. "Maturity Assessment for Systematic Performance Improvement in Manufacturing". This tool supports the understanding of the micro- (values and culture in shaping businesses and market and prices, workplace conditions, various business functions—finance, manufacturing, marketing and advertising) and macro (resource use—energy, water and minerals, climate change, household/consumer behaviour and population growth)-level factors influencing the current and future business environment and identifying requirements for the future that will affect the development and transformation of a novel sustainable business model. The analysis this tool carries out is particularly relevant to Step 1. It also supports Step 3 to stimulate innovation and

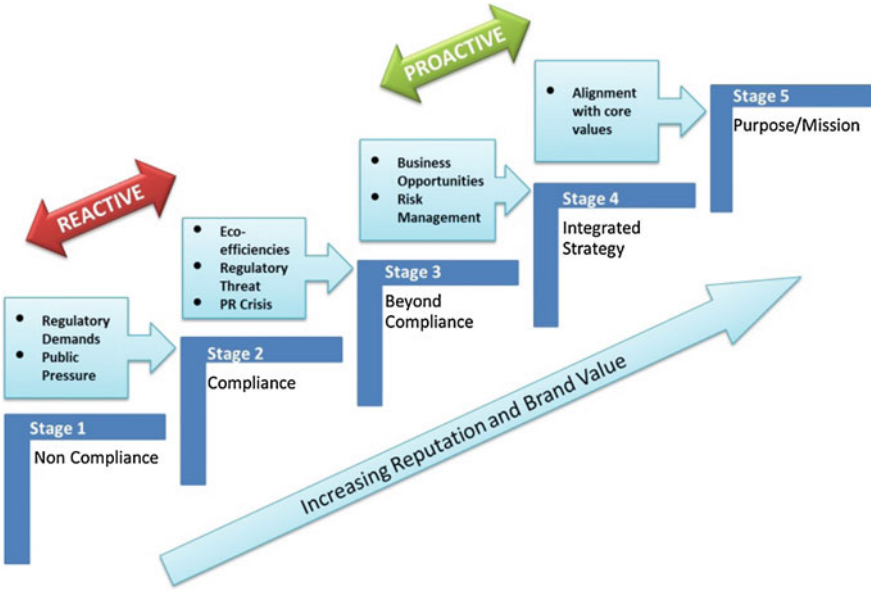

Fig. 9 Corporate sustainability continuum (Willard 2005)

understand stakeholder relationships. Hence, the tool is considered helpful to support the SBM process.

Scenario management tool is part of the future analysis, and its objective is to detect innovation potential within a defined topic. Innovation potentials are challenges that can be managed with a business model, product or service innovation in a potential market and are connected with the business portfolio. The main goal of scenario management is the description of realistic scenarios of a strategic formation field with which innovation potentials for business models, products or services can be identified. It was used to create more transparency for possible future developments related to potential changes in the environment of the agricultural business and considered all three pillars of sustainability. Economic interests and new market potentials were discussed, including investigations for potential technical developments (e.g. Internet connectivity in areas with fewer infrastructures). The identification and investigation of new environmental benefits through process optimisations were recognised, and social aspects (e.g. guidance and comfort for drivers of harvesters and tractors) were addressed.

Tool Rationale and Aim

The objective of the tool is to detect innovation potential within a defined topic by describing realistic scenarios of strategic formation fields with which innovation potential for business models, products or services can be identified. The tool is

generally applicable and not obligatory to be linked to a branch or size of a company. Furthermore, the tool is user-friendly and can be used with a variable number of participants and external stakeholders.

Using the Tool

The process of the scenario analysis tool was described clearly and detailed for the industrial partners in the form of a detailed PowerPoint presentation. The different steps of the scenario management procedure (below) were supported by further templates (e.g. influence factor matrix, the idea generation sheet or the risk attractiveness matrix).

Before the tool is applied, the following tasks need to be conducted: identification of the scope for design (e.g. PSS), definition horizon and time (time period and topic) and definition of the dimension for global and local surroundings of the topic (global dimensions cannot be influenced, and local factors can be influenced). The goal of this phase is to detect innovation potentials within a defined topic. It is important to have a heterogeneous group of different actors of a company/network (optional with external stakeholders) in order to get a broader view on the topic and by respecting different stakeholder's needs/interests. Scenario management tool includes the following steps:

- System analysis and selection of key factors:
  - Identify a topic with local (factors that the company can control) and global (factors that cannot be controlled but need to be considered) surroundings. This is followed by the selection of key influencing factors.
- Development of alternative future projections:
  - This includes the description of the present situation of the key influencing factors and estimation of their future projections in a conservative, trend and progressive way.
- Grouping of alternative projections into scenarios:
  - This step involves summing up the projections into scenarios in a morphological box using intuitive and logical bundling.
- Analysis of scenarios and prospect/risk observation:
  - Chance analysis with the aid of the defined scenarios and identification of the biggest innovation potential are carried out in this step (Fig. 10).

