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The LaST Tool – The Longevity and Sustainable Transition Tool

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Abstract. Due to customers' increased focus on environmental sustainability, companies have been looking to position themselves as producers of consumer goods with greater longevity. Useful tools exist within academia to assist companies in this transformation process. However, the knowledge is scattered, and the focus of tools is often on either the mapping of companies' status quo or actionable solutions that increase the longevity of their products. Creating a common understanding and coherency to make the knowledge usable in practice has proven to be difficult, as an immediate match of the most appropriate action tools to the mappings does not exist. Therefore, there is a need for a practical transition tool that, in the process of mapping, assists companies in understanding their positions and potential and proposes suitable action tools to assist in the required change process for producing consumer goods with greater longevity. This could mitigate the challenges for practitioners and bridge the different types of tools, hence enabling companies to develop products with increased longevity more easily.

Keywords: Sustainability · Tool · Product Longevity · Circular Economy

1 Introduction

Due to the rising global demand from consumers for sustainability, companies compete to position themselves in unique ways and deliver environmentally sustainable initiatives. Recycling, limiting plastic usage, lowering energy consumption and reducing production emissions have been among the main foci until now. However, the perception of product longevity as an important and effective element in the circular economy debate (Cooper 2020) and as a quality parameter (Cooper 2012) has raised demand for business and design methods to increase the longevity of their products. This paper adopts the definition presented by Bocken et al. (2016) that increased product longevity relates to slowing the consumption loop, with focus on the lifetime of a complete product including repair, multiple ownerships and remanufacturing but excluding recycling and upcycling, where the product is broken into sub-parts and used in new contexts.

For companies engaging with change towards producing consumer goods with greater longevity there exist several approaches, ranging from ways to increase the

physical durability of products to adapting product service systems into business models (Jensen et al. 2021.a; Kopecka et al. 2011; Verganti et al., 2011). How a company chooses to execute these can be difficult to decide in practice, however, as it depends on that company’s attitude, willingness, investment and structure regarding the subject; consequently, the approaches suggested in the literature may be difficult for practitioners to utilise. This perception has also produced considerable fragmentation and theoretical confusion in academia. No common understanding exists regarding how to assist the navigation of an industry practitioner who aims to increase the longevity of their products (Bocken et al. 2019).

In this article, we adopt the perception that two types of tools exist for longevity: mapping and action. Mapping tools can provide a momentary view of a company’s current situation, position and ambitions on a structural level towards product longevity. Action tools, on the other hand, are mostly focused on progress—how to enable change in a company and the necessary steps towards this. Hence, many tools already exist that can assist practitioners in most stages of product life and provide support in change towards developing viable products with greater longevity. Even so, it can be difficult for practitioners and researchers to define which insights to combine; it is challenging to translate the discoveries from the use of a mapping tool into more actionable tools and, in the end, into practically executable approaches (see Fig. 1).

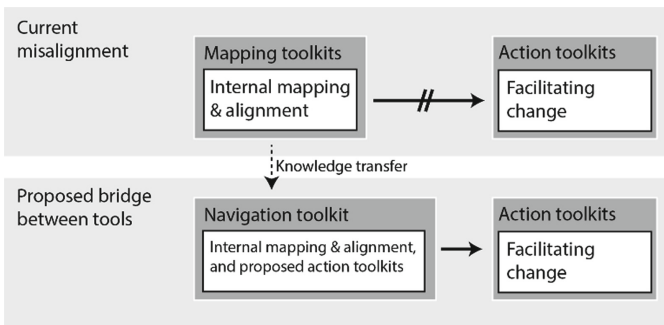


Fig. 1. Misconnection between mapping tools and action tools, and the proposed new navigational tool that facilitates bridging the current literature.

To mitigate these challenges and move the field towards a more unified process, an integrative understanding is needed. We propose a new navigation tool, synthesising the existing mapping tool, which could provide a bridge between mapping and understanding possibilities and creating the required change. Hence, we propose the following research question:

How can a new tool bridge existing mapping tools and action tools for product longevity to be more practically usable by industry practitioners?

2 Research Approach

To address this research question, an in-depth identification of existing tools for product longevity is necessary.

