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Value mapping for sustainable business thinking

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Pressures on business to operate sustainably are increasing. This requires companies to adopt a systemic approach that seeks to integrate consideration of the three dimensions of sustainability – social, environmental, and economic – in a manner that generates shared value creation for all stakeholders including the environment and society. This is referred to as sustainable business thinking. The business model concept offers a framework for system-level innovation for sustainability and provides the conceptual linkage with the activities of the firm such as design, production, supply chains, partnerships, and distribution channels. A value mapping tool has been presented in the literature to assist in sustainable business model innovation. This study explores the use of value mapping for broader sustainable business thinking, by reflection on its use in workshop settings. A range of new applications is identified which is expected to be of interest to business practitioners, policy makers, and academic researchers.

Keywords: sustainable consumption and production; stakeholders; business model; business model innovation; shared value creation; systems thinking

1. Background

System-level challenges for sustainability such as climate change, resource use, and inequality are increasing the pressure on businesses to address sustainability through significant changes in their everyday business operations and behavior. The World Business Council for Sustainable Development [50] in its Vision 2050 spells out the "must haves" for a sustainable society, including internalizing the costs of externalities (carbon, ecosystem services, and water), doubling agricultural output without increasing land or water use, stopping deforestation, and increasing existing forest yields.

The way businesses think and operate needs to change considerably to address such systemic challenges. In particular, collaboration across a wider set of stakeholders in the industrial system is necessary to deliver sustainability. A sustainable society cannot be achieved if individual agents advance their own interests independently [23]. Decision-making on sustainability involves value judgments and ethical considerations – social, economic, and ethical analyses may be used to inform these value judgments and take into account a range of forms of value, including human well-being, cultural values, and non-human values [23]. As Krantz [26] proposes "companies will need even bigger changes, including new business models, greater trust, and greater stakeholder engagement" based on a "long-term vision" for pursuing sustainability.

The framework of a "business model" might provide a structured way for sustainable business thinking by mapping the purpose, opportunities for value creation across the network, and value capture (how to generate revenue) in companies. Various tools, such as the business model canvas [33], assist in the design and innovation of business models, whereas others assist in part of the innovation process for business models (e.g. eco-design and eco-ideation tools; [2,5]). However, for *sustainable* business model innovation, a wider range of stakeholders, including environment and society, and value creation, needs to be considered [6]. A value mapping tool was developed to assist in the design of sustainable business models, by considering different forms of value exchanges for a range of stakeholders as part of the business model [6] (Figure 1). Although business model (re-)development is a core component of sustainable business transition, it only addresses part of the transformation.

The multi-stakeholder perspective on value as expounded in Freeman's stakeholder theory [18] embedded in the value mapping tool is considered to be powerful and may have relevance to other aspects of business planning, but to date, there are very few practical tools offering such an approach. Business model transformation is a top-level planning activity; yet, to achieve most impact, consideration of value throughout business operations planning activities is also required.

This research seeks to extend the use of value mapping to other areas of business planning that are important determinants of positive sustainability outcomes such as product and process design, which are not typically included in the business model planning process. As such, this research investigates how the value mapping tool might be used more broadly to facilitate "sustainable business thinking" – an approach to integrate social, environmental, and economic sustainability into business thinking and operation, in a manner that generates shared value creation for all stakeholders

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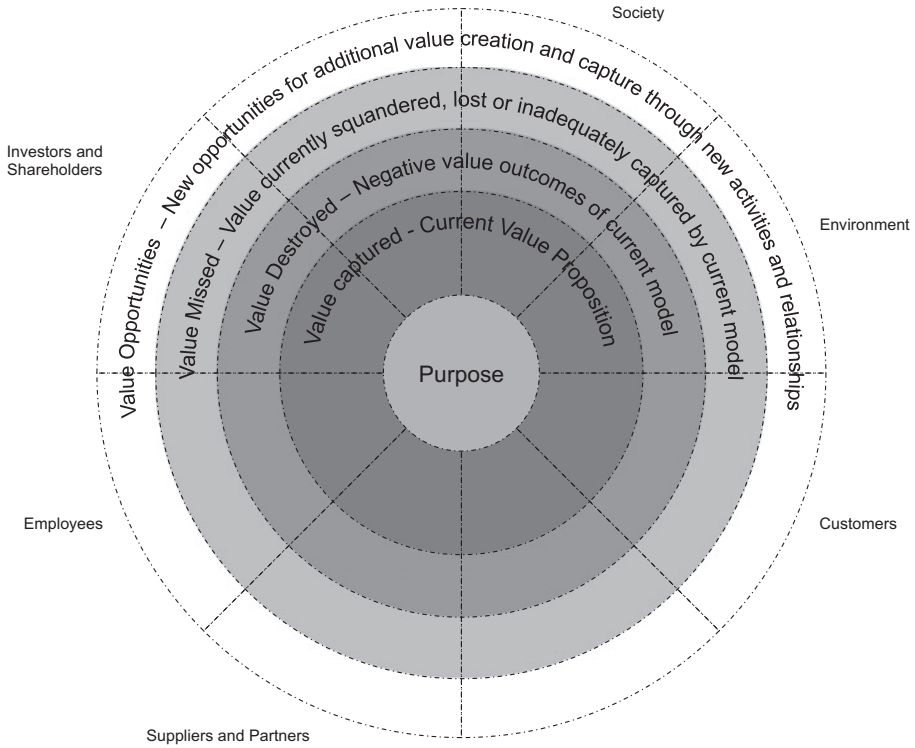

Figure 1. Value mapping tool. Source: Bocken et al. [6].
Note: This version of the tool includes open spaces so that participants can use to add their own key stakeholders or elaborate on specific ones (e.g. society to be split up into "global society" and "local communities").

including the environment and society. This is investigated by reflection on the tool's use in different workshop contexts. The research question this study addresses is *How might value mapping as a tool and process be used for sustainable business thinking.*

2. Literature

The linkages between the key concepts – sustainable business thinking, sustainable business model innovation, shared value creation (multi-stakeholder), and the value mapping tool are discussed in the following sections. This section aims to illustrate how these key concepts facilitate or support sustainable business thinking. Figure 2 visualizes the connections between these concepts. Sustainable business thinking, as defined in this study, is a way of thinking in which businesses are viewed as a positive force, which contributes to society and environment while generating a profit. Sustainable business model innovation represents a subset of sustainable business thinking, which, building on Boons and Lüdeke-Freund [8], is described as innovation to the way business is done by creating a competitive advantage through superior customer value while contributing positively to the company, society, and environment while minimizing harm. Value mapping is an approach for ideation and analysis for sustainable business model innovation involving mapping the value captured, missed and destroyed and new opportunities for a range of stakeholders. It is an approach to identify failed value exchanges to develop new opportunities.

