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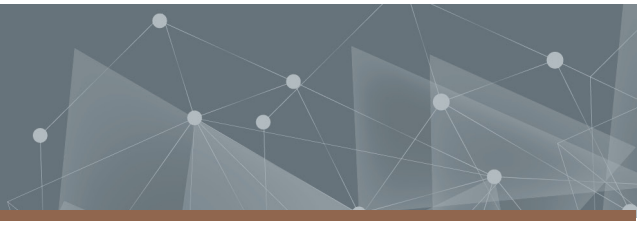

A Conceptual Data Model for Sustainability Tools

Master's Thesis in Circular Economy

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Summary

In response to environmental degradation and social inequality, nations have expressed the need for a sustainable development trajectory, most notably through the creation of the Sustainable Development Goals. As the pressure to comply with sustainability commitments increases and governments gain greater insight into the environmental and social performance of different sectors, organizations will need to find new ways to meaningfully generate sustainable value. However, implementation remains difficult because sustainability is a complex issue that requires systems thinking, a macro-vision, and a multidisciplinary approach. Sustainability toolkits can help organizations overcome these challenges by providing them with a diverse array of frameworks and strategies to follow. If stakeholders choose the wrong tool or use tools incorrectly, however, they run the risk of losing valuable resources and contributing to greenwashing. Thus, there is a need to guide stakeholders in decision making around sustainability tools themselves. In an effort to contribute to the field of research supporting the sustainability transition, this study aims to develop a conceptual data model to organize a sustainability toolkit in a manner that supports practitioners in selecting tools and subsequently utilize this organizational structure to reveal insights about an existing sustainable entrepreneurship and innovation toolkit, known as the ENHANCE toolkit.

Keywords: sustainability tools, conceptual data model, information architecture, informed decision-making

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List of Acronyms

Below is the list of acronyms that have been used throughout this thesis listed in alphabetical order:

BM	Business Model
CBMI	Circular Business Model Innovation
CE	Circular Economy
CSRD	Corporate Sustainability Reporting Directive
DSIP	Digital Sustainability Implementation Package
ESG	Environmental, Social, & Governance
EU	European Union
GHG	Greenhouse Gas
GDP	Gross Domestic Product
IPCC	Intergovernmental Panel on Climate Change
LE	Linear Economy
NFRD	Non-Financial Reporting Directive
PPP	People Planet Profit
SBM	Sustainable Business Model
SDGs	Sustainable Development Goals
SMEs	Small & Medium-sized Enterprises
TBL	Triple Bottom Line
TME	Technology Management & Economics
UN	United Nations

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1

Introduction

Driven by a predominantly Linear Economy (LE) that generates profit through the extraction, use, and disposal of natural resources, the immense scale of economic activity since the Industrial Revolution has been credited with advances in human well-being over time, such as higher income and employment levels (Esposito, Tse, and Soufani 2018; Costanza et al. 2014). While increased economic activity has traditionally been viewed as an indicator of progress, it has resulted in demographic shifts and changes in consumption patterns that have led to the depletion of crucial natural resources and large-scale environmental changes, such as climate change and biodiversity impacts (Esposito, Tse, and Soufani 2018; Costanza et al. 2014; Polasky et al. 2019). Moreover, the economic value generated from the current system is unevenly distributed; income disparities have risen in the majority of developed countries and there is an increasing concentration of wealth amongst the richest percentile group (Costanza et al. 2014; UN Department of Economic and Social Affairs 2020). Nevertheless, persistent social issues, such as extreme poverty and malnutrition, warrant further economic development in the future (Polasky et al. 2019).

As a result of environmental degradation and social inequality, nations have expressed the need for a sustainable development trajectory, most notably through the creation of the Sustainable Development Goals (SDGs) (Waas et al. 2014; UN 2015). Civil society, governments, and the private sector all play major roles in achieving a sustainable development pathway through their relevant initiatives and approaches, such as Circular Business Model Innovation (CBMI) (Lozano 2020; Lee et al. 2023; Rashed and Shah 2021; Pieroni, McAloone, and Pigosso 2019a). However, the satisfactory implementation of sustainability is hampered by an array of challenges, including sparse funding, a lack of influential leadership and partnerships, insufficient engagement from crucial stakeholders, and fragmented monitoring and evaluation mechanisms (Lee et al. 2023; Rashed and Shah 2021).

Several policy instruments, such as the European Union (EU) Green Deal and the EU Taxonomy, are regional efforts to provide organizations with financial resources and operational guidance to facilitate the transition to a low-carbon, resilient, and resource-efficient economy (European Commission 2019, 2021b). Moreover, the Corporate Sustainability Reporting Directive (CSRD) was launched in 2022 to improve monitoring of sustainability performance within the private sector by mandating

that large organizations within the EU disclose relevant sustainability information by early 2025 and Small & Medium-sized Enterprises (SMEs) disclose by early 2026 (European Commission 2021a). The CSRD will enhance the quality of sustainability reporting by providing standardization, as well as the quantity of data through new reporting requirements like resource use and CE metrics (European Commission 2021a; Opferkuch et al. 2022; Opferkuch et al. 2023). Greater insight into organizations' sustainability performance is crucial to achieving sustainability, as it helps to reduce greenwashing and improve their ability to secure financial resources (Opferkuch et al. 2022; Hobs and Wollmert 2022).

As the pressure to comply with sustainability commitments increases and governments gain greater insight into the environmental and social performance of different sectors, organizations will need to find new ways to meaningfully generate sustainable value (Waas et al. 2014). Forms of sustainable entrepreneurship, such as increased investment in sustainable technological innovations and business model innovation, are promising mechanisms for improving organizations' contributions to achieving the SDGs (Ludeke-Freund 2020; Yang, Vladimirova, and Evans 2017). However, despite the recent legislative incentives, implementation remains difficult because sustainability is a complex issue that requires systems thinking, a macro-vision and a multidisciplinary approach (Government Office for Science 2023a; Upward and Jones 2016). Waas et al. (2014) assert that "*the intrinsic holistic and multi-dimensional nature of sustainable development with its uncertainties and risks renders it assessment and measurement complex*". Similarly, Rashed and Shah (2021) note that "*the exhaustiveness and complexity of interlinkages among the goals and their targets*" remains a key barrier to implementation.

Previous research by Waas et al. (2014) has suggested that the successful implementation of sustainability can be supported through informed decision making to steer the course of action taken by key stakeholders. To facilitate decision making, three challenges should be addressed (Waas et al. 2014):

- *Interpretation:* Sustainability should be interpreted according to its organizing principles and within the given socio-environmental context.
- *Information-structuring:* The intrinsic complexity and multi-dimensional nature of sustainability should be properly organized and communicated.
- *Influence:* Sustainability information should influence implementation.

Sustainability toolkits can help organizations overcome these challenges by providing them with a diverse array of frameworks and strategies to follow (Lozano 2020; Grainger-Brown and Malekpour 2019). For example, the Chalmers University of Technology's Department of Technology Management and Economics (TME) collated a sustainable entrepreneurship and innovation toolkit for the ENHANCE Alliance[1] to support practitioners with conceptualizing, operationalizing and implementing sustainability strategies (Mansoori 2023). However, the ability to access

[1]The ENHANCE Alliance is a coalition of research universities focused on science and technology (ENHANCE Alliance, n.d.)

sustainability tools is not sufficient to support implementation. Stakeholders must also be empowered to choose the right tool for their use case and apply it properly.

If stakeholders choose the wrong tool or use tools incorrectly, they run the risk of losing valuable resources and contributing to greenwashing (Mitchell, O'Dowd, and Dimache 2020; Zharfpeykan 2021). Thus, there is a need to guide stakeholders in decision making around sustainability tools themselves. Interpretation challenges associated with understanding and using individual tools correctly can be mitigated through formal education and capacity building. This competence must also be accompanied by stakeholders' ability to easily sort through the large amount of tools at their disposal, yet it is unclear how sustainability toolkits can be organized from a systems thinking perspective within the context of a complex sustainability framework. In an effort to contribute to the field of research supporting the sustainability transition, this study aims to answer two research questions:

1. *How can a sustainability toolkit be organized to support practitioners in selecting tools?*

2. *What can this organizational structure reveal about the ENHANCE toolkit?*

1.1 Delimitations

The tools within the ENHANCE toolkit were used as the empirical data for the study (Mansoori 2022). The tools were collected between 2021-2022 by Yashar Mansoori at Chalmers University of Technology's TME Department for the ENHANCE Alliance (Mansoori 2023). Due to time constraints, only 59 tools within the toolbox were included in the data analysis. The majority of tools from 17 external toolkits that were linked to the ENHANCE toolkit were excluded. The criteria used to determine which tools were included in the study are described in Section 3.2.

1.2 Thesis Structure

The thesis is structured into the following sections: theoretical background, methodology, results, discussion, and conclusion. The next section outlines the literature review that provides the theoretical foundation of the sustainability transition and a baseline for the interpretation of the findings. Section 3 outlines the key steps in the content analysis and conceptual data model development phases of the research, as well as the research approach and limitations of the methodology. Section 4 outlines the findings from the development and application of the model fed by the data in the ENHANCE toolkit. Section 5 provides the practical and theoretical implications that emerged as a result of the experiment conducted with the model and the aforementioned toolkit. Finally, the study's conclusions and suggestions for future research are summarized in Section 6.

2

Theoretical Background

This chapter provides, firstly, a broad overview of the current environmental and social challenges caused by the prevailing socioeconomic system. Secondly, it covers the ideology, policies, frameworks, and strategies, such as the CE, that support the sustainability transition mainly within the European context. Lastly, it elaborates on the complexity of sustainability, the challenges faced in implementing it, and suggested approaches to mitigate these challenges, including systems thinking, capacity building, and informed decision making processes.

2.1 Current Economic Paradigm

Scientists have declared that humankind has entered a new geological epoch called the Anthropocene, characterized by remarkable environmental changes due to human development that put the Earth's climate system resilience at risk (Steffen et al. 2011). All physical components of the Earth's climate system – atmosphere, hydrosphere, geosphere, and cryosphere – have gained heat in the past century (Smerdon and Smerdon 2018). In particular, nine planetary boundaries have been identified and integrated into the Intergovernmental Panel on Climate Change (IPCC) Report, which calls for limiting global warming (IPCC 2018). As outlined by Rockström et al. (2009), these nine environmental boundaries identify "*a safe operating space for humanity*" and cannot be surpassed if a livable planet for humankind is to be secured (Johan et al. 2009). These boundaries are climate change, rate of biodiversity loss, interference with the nitrogen and phosphorus cycles, stratospheric ozone depletion, ocean acidification, global freshwater use, land use change, chemical pollution, and atmospheric aerosol loading (Johan et al. 2009).

The rapid progression of global warming has led to a chain reaction of environmental consequences, such as drought, decreased water supplies, extreme and unusual weather events, and rising sea levels (IPCC 2018; Ivanova and Serrano 2022). These events have the potential to severely affect socioeconomic systems (Smerdon and Smerdon 2018). As mentioned in the 2018 IPCC Report, the most pressing environmental issue is climate change because it is intertwined with several other sustainability challenges that directly threaten human well-being, including inequality, human rights crises, poverty, famine, resource scarcity, reduced crop yields, clean water shortages, illness, and slower economic growth (Smerdon and Smerdon 2018;

IPCC 2018; Nancy Bocken et al. 2019; Ivanova and Serrano 2022).

The world's current economic system, which is recognized to be largely linear, is a significant contributor to environmental degradation and climate change impacts (Morseletto 2023). The LE refers to an economic system in which virgin raw materials are extracted and products are typically disposed of in landfills at the end of their life cycles (Morseletto 2023). Since there are no recycling or reuse processes in the LE, its dynamic can be characterized by phrases like 'make-use-dispose', 'take-make-use-dispose' or 'cradle-to-grave' (Morseletto 2023). The LE puts pressure on the environment and increases the vulnerability of raw materials' supply chains (Neves and Marques 2022).

2.2 Sustainable Development

A more sustainable and resilient development approach is needed to secure a livable planet for current and future generations (Neves and Marques 2022). Published by the World Commission on Environment and Development in 1987, the Our Common Future Report[1] provided the guiding principles for sustainable development, as well as a common definition: "*Sustainable development is the development that meets the needs of the present without compromising the ability of future generations to meet their own needs.*" (World Commission on Environment and Development 1987). The report stated that critical social and environmental problems are consequences of the unsustainable consumption and production patterns in the Global North and poverty in the Global South (World Commission on Environment and Development 1987). In contrast to this historical development pathway, sustainable development exhorts a harmonizing strategy for human development and the environment (World Commission on Environment and Development 1987).

Sustainable development promotes a shared vision and understanding of life quality that focuses on the intersection of the three main spheres – social inclusion, economic performance, and environmental resilience – of the socioeconomic system (Fernandes, Rodrigues, and Ferreira 2022; Goodland 1995; Kim and Coonan 2023; Pieroni, McAloone, and Pigosso 2019a; Geissdoerfer et al. 2017). Also referred to as the Triple Bottom Line (TBL) or People, Planet, Profit (PPP), these spheres are known as the three pillars of sustainability (Joyce and Paquin 2016). Over time, the aligned vision of sustainability led to the creation of the 2030 Agenda for Sustainable Development, which provides a blueprint of 17 SDGs that seek to build a prosperous, harmonious, and peaceful system for the planet and people (UN 2015).

Devised from the Millennium Development Goals, the SDGs were published and signed in 2015 by 193 members of the United Nations (UN) (Korhonen et al. 2021; Nancy Bocken et al. 2019; UN Department of Economic and Social Affairs 2015; UN 2020). The 17 SDGs are: 1. no poverty, 2. zero hunger, 3. good health and

[1] The Our Common Future Report is also known as the Brundtland Report after the Commission's chairwoman, Gro Harlem Brundtland (World Commission on Environment and Development 1987).

well-being, 4. quality education, 5. gender equality, 6. clean water and sanitation, 7. affordable and clean energy, 8. decent work and economic growth, 9. industry innovation and infrastructure, 10. reduced inequalities, 11. sustainable cities and communities, 12. responsible consumption and production, 13. climate action, 14. life below water, 15. life on land, 16. peace, justice, and strong institutions, and 17. partnerships for the goals (UN 2015, 2020; UN Department of Economic and Social Affairs 2015). The SDGs include 169 more detailed targets that aim to end poverty and build strategies to improve health and education, reduce inequality, and promote economic growth, while mitigating climate change and preserving life on the planet (UN 2015; UN Department of Economic and Social Affairs 2015; UN 2020).

The aim of having synchronized sustainability goals is to increase the speed of the sustainability transition, generate peer pressure, and mobilize capital and stakeholder networks (Birch 2015; Kim and Coonan 2023). In practice, organizations could implement sustainability goals through strategies like footprint reduction, poverty alleviation, fair distribution, waste reduction, transparency, clean technology, pollution prevention, and product stewardship (Evans et al. 2017; Poveda 2017a). The SDGs ultimately provide a shared framework to enhance societal change and channel investments towards a sustainable and resilient socioeconomic path (Grainger-Brown and Malekpour 2019; Clark, Reed, and Sunderland 2018). However, this transition requires vast capital that governments cannot completely fulfill; it is therefore crucial that the private sector actively participates in achieving sustainability (Clark, Reed, and Sunderland 2018).

2.2.1 Sustainable Economic System

Negative environmental trends are driving a paradigm shift among scholars, policymakers, and organizations to transform the current economic system into a sustainable one by encouraging moderate consumption, cleaner production methods, institutional change, and new policies (Fernandes, Rodrigues, and Ferreira 2022; Durán-Romero et al. 2020; Markard, Raven, and Truffer 2012; Nancy Bocken et al. 2019). A sustainable economic system may have the following characteristics, among others (N.M.P. Bocken et al. 2014; Morseletto 2023; Neves and Marques 2022):

1. Incentivizes minimizing consumption and establishes cap quotas on energy and natural resources.

2. Maximizes social and environmental benefits rather than prioritizing economic growth.

3. Promotes a closed-loop system where waste is designed out of the system; repair, refurbishment, and remanufacturing are prioritized over recycling.

4. Delivers functionality, service, and experience rather than product ownership.

5. Attempts to provide fulfilling and rewarding work experiences.

6. Cultivates collaboration and sharing rather than competition.

2.2.2 Circular Economy

The CE has emerged under the umbrella of sustainable development as a framework to operationalize sustainability in the industrial arena (Geissdoerfer et al. 2017). First introduced by the Ellen MacArthur Foundation in 2013, the CE is an alternative economic structure to the LE that aims to replace the 'take-make-use-dispose' process with 'make-use-reuse-remake-recycle' (Geissdoerfer et al. 2017; Mhatre et al. 2021). In this sense, the CE approach focuses on redesigning manufacturing processes, disrupting usage and disposal patterns of products and services, minimizing waste, and regenerating natural resources (Mhatre et al. 2021). The CE intentionally optimizes industrial processes by reducing the resources and materials used for production, improving product design to increase efficiency during the use phase, slowing the rate of consumption, postponing the end of life, and closing the material loop (Pieroni, McAloone, and Pigosso 2019b, 2019a; Geissdoerfer et al. 2017; Guldmann and Huulgaard 2019; Morseletto 2023; Neves and Marques 2022). In a nutshell, it is the proposition of an economic system where the 'end-of-life' concept is replaced by reusing, reducing, recycling, and recovering materials throughout the life cycle process (Kirchherr, Reike, and Hekkert 2017).