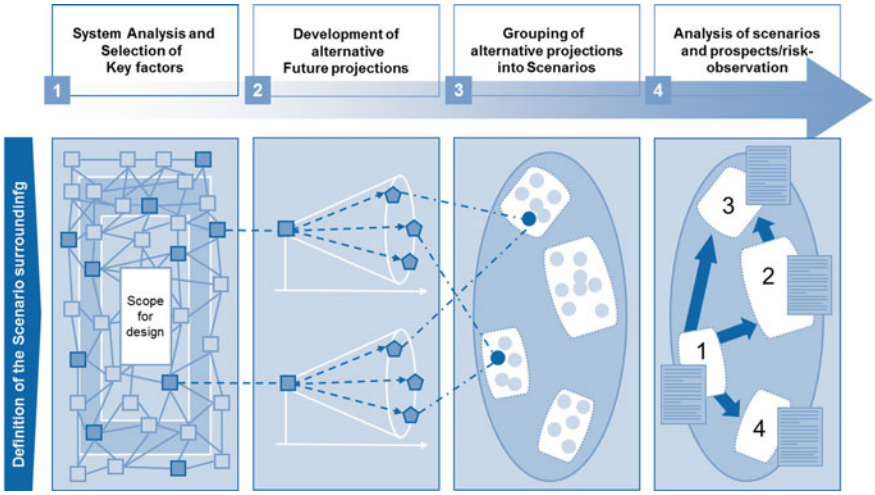

Fig. 10 Scenario management tool procedure

Applicability of the Tool

Many companies do not know the surroundings of their business and how they may change. The tool helps to develop realistic future prospects and demonstrates where future business models, products or services can be situated. It can be used in MNCs, SMEs and start-ups of all industries.

4.2.6 Sustainability Impact Calculation (SIC) Tool

The SIC tool supports Step 4 (business models or solutions selection) of the SBM process. It is illustrated and explained further in Chap. "Methods and Tools for Sustainable Development of Products and Services". This tool is included in this step as it supports in evaluating the sustainability impact across the life cycle and in the selection of sustainable solutions.

The modelling approach covers all life cycle phases (cradle to cradle) and therefore provides a holistic sustainability evaluation of a product service system (PSS). The tool combines existing PSS approaches for the detection and assessment of sustainability impacts, with sustainability aspects and thus forms a new evaluation methodology for sustainable solutions; economic, environmental and social sustainability are considered. The SIC tool demonstrates how a sustainable product or product service system performs over its whole life cycle, while covering the economic, environmental and social aspects. Economic sustainability is illustrated by the net present value (NPV) and life cycle costing (LCC), and environmental sustainability is measured via the material input per service unit (MIPS). MIPS methodology is developed by the Wuppertal Institute for Climate, Environment and

Energy which tries to measure and to estimate the environmental impacts caused by a product or service that considers the total material input and divides it into five categories (abiotic and biotic materials, air, water, erosion). Furthermore, other KPIs or methodologies are combined to assess the environmental impact. Social sustainability is measured with the aid of the Social Accountability (SA) 8000 guideline and further social aspects. The integrated life cycle concept segregates investment into separate phases over the life cycle and in this way identifies "cost drivers" of each phase.

Tool Rationale and Aim

The objective of the SIC tool is to assess and measure sustainability impacts on society, environment and economy, as well as their correlations and development over time.

Using the Tool

The first task is to stipulate a "service unit". A service unit (SU) defines a product (or service) and its usage cycle; e.g., if the tasks would be to estimate a T-Shirt's sustainability impact, a SU would be defined as one wearing cycle of the T-Shirt including washing and ironing. Besides, it has to describe for how many life cycles the T-Shirt will be used. Costs, such as manufacturing, raw materials, transportation and delivery, will be broken down into the defined number of service units. The result of the tool is a concrete estimation of the service unit. The tool is based on Excel calculations and consists of different files and sheets within each file. Each file represents one life cycle phase, including material input and output, social inputs and environmental, economic and social impacts. The additional output file then calculates and consolidates the environmental, economic and social impacts.

Applicability of the Tool

The tool is at the prototype stage and was used with CLAAS. However, the mode of operation is not linked to a special branch or to a size of an industry. If many companies use this tool, a wide basis for comparison can be created which can help with the classification and evaluation of service units. So the tasks for the future are to standardise the data and the evaluation of the tool with more industry partners.