Clarifying the value logic of doing business, and integrating stakeholder concerns including (society and environment) in the thinking process, is expected to not only be useful for sustainable business model innovation, but also for wider sustainable business thinking. Figure 2 illustrates the relationship between the concepts, and the dotted area of the value mapping shows the potential extension of the tool for broader sustainable business thinking.

2.1. *Sustainable business thinking*

Significant shifts are required in the way of thinking by aspiring entrepreneurs, existing managers in businesses and the new generation of business managers, designers and engineers who will think about and develop solutions. It requires a change in thinking about business that seeks to integrate consideration of the three dimensions of sustainability – social, environmental and economic – (Elkington [16]) in a manner that seeks to align positive value creation for all stakeholders including the environment and society at all levels and through all activities of the business. This may be referred to as *sustainable*

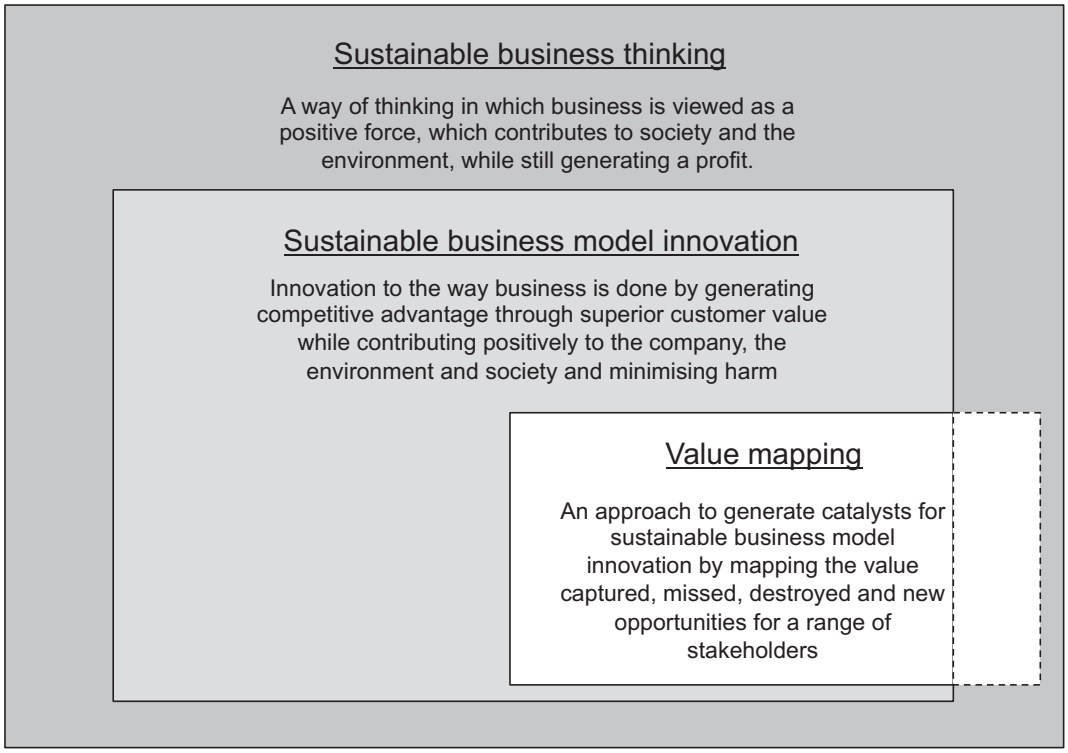

Figure 2. Conceptual framework developed in this research.

business thinking – defined here as a way of thinking in which business is viewed as a positive force, which contributes to society and the environment, while still generating a profit. This shift in thinking and re-evaluating the role of businesses to integrate the triple bottom line and shared value creation into the way business is done has already been advocated by a range of authors (including Elkington [16]; Ehrenfeld and Hoffman [15]; Porter and Kramer [35]; and Bocken et al. [7]). The aim of this study was to address how this change in thinking can be stimulated.

2.1.1. *Tools for sustainable business thinking and gaps*

Various tools have been developed for product design focusing on environmental performance such as life cycle assessment (LCA; defined in [24]), eco-design [2] and eco-ideation [5]. *LCA* addresses the environmental aspects and potential environmental impact throughout a product's life cycle from raw material acquisition through production, use, end-of-life treatment, and disposal, and includes the development of an inventory of inputs and outputs, potential impacts and an interpretation of the results [24]. In *eco-design*, the engineer's task includes selecting appropriate material, designing products for recycling, reuse and remanufacture, while management's challenge is to ensure that the different players such as raw material suppliers, recyclers, employees and consumers understand and achieve the environmental goals [2]. *Eco-ideation* is a process to generate ideas that help reduce the environmental impact of products across a product life cycle [5]. These tools can provide important background information (e.g. LCA, about the environmental impacts of products) or give people qualitative insights on certain aspects of product design (e.g. eco-design). However, with exceptions, tools such as LCA tend to be narrowly used on a limited range of parameters such as energy and carbon, rather than offering a holistic perspective for analysis embracing all stakeholder considerations, and particularly social dimensions.

At the business model innovation level, tools such as the "business model canvas" by Osterwalder and Pigneur [33] have been developed, which give insights on the specific elements of a business model, but do not focus on sustainability necessarily. The focal point of the business model canvas is the value proposition for the customer, and limited stakeholders (i.e. those in the supply chain such as partners and suppliers) are considered. However, stakeholders such as "society" and "environment" are excluded from the canvas.

To conduct stakeholder analysis, several tools have been identified, such as stakeholder maps, actor-linkage diagrams and social network analysis (SNA) [37]. Stakeholder maps are visual mind maps, which show the main stakeholders in a system (e.g. industry), actor-linkage diagrams indicate types of relationships between stakeholders and can take the shape of visual maps,

Venn diagrams, matrices and tables, and SNA aims to model patterns in relationships between actors (e.g. a retailer and a NGO), which often takes a matrix format where each field shows the presence and type of relationship [37]. Although focused on stakeholder mapping, these tools do not necessarily help identify value creation for sustainability.