The CE proposes to embed environmental responsibility in the supply and demand side of products and services (Geissdoerfer et al. 2017). According to a literature review conducted across the EU by Mhatre et al. (2021), different CE strategies are being implemented through frameworks, such as ReSOLVE, that propose diverse strategies aimed at looping materials back into the system, such as refurbishment, recycling, and waste management (Mhatre et al. 2021). Introduced by the Ellen MacArthur Foundation and described further in Appendix A.1, the ReSOLVE framework stands for regenerate, share, optimize, loop, virtualize, and exchange (Mhatre et al. 2021). The CE considers both technical and biological cycles; the first relates to recycling, reuse, refurbishing, and maintaining, while the latter points out the biological cycles that the resources can undergo, such as extraction of biochemical feedback, anaerobic digestion, regeneration (Mhatre et al. 2021; Husgafvel et al. 2018). Overall, CE implementation has the potential to produce positive sociotechnological changes that intersect with business model innovation, as well as institutional frameworks, rules, and policies (Morseletto 2023).

The economy has always been a mix of circular and linear economies (Morseletto 2023). Nonetheless, their uneven application is caused by the availability of resources, natural and political environments at regional or global levels, desired profit, business opportunities, innovations, new technologies, knowledge, and scarcity of time, labor, or skills (Morseletto 2023). In addition, society's behavior, such as overproduction and fast consumption, could hinder the development of a CE, favoring a 'throwaway society' (Morseletto 2023). Similarly, the lock-in effect, path dependencies, and the massive and cheap production of goods can perpetuate the LE across different sectors (Morseletto 2023).

Despite the promising positive environmental impacts of the CE, research has shown that transitioning to a CE is complex and requires designing a new system supported by public policy and technological innovation to incorporate most industrial sectors and enable the flow of resources along the value chain (Mhatre et al. 2021). The CE operates at different levels that need to be synchronized: the *micro-level* refers to products, companies, and consumers; the *meso-level* refers to eco-industrial parks; and the *macro-level* refers to cities, regions and nations (Kirchherr, Reike, and Hekkert 2017). Each of these levels plays a crucial role in the successful execution of a sustainable CE system (Kirchherr, Reike, and Hekkert 2017).

The CE transition depends on social, environmental, and economic factors (Neves and Marques 2022). A study in nineteen European countries, conducted by Neves and Marques (2022), illustrated that social factors, such as age distribution, can interfere with the CE transition. Therefore, policymakers could design strategies to incentivize sustainable consumption within this population segment (Neves and Marques 2022). Similarly, countries with higher income levels have a negative correlation with the acceptance of products based on recycled materials; conversely, the study shows that higher education levels are positively correlated with recycling efforts and environmentally-friendly behavior, as illustrated by the European middle-class (Neves and Marques 2022).

Drivers of the CE are consumption patterns, environmental awareness, and regulations (Neves and Marques 2022). Therefore, it is worth emphasizing the importance of well-designed environmental policies that aim to modify consumers' behavior towards sustainability and circularity by promoting reutilization, reducing waste and unnecessary packaging, and designing products that last to mitigate 'planned obsolescence' (Neves and Marques 2022; Magazzino et al. 2021). Currently, standard CE metrics include the recyclability rate and the reintroduction rate of products in the economy. As a result, the revalorization of waste is crucial to decouple waste generation from economic growth (Pieroni, McAloone, and Pigosso 2019b, 2019a; Geissdoerfer et al. 2017; Mhatre et al. 2021; Neves and Marques 2022). Investment is also required to generate more Sustainable Business Models (SBMs), as well as guarantee efficient and environmentally-sound production processes[2] (Neves and Marques 2022). However, the CE is not just about generating and investing economic value, but also about redesigning consumption and production patterns. Thus, its success cannot be solely measured by monetary means but rather by broader metrics capable of measuring more complex topics like biodiversity loss and ecosystem services (Geissdoerfer et al. 2017; Morseletto 2023).

2.3 Sustainability Legislation

More than 190 nations signed the Paris Agreement in 2015 to formalize an action plan that ensures global temperature increases remain "*well below 2°C above pre-industrial levels*" (Reckien et al. 2018). The agreement has extensive implications

[2]The channeling of financial resources to more sustainable business models and production processes is called green finance (Neves and Marques 2022).

for the majority of the cities in the world, but in particular for European cities that contribute a significant share of greenhouse gas (GHG) emissions worldwide (Reckien et al. 2018). In order to comply, many governments are incentivizing businesses and industries towards sustainable growth and competitiveness with the shared understanding that economic progress cannot be achieved if it involves damaging the environment (Fernandes, Rodrigues, and Ferreira 2022).

In an effort to help investors and companies navigate the transition to a low-carbon, resilient, and resource-efficient economy, the European Commission published the Non-Financial Reporting Directive (NFRD) in 2017 and an amendment, known as the EU Taxonomy, in 2019 to provide climate-related reporting guidelines that are in line with the Paris Agreement (European Commission 2021b). The EU Taxonomy seeks to inform and encourage green finance by clarifying which economic activities contribute to the EU's environmental goals of decarbonizing the economy, restoring ecosystems, and building a modern and competitive economy (European Commission 2019, 2021b). The EU taxonomy proposes six environmental objectives: 1. climate change mitigation, 2. climate change adaptation, 3. sustainable use and protection of water and marine resources, 4. transition to a circular economy, 5. pollution prevention and control, and 6. protection and restoration of biodiversity and ecosystems (European Commission 2021b).

The EU Taxonomy provides the guidelines for the EU Green Deal, a major project with initiatives targeting climate change, the environment, energy, transport, industry, agriculture, and sustainable finance (European Commission 2019). The project has three main directives: net zero emissions of GHGs by 2050, reduce net GHG emissions by at least 55% by 2030 compared to 1990 levels, and decouple economic growth from resource use with no person or place left behind (European Commission 2019). In response to the EU Taxonomy stating that the CE transition is a priority in the policy agenda, the European Commission has also published the Circular Economy Action Plan which aims to reduce natural resource use, protect biodiversity, and create sustainable growth (European Commission 2021b). Some of the plan's suggested strategies include improving product life cycles, promoting CE processes, and designing waste out of the system to keep resources in the economy for as long as possible (European Commission 2021b; N.M.P. Bocken et al. 2014). This act offers clear strategies for resource-intensive sectors with high potential for circularity, such as electronics, batteries and vehicles, packaging, plastics, textiles, construction and buildings, and food, water and nutrients (N.M.P. Bocken et al. 2014).

2.3.1 Monitoring Sustainability Performance

The increasing demand for corporate sustainability reporting comes from various sources: 1. legislation aiming to promote standardization, enhance a transparent transition, and achieve environmental objectives, 2. stakeholders interested in the origin and production of goods, and 3. investors and asset managers aware of the changing nature of financial risks related to sustainability and climate change (European Commission 2021a). In this context, sustainability reporting can increase organizations' access to financial resources by helping to manage risks related to

sustainability (Hobs and Wollmert 2022). Despite the increased demand for sustainability information, the lack of standardized methods for measuring, valuing, and managing sustainability-related risks remains an obstacle to ensuring that business models and activities are truly sustainable (European Commission 2021a). As a result, there is a clear need to develop assessment instruments that measure progress towards sustainability and determine the degree of success of macro-level policies, plans, and programs at the organizational- and project-level (Nipper, Ostermaier, and Theis 2022).

The EU Taxonomy mandates the disclosure of standardized sustainability metrics related to organizations' social and environmental impacts, as well as their green revenue[3] (Clark, Reed, and Sunderland 2018; Nipper, Ostermaier, and Theis 2022). However, these metrics can vary from objective and quantitative measurements to more subjective and qualitative ones, which could explain a historically slow evolution and uptake of standardized sustainability assessment tools (Poveda 2017a; Nipper, Ostermaier, and Theis 2022). The large variety of measurement methodologies also gives organizations the opportunity to present multiple incongruent metrics that may be misleading and makes it difficult for investors to measure green revenue relative to sustainability ratings (Nipper, Ostermaier, and Theis 2022). In response to these challenges, the European Commission replaced the NFRD with the Corporate Sustainability Reporting Directive (CSRD) in 2022 to provide a set of metrics that are understandable, relevant, representative, verifiable, and comparable (European Commission 2021a). Appendix A.2 provides an overview of the CSRD articles that indicate the types of information that should be disclosed (European Commission 2021a). The directive will apply to all companies listed on EU regulated markets, except for listed micro companies that can disclose the information on a voluntary basis; this particularly impacts SMEs that will now be required to report sustainability information by January 2026 (Eurosif 2021b).

In addition to regional reporting requirements, there are international standards and metrics that aim to improve the transparency around organizations' sustainability performance. For example, the UN's Global Indicator Framework outlines 231 unique indicators covering the 17 SDGs; indicators can serve as powerful decision making and reporting tools for organizations (UN 2020; Poveda 2017b). Additionally, the Global Sustainable Development Report (GSDR) plays a key role in evaluating the implementation of the 2030 Agenda and the achievement of the SDGs (UN Department of Economic and Social Affairs 2015). The SDG Impact Standards for Financing Sustainable Development is a more specialized framework designed to shed light on positive and negative Environmental, Social, and Governance (ESG) impacts (Eurosif 2021a). These standards, which are aligned with existing high-level principles and taxonomies, provide practical and actionable steps for enterprises, private equity funds, fund managers, and bond issuers to accelerate the sustainability transition (UN 2020).

[3]Green revenue refers to the portion of revenue, capital expenditures, and operating expenditures associated with sustainable business activities, such as investments in green technology or sustainable projects within a firm (Poveda 2017a).

2.3.2 Greenwashing

Monitoring sustainability helps to avoid 'greenwashing', a term used to describe the dishonest practice of communicating misleading, incomplete, or false information about the environmental and social impacts of products or manufacturing processes (Carmichael, Soonawalla, and Stroehle 2023). According to Carmichael, Soonawalla, and Stroehle (2023), the three most common greenwashing strategies are:

1. *Deception*, referring to the lack of information about which standards and frameworks were applied to measure sustainability and how the assurance process was conducted.

2. *Obfuscation*, when the company decides to disclose selected information to define indicators and serve as the focus for sustainability assurance. This raises serious questions about bias, since the management is deciding which metrics are subject to independent assurance and which are not.

3. *Diversion*, when companies intentionally avoid mentioning important information to distract from an unwanted story.

Companies can improve the credibility of sustainability reports by providing more complete and consistent information. In order to increase the credibility of reporting and auditing, Carmichael, Soonawalla, and Stroehle (2023) state that a company should disclose what framework and methodology are used to prepare and report the information; what specific information and metrics are independently assured, and by whom; whether the assurance is limited or reasonable; and any supplementary information that will help to contextualize the aforementioned details. The demand for transparency and accuracy of sustainability reports has also opened a new market for independent assurance that provides credibility to companies' sustainability data (Carmichael, Soonawalla, and Stroehle 2023). Despite the critical role of these data providers in the market, they are not subject to any specific regulations, raising concerns about conflicts of interest or the methodologies they apply (Eurosif 2021a). Consequently, the EU has enforced the CSRD, which improves transparency by using external assurers for audits and expands the scope of disclosure obligations by requesting more detailed ESG reports (Eurosif 2021b).

2.4 Generating Sustainable Value

Organizational value has generally been understood in monetary or economic terms (Yang, Vladimirova, and Evans 2017). Sustainable value, on the other hand, integrates the three pillars of sustainability (Evans et al. 2017). Another accepted definition of sustainable value is proactively creating monetary and non-monetary value with a long-term perspective for a broad range of stakeholders (Ludeke-Freund 2020; Yang, Vladimirova, and Evans 2017). Sustainable value could also mean the sufficient profitability of a business that reduces harm through the delivery of socially- and environmentally-responsible products and services (Pieroni, McAloone, and Pigosso 2019b). The notion that generating sustainable value is an essential fac-

tor for long-term business model success is gaining popularity (Yang, Vladimirova, and Evans 2017). In line with this perspective, companies and manufacturers are increasingly viewing the sustainability transition as an opportunity for growth and innovation, such as through the establishment of service-oriented business models (Evans et al. 2017).

2.4.1 Economic Value

Most companies are profit-oriented and prioritize financial success over other types of value (Joyce and Paquin 2016). Economic value is most commonly measured in monetary units and classified into profit, cost savings, and economic growth (Picciotto 2021). The latter is primarily estimated through Gross Domestic Product (GDP), which measures national economic activity in terms of production and has become the main indicator of economic development for policymakers (Landefeld 2000; Costanza et al. 2014). However, certain ideological movements are now advocating for the development of 'beyond GDP' indicators that are capable of integrating all three pillars of sustainability (Costanza et al. 2014; Picciotto 2021).

Neoclassical economics currently attempts to incorporate sustainability through environmental policy and taxation that establishes a price on natural resources, ecosystem services, and the cost of environmental degradation (Baksay and Kiss 2023). Some scholars argue that such metrics are disproportionate to the climate emergency society faces (Baksay and Kiss 2023). In other words, sustainability aims to create inclusive welfare on a long-term horizon that a neoclassical model cannot conceive (Randall 2022). However, estimations associated with this long-term perspective are volatile, since they involve future expectations, assumptions about the state of the socioeconomic system, resource availability, and unobserved outcomes of current policies (Randall 2022). Researchers solely using neoclassical economics to advise on sustainability fall short in the integration of a holistic perspective, as economic value cannot be the only factor in the sustainability discussion (Randall 2022).

2.4.2 Environmental Value

Environmental impact is the stakeholder influence on the natural environment, which can be positive or negative (Fernandes, Rodrigues, and Ferreira 2022). The ecological cost of an organization's actions can be measured through different biophysical indicators, such as GHG emissions, pollution, human health, natural resource depletion and water consumption (Fernandes, Rodrigues, and Ferreira 2022; Joyce and Paquin 2016). Moreover, the environmental impacts of products or services can be measured and assessed through a variety of tools, such as life cycle costing, material flow analysis and life cycle assessment (Joyce and Paquin 2016; Ylmén et al. 2020). Alternatively, environmental benefits can be achieved through the reduction of ecological harm or creation of regenerative ecological value (Joyce and Paquin 2016; N.M.P. Bocken et al. 2014). Examples include maximizing material and energy efficiency, substituting unsustainable energy sources with renewable and natural processes, creating value out of waste, and repurposing products to be more environmentally-friendly (Joyce and Paquin 2016; N.M.P. Bocken et al. 2014).

The CE can be viewed as a means to simultaneously generate environmental and economic value (Pieroni, McAloone, and Pigosso 2019a). The transition towards a CE requires re-thinking Business Models (BMs) to decouple value creation from resource consumption (Geissdoerfer, Vladimirova, and Evans 2018). The manufacturing industry has illustrated the economic benefits associated with resource efficiency strategies, including reuse, waste reduction, reverse logistics, and re-valuing resources (Mhatre et al. 2021). Automotive, machinery, and electronics companies, for example, have started implementing collection and take-back systems to recover scarce resources and reduce their dependency on the extraction of virgin raw materials (Mhatre et al. 2021). The successful implementation of such strategies requires coordination with a broad range of stakeholders and suppliers, as well as supportive policies like 'Extended Producer Responsibility', 'pay-as-you-throw', and waste taxation (Mhatre et al. 2021). However, it is essential to acknowledge that not all circular strategies will be intrinsically more sustainable (Geissdoerfer, Vladimirova, and Evans 2018).

2.4.3 Social Value

Social value is created when companies' activities result in benefits for stakeholders and improve the well-being of society (Joyce and Paquin 2016). In the case of social-oriented companies, social value is at the core of their mission and is the main driver of the business, thus an organization can create positive social value by conducting its economic activity with good governance (Joyce and Paquin 2016). Governance is defined as a component that captures an organization's structure and decision making policies, such as health standards, equal opportunities, and safety. Thus, social value is highly related to the impact that it has on its stakeholders and how the organization decides to engage them to create this type of value (Joyce and Paquin 2016).

Social value can also be generated through BMs that provide functionality rather than ownership, such as rental leases, pay-per-use, and product-oriented services for maintenance and extended warranties (N.M.P. Bocken et al. 2014). Another strategy is to adopt a stewardship role and promote ethical trade, biodiversity protection, consumer care, transparency around environmental and societal impacts, and resource stewardship (N.M.P. Bocken et al. 2014). Lastly, companies create social value by positively influencing consumer behavior through, for example, consumer education, demand management (such as cap and trade), product longevity, and responsible product distribution and promotion (N.M.P. Bocken et al. 2014).