4.2.7 Life Cycle Cost (LCC) Estimation Tool

The LCC tool (Uusitalo et al. 2015) is included in Step 5 (configure and coordinate) of the SBM process as it supports in the evaluation and selection of a cost-effective

and sustainable solution, while providing a summary of the cost incurred across the life cycle. The tool is illustrated and explained further in Chap. "Methods and Tools for Sustainable Development of Products and Services". The LCC tool calculates and estimates the costs and effects of products during products' life cycle. With the tool, the user can compare five different solutions according to their annual and lifetime costs. Main cost categories that are taken into account are acquisition costs, use costs and disposal costs. Acquisition costs include the acquisition and installation of the components selected for the current solution. Annual use costs are costs caused by preventive and corrective maintenance, outages and electricity consumption. Power supply systems can also include components for power production (e.g. windmill or solar cells), which are taken into account as a decreased need for power from outside. All cost incurred by recycling of components or materials and waste treatment is considered disposal costs.

As a result, the tool calculates the life cycle costs of different options. Life cycle costs are shown by cost categories so that the user can make a comparison of the options by total costs and also by different categories. Life cycle profits are not considered because the power supply system is to ensure good quality of power supply, and thus, it does not provide direct profit; for example, it does not increase production volume. When considering future costs, estimates are obviously uncertain. The effect of this uncertainty is assessed by sensitivity analysis which is done by Monte Carlo simulation. In one simulation run, it is calculated life cycle costs of compared options in a case when future costs are different than what was first estimated. When this calculation is done several, e.g. 1000, times, the variation of expected life cycle costs becomes visible. As the cost factors differ case by case, this tool cannot directly be generalised for all kind of products. In this power supply system case, it is easy to combine financial and environmental aspects with life cycle costs because the main environmental effects come from electricity consumption whose monetary value can be easily measured.

Tool Rationale and Aim

The aim of the LCC tool is to bridge the gap between practical decision-making and visions about sustainable decisions. The tool supports sustainable decision-making by providing information about both investment costs and also future costs which will be realised during the use and end-of-life periods. In the power supply system case, use and maintenance costs are directly related to environmental impacts. The LCC tool includes a cost breakdown structure for the case product, data input forms, calculation of result indicators, sensitivity analysis and presentation of results by numbers and graphs.

Using the Tool

All calculations implemented into the LCC tool are done in Excel worksheets. To make the tool more user-friendly, separate forms for data input and result examination were also developed. Forms were created by Excel VBA programming language. Although data input and result examination are possible without form interface, it was implemented into this prototype because the user-friendly interface facilitates substantially better real user tests. The use of the LCC tool can be described as a process with the following steps:

- Step 1—Define the possible solutions that meet the customer's technical requirements and are options to be analysed.
- Step 2—Populate the LCC tool with input data, i.e. give numerical values to the relevant cost parameters for current case.
- Step 3—Calculate point estimates of life cycle costs. This is done automatically by the LCC tool.
- Step 4—Assess the uncertainty of numerical values of cost parameters given in the Step 2. Uncertainty is expressed by statistical distributions defined by a graphical tool implemented in the LCC tool.
- Step 5—Calculate expected variation of life cycle costs based on statistical distribution given in the Step 4. This is done automatically by the LCC tool.
- Step 6—Assess the results and compare the options using result indicators from the LCC calculation.
- Step 7—Make the decision for the current case based on economic criteria. For multivariate analysis, other criteria can be used to support the decision.

Applicability of the Tool

Life cycle cost calculations can be utilised internally in the company or externally with customers. The life cycle cost calculation can be used in negotiations with potential customers to provide more detailed cost information than just the acquisition price for their decision-making. In this case, the LCC calculations were originally meant to be utilised in the delivery project negotiations with potential customers to serve the case company's need to explain the higher purchasing price with lower life cycle costs and more sustainable solutions. The tool that was developed provides a reasonably quick and easy way to review different solutions, and it can bring new solutions that differ from the customer's first ideas about the solution into the negotiations.

During the LCC tool development and testing, the case company used the tool to analyse elements of its product portfolio. In these tests, it was realised that this kind of calculation can elicit ideas to improve products from the life cycle perspective. This internal use of the LCC tool can reveal products that are not good enough from a life cycle point of view and should be replaced with products that lead to better

overall results. Applicability of the developed LCC tool is limited. Instead, the methodology of life cycle cost calculation can and has been applied widely.

4.2.8 Sustainability Performance Framework

The threefold approach to the measurement and management of sustainability performance framework is considered in the Step 5 of the SBM process to provide further understanding of the networks and relationships and the changes required. The framework is illustrated and explained in Chap. "Integrated Performance Framework for Sustainable Manufacturing Networks". The framework consists of three interlinked principal components: network conditions, internal performance levers, and outcome (triple-bottom-line assessment). The purpose of the framework is to raise awareness of complexities in the organisational environment and provide a basis for performance assessment and tracing of potentially adversarial factors inhibiting sustainability of the business as well as for improvement of sustainability performance.