A number of scholars have identified the need for more comprehensive tools to assist firms in embedding sustainability at the core of doing business: Robèrt et al. [39] provide a review of existing tools for sustainability, whereas Waage [49] identifies the need for holistic sustainability approach within the product design process and offers a framework for such integration. Allee [1] suggests the use of value network analysis (VNA) – improving firm performance by understanding the dynamics of value creation in financial and non-financial terms, including economic and societal impact. However, the work on VNA is still emerging.

The value mapping tool (Figure 1) is considered as a tool for further exploration in this study, because it provides a simple and visually engaging format to help businesses create value for the company, society and environment from the core of their business and the network. It aims to provide a framework for companies to rethink their existing business models or design sustainable business models from the outset. As the business model connects various organizational functions (see Section 2.3), it is proposed that the tool can also be used more broadly for "sustainable business thinking."

2.2. *Sustainable business model innovation*

A range of authors views the business model as an important driver for (sustainable) innovation – see, for example, Teece [46] and Chesbrough [11] who investigated business model innovation, and Yunus et al. [51], Johnson and Suskewicz [25], Thompson and MacMillan [47], Boons and Lüdeke-Freund [8] and Bocken et al. [7] who focus on sustainable business model innovations.

A business model conceptually describes how a company does business [29]. As Zott and Amit [53] argue, business models focus on the logic of how value is created for *all* stakeholders, not just how it is captured by the focal firm. Business models emphasize a system-level holistic approach toward explaining how firms "do business"; they show activities performed by the focal firm as well as by partners, suppliers and customers [49]. Business models are often perceived from a value creation perspective that focuses on satisfying customer needs, economic return and compliance [44]. For sustainability thinking, this focus is too narrow and raises the need for a more holistic view of value that integrates social and environmental goals, to ensure balancing or ideally alignment of all stakeholder interests to deliver "sustainable value" creation.

Sustainable business models consider a wider group of stakeholders than just customers and shareholders and explicitly consider society and environment as stakeholders [44]. They seek to internalize the benefits and harms to society and the environment by the way business is done. Sustainable business model innovation is concerned with innovation in the way business is done by generating competitive advantage through superior customer value while contributing positively to the company, the environment and society and minimizing harm (building on [28]).

An example of a business model that might deliver greater social and environmental benefit is the car club model, where customers pay for a service to use the car, rather than buying and owning the car itself [21]. Cars are accessible to those who could previously perhaps not afford this by changing the value proposition (product/service), value creation (e.g. "making cars available" through a service rather than selling them) and value capture (pay per hour of use). The fact that customers need to pay per use may make them think before they use the car and subsequently reduce their car usage [21]. Car sharing models may deliver better utilization of cars and so reduce need for construction of new cars, further contributing to mitigation of environmental impact.

2.3. *The connection between the business model and organizational functions*

The business model provides the conceptual logic, which connects functional activities in a business such as finance, marketing, R&D, procurement, product design and manufacturing to one another [33,52]. Business model innovation for sustainability can drive innovation across internal business functions, across supply chains and, on a broader level, across industries. Figure 3 offers a conceptual framework for a sustainable business model, which shows the interconnectedness, including the value proposition (benefits or product/service offering to customer and society and environment, customer segments and relationships), value creation (resources, suppliers and other partners who help create value) and value capture mechanism (cost structures and revenue streams, value capture for society and environment).

Innovation for sustainability more generally needs to capture the challenges of a complex context and span across company boundaries [45]. Szekely and Strebel [45] describe three types of innovation, which show the linkages between innovation for sustainability and business functions: incremental innovation (novelty at the product, service and process level), radical innovation (wider sphere of activity and closer interaction with suppliers, regulators and other stakeholders), and game-changing innovation (profound transformation of the practices, structures and the very aims of business). Value is no longer created by firms acting in isolation, but by firms acting together through informal arrangements or formal

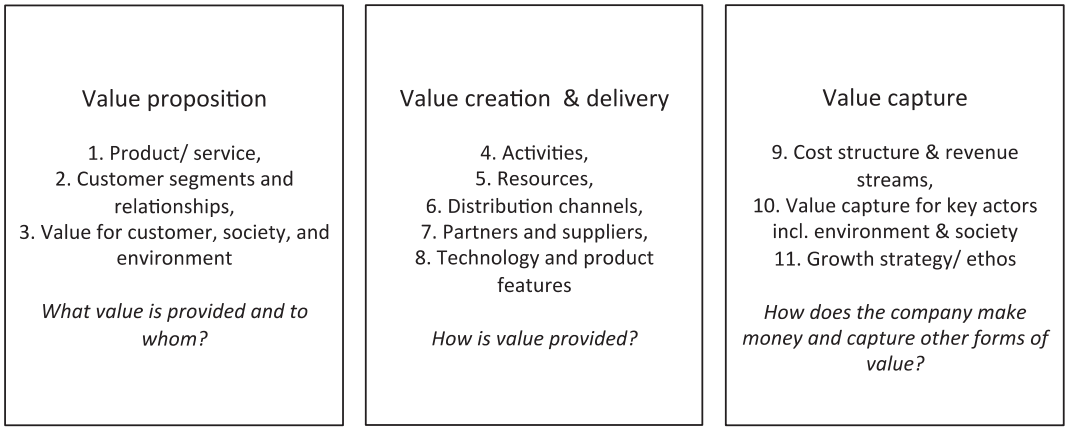

Figure 3. Conceptual sustainable business model framework.
Note: Source: adapted from Richardson [38], Osterwalder and Pigneur [32], Bocken et al. [7] and Short et al. [41].

alliances [3]. Porter and Kramer [35] discuss the "shared value creation" concept, which "focuses on identifying and expanding the connections between societal and economic progress." They highlight the need to reconceive and innovate products, markets and value chain activities to broaden the "value perspective." Moreover, innovation is not restricted anymore to corporations: "everyone" can become an entrepreneur in new peer-to-peer models such as peer-to-peer lending [e.g. 19], home rental [22] and car sharing [21]. In the most impactful sense, innovation for sustainability transforms infrastructures and the very premises of the way business is done. This is especially the case for more radical and game-changing types of innovation, which involve multiple stakeholders and fundamentally challenge the way business is done.