Measuring social impact, which can be understood as the social cost of an organization, adds a layer of complexity to sustainability assessments because it is hard to quantify (Benoit et al. 2010). The most common indicators are working hours, freedom of speech, health and safety, community engagement, fair competition, and respect for intellectual property rights (Benoit et al. 2010). The decision of which social indicators to include in a sustainability assessment can be company and context dependent (Joyce and Paquin 2016).

2.5 Sustainable Innovation

The most pressing environmental and social issues require that sustainable innovations are diffused in the market to disrupt the current economic system in remarkable ways (Nancy Bocken et al. 2019; Ludeke-Freund 2020). Schumpeter's theory describes innovation as new combinations of products, processes or methods of production, markets and forms of organization, resources, services, policies or systems (Korhonen et al. 2021). The theory also states that the primary purpose of innovation is to enhance competitiveness and economic development driven by entrepreneurial activities (Fernandes, Rodrigues, and Ferreira 2022). In line with this, sustainable innovation systems play a crucial role in creating and diffusing knowledge and technology that boost green economic growth, accelerate the sustainability transition, and mitigate climate change (Fernandes, Rodrigues, and Ferreira 2022).

Sustainable innovation, particularly technology transfer and green innovation, can have a profound impact on economic development (Fernandes, Rodrigues, and Ferreira 2022; Ferreira, Fernandes, and Ferreira 2020; Bresciani et al. 2021). Although the SDGs aim to improve people's well-being at a global scale, there are barriers to achieving them at the regional level, as a result of local resources, culture and policies (Fernandes, Rodrigues, and Ferreira 2022). Therefore, regional innovation policies are necessary to maximize synergies between the various strategies to achieve the SDGs (Fernandes, Rodrigues, and Ferreira 2022; Korhonen et al. 2021).

At the micro-level, successful innovation is resource and context-dependent; it is usually influenced by an organization's capabilities related to product innovation, processes, technologies, organizational practices, and BMs (Nancy Bocken et al. 2019). An innovation theory known as the Resource-Based View asserts that a firm's competitive advantage and innovation activities are highly dependent on its irreplaceable capabilities and resources (Kiefer, Del Río González, and Carrillo-Hermosilla 2019). Innovation for sustainability intentionally seeks to create social and environmental value along with economic value through the introduction of radically new or incrementally improved products or services, changing the organization's values and activities in the process (Nancy Bocken et al. 2019). There are various forms of innovation, most notably product innovation, technology innovation, service innovation, social innovation, and systems innovation (Fernandes, Rodrigues, and Ferreira 2022; Ferreira, Fernandes, and Ferreira 2020; Bresciani et al. 2021; Nancy Bocken et al. 2019; Kiefer, Del Río González, and Carrillo-Hermosilla 2019).

2.5.1 Sustainable Business Model Innovation

BMs are conceptual frameworks that provide a holistic description of how a firm converts its resources and capabilities into economic value (N.M.P. Bocken et al. 2014). They describe a series of elements that, together, build the value proposition of a company and can be used to analyze, compare, assess, and manage communication and innovation (Joyce and Paquin 2016; N.M.P. Bocken et al. 2014). In this vein, BMs are a mediating device between strategy, innovation processes, technology, and value (Pieroni, McAloone, and Pigosso 2019b; Ludeke-Freund 2020).

In conventional BMs, value is solely measured by financial outcomes, without consideration of the social and environmental impacts (Upward and Jones 2016). Alternatively, SBMs integrates the TBL approach and considers a wide range of stakeholders, the environment, and society at large (N.M.P. Bocken et al. 2014). A SBM describes the company's sustainable value proposition to its customers and stakeholders; it also outlines how it creates, captures and delivers these various forms of value (Ludeke-Freund 2020). A successful sustainable firm is complex and requires the integration of multidisciplinary knowledge and expertise (Upward and Jones 2016). However, the way in which sustainable organizations achieve success can differ; for instance, a company aiming to increase it social value could prioritize that instead of maximizing its revenue (Ludeke-Freund 2020).

It is imperative that organizations view sustainability as an opportunity for value creation, since sustainable BM innovation requires significant changes across systems, design processes, and operations (Yang, Vladimirova, and Evans 2017). According to Yang, Vladimirova, and Evans (2017), several main concepts need to be well understood for sustainable BM innovation to be successful: product life-cycle thinking, including manufacturing; use and disposal of products; relevant stakeholders; value uncaptured; and economic, social and environmental value. Embedding sustainability at the core of the business strategy can lead to discovering new ways to create and capture value beyond those solely focusing on changing one of the many gears of the system (Yang, Vladimirova, and Evans 2017).

2.5.2 Circular Economy Business Model Innovation

As the sustainability transition gains support in the public and private domains, business model innovation for circularity becomes increasingly key to preserving companies' competitive advantage (Pieroni, McAloone, and Pigosso 2019a). CBMI entails re-configuring several factors of conventional BMs, including company operations, suppliers, procedures, values, and beliefs (Guldmann and Huulgaard 2019; Zollo, Cennamo, and Neumann 2013). According to research conducted by Urbinati, Chiaroni, and Chiesa (2017), there are three possible strategies to integrate CE practices into BMs:

- *Downstream circular strategies*, targeting the lower end of the value chain. These strategies do not aim to change production procedures or design products for circularity. They solely focus on changing customers' interactions with products and developing new revenue streams, such as marketing for reuse.
- *Upstream circular strategies*, related to product design for circularity and developing relationships with new suppliers. These strategies target cost reduction and resource efficiency. Thus, their effects are typically not visible to the customers because they are often unrelated to the price or marketing.
- *Fully circular BMs*, combining upstream and downstream strategies to embed circularity in each value chain stage.

Despite the environmental and economic benefits, transitioning to a circular BM

could add uncertainty and complexity to conventional strategic planning, since new variables like reverse logistics, customers' preferences for new items, and product quality have to be considered (Pieroni, McAloone, and Pigosso 2019b). Guldmann and Huulgaard (2019) outline three types of CBMI: internal innovation, hybrid innovation, and systemic innovation. Internal innovation refers to innovations that do not interfere with the core BM; hybrid innovation refers to new circular services and product designs that interact with the current BM; and systemic innovation improves the existing BM through new or refined circular services (Guldmann and Huulgaard 2019). Common CE practices often aim to 'create value out of waste', such as recycling that intends to retain the value of products after their first end-of-life by using them as valuable inputs for other purposes (N.M.P. Bocken et al. 2014). In addition to recycling, reuse and remanufacturing are other CE strategies that attempt to close resource loops (N.M.P. Bocken et al. 2014).

Recycling strategies may require stakeholder cooperation, well-designed reverse logistics, a robust supply chain network, and the identification of new partners to fulfill crucial tasks (Guldmann and Huulgaard 2019). This example illustrates that CBMI is an ongoing learning process with numerous challenges, since the outcome of the new BMs cannot be fully anticipated (Guldmann and Huulgaard 2019). Most businesses also face the challenge of being locked-in to the organizational, technological, industrial, social and institutional structures in which they operate (Guldmann and Huulgaard 2019). Moreover, the alteration of a business strategy during the innovation process could go against the existing business logic and impact the company's competitiveness (Chesbrough 2010). Nevertheless, it is essential to allow experimentation with CBMI to minimize uncertainties regarding new business strategies (Guldmann and Huulgaard 2019; Geissdoerfer et al. 2017).

2.6 Addressing Implementation Challenges

Despite the need for a great shift towards sustainability, its implementation is slow and falling short (Randall 2022). This insufficient progress is often attributed to the complexity of the topic, which makes it challenging to understand and develop strategies that guide decision making processes (Randall 2022; Government Office for Science 2023a). Complex systems are characterized by underlying patterns, such as feedback loops, that make it difficult to relate the causes with the consequences (Government Office for Science 2023a). Sustainable development and climate change mitigation are inherently complex, as they have long-term scopes and require collaboration across disciplines to transform the current sociotechnical systems (Horn, Urias, and Zweekhorst 2022; Markard, Raven, and Truffer 2012; Fernandes, Rodrigues, and Ferreira 2022). Considering that the intrinsic complexity of the system cannot be fully understood, the knowledge required to implement sustainability goes beyond traditional disciplines and a deep understanding of the topic requires multidisciplinary knowledge to navigate its complexity (Raimbault and Pumain 2022; Upward and Jones 2016). The complexity of sustainability also partially arises from the contradictory objectives of different stakeholders in their pursuits to integrate and achieve their TBLs (Raimbault and Pumain 2022).

In addition, sustainability requires an understanding of the macro-dynamics of the natural ecosystem and its embedded subsystems, as well as the connection between the three pillars of sustainability (Upward and Jones 2016). Otherwise, its interpretation could fall into the category of 'weak sustainability', which refers to an extension of the neoclassical economic system that is known to be simplistic and predominantly focused on monetary success (Upward and Jones 2016). The broad perspective of a multidisciplinary team is likely better equipped to weigh the trade-offs and benefits of different implementation strategies (Raimbault and Pumain 2022; UN Department of Economic and Social Affairs 2015). In summary, the construction of sustainability strategies demands interdisciplinary approaches characterized by cross-disciplinary collaboration among professionals (Horn, Urias, and Zweekhorst 2022; Clark et al. 2016). While this will allow for a more comprehensive approach to sustainability challenges, reconciling different stakeholder perspectives may require significant effort (Horn, Urias, and Zweekhorst 2022).

2.6.1 Systems Thinking

Systems thinking is a recommended approach for sustainability, since it is a holistic framework that can be used to understand how different elements interact within an intricate structure (Government Office for Science 2023a). The systems thinking school of thought provides a cognitive process for structuring the information of a complex system to analyze and steward the system effectively (Government Office for Science 2023a). Cities and the business environment are good representations of a complex system in which systemic changes can influence supply chain dynamics and encourage stakeholder integration into new collaboration networks (Raimbault and Pumain 2022; Ludeke-Freund 2020; Kiefer, Del Río González, and Carrillo-Hermosilla 2019). Government Office for Science (2023a) maintains that situations, projects or systems to be analyzed through the systems thinking approach have the following characteristics: the problem is not well-defined; there are several stakeholders with diverse opinions about what to do; there are many interrelated and dynamic connections between the problem and the broader environment, which is unstable and dynamic; and the aim is to make a sustained change at a broad scale.

By analyzing the whole rather than the pieces, systems thinking is a discipline that highlights interrelationships and attempts to make better decisions based on patterns and behaviors over time instead of a static view of the system (Kim and Coonan 2023). Consequently, systems thinking creates a comprehensible and measurable link between sustainability and equity (Kim and Coonan 2023; Woods 2018). By inciting critical thinking and providing a complete and integrated understanding, systems thinking has been lauded as a fundamental and necessary outcome of higher education related to sustainability and climate change (Kim and Coonan 2023).

2.6.2 Capacity Building

Due to its complexity, one of the first steps in achieving sustainability is to educate society on the topic at large, especially professionals that can evaluate the effectiveness of the current processes, strategies, and BMs (Upward and Jones 2016;

Kim and Coonan 2023). The UN Department of Economic and Social Affairs, for example, provides support and capacity-building for the SDGs across different areas of knowledge and issues, such as water, energy, climate, oceans, urbanization, transport, science, and technology (UN Department of Economic and Social Affairs 2015). In addition to education, capacity building requires communities of practice and networks of knowledge that can provide expertise on context-dependent challenges (Kim and Coonan 2023). These communities and networks are vital to achieving a common goal and require collaboration between community leaders, politicians, the scientific community, international organizations and the business sector, the academic community, civil society, youth, and intergovernmental and non-governmental organizations (Kim and Coonan 2023; Birch 2015; Horn, Urias, and Zweekhorst 2022). According to Birch (2015), this collaboration warrants a fourth sustainability pillar, good governance, which is understood as the synergy between the public and private sectors to successfully achieve the SDGs.

Capacity building should begin in the early stage of one's professional education, since a formal education on sustainability is critical to developing the necessary capabilities that future professionals will need to lead change (Kim and Coonan 2023). In order to achieve the SDGs, recent studies have illustrated the importance of integrating sustainability in university curricula to provide future professionals with the necessary knowledge and critical thinking skills they need to make sustainable decisions in their workplaces (Kim and Coonan 2023; Dobson 2007). Education for sustainability requires the development of both cognitive and non-cognitive skills, such as creative thinking, problem solving, resilience building, collaboration, and social and emotional skills (Kim and Coonan 2023).

2.6.3 Informed Decision Making

Strategic management is the process and tool for effectively handling critical decisions, actions, and execution within organizations; tangible organizational action requires setting objectives, developing strategies, and executing the plan (Rasche 2008). According to Grainger-Brown and Malekpour (2019), the development of a strategy undergoes three phases: 1. the ideation phase, where the strategic objectives are defined and articulated; 2. the development phase, where multiple options to realize the objectives are analyzed; and 3. the implementation phase, where the selected strategy is executed and monitored. Due to the vast diversity of economic activities across industries, there is no 'one-size-fits-all' strategy to guide sustainability action. However, it is crucial that organizations have an effective decision-making process to choose a strategy, which is defined by Mintzberg (1987) as the *"direction and scope of an organization over the long-term, which achieves advantage in a changing environment through its configuration of resources and competences"*. In order to select and implement the right sustainability strategy, organizations must engage in informed decision making (Waas et al. 2014). This requires organizations to have essential information at their disposal, which is then turned into understandable knowledge and actionable insights (Sherman 2015; Ross and Kimball 2013).

3

Methodology

This chapter provides an overview of the research design and approach that were used to answer the respective research questions:

1. *How can a sustainability toolkit be organized to support practitioners in selecting tools?*

2. *What can this organizational structure reveal about the ENHANCE toolkit?*

In order to answer the first research question, a content analysis of the ENHANCE toolkit was performed and a conceptual data model was subsequently developed. In answering the second research question, the conceptual data model was applied to the ENHANCE toolkit and insights were gathered. The research approach for the content analysis entailed defining the tagging approach and ontological orientation of the research, as well as clarifying the types of tags that were used for the analysis. A dimensional data modeling approach, which structures information around key user information needs, was used for the development of the conceptual data model.

3.1 Research Design

The research design consisted of four key steps: familiarization, tagging, categorization, and defining dimensions. The familiarization and tagging steps constituted the content analysis phase of the research, whereas developing categories and defining dimensions were part of the conceptual data model development phase. During the familiarization step, the toolkit was reviewed and the authors developed criteria to identify the tools that would be included in the analysis. In the tagging step, the tool descriptions were reviewed in-depth and text segments of interest within each description were tagged with key words, hereafter referred to as tags, through an iterative process. Tags were then grouped and a literature review was conducted to find relevant frameworks that could be used to provide structure to the categories. These categories served as the basis for the overarching dimensions of the conceptual data model. An overview of the research design, which is also discussed in more detail in the sections below, is summarized in Figure 3.1.

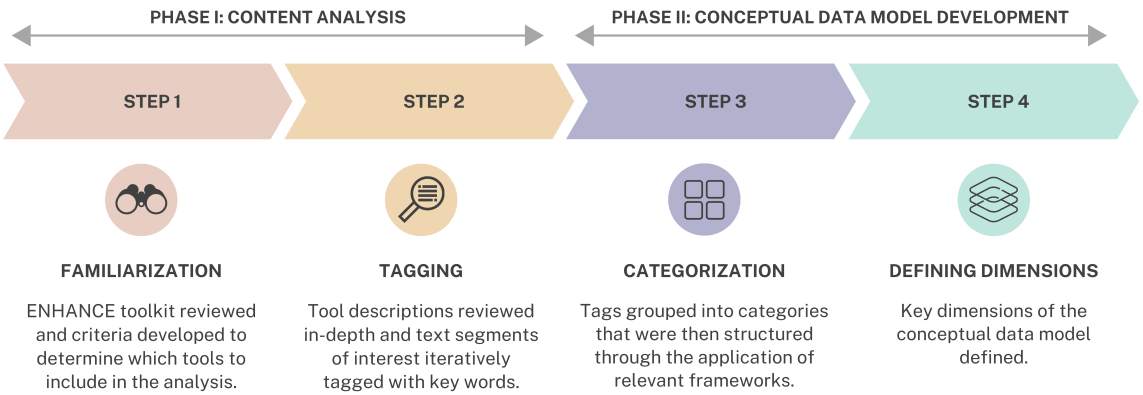

Figure 3.1: An overview of the research design.

3.2 Content Analysis

Content analysis, also commonly referred to as thematic analysis, is a data analysis technique that serves as a systemic approach to highlight terms or phrases within textual data, in an effort to ultimately identify important concepts or themes within the data (Willig and Rogers 2017; Cope 2010). The content analysis methodology proposed by Willig and Rogers (2017) was adapted for the purposes of this study to perform the familiarization and tagging steps of the research. This approach to content analysis was chosen because it is a flexible approach that can be used to organically unearth themes in the data unlike other more prescriptive approaches that prioritize accuracy at the expense of exploration.