The above process and tools will assist manufacturing companies in developing business models and solutions for sustainable and efficient production. They provide support at strategic and operational levels of the companies to deliver sustainability. During the industrial application of the tools, it was observed that the companies adopt different approaches and are varied in the level of receptiveness to change, to sustainability. Start-ups and small-scale businesses seem more receptive to exploring new business models and opportunities compared to larger companies (multinationals). One of the reasons may be that larger companies have relatively more rigid organisational structures and broader networks, which make exploring and adopting new ideas and business models for sustainability more gradually. A transition (transformation and implementation) path towards sustainability will follow a long-term vision with an evolutionary and incremental path, which needs to be considered when using the process and tools.

5 Conclusion

Sustainability requires systems-based and integrated solutions/processes, which necessitates better connection between the individual company's business model and the value network (or multiple value networks). As Sommer (2012) further explains, "the business model concept does not solely focus on the organisation but also considers external parties that participate in or benefit from the company's value creation activities. These external parties are not limited to suppliers or customers but also include various partners that need to be considered for any transformation effort". This transition in particular requires business model innovation to embed sustainability in the proposition, delivery and creation and capture of value through a multistakeholder view.

Business model innovation and redesign can assist in embedding sustainability into the core purpose and operations of companies, through a comprehensive consideration of a network-wide perspective to rethink the value proposition and to create, deliver and capture sustainable value. Michaelis (2002) emphasises on developing "shared goals, targets and relationships" between stakeholders in the network to understand consumption and its patterns towards improving sustainable production (resource efficiency, sustainable design and clean technologies), while "reinforcing the values that would foster more sustainable production and consumption". Business models that take into consideration sustainability issues, such as resource availability, product design, technology, consumer behaviour and aligning stakeholder value and goals, are pertinent for the manufacturing industry.

The SBM process and toolset are expected to support the analysis and design of sustainable business model/s. Business model redesign can assist in embedding sustainability into the core purpose and processes of companies. More specifically, the process and toolset provide a preliminary consideration of a network-wide perspective to rethink the value proposition and to create, deliver and capture sustainable value. Companies can select and use the tools at each step of the SBM process as per the requirement of their business and its operations.

The SBM process and tools are envisaged to have use and applicability to all sustainable business modelling activities, from exploring opportunities for new start-ups, to assisting in redesigning business models for established large corporations. Entrepreneurs, intrapreneurs, consultants, managers, start-ups, SMEs and multinationals through the use of this process and tools can gain a more complete understanding of developing sustainable business models and the value proposition of the company, and it explores opportunities for transforming the value proposition towards more sustainable solutions. The use of the tools and the design of any workshops to use the tool should be adapted to the size and complexity of the business. Further work is recommended to develop the SBM modelling process and refine tools to support the process.

There are good emerging industrial examples of companies pushing the boundaries to deliver sustainability through transitions in their businesses such as the case studies (Chap. "Methods and Tools for Sustainable Development of Products and Services"), Toyota, Marks and Spencer, Unilever, Patagonia, Xerox, Interface and ZipCar, to name a few. These adopt very different approaches to sustainability, but the common theme of these examples is that there is a sound economic business case for pursuing sustainability objectives: that is, they reduce production costs and risks and/or increase revenue and market share. A key consideration in the business modelling process described is establishing expectations and standards of sustainability performance. Assisting companies in understanding the true scope of the impact of their activities on the broad range of stakeholders and identifying possible pathways to adaptation is the only part of the challenge. The greater challenge is persuading companies to adopt challenging stretch targets to do better when the business case is not so clear or the payback period is unattractive. A better understanding of the limits of the opportunities for creating an economically viable "business case" through business model innovation will be

important in helping to define future policy approaches to better encourage sustainable business models.

The research, hence, raises questions such as do existing examples of business model innovations go far enough? Are the required business transformations for sustainability really possible within the current business and economic paradigm that demands continuous economic growth, particularly for established companies that may have much to lose from radical shifts in manufacturing? What policies might be needed to support sustainable business models? Future work on exploring these questions, while further enhancing and updating the SBM process and toolset with new tools, methods and frameworks, which have a network-centric approach based on the emerging business environment and requirements, is anticipated.

The industrial practice review and use and test phase focused on start-ups, SMEs and multinationals in the manufacturing sector (production and service networks) based in or with headquarters in Europe and were tested primarily with the four industrial partners and a few external organisations due to the scope, feasibility and funding of the SustainValue project. Different perspectives may emerge if the process and tools are discussed and/osr used with a broader set of organisations in different sectors (development, finance, think tanks) and geographical locations with the possibility of resulting in interdisciplinary examples of concepts, frameworks and models that support sustainable value creation and sustainable business models. The study carried out provides an essential analysis for identifying and extending the research opportunities (suggested earlier) to other sectors and research domains.

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