It is recognized that innovation for sustainability should occur at multiple levels of an organization from the strategic level down to the details of manufacturing systems and product design [1, 49]. These levels can be integrated within the overarching context of the *business model* [45, 49]. For example, business model innovation for sustainability is clearly linked to areas such as sustainable manufacturing and design, which are at the core of manufacturing organizations. *Sustainable manufacturing* as described by Rashid et al. [36] is characterized by strategies such as waste minimization, material and resource efficiency and eco-efficiency, the latter being defined as creating more value with reduced waste, resource use and toxicity [40]. *Eco-design* adopts a life cycle approach to tackle the greatest impacts across the product's life cycle, whereas *sustainable design* takes a holistic approach, including concerns for ethics, dematerialization, empowerment, sharing, as well as eco-design [14]. This demonstrates the connectedness of innovation for sustainability across organizational functions and levels.

For sustainable business thinking to become more widespread in companies, it needs to become an integral part of doing businesses, integrated throughout all the activities of business.

2.4. *The value mapping tool and process*

A value mapping tool has been presented in the literature to assist in providing a systemic approach to the generation of new business model ideas for sustainability that uses a multi-stakeholder perspective and explores both positive and negative forms of value creation. It aims to help companies align value creation for all stakeholders including the environment and society at all levels and through all activities of the business. The value mapping tool was developed to assist in sustainable business modeling and aims to assist users in:

- Understanding the positive and negative aspects of value in a network of stakeholders.
- Identifying conflicting values (i.e. where one stakeholder benefit creates a negative for another stakeholder).
- Identifying opportunities for sustainable business model redesign – especially to improve societal and environmental impact – based on qualitative value judgments.

The value mapping tool takes a multi-stakeholder perspective and considers different forms of value. It considers multiple forms of value: value captured, value missed, value destroyed, and new value opportunities [6]. Value captured represents the positive benefits delivered to stakeholders (i.e. the value proposition for multiple stakeholders). Value missed represents cases where stakeholders fail to capitalize on existing assets, capabilities and resources, are operating below best practice or fail to receive benefits they seek from the network. Value destroyed is negative outcomes of the business (sometimes referred to as "negative externalities"; see Chertow and Ehrenfeld [10]) and concerns the damaging social and environmental impacts of business (e.g. overuse of resources). Ultimately, firms will need to go beyond "damage control" and seek out new value creation opportunities to deliver novel solutions to social and

environmental problems that begin to address the wider sustainability challenges directly [see e.g. 22]. The multi-stakeholder approach of the tool seeks to identify and reduce conflicts and trade-offs between different stakeholder groups and assist in better aligning positive outcomes for all stakeholders. This approach is crucial for understanding and exploring sustainability and can and must be applied at all levels for successful sustainability innovation: it does not only concern strategy-making but also needs to involve product designers and production engineers who design the products and processes for sustainability.

The value mapping process typically consists of four simple brainstorms:

Brainstorm 1: The purpose of the business is discussed. Why is the business here in the first place? What is the product or service offered?

Brainstorm 2: What value is created for different types of stakeholders? What positive value is created and what negative value do the stakeholders mitigate?

Brainstorm 3: What is the value destroyed or missed or negative outcomes for any of the stakeholders? Is the business missing an opportunity to capture value or wasting value in its existing operations? For example, are assets, capacity and capabilities underutilized? Are potentially useful materials going to landfill?

Brainstorm 4: This brainstorm is intentionally put at the end and is about blue-sky thinking. The focus is on turning the identified negatives into positives to ensure a win-win for all stakeholder groups. What new positive value might the network create for its stakeholders through introduction of activities and collaborations? What can you learn from competitors, suppliers, customers or even other industries to further enhance stakeholder alignment and sustainability outcomes?

Before the session, there may be an introduction on sustainability (depending on the background knowledge of participants) including some inspiring examples of how other businesses have pursued business model innovation for sustainability. After the brainstorms a selection process might take place to decide upon the best options to pursue by the organization. Appendix 1 includes illustrative examples of value destroyed, missed, and new opportunities to help populate the tool. The process is discussed more fully in Bocken et al. [6]. Although initially developed for generation of new business model ideas for aspiring and existing businesses, the authors propose that the value mapping tool may be used for wider purposes of "sustainable business thinking."

It should be noted that the value mapping tool has a few limitations, which include the following: it is mainly suited for qualitative assessment and it has mainly been used for initial assessment of value, and not for in-depth analysis.

3. Research method

This study investigates the following research question: How can value mapping as a tool and process be used to enhance sustainable business thinking?

The method is visualized in Figure 4. The method is based on reflection on experiences of using the value mapping tool with practitioners through workshops and discourse with practitioners on using the value mapping tool. Observations, complemented with a workshop evaluation schedule (available upon request), were used to collect data.

First, feedback from use of the tool in former workshops described in Bocken et al. [6], and a range of discussions with practitioners who have adopted the tool, led to the notion that the tool could be used for wider sustainable business thinking. In this exploratory phase, the authors identified education, life cycle thinking and product/ process design and systems thinking as additional uses of the tool. Second, a total of 20 workshop sessions were conducted and analyzed to seek to test and validate new potential uses of the tool. These 20 workshops took place in Europe and the US between 2012 and 2014 (numbers 1–12 in Table 1). Subsequently, the experiences of using the tool with different groups – students, NGOs, start-ups and established small and large companies – were collated using a workshop evaluation schedule to develop the range of potential uses of the value mapping tool for sustainable business thinking. The experiences of using the tool were collected by the workshop evaluation schedule including queries on:

(1) The brainstorming outputs of the workshop (actual ideas generated)
(2) Usability and effectiveness of the tool to capture sustainable innovation
(3) Additional opportunities for using the tool
(4) Any other feedback by the tool users

Finally, the workshop evaluation schedules were scanned in particular to identify additional opportunities (points 3 and 4). This process led to the identification and preliminary validation of potential additional uses of the tool to assist in sustainable business thinking. These are shown in Table 1.

4. Findings

The value mapping tool was developed as an idea generation tool in the business modeling context, but appears to have potential other purposes which are presented in this section. Table 1 shows that usage of the tool was

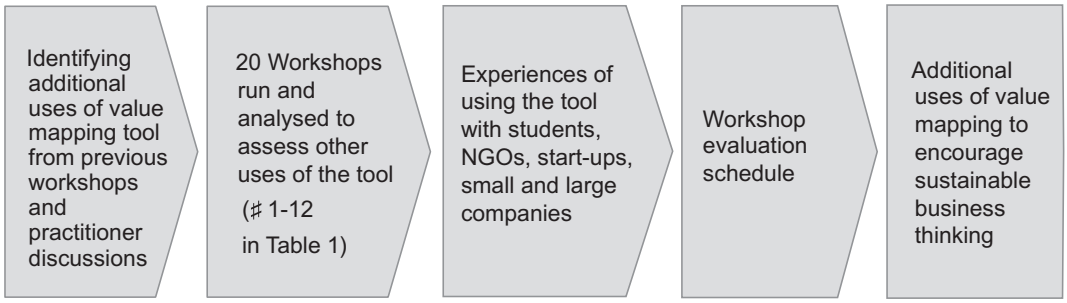

Figure 4. Method applied in this study.