2.1 Phase 1: Identifying Existing Literature on Product Longevity Tools

The literature for this paper was identified in a three-stage process. First, a screening of the literature in Bocken et al.'s (2019) review of circular business innovation tools provided a solid basis of 13 tools and broad coverage of the existing tools. Second, through a forthcoming review of tools for product longevity by Özçelik et al. (2022), five additional relevant articles were added. Two tools produced by research teams led by one of the co-authors were also added (Cooper et al. 2016, 2021). Furthermore, a broad database search across Scopus, SciTech Premium Collection, DOAJ, ABI/INFORM Collection and Springer Online Journals Complete was conducted using the search term “product longevity” AND “tool”, including peer-reviewed and open-access journal articles, book chapters and books. The search resulted in 124 articles that were screened, firstly by abstract then full text filtering, and narrowed down to 17 relevant papers on tools for longevity. In total, 37 articles were selected. App. 1 presents all the identified literature through the two-stage process and an overview of the format of the tools presented.

2.2 Phase 2: Clustering Types of Tools

As previously described, when looking at the identified literature on tools in App. 1, two major differences in the aims of the tools are apparent. On the one hand, several tools enable companies to understand their position broadly and assist in mapping out their aims, direction, goals and progression through a structured process. These are defined in this article as ‘mapping tools’. On the other hand, several tools guide participants through actionable suggestions for transformation; these are referred to as ‘action tools’ in this article. The distinction seen in the clustering is further emphasised by the mention in the existing articles by the authors that tools are used to understand either the current situation (mapping tools) or how to change it (action tools).

Mapping Tools. Mapping tools provide participants with increased insight into their company’s position and maturity, focusing on the general process at the managerial level and having a broad focus across different departments within a company. This can be helpful for practitioners aiming to produce consumer goods with greater longevity; however, evaluating the impact of a mapping tool is limited to the ability of participants to execute sub-activities that are often not thoroughly described. The identified mapping tool literature is displayed in App. 2. Because these tools vary in their approaches, focus and paradigm, they aim to help different stakeholders, so selecting the correct tool, that suit users’ situations, is crucial.

This understanding of the basis of the methodology is crucial for achieving transformation towards developing products with greater longevity. Likewise, the overview of the stakeholders combined with the mapping provides information for the evaluation and selection of areas approachable for transformation in a given company and the extent of the transformation.

Action Tools. There also exists a range of action tools aimed at subprocesses within the transformation process. These tools provide the necessary knowledge to overcome

the more specific challenges and barriers faced by designers or managers. However, participants need to be aware of their position, limitations and opportunities to successfully select the appropriate action tool. The identified action tool literature is displayed in App. 3. Through these tools, practical approaches to transformation should emerge that incrementally drive companies towards producing consumer goods with increased longevity.

3 Results of the Metatheoretical Analysis

The two types of tools have contrasting strengths and weaknesses. Using mapping tools and action tools in the most relevant practical situation can assist practitioners in making more knowledgeable decisions in the incremental change process. In an ideal situation, perceiving the process of using these tools can be seen as an iterative process that starts with a practitioner acknowledging the need for change, leading to the selection and execution of a mapping tool, followed by the use of action tools, which leads to practical change.

In some situations, to enable the use of action tools (App. 3) for the application of concrete actionable initiatives, practitioners need to be aware of their situation and opportunities. Existing mapping tools (App. 1) may provide an effective foundation for companies to increase awareness of opportunities, challenges and barriers, hence enabling them to make more conscious decisions regarding the selection of approaches and action tools. However, the current mapping tools lack a direct connection to the action tools and therefore do not bridge practical understanding and action.

4 Development of a Navigation Tool that Integrates Existing Knowledge and Bridges the Actionable Literature

We propose, with inspiration from the circular representation of product life in Sinclair et al. (2018), an overview of a product's life as a circle. The circle is divided into three spatial levels indicating the main ownership and stakeholders responsible for the longevity of the product, namely the designers and developers, businesses and the user, inspired by the stakeholders identified by Jensen et al. (2021.b) in their exploration of barriers to product longevity (see Fig. 2).

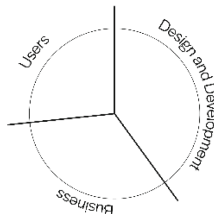


Fig. 2. Representation of product life, divided into three spatial fields in the LaST tool.

Based on the focus of the action tool, as seen in App. 3, the most influential life stages are included in the LaST navigational tool (Fig. 3). To bridge the LaST tool with the action tools (App. 3), the selection of the most relevant life stages is based on the life stages that the individual action tools mention and address, thereby aiming each subdivision of the spatial field towards appropriate action tools.