In the familiarization step, the contents of the toolkit were scanned and the data granularity[1] of the analysis was determined to be individual sustainability tools instead of toolkits (groups of tools). Next, each tool that was relevant to the study was reviewed and cataloged, whereas content that did not meet criteria was excluded from the research data set. Relevance was determined by two criteria:

- The tool had its own page in the ENHANCE toolkit
- If the tool was part of a linked toolkit, it was highlighted as the main tool

Once a list of tools to include in the analysis had been compiled, each tool description was reviewed in-depth during the tagging phase. These descriptions served as the textual data for the content analysis and were found on websites, in articles or within the tools themselves. Relevant segments of text within the tool descriptions were tagged to highlight central concepts; this process is described as coding by Willig and Rogers (2017). These tags were collated and defined in a glossary, described as a code book by Willig and Rogers (2017). The tagging process was highly iterative,

[1]Data granularity refers to the grain or level of detail of each row within the analyzed data set; defining the grain is a crucial step before performing data analysis or defining dimensions (Ross and Kimball 2013).

in the sense that new tags were continuously identified as tools were analyzed. This resulted in the need to retroactively tag previously analyzed tools with new tags.

3.2.1 Tagging Approach

According to Willig and Rogers (2017), there are two key approaches to content analysis: a qualitative approach and a coding reliability approach; these approaches "*are underpinned by very different conceptualisations of knowledge, research, and the researcher*". The qualitative approach is considered a bottom-up approach, since the tagging serves as a way to organically identify themes in the data (Willig and Rogers 2017). This approach allows for greater freedom within the content analysis because the glossary is continuously being developed through the tagging and, therefore, it is not constrained by a predefined glossary (Willig and Rogers 2017). However, the qualitative approach can result in a lower degree of accuracy compared to the coding reliability approach, since the coding reliability approach structures the analysis from the onset through the development of a glossary prior to tagging (Willig and Rogers 2017).

Considering that the findings from the content analysis would inform the development of a conceptual data model, a qualitative approach grounded in inductive theory was used for this study. Inductive theory is based on the assumption that research findings can be used to develop theories (Willig and Rogers 2017; Bryman 2016). It is worth noting that Willig and Rogers (2017) describe the qualitative approach as subjective and highly influenced by researchers' interpretations, since it is "*a creative rather than technical process that is a result of the researcher's engagement with the data set and the application of their analytic skills and experiences, and personal and conceptual standpoints*".

3.2.2 Types of Tags

In addition to clearly indicating the tagging approach, it is best practice to identify the types of tags that are used during the content analysis (Willig and Rogers 2017). Descriptive tags, also referred to as manifest codes, capture explicit meaning, whereas interpretative tags, also referred to as latent codes, capture implicit meaning (Willig and Rogers 2017; Cope 2010). To allow for greater flexibility within the tagging process, both descriptive and interpretative tags were used.

Descriptive tags were used when tool descriptions explicitly stated a key word or phrase of interest. For example, the tag *#business-model* was applied to all tools that included this key word in the title or when the purpose of the tool was described as supporting business-model innovation or development. Interpretative codes, on the other hand, were applied when the tool descriptions were subjectively interpreted to relate to important concepts. For example, tools were also coded as *#business-model* if there was potential for them to be used for business-model innovation or development, even if the key word was not explicitly stated in the tool description. The authors chose to use the same tag in both scenarios instead of separate tags (e.g., *#business-model-descriptive* and *#business-model-interpretive*)

because the main purpose of the content analysis was to broadly identify important concepts within the text, as opposed to distinguishing when the concept was explicitly or implicitly present within the tool descriptions.

3.3 Conceptual Data Model Development

Sherman (2015) describes a conceptual data model as an abstract, high-level and visual schema that illustrates how data could be structured to provide information for predefined requirements. Conceptual data models are purely theoretical and, therefore, are *"independent of any software, database or physical storage structure"* (Sherman 2015). Data modeling is the approach taken to develop the conceptual data model (Sherman 2015).

3.3.1 Dimensional Data Modeling Approach

A dimensional data modeling approach introduced by Ross and Kimball (2013) was utilized to develop the conceptual data model. According to Ross and Kimball (2013), dimensional data modelling is one of the most common techniques for querying analytic data because it structures information in a manner that is easily understood by users. The dimensional data modeling approach revolves around facilitating database navigation by identifying key dimensions that group and filter data (Ross and Kimball 2013). Dimensions typically provide context around "*who, what, where, when, how, why*" questions that data users may have with regards to the data set (Ross and Kimball 2013).

Once the tools had been tagged, the researchers assessed how tags naturally grouped together into thematic categories. A literature review was then performed to identify useful sustainability frameworks that helped to refine categories and organize them into various dimensions. Finally, the dimensions of the conceptual data model were defined, as well as the user information needs that each dimension addressed. The development of the dimensional data model ultimately resulted in hierarchical dimension tables that illustrate how dimensions, categories and tags relate to one another (Ross and Kimball 2013).

3.4 Limitations

There are two steps in the research process that the authors, due to time constraints, did not undertake as part of the study. First, they did not assess any other sustainability tools that could potentially be added to the toolkit. Thus, they worked under the assumption that the ENHANCE toolkit is an example of the types of toolboxes organizations would engage with when trying to understand or implement sustainability. It is possible that there are tools missing or there are biases in the data that the authors are unaware of. Considering this, the authors would caution against the use of the study's results to make generalizations about the landscape of sustainability tools at large. Instead, the results can provide general insights about

the ENHANCE toolkit and the development of conceptual data models that have the potential to increase the use-ability of sustainability toolboxes.

Secondly, a similar study conducted by Acerbi, Sassanelli, and Taisch (2022) included a phase to verify and validate the conceptual data model that was generated. Considering that this step was not included in the methodology, it is unknown whether users would find the data model useful. Moreover, the research cannot speak to the usefulness of the individual tools that are returned to the users by the model. This is because the usefulness of the tools themselves is highly dependent on the user's resources and capabilities, as well as the regulatory framework they are operating within. Thus, the conceptual data model would need to be tested in practice to determine how the model and toolkit could be modified to improve use-ability.

Finally, there are several limitations associated with the qualitative tagging approach that was utilized in the research. Firstly, the approach is highly subjective. Therefore, the reliability and accuracy of the tagging is likely lower than if a deductive approach had been applied. The use of both descriptive and interpretive codes increases the likelihood of this risk. Another limitation of the coding process arose from the flexibility of the inductive approach. Since the glossary was constructed as data analysis progressed, tools needed to be tagged retroactively when new tags were added to the glossary. This could potentially impact coding completeness, since tools that were analyzed earlier in the process may be missing relevant tags that were added to the glossary later. Due to these various limitations, the results from applying the conceptual data model to the ENHANCE toolkit should not be interpreted as definitive findings, but rather only as an indication of potential insights within the data.

4

Results

The following sections present the results from the four steps of the research process: familiarization, tagging, categorization, and dimension development. These steps were part of larger content analysis and conceptual data model development phases, which ultimately aimed to identify a way to organize sustainability toolkits and use the resulting data model to provide insights about the ENHANCE toolkit.

4.1 Familiarization Findings

In the familiarization step, the toolkit was reviewed and 59 tools were ultimately included in the data analysis. Two of the tools within the toolkit were excluded from the analysis because they could no longer be accessed at the original source or found in other sources online. In addition to individual tools, the database also linked to 17 external toolkits. Within these toolkits, twenty-three tools were included in the data analysis and upwards of 120 tools were excluded (this is a rough estimate and it is possible that the number is higher). As mentioned in Section 3.2, the tools from external toolkits that were included in the final analysis were deemed to be the most relevant to the study by the authors. Relevance was determined by two criteria: if the tool had its own page in the ENHANCE database or if the linked toolkit highlighted a particular tool as more important than others. An overview of the findings from the familiarization step are summarized in Table 4.1, whereas a detailed overview of the results is outlined in Appendix A.3.

Table 4.1: Summary of tools included in and excluded from the analysis.

Tools Included	Tools Excluded
59 (23 from external toolkits)	$\approx$ 122 ($\approx$ 120 from external toolkits)

4.2 Tagging Findings

The tools were tagged 890 times, with each tool receiving an average of 15 tags. The iterative coding process resulted in a list of 146 tags that highlight key terms or concepts within the tool descriptions. Of these tags, 86 were determined to be unique tags that were used in the data analysis and provided the foundation for the

glossary, as shown in Appendix A.4. The other 60 tags were identified as terms that overlapped with the unique codes; these tags were deemed to be synonyms and are described in more detail below.

4.2.1 Tag Overlap

During the coding process, a notable finding was that an array of terms with similar meanings were used in the tool descriptions. For example, the pillars of sustainable value were described in several ways:

- PPP
- Social, ecological and economic value
- Integrative sustainable value
- TBL

In order to mitigate ambiguity in the final results, efforts were made to reduce significant overlaps between tags by tracking related terms as synonyms. This led to the inclusion of a synonyms column in the glossary, as shown in Appendix A.4. The synonyms column aims to minimize confusion between overlapping tags and provide a reference point for how different terms are related.

4.2.2 Tag Frequency

As illustrated in Table 4.2, more than half of the tools were tagged with the keywords: *#sustainable-value*, *#research-driven*, *#private-sector*, *#ideation*, and *#practice-based*. The tags *#sustainable-value*, *#private-sector* and *#ideation* would be expected to appear often, considering the toolkit is related to sustainable innovation and entrepreneurship. With regards to *#practice-based* and *#research-driven*, these tags are related to the origin of the tool, which is relatively easy to identify in the majority of tool descriptions. Since information related to the origin of the tool is easy to find, these tags were used often. The frequency of all the unique tags can be found in Appendix A.5

Table 4.2: Most frequently used tags.
Note: Percentages are calculated by dividing the tools with a particular tag (numerator = x) by the grand total of tools (denominator = 59)

Index	Tag	Tools	(%)
1	#sustainable-value	42	71%
2	#research-driven	39	66%
3	#private-sector	35	59%
4	#practice-based	31	53%
5	#ideation	31	53%

While the tagging frequency provides an indication of how many tools relate to each keyword, analyzing insights on a 'tag-by-tag' basis is not ideal because it does not

provide a full picture. For example, Table 4.2 illustrates that nearly two-thirds of the tools were tagged with the keyword *#private-sector*. However, there are other tags that also relate to the private sector within the tagging, such as *#business-managers* and *#investors*. Tools were tagged as *#private-sector* when specific stakeholders within the private sector like investors and business managers were not identified and, thus, tools were deemed to apply to the private sector in general. As a result, it is important to cluster all relevant tags related to the sector prior to analyzing broad insights, so there is a full picture of the extent of tools that relate to the larger theme being analyzed. This challenge is addressed trough the development of the glossary and the conceptual data model, which provide a reference for how terms relate to one another and groups the tags around broader themes, respectively.

4.3 Categorization Findings

In order to create categories, tags were initially grouped according to how they were perceived by the authors to naturally cluster. A literature review subsequently revealed eight frameworks that could be used to provide further structure to the categories. Three frameworks focused on sustainable value generation, three on strategic phases in sustainability planning, one on major stakeholders for sustainable development, and one on the different purposes of sustainability tools. Four of these frameworks were chosen to structure categories, since they mapped the best to the clustered tags. The categorization of tags was an iterative process; chosen frameworks also influenced which tags were ultimately included in the final categories. It is worth noting that if a different toolbox had been chosen for the research, other frameworks could have potentially been used. Since the researchers specifically looked for frameworks that helped to structure the toolkit at hand, the final selection of frameworks was largely driven by the textual analysis of the ENHANCE toolkit.

No useful frameworks could be found to structure five categories that had been naturally grouped by the authors: evidence of impact, origin, related materials, requirements, and type. However, the authors kept these categories in the conceptual data model because they considered them to provide potentially useful information to users regarding tool attributes. Finally, there were two tags that could not be clustered and were excluded from the model. The final categorization of tags can be found in Appendix A.6.

4.3.1 Value Generation Categories

The literature review yielded three frameworks that provided different options for classifying sustainable value generation, as shown in Figure 4.1. These frameworks included a pillars framework with four categories (Rosario, Raimundo, and Cruz 2022), a Venn diagram with seven categories (Yang, Vladimirova, and Evans 2017) and a triangle framework with ten categories (Kleine and Von Hauff 2009). The pillars framework was determined to be insufficient for the model because it does not contain categories for integrative value generation, such as 'environmental-economic

value'. The triangle framework had too many categories, which resulted in difficulties when attempting to delineate which tags would be assigned to closely related categories like 'mainly ecologic' and 'ecologic value'. The Venn-diagram was chosen as the best fit because it offers categories related to intersected value creation, yet does not have an overwhelming number of categories.

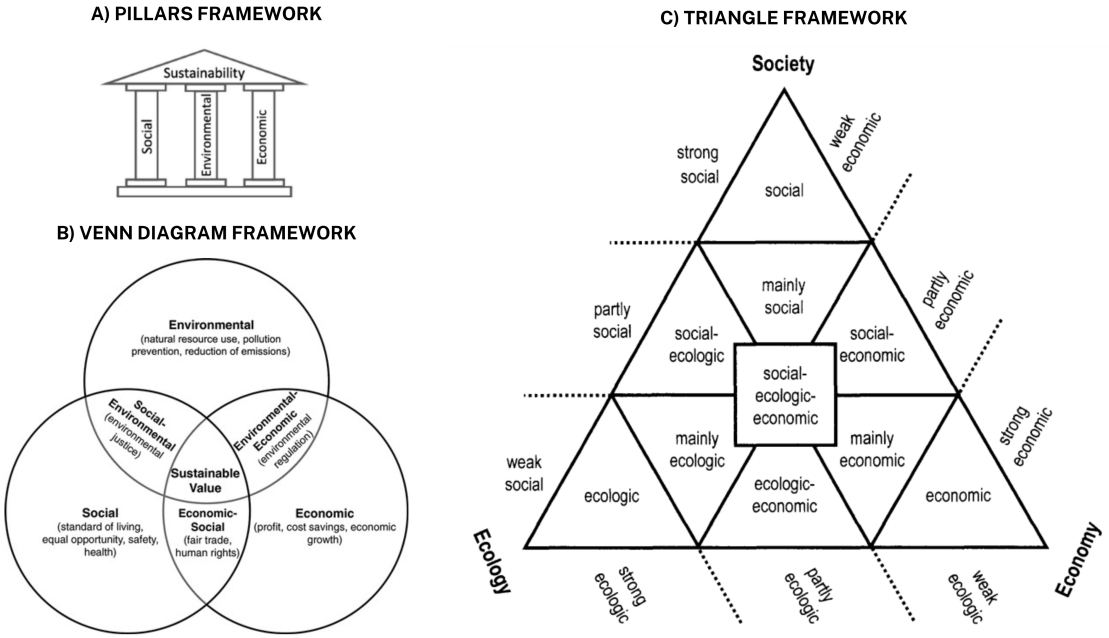

Figure 4.1: Value generation frameworks: a) pillars framework (Rosario, Raimundo, and Cruz 2022), b) Venn diagram framework (Yang, Vladimirova, and Evans 2017), and c) triangle framework (Kleine and Von Hauff 2009).

4.3.2 Strategic Phase Categories

As illustrated in Figure 4.2, three frameworks were found through the literature review that related to strategic phases in sustainability planning: a Generalized Strategic Management Process framework (Grainger-Brown and Malekpour 2019), the A-B-C-D Sustainability Planning model (Ny 2009), and the Business Models for Sustainability Innovation framework (Ludeke-Freund 2020). The Generalized Strategic Management Process framework provided three categories: ideation phase, development phase, and implementation phase. The A-B-C-D Sustainability Planning model offered four categories: awareness, problem list, solutions & visions list, and prioritization & planning. Finally, the Business Models for Sustainability Innovation framework provided three categories: sustainability innovation, business model, and business cases for sustainability. The Generalized Strategic Management Process model was ultimately chosen as the best fit because it was the simplest framework to map the categories to. Tags that were categorized in the ideation phase focused on activities for defining and articulating a strategy, tags in the development phased focused on activities for developing and selecting a strategy, and tags in the implementation phase focused on activities for executing and monitoring a strategy.