Table 1. Uses of the value mapping tool.

No.	Workshop	Use of tool in workshop	Additional uses identified
Finished workshops			
1	Workshop with Engineering Masters Students in Genoa, Italy, October 2012	A case study exercise to explore sustainability issues of companies	Education – it was used as a teaching and analysis tool to explore sustainability issues of companies. The exercise contributed toward case study write-up.
2	Workshop – Sustainable business modeling for circular economy, Netherlands, November 2012	Ideation for NGOs, small and large companies	Education about circular economy and sustainable business models, life cycle thinking for future products
3	Workshop – Start-up in the automotive sector, London, July 2013	Clarify the needs and expectations of each stakeholder group	Collaboration – identification and awareness of conflicts, while opening debate over impacts, trade-offs and compromises
4	*Eight* workshops with start-ups in logistics/ transport, software and hardware products and various manufacturing sectors (e.g. photovoltaics) Cambridge, Aug 2013–July 2014	Provide additional focus and insight into a strategy development process for start-up companies	Integration with other tools in a strategy workshop used to inform roadmapping sessions to formulate future strategies for start-ups
5	Workshop–System integrator SME and Finnish research institute, Finland, September 2013	Sustainable business model development – evaluating a new offering	Broader strategy development: revisiting the existing vision and business model of the company
6	Workshop - Sustainable business modeling, October 2013. Student sustainability entrepreneurship prize, Yale university, USA	Ideation and education on sustainable business models for aspiring entrepreneurs	Education on sustainable business models for start-ups, future product and process design
7	Sustainability innovation workshop, November 2013. Student social entrepreneurship prize, Yale University, USA	Ideation and education on sustainable business models (also nonprofit, social entrepreneurs) for aspiring entrepreneurs	Education, opportunities for aspiring entrepreneurs
8	Workshop – Manufacturing engineering students in Cambridge UK, March 2014	Ideation and education on sustainable business models for engineering students	Education, about sustainability and business model innovation for sustainability
9	Two eco-design workshops, three days each in February 2014, in France, using the extended value mapping tool (with a French translation)	Support eco-designers with the integration of multiple stakeholder concerns in design. Sequence of tools: simplified LCA (3 h), EcoASIT (3 h), BEC diagram, value mapping (3 h)	Eco-design concept improvement for existing industrial products to reduce environmental impact and improve societal impact
10	Workshop – Executive Training Sustainability, Cambridge UK, July 2014. Six subgroups brainstorming about "systems": mobility, food, housing, clothing, communication and cleaning	Systems thinking/considering systemic sustainability issues and the consequences for a manufacturer for an executive training course	Systems thinking, education
11	Workshop – Sustainability Summer School for multi-disciplinary audience, New York, USA. June–July 2014	Education about sustainable business models	Education, systems thinking
12	Workshop – for Product innovation platform in the Netherlands (6 groups of up to 8 people)	Experiencing how to rethink business models for sustainability	Education, systems thinking

Note: No. 4 refers to *eight* workshop sessions.

explored for multiple areas. It is suggested that the concepts of multi-stakeholder value creation, alignment of interests, a system perspective and understanding different forms of value (missed/destroyed, etc.) embodied in the value mapping tool can also be useful at the product/process level, the organizational level, the competitive positioning strategy level, the financial system level, and at institutional policy-making level. The findings from use of the tool in workshops are described in Section 4.1, followed by a brief case study in Section 4.2.

4.1. *Findings from use of the tool in workshops*

Through evaluation of the actual uses of the tool during the workshops, a range of potential uses of the value mapping tool for sustainable business thinking was identified and explored. These include the following:

(1) Ideation for entrepreneurs/start-ups who can design and refine their business model ideas (based on uses of the tool described in Bocken et al. [6] and sessions No. 1, 2, 3, 4, 6 and 7 in Table 1).
(2) Ideation for existing companies, looking to reinvent or reconfigure their business models (based on uses of the tool described in Bocken et al. [6] and sessions No. 2 and 5 in Table 1).
(3) Education – to help students consider sustainability dimensions of businesses more fully and more generally and raise awareness about the broader issues of business (un) sustainability (based on sessions No. 1, 2, 6, 7, 8 and 11 in Table 1).
(4) Product and process design and life cycle thinking to get product designers to think more broadly about the range of stakeholders during the product design phase and process designers to consider the wider societal and environmental impacts of manufacturing (based on sessions No. 2 and 9 in Table 1).
(5) Systems thinking to help participants think about the value captured, missed, destroyed and the new opportunities for "systems" around us (e.g. food, mobility, and housing) (based on sessions 2, 10 and 11 in Table 1).
(6) Evaluation and screening of business model options to evaluate and compare potential business model innovations and strategies (based on sessions 4 and 5 in Table 1).
(7) Collaboration with suppliers and customers seems integral to conventional business model (redesign). The tool could facilitate a high-level assessment of the value derived by different stakeholders from potential future collaborations. It can help draw out conflicts and create awareness of varying needs and objectives (based on session 3 in Table 1).

4.2. *Case study: education and rethinking business models*

This section includes a case study to present an example of how the value mapping tool has been used in practice. The value mapping tool was used in a product innovation management business community (Table 1, session 12). The purpose was to introduce the concept of sustainable business model innovation and learn how to apply this concept. Figure 5 summarizes one of the subgroup's outcomes of using the value mapping tool with an imaginary example of baby strollers.

Feedback from participants included that the tool was "intuitive," "easy to use," that it was an "enjoyable experience," and it led to new ways of thinking about sustainability. Whereas it was only a short session (2 h), the participants felt that they experienced the challenges and opportunities of designing new sustainable business models or redesigning existing business models for sustainability.