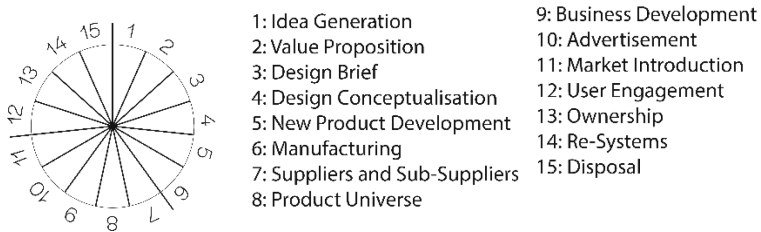


Fig. 3. Sub-divisions of the spatial fields into smaller subdivisions of product life.

To facilitate evaluation criteria for users of the LaST tool, evaluation parameters are likewise considered in the toolkit (Fig. 4.). These are based on the focus of proposed solutions, namely performance, behaviour or vision (inspired by Jensen et al. 2021.b). Performance-driven approaches mainly focus on the physical characteristics of products and their performance, while behaviour change-driven approaches focus on how businesses can influence customers and create more value through service, business model and behaviour. The vision-driven approaches include determining if the company’s approach to product longevity is a core value for it and collectively communicating the value of product longevity through product, business and customer engagement. The closer to the centre of the circle in each subdivision, the more holistic is the approach; the further away from the circle, the more product-orientated are the solutions presented. To incrementally move further towards the centre of the circle, action tools found in App. 3 that are linked to the specific subdivision can be applied.

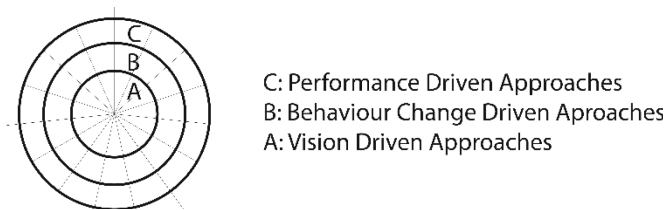


Fig. 4. Evaluation parameters of the LaST tool.

5 Conclusion and Limitations

Current literature reveals a disconnection between tools that assist practitioners in identifying their potential in terms of product longevity and those that assist in making the

actual change. The main contribution of this paper is the creation of a navigation tool that binds together the knowledge from existing mapping tools and creates a direct link to the existing action tools, while facilitating the transition through incremental change in product life. The LaST tool could be used for companies that are inexperienced in considering product longevity and utilised repeatedly throughout a period, as incremental changes can facilitate continuous development within the field and improve the longevity of products. Participants are likely to benefit from repeating and adapting the methodology to new avenues of improvement, and it is important to explore newly discovered knowledge gaps or secondary business areas for improvement.

As highlighted by this paper, there are gaps within the connection between academia and practice in product longevity. An interesting avenue for future research might therefore be to investigate the connection between the action tools and the long-term impact on product longevity, company revenue and environmental implications. Likewise, an exploration of a company's willingness to adopt new and more explorative business models to improve product longevity could be valuable.

Appendix:

App. 1. Complete list of the identified literature through Bocken et al. (2019), özçelik et al. (2022), co-authors and a supplementary literature search.

Author	Title
Mendoza J.M.F., et al. (2017)	Integrating Backcasting and Eco-Design for the Circular economy: The BECE Framework
Sinclair M., et al. (2018)	Consumer intervention mapping: A tool for designing future product strategies within circular product service systems
Hainess-Gadd, H., et al., D. (2018)	Emotional durability design nine-A tool for product longevity
Evans S. and Bocken N. (2014)	A tool for manufacturers to find opportunity in the circular economy
Heyes G., et al. (2018)	Developing and implementing circular economy business models in service-oriented technology companies
Whalen K., et al. (2018)	'All they do is win': Lessons learned from the use of a serious game for circular economy education
Whalen, K. (2017)	Risk and race: Creation of a finance-focused circular economy serious game
Bocken, N., et al. (2018)	Experimenting with a circular business model: Lessons from eight cases
Antikainen M., et al. (2017)	Circular economy business model innovation process—Case study