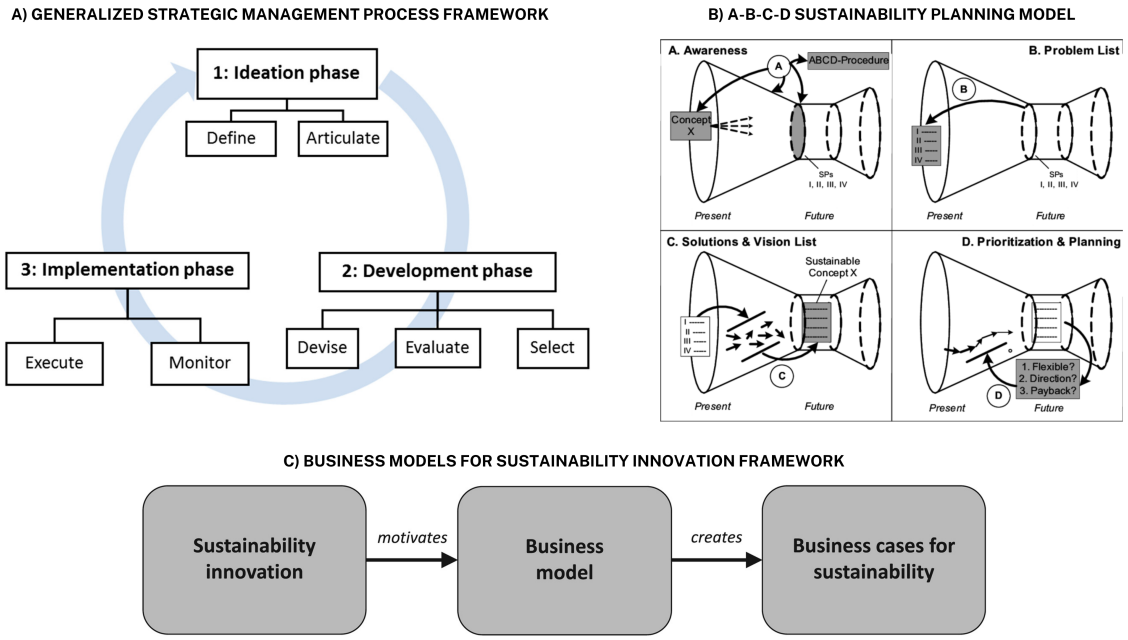

Figure 4.2: Strategic phase frameworks: a) Generalized Strategic Management Process framework (Grainger-Brown and Malekpour 2019), b) A-B-C-D Sustainability Planning model (Ny 2009), and c) Business Models for Sustainability Innovation framework (Ludeke-Freund 2020).

4.3.3 Tool Purpose Categories

In addition to the Generalized Strategic Management Process framework, Grainger-Brown and Malekpour (2019) developed a thematic typology of the ways sustainability tools are used across the key phases of a sustainability strategy to support organizations to achieve the SDGs. This tool purpose framework provides three categories (Grainger-Brown and Malekpour 2019): mapping tools, reporting tools, and aligning tools. Mapping tools support organizations to take stock of their activities, in an effort to understand how they are contributing to the SDGs in their current work (Grainger-Brown and Malekpour 2019). Reporting tools support companies to measure progress against the SDGS and report their findings (Grainger-Brown and Malekpour 2019). Finally, aligning tools help organization orient business activities to the SDGs, in order to gain a competitive advantage (Grainger-Brown and Malekpour 2019). The tool purpose categories are closely related to the strategic phase categories, since they both focus on processes and activities that organizations undertake to implement sustainability (Grainger-Brown and Malekpour 2019). However, the key difference is that the strategic phase categories pertain to which phase of a sustainability strategy tools should be used in, while tool purpose categories focus on how the tools can be used within phases to achieve sustainable development (Grainger-Brown and Malekpour 2019).

4.3.4 Stakeholders Categories

The key sectors in society that are vital to implementing and achieving sustainability were also identified during the literature review. Formalized by the UN, the Major Groups and other Stakeholders (MGoS) framework provides nine categories for sustainability stakeholders: 1. business & industry, 2. children & youth, 3. farmers, 4. indigenous peoples, 5. local authorities, 6. non-governmental organizations, 7. scientific & technological community, 8. women, and 9. workers & trade unions (UN 2023). Tags that were related to multiple sectors were grouped in a separate 'multi-sectoral' category that was subjectively created by the authors.

4.3.5 Tool Attributes Categories

Five categories, which were related to tool attributes, did not map to one of the identified frameworks: evidence of impact, origin, related materials, requirements, and type. The evidence of impact category relates to whether there is proof that users found the tool helpful or if the tool does indeed facilitate implementation. The origin category describes how the tool was developed. The related materials category provides context around whether there are additional materials that facilitate the use or implementation of the tool, such as related guides or sequenced tools. Finally, the requirements category outlines whether the tool has any prerequisites for it to be used and the type category describes the kinds of tools within the toolkit.

4.4 Dimension Development

The dimensions for the conceptual data model were derived from the identified sustainability frameworks or subjectively by the authors. As visualized in Figure 4.3, the dimensions for the conceptual data model are:

- *Value generation*, inclusive of the Venn-diagram framework categories and filters tools according to *what* type of value the tools support generating.
- *Strategic phase*, inclusive of the Generalized Strategic Management Process framework categories and filters tools according to *which* strategic phases the tools should be used in.
- *Tool purpose*, inclusive of the tool purpose typology categories and filters tools according to *what* purpose the tools have.
- *Stakeholders*, inclusive of the MGoS framework categories and filters tools according to *which* stakeholders the tools are relevant for.
- *Tool attributes*, inclusive of naturally-clustered categories that did not map to any frameworks (this dimension was therefore subjectively created by the authors) and filters tools according to *what* characteristics the tools have.

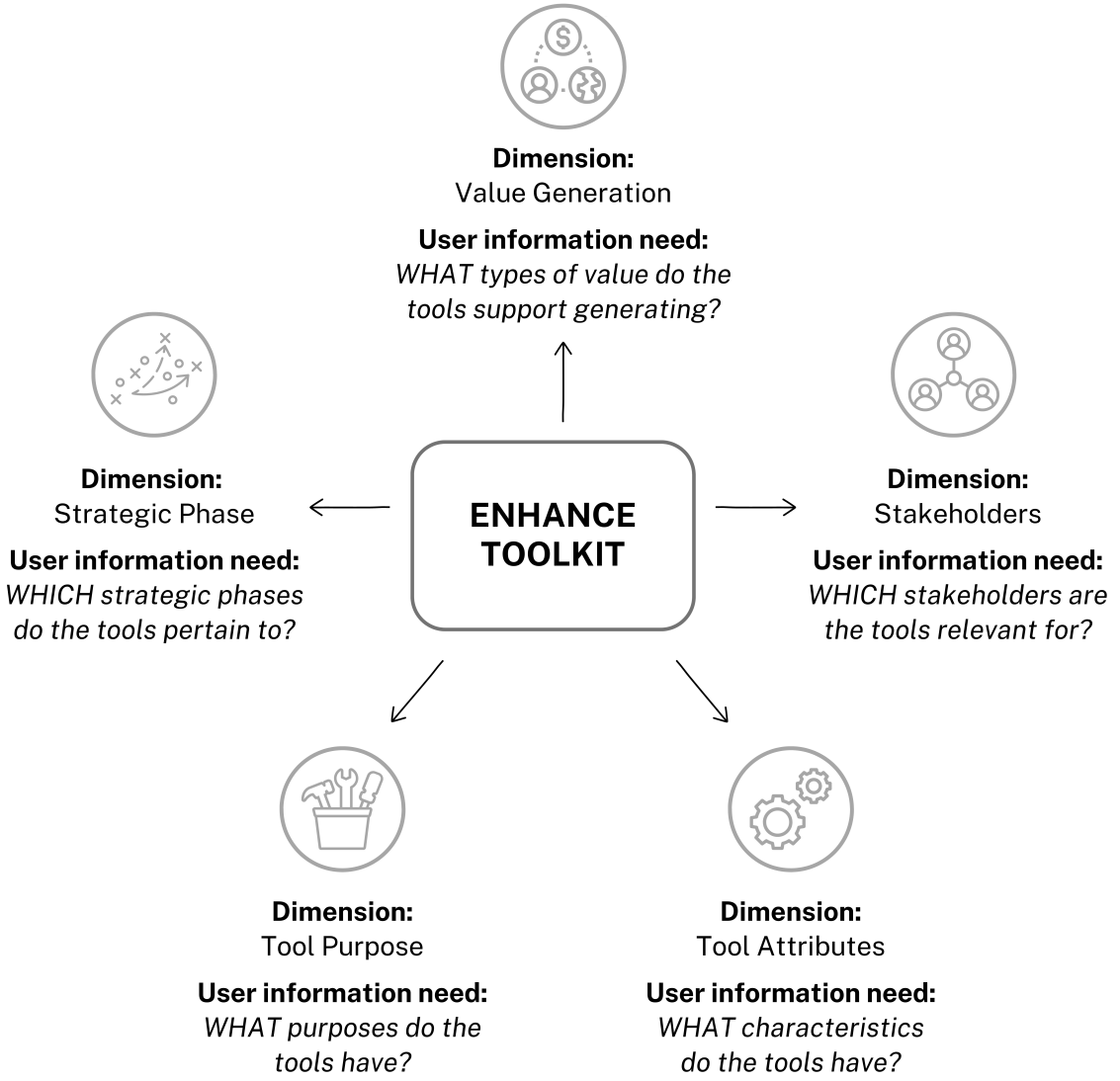

Figure 4.3: Key dimensions of the conceptual data model and the related user information needs that the dimensions address.

The conceptual data model's dimensions and categories, as well as the related tags and synonyms can be found in Appendix A.6. The categories provide the model's first layer of abstraction with the greatest level of detail and the dimensions provide the second layer of abstraction with the least amount of detail. The model is largely mutually exclusive; categories do not belong to more than one dimension and tags do not belong to more than one category within each dimension. However, the same tags are categorized in the *tool purpose* and *strategic phase* dimensions, since they both relate to activities and processes for implementing sustainability. This modeling decision was influenced by the research conducted by Grainger-Brown and Malekpour (2019), which assessed tools according to both strategic management phases and tool purpose. Finally, the tags are not mutually exclusive when used to contextualize tools, meaning one tool could have several tags that belong to different categories and dimensions. In other words, a single tool can belong to more than one category or dimension. This is a result of the inductive tagging process.

4.4.1 Value Generation Dimension

As shown in Table 4.3, the results from the development of the *value generation* dimension illustrate that concepts related to sustainable value, environmental-economic value, only economic value, and only social value were identified within ENHANCE, whereas concepts related to only environmental value, environmental-social value and social-economic value were not.

Table 4.3: Value generation dimension table.

Dimension	Categories	Tags	Synonyms
Value generation	Sustainable value	#SDGs #sustainable-value	- #integrative-value #PPP #TBL
	Environmental-economic value	#circular-economy #eco-design #life-cycle	#circular #circularity #biomimicry #green-design #cradle-to-cradle
	Environmental-social value	-	-
	Social-economic value	-	-
	Only economic value	#economic-value	#economy #financial-drivers #profit #revenue
	Only environmental value	-	-
	Only social value	#diversity #moral-justice #social-equality #social-value	- #human-rights #social-justice #social-inclusiveness #people #social-welfare #society

Table 4.4 illustrates how the ENHANCE tools break down across categories in the *value generation* dimension. It is important to note that for both the *value generation* and *stakeholders* dimensions, the authors determined that insights required analysis across categories as opposed to on a 'category-by-category' basis. Therefore categories were clustered solely for the analysis of the ENHANCE toolkit. The key insights related to *value generation* are that most tools focus on producing economic and/or environmental value, while fewer tools support the generation of social value (albeit the percentage that do is still quite high at 81%). Three-quarters of the tools could be used to create sustainable value.

Table 4.4: Value generation ENHANCE toolkit insights.
Note: Percentages are calculated by dividing the tools within the categories (numerator = x) by the grand total of tools (denominator = 59)

Insights	Categories	Tools	(%)
Tools that could be used to generate economic value	Sustainable value	44	
	Environmental-economic	11	
	Only economic	1	
	Total tools	*56*	*95%*
Tools that could be used to generate environmental value	Sustainable value	44	
	Environmental-economic	11	
	Total tools	*55*	*93%*
Tools that could be used to generate social value	Sustainable value	44	
	Only social	4	
	Total tools	*48*	*81%*
Tools that could be used to generate sustainable value	Sustainable value	44	
	Total tools	*44*	*75%*

4.4.2 Strategic Phase Dimension

The results from the development of the *strategic phase* dimension can be seen in Table 4.5. All categories have tags associated with them. Table 4.6 illustrates how the ENHANCE tools break down across the strategic phase categories. The key insights are that the majority of the tools focus on the implementation phase, more than three-quarters relate to the ideation phase, and nearly 70% apply to the development phase.

Table 4.5: Strategic phase dimension table.

Dimension	Categories	Tags	Synonyms
Strategic phase	Ideation phase	#design-thinking	#human-centered-design
		#entrepreneurial-thinking	-
		#ideation	#brainstorming #creativity
		#product-innovation	#product-design
		#service-innovation	-
		#setting-goals	#targets
		#social-innovation	-
		#systems-thinking	-
		#technology-innovation	-
	Development phase	#business-models	#BM-development #BM-innovation
		#identifying-markets	#where-to-play
		#piloting	-
		#strategic-planning	#prioritization

Implementation phase	#accelerator-programs	-
	#capacity-building	#build-readiness #competence #cultivate-champions #manage-talent
	#curriculum-development	-
	#impact-analysis	#assessment #LCA
	#mapping-activities	-
	#metrics-development	#indicators #measurement
	#performance-benchmarking	#tracking-progress
	#policy-development	-
	#reporting-progress	-
	#risk-mitigation	-
	#signaling-sustainability	#communication #storytelling
	#stakeholder-analysis	#stakeholder-mapping
	#stakeholder-engagement	#collaboration
	#value-analysis	#cost-benefit-analysis #value-capture #value-proposition

Table 4.6: Strategic phase ENHANCE toolkit insights.
Note: Percentages are calculated by dividing the tools within the categories (numerator = x) by the grand total of tools (denominator = 59)

Insights	Categories	Tools	(%)
Tools useful to the implementation phase	Implementation phase	53	90%
Tools useful to the ideation phase	Ideation phase	46	78%
Tools useful to the development phase	Development phase	40	68%

4.4.3 Tool Purpose Dimension

The results from the development of the *tool purpose* dimension can be seen in Table 4.7. All categories have tags associated with them. Table 4.8 illustrates how the ENHANCE tools break down across the tool purpose categories. The key insights are that the majority of the tools could be used to align with sustainability goals, whereas over 70% could be used to map activities. Approximately a third of the tools were found to be useful for supporting reporting activities.

Table 4.7: Tool purpose dimension table.

Dimension	Categories	Tags	Synonyms
Tool purpose	Map	#impact-analysis	#assessment #LCA
		#mapping-activities	-
		#stakeholder-analysis	#stakeholder-mapping
		#value-analysis	#cost-benefit-analysis #value-capture #value-proposition

Report	#metrics-development	#indicators #measurement
	#performance-benchmarking	#tracking-progress
	#reporting-progress	-
	#signaling-sustainability	#communication #storytelling
Align	#accelerator-programs	-
	#business-models	#BM-development #BM-innovation
	#capacity-building	#build-readiness #competence #cultivate-champions #manage-talent
	#curriculum-development	-
	#design-thinking	#human-centered-design
	#entrepreneurial-thinking	-
	#ideation	#brainstorming #creativity
	#identifying-markets	#where-to-play
	#piloting	-
	#policy-development	-
	#product-innovation	#product-design
	#risk-mitigation	-
	#service-innovation	-
	#setting-goals	#targets
	#social-innovation	-
	#stakeholder-engagement	#collaboration
	#strategic-planning	#prioritization
	#systems-thinking	-
	#technology-innovation	-

Table 4.8: Tool purpose ENHANCE toolkit insights.
Note: Percentages are calculated by dividing the tools within the categories (numerator = x) by the grand total of tools (denominator = 59)

Insights	Categories	Tools	(%)
Tools that support alignment	Align	56	95%
Tools that support mapping	Map	42	71%
Tools that support reporting	Report	18	31%

4.4.4 Stakeholders Dimension

As shown in Table 4.9, the results from the development of the *stakeholders* dimension illustrate that concepts related to business & industry, children & youth, local authorities, NGOs, and the scientific & tech community were identified within ENHANCE. There were also tags that pertained to the multi-sectoral category. No concepts related to the indigenous people, farmers, workers & trade unions, and women were identified. Table 4.10 illustrates how the ENHANCE tools break down across categories in the *stakeholders* dimension. The key insights are that the majority of tools are applicable to the business & industry and scientific & tech community sectors. Fewer tools relate to local authorities, children & youth, and NGOs. Approximately one-third of tools are relevant to multiple sectors.

Table 4.9: Stakeholder dimension table.

Dimension	Categories	Tags	Synonyms
Stakeholders	Business & industry	#business-managers	-
		#entrepreneurs	#start-ups
		#investors	-
		#private-sector	#enterprises #SMEs
		#product-designers	-
	Children & youth	#youth-workers	-
	Indigenous people	-	-
	Farmers	-	-
	Local authorities	#public-policy-analysts	-
		#public-sector	#government-officials
	NGOs	#NGOs	-
	Scientific & tech community	#design-academics	-
		#educators	#education-coordinators #education-councils #faculty
		#innovation-managers	-
		#researchers	#environmental-scientists #social-scientists
		#tech-sector	-
		#university-students	-
	Workers & trade unions	-	-
	Women	-	-
	Multi-sectoral	#assessment-institutions	-
		#decision-makers	#leaders #change-agents
		#practitioners	-
		#system-developers	-

Table 4.10: Stakeholder ENHANCE toolkit insights.
Note: Percentages are calculated by dividing the tools within the categories (numerator = x) by the grand total of tools (denominator = 59)

Insights	Categories	Tools	(%)
Tools useful to the business & industry group	Business & industry	37	
	Multi-sectoral	18	
	Total tools	*55*	*93%*
Tools that pertain to the scientific & tech group	Scientific & tech community	26	
	Multi-sectoral	18	
	Total tools	*44*	*75%*
Tools that pertain to the local authorities group	Local authorities	5	
	Multi-sectoral	18	
	Total tools	*23*	*39%*

Tools that pertain to the children & youth group	Children & youth	1	
	Multi-sectoral	18	
	Total tools	*19*	*34%*
Tools that pertain to the NGO group	NGOs	1	
	Multi-sectoral	18	
	Total tools	*19*	*34%*
Tools that pertain to all groups	Multi-sectoral	18	
	Total tools	*18*	*31%*

4.4.5 Tool Attributes Dimension

The results from the development of the *tool attributes* dimension can be seen in Table 4.11. Table 4.12 illustrates how the ENHANCE tools break down across the tool attribute categories. The key insights are that the majority of tools contain related materials and have information regarding type and origin. Less than half of the tools have evidence of impact and only 15% have requirements.