5. Discussion: value mapping for sustainable business model thinking

Value mapping as a tool and process was originally developed for sustainable business modeling – helping companies rethink their business models for sustainability. The tool was developed based on the observation that companies seeking to operate sustainably need to consider and align multiple types of value generated, missed and destroyed for different stakeholders, including value for society and environment, before thinking about new opportunities to generate new economic value [building on, 7].

As mentioned in the previous section, the use of the tool and process at various workshops triggered the notion of its application for "sustainable business thinking." The additional uses were explored and validated through twenty subsequent workshops. The following sections discuss the potential uses of the value mapping tool for sustainable business thinking in greater detail.

5.1. *Initial intended uses: Ideation for start-ups and established firms*

This section includes the initial intended uses of the value mapping tool: business model (re-) thinking for businesses of different sizes and maturity. For start-ups, the tool could be used to encourage thinking about how to best design their business models so they are sustainable from the outset. In this case (especially when the start-up idea is not yet well-developed), it can be beneficial to look at related incumbent industries first. For example, a start-up in the food industry might benefit from first jointly developing value maps from well-known brands before scrutinizing their own business models during a value mapping session. Start-ups in

particular may have difficulty in identifying their immediate customers (very often they focus on the end users) and articulating the benefits to them. Even if there are several relevant stakeholders (different customers, suppliers and partners), smaller companies may have only considered one or two. This tool helps them to identify and understand broader network of stakeholders.

Established companies can use the tool to start the redesign of their current business models. In existing firms, it can serve as a useful tool to stimulate discussion, raise awareness, engage with the broader range of stakeholders and begin the process of changing perspectives. The challenge here is to identify actions for the short, medium and long term, because business model change in large incumbent companies faces significant barriers due to the institutionalization of existing mental models and physical infrastructures. As such, it is likely to be an incremental and often difficult transition process [12,30].

5.2. *Additional uses of the tool*

This section contains the additional uses of the tool identified in this research. In addition to the uses identified in Bocken et al. [6] discussed in Section 5.1, the tool was validated for the potential uses identified in the exploratory phase: education; product and process design and life cycle thinking; and systems thinking. Through use of the tool in workshops, it was also found that value mapping could also be used for business model evaluation and screening and collaboration.

5.2.1. *Education – to teach students about sustainable business models*

The value mapping tool can serve as a visual aid for experiential learning, where students apply concepts in real-life contexts [17]; it may reduce dependency on the instructor by facilitating independent "problem-solving." Three potential ways to educate students about sustainable business models include interactive workshops, a case base method and a consulting exercise.

First, similar to the normal ideation sessions discussed, an *interactive workshop* could help students to grasp the concept of sustainable business models. However, more time would need to be dedicated to what a sustainable business model is and why these are important to make students more familiar with these concepts, which have not necessarily been introduced in the classroom before. This is especially important for students who do not necessarily have a business education background (e.g. engineers, designers). Second, a *case based-teaching method* could be used, where students are first exposed to the material on what a (sustainable) business model is, and then what the concepts of value missed, destroyed and opportunities are. The case could be fairly simple:

(1) Choose one of the companies [from a predefined list] as your case company.
(2) Consider the current business model. In what areas does the business model fail to capture environmental and societal concerns?
(3) What could potential sustainable business models look like for this company? Describe how the different elements of the model would need to change?

These simple questions can help students critically evaluate current business models and think about new ones. The full teaching note with questions for students to consider is available upon request by the authors. Third, the business case might be turned into a *consulting exercise* to help existing companies, which is recommended by Erzurumlu and Rollag [17] as a useful method to improve the usage of business teaching cases. These methods may be mixed, so that varied learning preferences and teaching objectives are catered for.

5.2.2. *Product and process design and life cycle thinking*

The value mapping tool can be used to encourage the exploration of life cycle impacts of a product, process or business model by evaluating value captured, missed, destroyed, and opportunities for different stakeholders. For designers, it might generate greater awareness of the potential impact of products, services and manufacturing processes. A key benefit of the tool in the product/process design and larger systems thinking context is the potential to better consider potential unintended impacts on external stakeholders: it can help reduce unintended consequences and rebound effects that can affect sustainability initiatives (e.g. biofuels compromising the food supply system) [43]. Secondly, it helps consider alternative solutions that offer greater alignment between stakeholder interests.

Rather than merely focusing on customer needs or production process efficiency (e.g. energy use) in isolation, the tool can give broader qualitative insights of the value created, destroyed and missed for a range of stakeholders without the need for a full LCA. The tool could encourage life cycle thinking or be useful in conjunction with LCA to gain deeper insights into the value missed, destroyed and opportunities at each life cycle stage. As such, the value mapping tool can be particularly useful for small- and medium-sized companies with limited time and budgets [9]. Compared to a typical LCA process or using detailed indicators (e.g. the Global Reporting Initiative), the value mapping tool might present a simplified and visually engaging tool. Potentially, the tool can also precede an in-depth LCA by exploring the positive and negative impacts of a company, or augment an LCA, by gaining insight on what the impacts of a LCA mean for different stakeholders at each stage of the product life cycle.