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Author	Title
Bocken N., Miller K., Evans, S (2016)	Assessing the environmental impact of new circular business models
Manninen K., et al. (2018)	Do circular economy business models capture intended environmental value propositions?
Nußholz J.L.K. (2018)	A circular business model mapping tool for creating value from prolonged product lifetime and closed material loops
Pigosso D.C.A., et al. (2018)	Measuring the Readiness of SMEs for Eco-Innovation and Industrial Symbiosis: Development of a Screening Tool
Jensen, P. B., et al. (2021)	Barriers to product longevity: A review of business, product development and user perspectives
Dokter, G., et al. (2020)	Cards for circularity: Towards circular design in practice
Jensen, P. B., et al. (2021)	A practical approach to companies' transformation toward product longevity: A best-case study
Rexfelt, O., Selvefors, A. (2021)	The use2use design tool—Tools for user-centred circular design
Garza-Reyes, J. A., et al. (2019)	A circularity measurement tool for manufacturing SMEs
Cooper, T., et al. (2021)	Clothing Durability Dozen: Strategies to improve design and testing for clothing longevity
Cooper, T., et al. (2016)	Dirt, Damage, Servicing and Repair: Understanding motivations for product disposal
Roberts, D., and Hughes, M. (2014)	Exploring consumers' motivations to engage in innovation through co-creation activities
Hora, M., et al. (2016)	Designing Business Models for Sustainable Mass Customization: A Framework Proposal
Yang, M., et al. (2018)	The Management of Operations Product-service systems business models for circular supply chains
Wastling, T., et al. (2018)	Design for Circular Behaviour: Considering Users in a Circular Economy
Cherry, C. E., & Pidgeon, N. F. (2018)	Why Is Ownership an Issue? Exploring Factors That Determine Public Acceptance of Product-Service Systems

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Author	Title
Wallner, T. S., et al. (2020)	An Exploration of the Value of Timeless Design Styles for the Consumer Acceptance of Refurbished Products
Albæk, J. K., et al. (2020)	Circularity Evaluation of Alternative Concepts During Early Product Design and Development
Terzioglu, N., & Wever, R. (2021)	Integrating Repair into Product Design Education: Insights on Repair, Design and Sustainability
Moalem, R. M., and Mosgaard, M. A. (2021)	A Critical Review of the Role of Repair Cafés in a Sustainable Circular Transition
Bocken, N. M. P., et al. (2015)	Value mapping for sustainable business thinking
Rogers, J. G., et al. (2015)	Product longevity and shared ownership: Sustainable routes to satisfying the world's growing demand for goods
Chapman, J. (2009)	Design for (Emotional) Durability
Boavida, R., et al. (2020)	A Combined Use of TRIZ Methodology and Eco-Compass tool as a Sustainable Innovation Model
Choi, Y. J., et al. (2018)	Carative Factors in the Design Development Process: Towards Understanding Owner–Object Detachment and Promoting Object Longevity
Haug, A., (2018)	Defining 'Resilient Design' in the Context of Consumer Products Defining 'Resilient Design' in the Context of Consumer Products
Gregori, E. J. S. P., and Wdowiak, I. K. M. A. (2021)	Entrepreneurial lean thinking for sustainable business modeling: a workshop design for incumbent firms
Rivera-torres, P. (2019)	Is It Possible to Change from a Linear to a Circular Economy? An Overview of Opportunities and Barriers for European Small and Medium-Sized Enterprise Companies

App. 2. List of mapping tools.

Author	Title	Type of situation where tool is applicable
Garza-Reyes, et al. (2019)	A circularity measurement tool for manufacturing SMEs	Measurement tool to identify SMEs' current maturity through an evaluation of circularity practices. Executed through a questionnaire
Sinclair M., et al. (2018)	Consumer intervention mapping: A tool for designing future product strategies within circular product service systems	Identifying the possible intervention points for companies to improve circularity in relation to customers. Executed through collective discussion of participants
Jensen, P.B., et al. (2021)	Barriers to product longevity: A review of business, product development and user perspectives	List of barriers that can hinder the development of products with high longevity. Serves as a foundation for the discussion of possible overlooked challenges
Pigosso D.C.A., et al. (2018)	Measuring the readiness of SMEs for eco-innovation and industrial symbiosis: Development of a screening tool	A screening tool to measure the readiness for SMEs to adopt circularity initiatives through discussion based on a questionnaire
Jensen, P. B., et al. (2021)	A practical approach to companies' transformation toward product longevity: A best-case study	Creates a foundation for understanding different maturity levels of companies, based on their perspective and focus in product, business and focus area

App. 3. List of action tools based on the identified literature.