Table 4.11: Tool attributes dimension table.

Dimension	Categories	Tags	Synonyms
Tool attributes	Evidence of impact	#community-of-practice	-
		#tested	-
		#testimonials	-
	Origin	#EU-resource	-
		#practice-based	-
		#research-driven	-
	Related materials	#linked-toolkit	-
		#related-article	-
		#related-framework	-
		#related-game	-
		#related-user-guidance	#documentation #instructions #resources
		#related-workshop	-
		#sequenced-tools	-
	Requirements	#requires-facilitation	-
		#requires-prior-knowledge	-
	Type	#article	-
		#canvas	-
		#collaborative-tool	-
		#compendium	-
		#course	-
		#exercises	#worksheets
		#framework	#model
		#guide	-
		#learning-tool	-
		#score-card	-

#taxonomy	#definition
#teaching-method	-
#use-case	-

Table 4.12: Tool attributes ENHANCE toolkit insights.
Note: Percentages are calculated by dividing the tools within the categories (numerator = x) by the grand total of tools (denominator = 59)

Insights	Categories	Tools	(%)
Tools with information related to the origin	Origin	59	100%
Tools with information related to the type	Type	57	97%
Tools with related materials	Related materials	51	86%
Tools with evidence of impact	Evidence of impact	24	41%
Tools with requirements	Requirements	9	15%

5

Discussion

The following sections highlight the practical implications of applying the conceptual data model to the ENHANCE toolkit, which are relevant to practitioners who are interested in using the toolkit to implement sustainability. It also explores the theoretical implications of using the methodology described in Section 3 to develop a conceptual data model aimed at organizing a sustainability toolkit. The theoretical implications may benefit researchers or practitioners who are interested in information architecture.

5.1 Practical Implications

In the case of the ENHANCE toolkit, organizations engaging in the implementation of the sustainability transition can use the model in its current state to find tools that fit their use case at an aggregate level. The model can return tools according to the defined categories and dimensions, as well as the identified tags that were derived from and are particularly relevant to the ENHANCE toolkit. This organizational structure reveals insights about the toolkit by providing a broad understanding of the balance of tools across each dimension. In the subsequent subsections, the researchers discuss the potential reasons behind the distribution of tools within each dimension and how this distribution could influence toolkit use. As noted in Section 3.4, it is important to reiterate that the dimension breakdowns are not statistical findings of the vast universe of sustainability tools in the market, but rather descriptive statistics of the ENHANCE toolkit. Thus, any subsequent discussion surrounding the larger landscape of sustainability tools is merely speculative.

5.1.1 Value Generation

As illustrated in Table 4.4, the model provided insights about the ENHANCE toolkit by breaking down which tools support different types of value generation. Over 90% of the tools support environmental and economic value generation, while 81% support the generation of social value and 75% support the generation of sustainable value (all three forms of value). Overall, the breakdown indicates that the toolkit is well-balanced within the *value generation* dimension.

Tools supporting the generation of environmental and economic value are likely the most prevalent due to the established frameworks and approaches in the academia

and business arenas. For example, there is a large consensus across practitioners with regards to CE strategies, frameworks, and metrics. The broad acceptance of the circular economy concept opens up space for innovation in tools that support companies to thrive in the market by reducing their environmental impact and contributing to building a circular economic system. Since users potentially already have baseline knowledge of the concept and capacity to presumably use the tools correctly, there may be greater demand for and quicker uptake of such tools. The high number of tools related to generating environmental-economic value could also be a result of the following: 1. Regulations have urged the private sector to take action on their environmental impact, 2. Scientist and researchers have long worked on developing metrics and tools to assess environmental impact, 3. Environmental metrics are already in their mature stage with a high rate of acceptance among scientist and practitioners, 4. As they have been long available, a community of practice has developed around those metrics, and capacity building and knowledge has spread across the socioeconomic system, and 5. Environmental impact is more straightforward to quantify in biological and monetary terms than social impacts.

Although 81% of tools support the generation of social value, there are fewer tools that support social value generation compared to environmental and economic value. This could be related to the fact that, according to the literature (Joyce and Paquin 2016; Benoit et al. 2010), there is less consensus on how social value should be applied due to its large variety of issues and stakeholders. In addition, it is recognized that a framework for social sustainability is even more complex than the other spheres of sustainability because it is highly context-dependent (Joyce and Paquin 2016). Therefore, it may be hard to find standardized or general tools guiding strategies to generate value within the social sphere.

Approximately three-quarters of the tools aim to create sustainable value. It would be expected to have a high number of tools that aim to simultaneously generate all forms of value, since organizations are expected to embedded integrative sustainability into their strategies. However, it is important to note that some tools may claim to generate multiple or all forms of value but, in practice, do not. The misrepresentation of tools within their descriptions could influence the distribution of tools within the dimension breakdowns, as a result of the use of both descriptive and interpretive tags in the analysis. This is a weakness of the tagging approach that is discussed in more detail in Subsection 5.2.2.

In terms of the *value generation* dimension, this weakness in the tagging methodology is particularly significant, as it may have implications for greenwashing. For example, some tools tagged as *#sustainable-value* may not actually include a specific procedure to create value for each of the spheres. For example, the Flourising Business Canvas claims to help companies map processes, value, and people across all three spheres of sustainability. However, the tool does not provide specific guidance, procedures or methods for generating and measuring meaningful sustainable value. This reinforces the argument that baseline knowledge is likely needed to properly interpret and apply sustainability tools, since misleading vocabulary may lead to misinterpretation and the potential misuse of the tools could have severe

implications for organizations. Moreover, the successful implementation of the tool and its 'degree of usefulness' is highly context and resource-dependent.

5.1.2 Strategic Phase

In the *strategic phase* dimension, 90% of tools were found to be applicable to the implementation phase of a strategy. This large proportion could be a result of the many challenges that are encountered during this phase. When implementing a sustainability strategy, organizations may find themselves with limited resources in terms of money, time, and knowledge, in addition to a limited scope of maneuver within their value chain and business environment. Thus, the implementation of a sustainability strategy is not just a transformational journey for the organization alone, but also for the whole system surrounding the organizations' economic activities since it requires that all relevant partners and stakeholders are committed to implementing the strategy. With regards to the ideation and development phases, 78% and 68% tools could be applied within these strategic management phases, respectively. This high occurrence indicates that the toolkit is well-balanced within this dimension.

5.1.3 Tool Purpose

With regards to the *tool purpose* dimension, 95% of the tools were found to support organizations to align with the SDGs and 42% to map activities. Mapping and aligning activities help organizations scrutinize the resources available and take action to make change. On the other hand, only around a third of the tools were found to support reporting, which indicates that there is an opportunity to incorporate more tools with this purpose in the ENHANCE toolkit.

Additional reporting tools that are added to the toolkit should pertain to public policies that dictate how companies report and disclose sustainability information, such as the EU Taxonomy and CSRD. Resources are needed to help standardize, create transparency, and ease the reporting burden for organizations with time and resource constraints. This could be particularly relevant for SMEs that will need to comply with CSRD reporting requirements in early 2026. Tools that could be potentially relevant for their use case could focus on automating the reporting processes and complying with the regulation without compromising their scarce resources, the reliability of their data, and the quality of their reports. As evidenced by a growing market of data providers that independently assure companies' sustainability data, sustainability reporting is in high demand. However, the lack of regulations around this type of independent assurance could lead to greenwashing if such reports are inaccurately done, illustrating the urgent need for straightforward and reliable reporting tools.

5.1.4 Stakeholders

It was observed that 93% of the tools could apply to businesses & industry, whereas 75% are relevant for the scientific and tech community. This breakdown could be a

reflection of the original focus of the ENHANCE toolkit on sustainable innovation and entrepreneurship. Around a third of the tools could be applicable to the other sectors, indicating a fair distribution of tools across the *stakeholders* dimension. This dimension could be highly relevant to the design and implementation of a sustainability strategy because the stakeholder management process is complex and requires organizations to take into account different and perhaps competing interests when defining objectives and priorities. The alignment of all stakeholder interests can be difficult to achieve and the reconciliation of all viewpoints could potentially be incompatible with the organization's economic objectives, which could ultimately hinder it from taking meaningful action towards change.

5.1.5 Tool Attributes

Within the *tool attributes* dimension, the breakdown of the ENHANCE toolkit illustrated that 86% of tools have related materials. These related materials could potentially facilitate the use of the tools, assuming that users have sufficient knowledge and expertise to apply them properly. On the other hand, the results indicate that only 41% of the tools have evidence of impact. This type of information is particularly important to help users gain an idea of how credible a tool is. For the tools that do not have clear evidence of impact, practitioners may face challenges in gauging whether the tool is worth investing time and resources in. In addition to credibility, users may need to understand whether the tool is accessible, which could be achieved through the creation of a new category that indicates if tools are free or require membership. Credibility and accessibility are two vital tool characteristics that should inform decision making around tool selection.

Only 15% of the tools provided information about the prerequisites to make proper use of the tools. This finding could indicate that the majority of tools do not have explicit requirements in order to be used. Another explanation could be that most tools are vague about the formal instruction or professional knowledge needed to apply them properly. For example, the Circular Product & Service Assessment tool looks at the most important design decisions that influence the impact of products and services along the life cycle stages. Based on research and practical experience, the tool translates these decision gates into a guiding questionnaire that aims to help organizations measure their impact and point them in the direction of carbon footprint calculators, life cycle analysis tools, and sustainability indicators. However, activities like GHG emission measurement are often complex and, thus, require adequate knowledge and expertise for the accurate production and correct interpretation of results. This could illustrate the need for tools to provide clear and reasonable frameworks that explicitly indicate what capacity users need, in order to utilize and apply them properly.

Considering the lack of information surrounding tool requirements, it is hard to deduce if the tools within the ENHANCE toolkit can be used in areas where knowledge, resources, and capacity are low. An interesting finding was that 36% of the tools were tagged as supporting capacity building; these tools could potentially be useful within these contexts. Overall, the ENHANCE toolkit insights have demonstrated

the importance of sufficient capacity at the practitioner level to select and apply the right tools. In order to address the complexity of sustainability, professional capacity building at the individual level should be supported by a multidisciplinary sustainability team that can provide different perspectives and a systems thinking approach to implementation efforts, as described in Section 2.6 (Kim and Coonan 2023; Horn, Urias, and Zweekhorst 2022; UN Department of Economic and Social Affairs 2015; Clark et al. 2016).

In summary, sustainability training, multidisciplinary teams and systems thinking are elements that can help toolkit users understand sociotechnical systems as a whole, instead of isolating the issues, as well as utilize the tools to implement holistic and robust solutions. If these elements are not in place, organizations run the risk of developing ineffective strategies that could result in weak sustainability. Weak sustainability has been declared by some scholars as one of the worst forms of greenwashing, since organizations efforts and investments do not ultimately lead to the fulfillment of sustainability commitments or further achievement of the SDGs (Randall 2022).

5.2 Theoretical Implications

The research revealed that a sustainability toolkit can be organized by conducting a inductive content analysis and using the results to develop a conceptual data model through a dimensional data modeling approach. The following section explores the various theoretical implications associated with using this methodology to organize a sustainability toolkit. These implications are particularly relevant to researchers or information architects who may be interested in replicating this process in the future to organize information related to sustainability tools.

5.2.1 Strengths of the Tagging Approach

Through the application of an inductive tagging approach, various strengths and weaknesses of this tagging methodology were revealed. The benefits of this approach is that it enables researchers to broadly explore the data and more organically uncover themes, theories, and hypotheses. For example, the iterative nature of the tagging allowed researchers to find interesting terms that may not have been uncovered if a predefined glossary had been used to guide the analysis. The wide array of tags that were uncovered through the analysis helped to shape a conceptual data model that is potentially more applicable to the ENHANCE toolkit than if a top-down tagging approach had been used. These tags can also provide insight into which sub-categories would potentially be useful to add to the conceptual data model in the future. The inductive tagging approach also helped to uncover 58 synonyms related to the key tags that were used to analyze the tools. This finding revealed the ambiguity and overlap of key terms within the tool descriptions.

5.2.2 Weaknesses of the Tagging Approach

The exploratory nature of the tagging also has several drawbacks that are associated with not defining a glossary prior to conducting the analysis. As mentioned in Section 3.4, the iterative tagging approach could result in low coding completeness if tags that are revealed later in the coding process are not uniformly applied to tools that were tagged earlier in the process. The implication of this limitation is that the model may not yield all the tools that are relevant to various dimensions and categories. Secondly, there is a risk of low coding accuracy because of the subjective nature of the tagging, as well as the use of both descriptive and interpretive tags during the content analysis.

The use of descriptive tags meant that the researchers tagged the tools when key words were found in tool descriptions. This could result in challenges with implementing the tool in practice depending on the use case. For instance, the Triple Layered Business Model Canvas is a tool for exploring sustainability-oriented business model innovation. It extends the original Business Model Canvas by adding two layers: an environmental layer based on a life cycle perspective and a social layer based on a stakeholder perspective. Since the tool has all three forms of value, it was tagged as a tool that could support the generation of sustainable value. However, it does not provide information regarding the meaning of social value or different ways to identify or create it.

Even if the model provides an applicable tool for a particular use case, this does not imply that the user will be able to apply the tool properly. For instance, tools within the 'reporting' category of the tool purpose dimension would return several tools with different degrees of difficulty, such as life-cycle assessment tools versus simple canvases. Some of these tools may require expertise in sustainability topics, yet do not provide pertinent background information or a clear step-by-step methodology of how to apply them. Therefore, the model may require further refinement to filter tools more accurately to the needs and capabilities of the users. This refinement could help to prevent misuse of tools, which could potentially have serious consequences for the organization like loss of valuable resources and unintentional greenwashing.

The example above illustrates the importance of toolkit organizers determining whether the tool descriptions are a true reflection of what a user can actually achieve by using the tool. If there is a potential mismatch between the tool description and what particular practitioners are capable of doing with the tool, it may be useful to only use interpretive tags for tagging the sustainability tools. This would require that the user of the model and the way key concepts are interpreted within tool descriptions is explicitly decided prior to tagging. For example, the criteria that determine whether a tool is contributing to social value or not would need to be identified before analyzing the Triple Layered Business Model Canvas, in order to make a clear judgement on whether the tool is capable of supporting the generation of social value within the context of the use case. Interpretive tags are often highly subjective and, therefore, toolkit organizers would need to be transparent about tag meanings and the tagging approach.

5.2.3 Utilizing Frameworks to Structure the Model

Aside from the tool attributes dimensions, four sustainability frameworks were used to refine the categories and define the dimensions of the conceptual data model. Grouping tags within dimensions and categories can reduce the number of initial choices users have, since parsing through 86 unique tags could potentially be a barrier to finding tools. Previous research by Besedeš et al. (2015) has shown that *"a larger number of choices may lead to choice overload, greater regret, and more indecision"*. The two levels of abstraction provided by the categories and dimensions could serve as a map to navigate the toolkit by providing users with the option to pick categories or dimensions that return a broader set of tools related to particular concepts. This organization of the toolkit also helps to contextualize how different tags potentially relate to one another within each dimension. Finally, the levels of abstraction could give users the opportunity to compare several tools related to a certain topic or dimension.

The use of frameworks to provide structure to conceptual data models can lead to two issues. First, certain categories that are developed by organically grouping tags may not map to the categories prescribed by the frameworks. For instance, the evidence of impact category did not pertain to any of the categories from the identified frameworks. To address this challenge, separate dimensions can be subjectively created to group categories, such as the tool attributes dimension in this model. Similarly, certain framework categories may have no tags and, therefore, no tools will be returned for those categories. This mismatch between tags and categories illustrates the potential need to deduce the next level of abstraction at the sub-category level within the model. For example, the current tags within the ENHANCE toolkit could be used as inspiration for a third level of abstraction within each dimension at the sub-category level. This process could be supplemented by a literature review to determine sub-categories for the categories that have no tags. Once this new layer of abstraction is developed, the tools within the toolkit could then be reorganized at the sub-category level. During this process, it would be advisable to determine whether the categories and sub-categories should remain mutually exclusive.