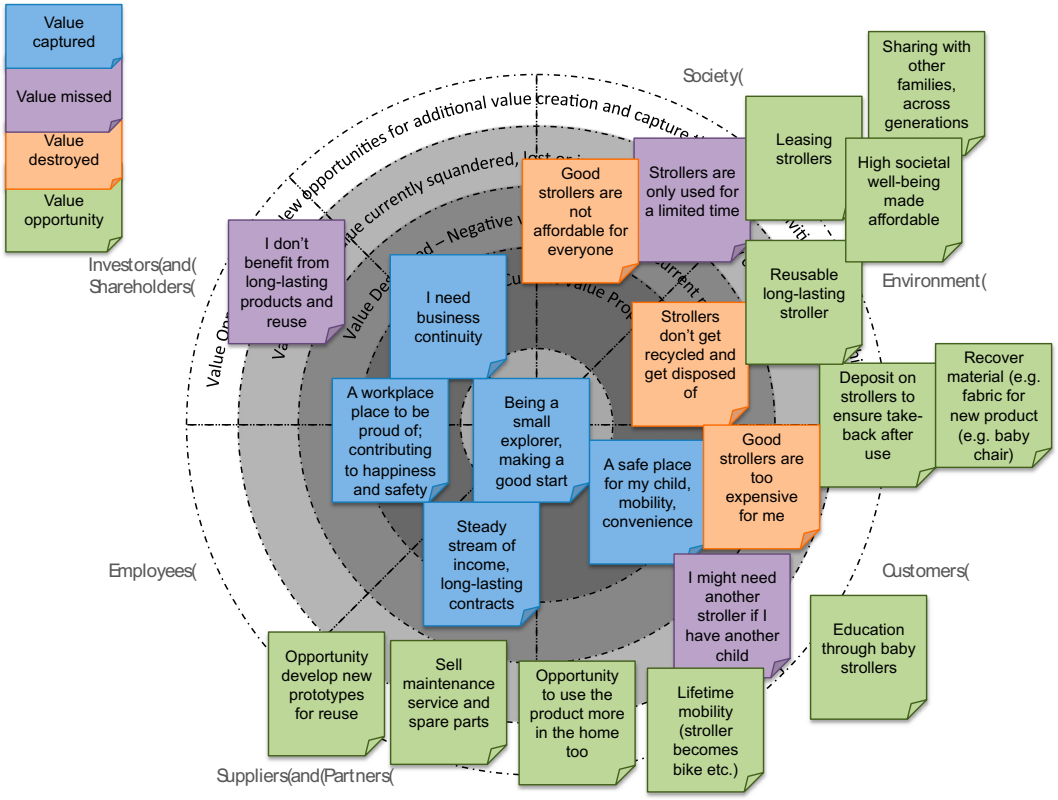

Figure 5. Consolidated outcome of use of the value mapping tool in session 12, Table 1.

5.2.3. *Systems thinking*

The multi-stakeholder perspective of the tool was found to be useful for wider systems thinking to consider the value captured, missed, destroyed, and opportunities through "systems" (e.g. food provision or mobility) for a range of stakeholders. This approach could be used to quickly assess the intended and unintended consequences of certain systems. During session 9 in Table 1, a group of participants of an executive training course in sustainability used value mapping for systems thinking. The systems considered were as follows: mobility, food, housing, clothing, communication and cleaning. A simplified tool with three stakeholder segments was used: participants were asked to consider the wider impacts of these systems using the terminology of value destroyed/missed and new opportunities for society (the collective societal benefits of a system), the environment, and the "customer" (i.e. a single beneficiary of the system), followed by a discussion on the impacts of this for the individual manufacturer (e.g. a food or clothing manufacturer). This exercise helped participants consider the wider impact of systems we rely on (e.g. food, mobility) and what the role of individual manufacturers would be within this. Finally, the tool was used for visioning exercises [13] to help a company engage with its stakeholders to create a joint future vision and the role of the business to contribute to this desired vision (this was done between the company in session 3 of Table 1 and its stakeholders). This enabled the company to take a systems perspective in doing business.

5.2.4. *Evaluation and screening*

The value mapping tool could be used for *evaluation* rather than ideation. The tool can give a general indication of the range of impacts of different business model innovation options, and serve as a first level of screening, before detailed analysis (e.g. financial, environmental) takes place. Although several qualitative and quantitative tools have been developed for evaluation in eco-design [2], this tool can be useful for business model evaluation by allowing for comparison of different business model options and their impacts on stakeholders. It can be a way to accelerate the decision-making process on which business model innovation looks most promising.

5.2.5. *Collaboration*

Practitioners viewed the tool as a potential mechanism to evaluate the value derived by different stakeholders on potential collaboration and even a merger or acquisition. Collaboration is regarded as increasingly important activity for companies to succeed and tackle sustainability issues [4, 19, 27], so this could be a promising use. As issues extend beyond business boundaries (e.g. climate

change, deforestation), partnerships will need to be formed to tackle these issues together. The tool could help potential collaborators evaluate the value and opportunity of new partnerships. A third-party could facilitate such a workshop or separate stakeholders can first individually form their value maps, before engaging in an open discussion with partners. The tool might help draw out the potential value created and destroyed from collaborations. Although the tool does not provide a quantified output and is not likely to be used for detailed investment decisions on mergers and acquisitions, it may be used to balance benefits and impacts across all stakeholders of informal or more formal collaborative arrangements.

5.3. *Complementary tools*

During some workshops, complimentary tools were used. Complementary tools identified include: road mapping [34]; the sustainable business model archetypes; EcoASIT [48] and the Business-Environment-Customer (BEC) diagram [31] and the business model canvas [33].

Road mapping [34] can assist the process of planning actions over time, because such visual aids allow people from various functional backgrounds to work together on a shared future vision and plan next steps. It was the main complimentary tool used during the sessions indicated as number 4 in Table 1. Roadmapping has been demonstrated for product and technology evolution through to top-level strategic planning (e.g. Phaal et al. [34]), and therefore, it is a potentially useful complementary tool for all of the identified uses of the value mapping tool.

Whereas roadmapping was used to give future direction to start-up teams, EcoASIT and the BEC diagram were used as initial creativity tools for designers, preceding value mapping, and so are more relevant to the product and process design. During the two sessions indicated as number 9 in Table 1, the following tools were used: EcoASIT [48], an eco-innovation tool aimed at stimulating life cycle thinking by providing system boundaries in the form of a nine-box matrix (past–present–future vs. sub-system, system and super-system), and the BEC diagram [31], a Venn diagram, which shows synergistic opportunities at various intersections of "business", "environment" and "customers."

Exemplars, such as sustainable business model archetypes [7, 42] can be used to stimulate idea generation. During all sessions, at least two examples of existing sustainable business models were presented, building on examples from the sustainable business model archetypes framework [7, 42].

Finally, the business model canvas by Osterwalder and Pigneur [33] and the business model framework in Figure 3 may be useful to map the business model elements that need to be changed (e.g. value proposition, activities and partnerships) as a result of the new business model idea.

6. Conclusions

"Sustainable business thinking" is a holistic approach to thinking about business that seeks to integrate consideration of the three dimensions of sustainability – social, environmental and economic – in a manner that balances or aligns value creation for all stakeholders including the environment and society at all levels and through all activities of the business. Figure 2 was introduced in this study as a conceptual framework, which links to concepts of sustainable business thinking, sustainable business model innovation and value mapping. It was included to support the view that value mapping might be a useful tool for wider sustainable business thinking, suitable for a range of functions across an organization.

How might value mapping as a tool and process be used for sustainable business thinking? This study has explored the potential application of the value mapping tool and process to encourage sustainable business thinking. The potential applications to stimulate sustainable business thinking identified by using the tool include the following: (1) ideation for start-ups and established firms, (2) education, (3) product and process design and life cycle thinking, (4) evaluation and screening, (5) systems thinking and, (6) collaboration.