Author	Title	Type of situation where tool is applicable
Dokter, G., et al. (2020)	Cards for circularity: Towards circular design in practice	Idea generation, design brief, and design conceptualisation process
Hainess-Gadd, H., et al. (2018)	Emotional durability design nine-A tool for product longevity	Design brief, new product development, Ownership
Rexfelt, O., Selvefors, A. (2021)	The use2use design tool—Tools for user-centred circular design	Idea generation and re-systems and Product Universe
Evans, S., Bocken N. (2014)	A tool for manufacturers to find opportunity in the circular economy	Idea generation, manufacturing, and business development
Heyes G., et al. (2018)	Developing and implementing circular economy business models in service-oriented technology companies	Business development
Mendoza, J.M.F. et al. (2017)	Integrating backcasting and eco-design for the circular economy: The BECE framework	Business development
Cooper, T., et al. (2016)	Dirt, Damage, Servicing and Repair: Understanding motivations for product disposal	Idea generation, design conceptualisation
Bocken, N., et al. (2018)	Experimenting with a circular business model: Lessons from eight cases	Value Proposition, Design Brief, and Design Conceptualisation
Antikainen M., et al. (2017)	Circular economy business model innovation process—Case study	Business Development and Market Introduction
Bocken N., et al. (2016)	Assessing the environmental impact of new circular business models	Manufacturing and Business Development
Manninen K., et al. (2018)	Do circular economy business models capture intended environmental value propositions?	Value Proposition, Design Brief, Business Development and Disposal

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Author	Title	Type of situation where tool is applicable
Nußholz, J.L.K. (2018)	A circular business model mapping tool for creating value from prolonged product lifetime and closed material loops	Business development, Re-systems, and Market Introduction
Whalen, K., et al. (2018)	'All they do is win': Lessons learned from the use of a serious game for circular economy education	New Product development, Manufacturing and Suppliers and Sub-suppliers
Whalen, K. (2017)	Risk and Race: Creation of a finance-focused circular economy serious game	Business Development, advertisement, market introduction
Cooper, T., et al. (2021)	Clothing Durability Dozen: Strategies to improve design and testing for clothing longevity	Idea generation, Design Brief and Business development
Roberts, D., and Hughes, M. (2014)	Exploring consumers' motivations to engage in innovation through co-creation activities	Business development, User Engagement and Ownership
Hora, M., et al. (2016)	Designing Business Models for Sustainable Mass Customization: A Framework Proposal	Business Development, advertisement, and User Engagement
Yang, M., et al. (2018)	The Management of Operations Product-service systems business models for circular supply chains	Suppliers and sub-suppliers, Business Model
Wastling, T., et al. (2018)	Design for Circular Behaviour: Considering Users in a Circular Economy	User Engagement, Ownership, Re-systems
Cherry, C. E., & Pidgeon, N. F. (2018)	Why Is Ownership an Issue? Exploring Factors That Determine Public Acceptance of Product-Service Systems	Business Development, User engagement, and Ownership
Wallner, T. S., et al. (2020)	An Exploration of the Value of Timeless Design Styles for the Consumer Acceptance of Refurbished Products	New Product Development, Ownership, and Disposal

(continued)

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Author	Title	Type of situation where tool is applicable
Albæk, J. K., et al. (2020)	Circularity Evaluation of Alternative Concepts During Early Product Design and Development	Idea Generation, Design Brief, and Design Conceptualisation
Terzioglu, N., & Wever, R. (2021)	Integrating Repair into Product Design Education: Insights on Repair, Design and Sustainability	Design Conceptualisation and New Product Development
Moalem, R. M., and Mosgaard, M. A. (2021)	A Critical Review of the Role of Repair Cafés in a Sustainable Circular Transition	Ownership, Re-systems, and Disposal
Bocken, N. M. P., et al. (2015)	Value mapping for sustainable business thinking	Business Development, Market Introduction
Rogers, J. G., et al. (2015)	Product longevity and shared ownership: Sustainable routes to satisfying the world's growing demand for goods	Business Development, Re-systems, and User Engagement
Chapman, J. (2009)	Design for (Emotional) Durability	Design Conceptualisation, New Product Development, and Ownership
Boavida, R., et al. (2020)	A Combined Use of TRIZ Methodology and Eco-Compass tool as a Sustainable Innovation Model	Idea Generation, Design Brief, and Design Conceptualisation
Choi, Y. J., et al. (2018)	Carative Factors in the Design Development Process: Towards Understanding Owner–Object Detachment and Promoting Object Longevity	New Product Development, Ownership, and Disposal
Haug, A., and Haug, A. (2018)	Defining 'Resilient Design' in the Context of Consumer Products Defining 'Resilient Design' in the Context of Consumer Products	Design Conceptualisation, New Product Development
Gregori, E. J. S. P., and Wdowiak, I. K. M. A. (2021)	Entrepreneurial lean thinking for sustainable business modelling: a workshop design for incumbent firms	Business Development, User Engagement, and Ownership

(continued)

(continued)

Author	Title	Type of situation where tool is applicable
Rivera-torres, P. (2019)	Is It Possible to Change from a Linear to a Circular Economy? An Overview of Opportunities and Barriers for European Small and Medium-Sized Enterprise Companies	Business Development, Ownership

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