5.2.4 Importance of the Glossary

Throughout the tagging process, different terms were found to describe similar concepts during the analysis. The overlap between terms could potentially be caused by the embedded complexity of sustainability, which makes it hard to define terms with rigid limits that are clearly delineated from other related terms. In this sense, the model can, to an extent, only be as precise as the sustainability topic at hand. The use of many different terms to describe a similar concept could impact users' ability to determine which tools apply to their use case. While there may be ideological differences in when and how different actors in various fields use these terms, it may not always be immediately clear to users what the intended meaning of the term is if there is no definition provided or if the user does not have a strong background in sustainability. Moreover, users may not understand how similar tags relate to or differ from one another. This has the potential to lead to the misuse of sustainability

tools if users are unable to interpret the information within the tools correctly.

The researchers attempted to minimize the overlap in tags through the development of the glossary, which clarifies what unique tags were used to analyze the database and what the synonyms of these tags are. The construction of the glossary aimed to create a shared understanding of the tags between researchers and database users. Nonetheless, it is possible that whenever the conceptual model is used to filter the database, the users may overlook the glossary and, therefore, do not have the necessary context they need to understand how the toolkit is structured. Thus, it is vital that the use of the conceptual data model is accompanied by the glossary, in order to minimize confusion between overlapping tags and provide a reference point for which terms are related. This is particularly relevant to users with little or no explicit knowledge of sustainability, since they may not understand the terms or concepts associated with the model on their own. The glossary could also be accompanied by a manual that provides users with more information of how the glossary was developed and how it should be used.

5.2.5 Disparate Sustainability Toolkits

During the familiarization phase, 17 external toolkits linked to the ENHANCE toolkit were identified. There are also other toolkits that are not linked to ENHANCE but could still be relevant to organizations that are implementing sustainability, such as the Digital Sustainability Implementation Package (DSIP) knowledge platform that is currently being developed by the Blekinge Institute of Technology (2022). This illustrates that there are a wide array of sustainability toolkits available to stakeholders, each of which could be considered its own information database of tools. However, it is unclear how different toolkits relate to one another, much less to a common sustainability framework, since the information within them is organized differently. For instance, the dimensions used to organize the DSIP toolkit are 1. Methodology step, 2. Type, 3. Product development phase, 4. Facilitation needed, 5. Intended user/role/discipline, 6. Product lifecycle phase and 7. Keywords. These differ in several ways from the dimensions that were identified for the ENHANCE toolkit, since the DSIP toolkit focuses primarily on sustainable product design.

An overarching framework that provides users with the context surrounding how DSIP, ENHANCE and other sustainability toolkits overlap, differ, or could be used in tandem is currently missing. The lack of standardization across toolkits could make it difficult for users to understand which toolkits are best suited for their particular needs. The fragmented collection of sustainability tools in disparate databases could also make it difficult for researchers and practitioners to clearly understand where there are gaps in sustainability tools or if there are already tools available for certain user needs. This could lead to duplicative efforts in tool development, which could result in the creation of many tools with similar functions and cause confusion among users. A potential solution to this would be to develop an overarching and comprehensive framework that is capable of structuring and standardizing a wide array of sustainability tools across different toolkits, in order to ensure data integrity and interoperability between databases of tools.

6

Conclusion

This chapter will provide an overview of the study's conclusions and answers to the following research questions:

1. *How can a sustainability toolkit be organized to support practitioners in selecting tools?*

2. *What can this organizational structure reveal about the ENHANCE toolkit?*

There is a growing demand for frameworks, tools, and knowledge dissemination related to sustainability assessment, standardized metrics, reporting frameworks, and operationalization strategies that are tailored to different industries, in order to help them address their diverse challenges and unique needs. The study aimed to contribute to the field of research supporting the sustainability transition by addressing the research challenge surrounding how sustainability toolkits can be structured from a systems thinking perspective, considering the complex nature of sustainability. The coherent organization of toolkits is important to ensure that practitioners are capable of finding the right tool for their use case, in order to avoid wasting resources or potential greenwashing when implementing the tool. In order to answer the research questions above, tools from the ENHANCE toolkit were used as the data for the qualitative analysis.

The research revealed that a sustainability toolkit can be organized by conducting an inductive content analysis and using the results to develop a conceptual data model through a dimensional data modeling approach. The model that was developed contained two layers of abstraction: dimensions and categories within each dimension. The categories were developed by clustering tags from the content analysis around key concepts within tool descriptions. Sustainability frameworks were then used to refine and structure the categories further. Ultimately, the following key dimensions of the model were identified: value generation, strategic phase, tool purpose, stakeholders and tool attributes.

The organization of a sustainability toolkit using this methodology has various theoretical implications for researchers or information architects who are interested in replicating it. First, the inductive tagging approach has pros and cons that must be considered. The strengths of the tagging approach is that it enables researchers to broadly explore the data and more organically uncover themes, theories and

hypotheses. On the other hand, the approach can result in both low coding completeness and accuracy, as a result of the iterative nature of the tagging, the use of both descriptive and interpretive tags, and the subjectivity of the process. Furthermore, the use of a glossary is vital to using the model correctly. Finally, the use of frameworks to structure categories may result in some categories not mapping to frameworks, as well as some categories having no tags and, thus, no tools.

Moreover, the use of descriptive tags could result in tools being associated with certain concepts that may not be true in practice. This could lead users to a tool that is not necessarily helpful or does not do what the description claims. This provides evidence that researchers may consider only using interpretive tags for toolkit organization in the future. Since interpretive tags are highly subjective, toolkit organizers must be extremely transparent around the tag definitions and tagging approach they use. Similarly, even if a user finds the right tool through the organization provided by the conceptual data model, they may still require background or capacity building to implement the tool properly and avoid negative consequences, such as greenwashing or wasted resources. Finally, the discovery of several disparate toolkits could result in further confusion among users in finding the right tool, duplicative efforts in tool development, and a lack of clarity among researchers and practitioners regarding gaps in sustainability tools.

Once the conceptual data model had been developed, it was applied to the ENHANCE toolkit to reveal insights that would be applicable to practitioners interested in using the database. The key insight from the value generation dimension was that the majority of tools supported the generation of environmental and economic value, which could potentially be caused by prevalence of frameworks related to these types of value. In terms of the strategic phase dimension, there was a good balance of tools for each phase; this indicates that the ENHANCE toolkit is relevant for activities throughout the development and deployment of a sustainability strategy. Insights from the tool purpose dimension illustrated that there was a lower number of tools related to reporting, which could mean that tools related to monitoring performance may be lacking within the ENHANCE toolkit. With regards to the stakeholders dimension, the toolkit is likely most relevant to the business and industry, scientific community, and technology sectors. Finally, the tool attributes dimension alludes to the need for capacity building to interpret and use the tools correctly, since only half of the tools had evidence of impact and very few are explicit about the pre-requisites needed.

Ultimately, the complexity of the sustainability transition requires further exploration of toolkits that could help stakeholders to easily design and implement strategies that bring them closer to achieving the SDGs, while financially sustaining their businesses and organizations. The further refinement of the toolkits is highly dependent on the capacity that can be built across the different sectors in the economy, as well as their willingness to internalize their impact.

6.1 Future Research

In the future, the researchers would recommend that the conceptual data model be refined, validated, and expanded. In order to refine the model, a deductive approach to the tagging could be applied by establishing a complete set of sub-categories and using them as a predefined glossary to re-tag the ENHANCE toolkit. This approach would provide a more accurate and reliable breakdown of how the tools are distributed across each dimension, since the predefined glossary would provide structure to the tagging from the onset. This refinement could also serve as a way to create an additional level of the abstraction within the model that supports more advanced filtering of tools.

After refinement, the model should be validated, which can be achieved in variety of ways. For example, the model could be tested with users to gain feedback on use-ability. It could also be applied to other toolkits to determine if it is generic enough to be scaled. Similarly, the model could be compared to the structure of other toolkits, such as DSIP, to identify additional dimensions, categories or levels of abstraction that could be useful. Overall, the validation of the model should reveal how the model can more accurately organize tools according to user needs. Additional analysis could also be done to identify whether the tools that are returned by the model are applicable to different use cases. Findings from the validation phase can be subsequently used to further refine the model.

In addition to validation and refinement, a process should be developed to expand the model when future user needs or trends within the sustainability field need to be incorporated. For instance, user studies may reveal the need for organizing tools around popular approaches to sustainability implementation or relevant reporting frameworks, such as CE or CSDR. One way of achieving this would be to define the dimensions for each framework, determine how many levels of abstraction are necessary within the dimension, structure each level of abstraction, and organize the tools at the lowest level of abstraction. For example, a CE dimension could be organized through the ReSOLVE framework, while a CSDR dimension could be organized according to the types of sustainability information organizations must disclose. Once a robust model has been developed, an overarching framework should be created that identifies how this model relates to other toolkit structures and provides standardization across disparate sustainability toolkits.

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A

Appendix

A.1 ReSOLVE Framework

If the target audience of the toolkit is deemed to be organizations interested in implementing the CE, the ReSOLVE framework could serve as guidance for further refining the conceptual data model to support sustainability implementation. The framework's circular strategies include (Mhatre et al. 2021):

- *"Regenerate*: To design the production, usage, and disposal of a product so that it is sustainable for the ecosystem, and nutrients are returned to the biosphere without toxic emissions or leakages. Another approach to regeneration is the transition to renewable energy in the production process.
- *Share*: To share products or services, encourage use-reuse of second-hand items, and prolong the life of the products through maintenance and repair activities. In addition to the environmental benefits provided by this strategy, it also helps to build social consciousness and public engagement.
- *Optimize*: To improve products' performance, optimize resource efficiency during production, improve supply chain management and design waste out of the system. Some practices related to this strategy are automation, digitalization, big data, smart grids, net-zero energy, decentralized energy, and water systems.
- *Loop*: To 'close the loop' through remanufacturing, refurbishing, or recycling of materials and products. The operationalization of this strategy consists of reuse policies, second-hand markets, and training people for remanufacturing and refurbishment activities. Looping resources can provide several economic opportunities.
- *Virtualize*: To virtualize refers to dematerialization through digitalization of the product or business itself. This strategy is most common in the information and communication sector.
- *Exchange*: To exchange traditional materials and technologies for green materials and processes that are economically, environmentally, and socially beneficial."

A.2 CSRD Articles

If the target audience of the toolkit is deemed to be EU companies that need support with reporting, the CSRD framework could serve as guidance for further refining the conceptual data model to support sustainability implementation. The CSRD Articles 19a and 19b, which are outlined below, clarify the current reporting requirements for public companies in the EU, including SMEs beginning in 2026 (European Commission 2021a).

Article 19a

1. "a brief description of the undertaking's business model and strategy, including:

   (a) the resilience of the undertaking's business model and strategy to risks related to sustainability matters

   (b) the opportunities for the undertaking related to sustainability matters

   (c) the plans of the undertaking to ensure that its business model and strategy are compatible with the transition to a sustainable economy and with the limiting of global warming to 1.5 °C in line with the Paris Agreement

   (d) how the undertaking's business model and strategy take account of the interests of the undertaking's stakeholders and of the impacts of the undertaking on sustainability matters

   (e) how the undertaking's strategy has been implemented with regard to sustainability matters

   (i) the resilience of the undertaking's business model and strategy to risks related to sustainability matters

2. a description of the targets related to sustainability matters set by the undertaking and of the progress the undertaking has made towards achieving those targets

3. a description of the role of the administrative, management and supervisory bodies with regard to sustainability matters

4. a description of the undertaking's policies in relation to sustainability matters

5. a description of

   (a) the due diligence process implemented with regard to sustainability matters

   (b) the principal actual or potential adverse impacts connected with the undertaking's value chain, including its operations, its products and services, its business relationships and its supply chain

(c) any actions taken, and the result of such actions, to prevent, mitigate or remediate actual or potential adverse impacts

6. a description of the principal risks to the undertaking related to sustainability matters, including the undertaking's principal dependencies on such matters, and how the undertaking manages those risks

7. indicators relevant to the disclosures referred to in points (a) to (f).

Article 19b

- Environmental factors: (i) climate change mitigation (ii) climate change adaptation; (iii) water and marine resources; (iv) resource use and circular economy; (v) pollution; (vi) biodiversity and ecosystems.

- Social factors: (i) equal opportunities for all, including gender equality and equal pay for equal work, training and skills development, and employment and inclusion of people with disabilities; (ii) working conditions, including secure and adaptable employment, wages, social dialogue, collective bargaining and the involvement of workers, work-life balance, and a healthy, safe and well adapted work environment; (iii) respect for the human rights.

- Governance factors: (i) the role of the undertaking's administrative, management and supervisory bodies regarding sustainability matters, and their composition; (ii) business ethics and corporate culture, including anti-corruption and anti-bribery; (iii) political engagements of the undertaking, including its lobbying activities; (iv) the management and quality of relationships with business partners, including payment practices; (v) the undertaking's internal control and risk management systems."

A.3 Data Sources

*Note: * indicates that the tool was found directly within the ENHANCE toolkit*

Index	Tools Included in Data Analysis	Source
1	Biomimicry Design Spiral	Website
2	Build a Sustainability Plan 101	Website
3	Business Model Innovation for CE and Sustainability	Guide
4	Cambridge Value Mapping Tool	Article
5	Circular Canvas	Website
6	Circular Business Model Planning Tool	Guide
7	Circular Collaboration Canvas	Article
8	Circular Joint Venture Design Workshop	Guide
9	Circular Product & Service Assessment	Website
10	CircularStart Assessment	Website
11	Collective Impact Approach	Article
12	Competence Framework for Sustainable Entrepreneurship	Article
13	Design for Sustainability (DfS) Framework	Article
14	Design Thinking for Practice-Based Intervention	Article
15	DIY Toolkit	Guide
16	Ecodesign in Higher Education	Guide
17	Ecodesign Strategy Wheel	Guide
18	Education for Sustainable Development (ESD) Lens	Article
19	Embedding Framework	Website
19	Embedding Framework	Guide
20	Ethical Explorer Pack	Website
20	Ethical Explorer Pack	Guide*
21	Flourishing Business Canvas	Website
22	Framework for Strategic Sustainable Development	Article
23	Future-Fit Business Benchmark	Website
24	Iceberg Model	Website
25	Idea Canvas	Website
26	Impact Assessment for Startups	Website
27	Impact Compass	Guide
28	Impact Gap Canvas	Website
29	Impact Management Norms	Website
30	Key Competencies in Sustainability	Article
31	Market Opportunity Navigator	Website
32	Non-Formal Education Methods	Guide
33	Ontology for Strongly Sustainable Business Models	Article
34	Project Resilience Review	Guide*
35	Responsible Entrepreneurship Education Ecosystem (EEE)	Article
36	SDG Impact Assessment Tool	Website
36	SDG Impact Assessment Tool	Guide*
37	Social Blueprint Toolkit Impact Canvas	Guide
38	Social Impact Intentions Mapper	Website
39	Social Impact Wheel	Website
40	Support Pack for D&I in SEI	Guide*
41	Sustainability and Eco-Innovation (SEco) Framework	Article
42	Sustainability Assessment of Start-Ups	Guide*
43	Sustainability Balanced Scorecard	Website
44	Sustainability Impact Canvas	Website
45	Sustainability SWOT Analysis	Website
46	Sustainable Business Model Archetypes	Article

47	Sustainable Business Model Canvas	Website
48	Sustainable Business Model Pattern Taxonomy	Article
49	Sustainable Business Value (SBV) Method	Article
50	Sustainable Design Tools	Website
51	Sustainable Entrepreneurship Certificate Leuphana University	Guide*
52	Sustainable Value Analysis Tool (SVAT)	Article
52	Sustainable Value Analysis Tool (SVAT)	Website
53	Sustainable Value Proposition Builder	Article
54	Technology Innovation for Sustainable Development	Website
55	Theoretical Framework of Sustainable Value Creation	Article
56	Tool for Responsible Tech	Website
57	Triple Layered Business Model Canvas	Article
58	UCD Impact Planning Canvas	Website
59	What Does Sustainability Mean in Business	Article

Index	Tools Excluded from Data Analysis	Issue
1	Scenario Planning	Broken link
2	Sustainability, Innovation and Entrepreneurship Course	Broken link

Index	Toolkits	Source
1	Biomimicry Toolbox (1 included)	Website
2	Cambridge Industrial Sustainability Tools (3 tools included)	Website
3	Circulab Toolbox (1 tool included)	Website
4	CircularStart Project (1 tool included)	Website
5	Circular Design Toolkit (1 included)	Website
6	E3 Sustainability Tools (0 tools included)	Website
7	Entrepreneurship Teaching Toolkit (0 tools included)	Website*
8	Flourishing Enterprise Innovation Tools (1 tool included)	Website
9	Innovators Toolbox (1 tool included)	Website
10	Learning Network on Sustainability - LENS (0 tools included)	Website
11	Research Impact Toolkit (1 tool included)	Website
12	Resources for Embedding Sustainability (1 tool included)	Website
13	Social Blueprint Toolkit (1 tool included)	Website
14	Summary of Sustainability Tools (2 tools included)	Compendium*
15	Sustainability Guide (1 tool included)	Website
16	Threebility Tools for Sustainable Innovation (4 tools included)	Website
17	Tools for Sustainable Innovation (4 included)	Website