As demonstrated in this study, the value mapping tool and process can be used in a range of ways for sustainable business thinking. The tool was found to be simple and visually engaging. The inclusion of multi-stakeholders and a systematic consideration of both positive and negative outcomes of doing business provided a useful supporting framework for sustainable business thinking. A key benefit of the tool in the product/process design and larger systems thinking context is the potential to better consider potential unintended impacts on external stakeholders and alternative solutions that offer greater alignment between stakeholder interests.

There are some limitations to the value mapping tool and process. First, the tool is largely qualitative in nature and does not allow for detailed quantitative analysis. However, as argued by the IPCC [23], decision-making on climate change and sustainability involves value judgments and ethical considerations. This type of decision-making is evidently hard to approach with quantitative measurement. Second, the tool might be useful in conjunction with certain strategy and business modeling tools, for example technology roadmapping [34], sustainable business model exemplars, such as business model archetypes [7, 42] or perhaps in conjunction with LCA. Third, the effectiveness of the value mapping tool and process is dependent on the facilitators and users. Appendix 1 provides some indication of examples of value captured, value missed, destroyed, and new opportunities to "de-risk" the facilitation process. However, industry-specific knowledge and facilitation (e.g. through LCA, market analysis and expert knowledge) might be necessary to improve the quality of the value mapping

tool and process. It is argued that similar to other conceptual tools such as PEST and SWOT, the application by the users and facilitators to a specific context is crucial. Frameworks such as the one presented in Appendix 1 of this study and the facilitation guidelines referred to in Bocken et al. [6] might assist in educating users. Finally, the value mapping tool might be flexible and serve multiple purposes, but may not always be the best approach for each of these purposes, because specific specialized tools might be more suitable. For example, when detailed quantitative data are required on environmental impact of a product or service, an LCA will be more suitable than qualitative value mapping. Tool users are encouraged to take note of this, rather than regarding the tool as a "one size fits all" approach.

Future research might look into exploring the potential of using value mapping in broader contexts of decision-making involving multiple stakeholders, such as policy-making and investigating "wicked challenges" – those challenges which involve multiple stakeholders and do not have straightforward answers (e.g. sustainable sourcing of raw materials and land use changes). In addition, future research may attempt to approach value mapping in a (semi-) quantitative way to better support sustainable business decision-making. Finally, future work may include further testing of the tool in a range of settings with different complimentary tools. This will help clarify what the best ways are to stimulate sustainable business model thinking through education, ideation, life cycle thinking, screening and strategy development. Future researchers are encouraged to develop further tools and frameworks, which facilitate "sustainable business thinking" within and across company boundaries.

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Appendix 1. Value mapping – illustrative examples of value created, missed, destroyed and new opportunities

Stakeholder	Value created	Value destroyed	Value missed	New value opportunities
Customers	Use utility, functionality, health benefit, well-being, prestige, feel good	Detrimental health/ safety impacts, over-priced products/services, compromised use (poor functionality, quality), premature replacement requirement (over-selling, short fashion cycles), unfair exclusion from benefits	Poorly served markets/ customer segments, failure to provide full range of desired functionality/ utility/performance, failure to understand full benefits of product/service, failure to make full use of product/ service (idle assets)	New markets, segments, new product/service features/offerings/ functionality (building on existing assets, or new diversification), greater product longevity and durability, lower cost
Employees	Employment, wealth distribution, livelihood security, meaning and purpose, learning and development	Under-paid, job stagnation and diminution of skills, stress and mental health disorder through overwork and mistreatment, accidents and dangerous working conditions, lay-offs	Under–utilized/ unused skills or working time, lack of development opportunities, poor incentives, poor management guidance, inadequate tools (e.g. IT), few internship opportunities	New job creation, training and development, promotion/ pay increase, new opportunities to apply skills/creativity, meaningful work, job rotation, enhanced health/ safety, incentive scheme, employee ownership.
Society	Poverty alleviation, community development, social justice, health and well-being, secure and meaningful employment for all	Job lay-offs, failure to contribute to taxation, breach of ethics, detrimental impact on health/ wellbeing and debt, distortion of democratic political system through lobbying, exclusion of societal segments from access to products/services, abuse of monopoly position	Underdeveloped stagnating communities, high youth unemployment, mass migration, decaying infrastructure and urban centers, forced early retirement, failure to adequately cater to all groups in society (aging population, ethnic minorities, disabled etc.)	Extend product/service to broader segments of society, community investment and development initiatives, apprenticeship and investment in education, research, and training programs, support to give people work experience. Lobbying for legislation to support introduction of societally beneficial products/services.
Environment	Resource use within regeneration rates; emissions and waste levels within metabolism limits; biodiversity protection	Toxic emissions and waste to landfill, consumption of non-renewable resources, depletion of biodiversity, depletion of resource bases	Waste to landfill that could be reused/recycled, premature end-of-life of product, losses in value chain (e.g. food losses)	Switch to renewable materials and processes, reduce waste, improve efficiency and productivity, end of pipe capture, green chemistry, closed loop reuse of waste (industrial symbiosis, remanufacture, reuse, recycle), net positive contributions to biodiversity, etc.

(*Continued*)

Appendix 1. (*Continued*)

Stakeholder	Value created	Value destroyed	Value missed	New value opportunities
Shareholders/ investors	Profit, ROI, growth, financial resilience, long-term viability	Economic loss, premature right off or degradation of assets, stranded assets, penalties and fines	Failing to capture value from delivering customer or public value, underinvestment in growth/development opportunities	Seek new revenue generation mechanisms, reduce costs, seek higher value added opportunities (higher profitability), diversification, reduce exposure to potential penalties, reduce waste to landfill taxes, strategic investment in technology, R&D, resources and assets
Suppliers/ partners	Profit, ROI, growth, market access, development, long-term beneficial relationships, relationship stability and predictability, and long-term viability	Economic loss, underpaid, late payment, loss of contract or reneged supply agreements, overly oppressive contractual arrangements or management practices that compromise relationships and constrict business performance.	Failing to utilize full assets and capabilities, unpredictable demands for goods/services provision, underpayment for services/ goods provided, failing to engage with new technologies and capabilities in the industry/ other industries	Extend relationships, seek further opportunities to create shared value, forge new relationships to access new capabilities, technologies, markets, etc. Open innovation approaches to encourage broader collaborative networks outside traditional industry boundaries (e.g. NGOs)