A.4 Glossary of Tags

Tags	Definition	Synonyms
#accelerator-programs	'Provide mentoring, education, and financing to help companies learn how to run their business' (Harvard Business Review 2016) .	-
#article	'A piece of writing on a particular subject in a newspaper or magazine, or on the internet' (Cambridge 2023a).	-
#assessment-institutions	'Institutions that judge or decide the amount, value, quality, or importance of something' (Cambridge 2023b).	-
#business-managers	'A person in a company whose job is to manage one of its departments or areas of activity' (Cambridge 2023c).	-
#business-models	'A description of the different parts of a business or organization showing how they will work together successfully to make money' (Johnson 2020).	#business-model-innovation #business-model-development
#canvas	'A strategic management framework for describing and designing business models' (Cambridge 2020i).	-
#capacity-building	'Prepare employees for their role in supporting an organization's vision' (Kim and Coonan 2023).	#build-readiness #competence #cultivate-champions #manage-talent
#circular-economy	'The circular economy is a model of production and consumption in which the life cycle of products is extended' (European Parliament 2020).	#circular #circularity
#collaborative-tool	'Involving two or more people working together for a special purpose' (Cambridge 2020a). In this case, the tool encourages collaborative work.	-
#community-of-practice	The tool has a community of practice, e.g. a Linked-In group.	
#compendium	'A list or collection of various items' (Cambridge 2023d).	-
#course	'A set of classes or a plan of study on a particular subject' (Cambridge 2020b).	-
#curriculum-development	The development of a learning curriculum.	-

Tags	Definition	Synonyms
#decision-makers	'A person who decides things, especially at a high level in an organization' (Cambridge 2020c).	#change-agents #leaders
#design-academics	'Academics focused on design-oriented studies' (Lloyd 2023).	-
#design-thinking	'Design thinking embeds innovators in the problems that need solving, putting them in close proximity to the people they are designing for' (Stanford 2021).	#human-centered-design
#diversity	'Many different types of things or people being included in something' (Cambridge 2020d).	-
#eco-design	'Designing or redesigning products, services, processes or systems to avoid or repair damage to the environment, society and the economy' (NI Business Info 2020).	#biomimicry #green-design
#economic-value	'The value that the market or an individual places on a good or service, representing the maximum amount of money they are willing to pay or exchange for it' (Finance R 2020).	#economy #financial-drivers #profit #revenue
#educators	'Those who teach' (Cambridge 2020e).	#education-coordinators #education-councils #faculty
#entrepreneurial-thinking	'The mindset and approach that individuals use to identify and pursue opportunities for innovation and growth; continuously seeking out ways to create value and solve problems' (Melbado 2020).	-
#entrepreneurs	'Someone starting something new, such as a new company or new initiative in an established company' (Cambridge 2020f).	#startups
#EU-resource	'Developed through EU funding' (European Commission 2021b).	-
#exercises	'An action or actions intended to improve something or make something happen' (Cambridge 2020h).	#worksheets
#framework	'A supporting structure around which something can be built' (Cambridge 2020i).	#model
#guide	'Something that helps you form an opinion or make a decision about something else' (Cambridge 2020j).	-
#ideation	'The ideation phase involves developing a set of objectives that need to be achieved by the enterprise' (Grainger-Brown and Malekpour 2019).	#brainstorming #creativity

Tags	Definition	Synonyms
#identifying-markets	'A market is a place where buyers and sellers can meet to facilitate the exchange or transaction of goods and services' (Kenton 2021).	#where-to-play
#impact-analysis	'The process of evaluating the likely impacts of a proposed project or development' (Shah 2020).	#assessment #LCA
#innovation-managers	'A person in a company whose job is to manage the innovation department or areas of activity' (Noorily 2020).	-
#investors	'A person who puts money into something in order to make a profit or get an advantage' (Cambridge 2020k).	-
#learning-tool	'Resources used for pedagogical purposes that facilitate learning' (COPE 2020).	-
#life-cycle	'The length of time that something lasts or can be used' (Cambridge 2020l).	#cradle-to-cradle
#linked-toolkit	The tool contains a related toolkit.	-
#mapping-activities	'Outlining existing activities within an organization' (Grainger-Brown and Malekpour 2019).	-
#metrics-development	'The development of measures that evaluate the performance and impact of environmental, social, and economic approaches at different levels' (Earth Institute 2020).	#indicators #measurement
#moral-justice	'Moral justice is commonly referred to as legal justice' (Law Insider 2020).	#human-rights #social-justice
#NGOs	Non-Governmental Organizations.	-
#performance-benchmarking	'Comparing your performance against standards or other organizations' (Grainger-Brown and Malekpour 2019).	#tracking-progress
#piloting	'A plan, product, or system that is used to test how good something is before introducing it' (Cambridge 2020m).	-
#policy-development	'Public policy development is a crucial process that helps governments make decisions that affect their citizens; it involves analyzing complex issues, identifying possible solutions, and selecting the best course of action to address these issues' (CDC 2020).	-
#practice-based	Developed by companies.	-

Tags	Definition	Synonyms
#practitioners	'Those who put things into practice' (Cambridge 2020n).	-
#private-sector	'Businesses and industries that are not owned or controlled by the government' (Cambridge 2020o).	#enterprises #SMEs
#product-designers	People designing products.	-
#product-innovation	'The process of designing new products or making improvements to existing ones' (Ludeke-Freund 2020).	#product-design
#public-policy-analysts	'People working in the government towards the creation of public policy' (CDC 2020).	-
#public-sector	'Governmental institutions, not owned by private actors' (Cambridge 2020o).	#government-officials
#related-article	An article is related to the tool.	-
#related-framework	A framework is related to the tool.	-
#related-game	A game is related to the tool.	-
#related-user-guidance	'Some sort of guidance is provided to the user to make the best use of the tool' (Cambridge 2020j).	-
#related-workshop	'A workshop is related to the tool' (Doorsselaer 2013).	-
#reporting-progress	'Reporting positive changes in performance' (Grainger-Brown and Malekpour 2019).	-
#requires-facilitation	'The tool requires some aid to make the tool' easier to use' (Cambridge 2020g).	-
#requires-prior-knowledge	'Core competency that must be demonstrated before tackling a course that requires foundational knowledge' (Britannica 2020).	-
#research-driven	The tool has a research article associated with it or draws from scientific theories.	-
#researchers	'Someone whose job is to study a subject carefully, especially in order to discover new information or understand the subject better' (Cambridge 2020p).	-
#risk-mitigation	'Process of reducing risk exposure and minimizing the likelihood of an incident' (Logic Manager 2020).	-
#score-card	'A small card for recording the score while watching or taking part in a game, race, or competition' (Cambridge 2020q).	-

Tags	Definition	Synonyms
#SDGs	Sustainable Development Goals.	-
#sequenced-tools	Linked to other tools.	-
#service-innovation	'Changing how a business delivers utilities and services to anticipate demand and drive growth' (Green 2020).	-
#setting-goals	Identifying targets that an organization aims to meet in the future.	#targets
#signaling-sustainability	'Clarifying purpose by referencing sustainability in mission, vision and values' (UN 2015).	#communication #storytelling
#simple-graphic	A simple design or visual image.	-
#social-equality	'The belief that everyone should be treated the same, regardless of social status, race, gender, or religion' (Fourie 2012).	#social-inclusiveness
#social-innovation	'Developing and deploying effective solutions to challenging and often systemic social and environmental issues in support of social progress' (Stanford Business 2020).	-
#social-value	'Contribution towards the social well-being of communities' (Surrey 2020).	#people #social-welfare #society
#stakeholder-analysis	'Mapping, measuring and/or analyzing stakeholders' (APM 2020).	#stakeholder-mapping
#stakeholder-engagement	'Systematic identification, analysis, planning and implementation of actions designed to influence stakeholders' (APM 2020).	#collaboration
#strategic-planning	'Developing and communicating a defined business strategy that informs an organization's direction, goals, and actions '(BDC 2020).	#prioritization
#sustainable-value	'Creating social, environmental and economic value simultaneously' (Rosario, Raimundo, and Cruz 2022).	#integrative-value #TBL #PPP
#system-developers	People who develop systems.	-
#systems-thinking	'A holistic approach to problem solving that involves inspecting various parts of a system and understanding how they interact with each other and with other systems' (Government Office for Science 2023b).	-

Tags	Definition	Synonyms
#taxonomy	'A system for naming and organizing things into groups that share similar qualities' (Cambridge 2020r).	#definition
#teaching-method	'Methods that support and structure the teaching process in order to realize proposed competences' (Landoy, Popa, and Repanovici 2020).	-
#tech-sector	'Businesses that focus on electronics, software, computers, social media, and other industries related to technology' (Frankenfield 2022).	-
#technology-innovation	'Process or outcome of introducing new or considerably improved products, processes, or theories based on technology' (Scherer 2001).	-
#tested	The tool has been tested.	-
#testimonials	'A statement about the character or qualities of something' (Cambridge 2020s).	-
#university-students	Those enrolled in a University.	-
#use-case	'A specific situation in which a product or service could potentially be used' (Chapman 2020).	-
#user-friendly-interface	Visually-appealing and intuitive interface.	-
#value-analysis	'Mapping, measuring and/or analyzing value' (Cambridge 2020t).	#cost-benefit-analysis #value-capture #value-proposition
#youth-workers	Those who work with youth.	-

A.5 Tagging Results

Note: Percentages are calculated by dividing the tools with a particular tag (numerator = x) by the grand total of tools (denominator = 59)

	Tags	Tools	(%)		Tags	Tools	(%)
1	#sustainable-value	42	71%	44	#investors	6	10%
2	#research-driven	39	66%	45	#SDGs	6	10%
3	#private-sector	35	59%	46	#related-workshop	6	10%
4	#ideation	31	53%	47	#entrepreneurial-thinking	5	8%
5	#practice-based	31	53%	48	#EU-resource	5	8%
6	#related-user-guidance	26	44%	49	#exercises	5	8%
7	#business-models	25	42%	50	#piloting	5	8%
8	#mapping-activities	25	42%	51	#reporting-progress	5	8%
9	#educators	24	41%	52	#requires-facilitation	5	8%
10	#linked-toolkit	24	41%	53	#service-innovation	5	8%
11	#simple-graphic	23	39%	54	#setting-goals	5	8%
12	#strategic-planning	23	39%	55	#social-value	5	8%
13	#canvas	22	37%	56	#taxonomy	5	8%
14	#framework	22	37%	57	#use-case	5	8%
15	#tested	22	37%	58	#community-of-practice	4	7%
16	#capacity-building	21	36%	59	#course	4	7%
17	#impact-analysis	21	36%	60	#eco-design	4	7%
18	#entrepreneurs	19	32%	61	#identifying-markets	4	7%
19	#systems-thinking	19	32%	62	#public-sector	4	7%
20	#learning-tool	18	31%	63	#related-framework	4	7%
21	#sequenced-tools	16	27%	64	#requires-prior-knowledge	4	7%
22	#stakeholder-analysis	16	27%	65	#technology-innovation	4	7%
23	#design-thinking	14	24%	66	#compendium	3	5%
24	#value-analysis	14	24%	67	#decision-makers	3	5%
25	#collaborative-tool	13	22%	68	#policy-development	3	5%
26	#practitioners	13	22%	69	#teaching-method	3	5%
27	#life-cycle	12	20%	70	#assessment-institutions	2	3%
28	#guide	11	19%	71	#social-equality	2	3%
29	#product-innovation	11	19%	72	#social-innovation	2	3%
30	#circular-economy	10	17%	73	#testimonials	2	3%
31	#metrics-development	10	17%	74	#accelerator-programs	1	2%
32	#related-article	10	17%	75	#design-academics	1	2%
33	#article	9	15%	76	#diversity	1	2%
34	#performance-benchmarking	9	15%	77	#innovation-managers	1	2%
35	#researchers	9	15%	78	#moral-justice	1	2%
36	#university-students	9	15%	79	#NGO	1	2%
37	#user-friendly-interface	9	15%	80	#public-policy-analysts	1	2%
38	#product-designers	8	14%	81	#related-game	1	2%
39	#signaling-sustainability	8	14%	82	#revenue	1	2%
40	#stakeholder-engagement	8	14%	83	#risk-mitigation	1	2%
41	#tech-sector	7	12%	84	#score-card	1	2%
42	#business-managers	6	10%	85	#system-developers	1	2%
43	#curriculum-development	6	10%	86	#youth-workers	1	2%

A.6 Hierarchical Dimension Tables

Dimensions	Categories	Tag	Synonyms
Value generation	Sustainable value	#SDGs	-
		#sustainable-value	#integrative-value
			#PPP #TBL
	Environmental-economic value	#circular-economy	#circular #circularity
		#eco-design	#biomimicry
			#green-design
		#life-cycle	#cradle-to-cradle
	Environmental-social value	-	-
	Social-economic value	-	-
	Only economic value	#economic-value	#economy
			#financial-drivers
			#profit #revenue
	Only environmental value	-	-
	Only social value	#diversity	-
		#moral-justice	#human-rights
			#social-justice
		#social-equality	#social-inclusiveness
		#social-value	#people #social-welfare
			#society
Strategic phase	Ideation phase	#design-thinking	#human-centered-design
		#entrepreneurial-thinking	-
		#ideation	#brainstorming
			#creativity
		#product-innovation	#product-design
		#service-innovation	-
		#setting-goals	#targets
		#social-innovation	-
		#systems-thinking	-
		#technology-innovation	-
	Development phase	#business-models	#BM-development
			#BM-innovation
		#identifying-markets	#where-to-play
		#piloting	-
		#strategic-planning	#prioritization
	Implementation phase	#accelerator-programs	-
		#capacity-building	#build-readiness
			#competence
			#cultivate-champions
			#manage-talent
		#curriculum-development	-
		#impact-analysis	#assessment #LCA

		#mapping-activities	-
		#metrics-development	#indicators #measurement
		#performance-benchmarking	#tracking-progress
		#policy-development	-
		#reporting-progress	-
		#risk-mitigation	-
		#signaling-sustainability	#communication #storytelling
		#stakeholder-analysis	#stakeholder-mapping
		#stakeholder-engagement	#collaboration
		#value-analysis	#cost-benefit-analysis #value-capture #value-proposition
Tool purpose	Map	#impact-analysis	#assessment #LCA
		#mapping-activities	-
		#stakeholder-analysis	#stakeholder-mapping
		#value-analysis	#cost-benefit-analysis #value-capture #value-proposition
	Report	#metrics-development	#indicators #measurement
		#performance-benchmarking	#tracking-progress
		#reporting-progress	-
		#signaling-sustainability	#communication #storytelling
	Align	#accelerator-programs	-
		#business-models	#BM-development #BM-innovation
		#capacity-building	#build-readiness #competence #cultivate-champions #manage-talent
		#curriculum-development	-
		#design-thinking	#human-centered-design
		#entrepreneurial-thinking	-
		#ideation	#brainstorming #creativity
		#identifying-markets	#where-to-play
		#piloting	-
		#policy-development	-
		#product-innovation	#product-design
		#risk-mitigation	-
		#service-innovation	-
		#setting-goals	#targets
		#social-innovation	-
		#stakeholder-engagement	#collaboration
		#strategic-planning	#prioritization
		#systems-thinking	-
		#technology-innovation	-

Stake-holders	Business & industry	#business-managers #entrepreneurs #investors #private-sector #product-designers	- #start-ups - #enterprises #SMEs -
	Children & youth	#youth-workers	-
	Indigenous people	-	-
	Farmers	-	-
	Local authorities	#public-policy-analysts #public-sector	- #government-officials
	NGOs	#NGOs	-
	Scientific & tech community	#design-academics #educators #innovation-managers #researchers #tech-sector #university-students	- #education-coordinators #education-councils #faculty - #environmental-scientists #social-scientists - -
	Workers & trade unions	-	-
	Women	-	-
	Multi-sectoral	#assessment-institutions #decision-makers #practitioners #system-developers	- #leaders #change-agents - -
Tool Attributes	Evidence of impact	#community-of-practice #tested #testimonials	- - -
	Origin	#EU-resource #practice-based #research-driven	- - -
	Related materials	#linked-toolkit #related-article #related-framework #related-game #related-user-guidance #related-workshop #sequenced-tools	- - - - #documentation #instructions #resources - -
	Requirements	#requires-facilitation #requires-prior-knowledge	- -
	Type	#article #canvas #collaborative-tool #compendium	- - - -

		#course	-
		#exercises	#worksheets
		#framework	#model
		#guide	-
		#learning-tool	-
		#score-card	-
		#taxonomy	#definition
		#teaching-method	-
		#use-case	-
No Dimension	No category	#simple-graphic	-
		#user-friendly-interface	-

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