The Circularity Radar: A digital tool for SMEs to assess circular opportunities

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Abstract: The transition to more sustainable and circular business models (CMBs) is complex, and small and medium-sized enterprises (SMEs) often struggle with the intricacies and additional costs of achieving sustainability. To address these challenges, we developed an interactive web application – the Circularity Radar – in the open-source language for statistical computing and data visualisation R. We used the Shiny package, which provides desirable features for businesses such as a choice between local or online deployment that preserves data privacy, an interactive interface that allows users to specify the conditions under which computations are executed, and dynamic visualisations rendered through input variables. The Circularity Radar can provide low-cost insights to guide SMEs and practitioners in retail and manufacturing industries in exploring the drivers of their sustainability transition, assessing their situations, and understanding the obstacles they must overcome. Our tool incorporates a digital companion framework that involves seven elements of circularity: sustainable materials, sustainable operations, eco-design, product stewardship, R-terms, strategic organisational positioning, and social aspects. Additionally, the Circularity Radar presents alternative instruments and metrics businesses can use to quantitatively and qualitatively assess their progress regarding CBM implementation.

1. Introduction

Growing environmental concerns are driving businesses to adopt more sustainable practices and communicate this endeavour to their stakeholders, including customers and the general public. The concept of circular business model (CBM) has emerged as a focal point in this shift, gaining attention and prominence as a direct response to the broader concept of the Circular Economy (CE) [1].

Research has shown that many companies in manufacturing and retail declare intentions to reduce their environmental impact in their mission statement yet struggle to implement measurable changes in practice [2]. These challenges are exacerbated in the case of SMEs, which often face financial constraints and other limitations when implementing and evaluating sustainability and circularity opportunities [3].

An additional challenge is the assessment of their sustainability performance once changes have been implemented and mapping them against further opportunities for improvement. Some tools exist to support companies, but they are often complex and costly and may require companies to enter their data into websites or submit them to third parties for analysis.

In addition to the cost of implementing or paying for commercial platforms and tools to assess circular opportunities, companies also encounter further limitations regarding i) privacy and confidentiality, ii) pertinence, and iii) technical expertise needed to assess sustainability and circularity opportunities.

In terms of privacy, many businesses strongly prefer not to share sensitive information and considerable amounts of data with third-party organisations to protect their competitiveness. However, organisations and companies providing circularity tools and services can sometimes demand and use clients' submitted information to provide aggregated statistics and trends [4], which businesses might want to keep private.

Regarding pertinence, the wide variety of business models across companies of different sizes, markets, and natures means that businesses often require tailored solutions that are not readily available or easily adaptable to their specific needs.

Lastly, the transition to new circular business models is a complex process that requires a deep understanding of the evolving nature of the tools and technology available. It also requires the expertise to design, implement, and evaluate innovative business models. Recognising this, companies need additional guidelines and information to ensure successful transitions and continued success.

With this goal in mind, we developed a free and open-source interactive application that guides practitioners in exploring and assessing their transition to more sustainable and circular business models. The tool constitutes an early

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stage and guided self-assessment exercise that can help businesses evaluate their current situation and potential for improvement through a simple and user-friendly interface. Once an initial self-assessment is completed, companies can use the information available in the tool to explore additional ways to measure and monitor circularity opportunities through more specific instruments at different levels beyond the organisational one, like products, departments or their supply chain.

Our digital tool ensures the privacy and confidentiality of the information by allowing companies to deploy the application locally using the open-source and free software R [5]. This approach prevents the need for data sharing with third parties. Moreover, the open-source nature of the application enables companies to tailor the circularity tool to their own needs, especially if the pre-defined interface or parameters do not correspond to the company's nature, business model, or needs. As detailed in Section 5, we have made available the source code of the application along with a user-friendly parametrisation that supports organisations in either retail or manufacturing in adapting our tool to their specific needs. The application is also flexible enough that users can exclude features that are not applicable or relevant to their specific needs. SMEs can leverage this tool to run various "what-if" scenarios, providing sustainable solutions and insights. This capability supports the evaluation of uncertain strategies and facilitates more informed decision-making. Finally, the platform is also designed to inform and orient businesses regarding state-of-the-art circular business models and metrics.

Overall, the tool aims to inform and guide practitioners in exploring the drivers of their sustainability transition, to assess their present situation and the obstacles they need to overcome, and ultimately to help them explore the mechanisms that can be used to create sustainability and circularity at the company level. The tool incorporates the developed theoretical framework composed of seven elements of circularity, as presented in Fig. 1: sustainable materials, sustainable operations, eco-design, product stewardship, R-terms (such as reduce, reuse, repair, refurbish, remanufacture, etc.), strategic organisational positioning, and social aspects. Additionally, our application also points the user towards alternative instruments and metrics businesses can use to quantitatively and qualitatively assess their progress regarding circular business models and opportunities. By offering affordable digital solutions to help small and medium-sized businesses adopt more sustainable practices, we are ultimately supporting companies in a twofold circular and digital transformation journey.

This research has important managerial implications, as companies can immediately start using a low-cost, user-friendly, private, and confidential application to assess circular opportunities. Independently of companies' familiarity with circular business principles, managers can use the tool to evaluate or complement their knowledge regarding CBMs and circularity metrics. The assessment can initiate more exhaustive strategic plans at the organisational level to support the transition to more circular business models. Additionally, policymakers can use our conceptual framework and information tool to identify potential future regulatory avenues.

The rest of the paper is organised as follows. Section 2 briefly presents some related work focusing on CBMs and circularity tools. Section 3 describes our mixed-method research approach, and Section 4 presents the key elements of circularity incorporated in our web application. Finally, Section 5 presents some technical aspects of our tool to assess circular opportunities, and Section 6 closes with the final discussion, conclusions and future work.

2. Related work

Circular practices and CBMs have recently gained growing attention, as consumers are increasingly aware of the need for more sustainable practices, and companies are preparing for the EU legislation being introduced under the EU Green Deal [6].

CBMs are closely related to the broader concept of the Circular Economy (CE), which is a response to unsustainable production and consumption of the traditional linear model of "take-make-consume-discard" [7]. The CE is an economic model focused on reusing resources throughout a product's lifespan, from extraction to end-of-life solutions, replacing the linear 'cradle-to-grave' approach with the circular 'cradle-to-cradle' vision.

Despite the recognition of the Circular Economy and CBMs, businesses across all sectors and sizes continue to struggle with the comprehensive nature of more circular ecosystems. A significant burden in this transition is the persistent lack of consensus on the effective measurement of circular business practices and economic systems [8]. Recent academic reviews consistently highlight the intricate nature of the distinctive elements and methods for measuring circularity. Two recent reviews of circularity metrics and assessment tools [8], [9] found little consensus in the proposed metrics and frameworks to assess circularity, and most tools are limited to specific applications.

A critical aspect involves the target level of measurement or applicability, which is sometimes classified in the literature as macro, meso, micro and nano levels [10]. *Macro* usually refers to large geographical units like countries or regions, *meso* to sub-units within a well-defined geographical unit like a sub-region or industrial park, *micro* to business or organisation, and *nano* to the product level. Our research objective and target organisations imply that our tool is specifically designed for the micro-level category, with a particular emphasis on SMEs.

Additional key features of tools and metrics used to assess circularity, as discussed in the literature, include

measurement typology (quantitative, qualitative, etc.), ownership (government, private, non-governmental organisation, etc.), licence type (commercial, non-commercial, etc.), organisation type (production, services, etc.), language availability, interface, among others.

We consider that sustainability tools should be made widely accessible to achieve fast and large-scale implementation of circular practices. This is why we have developed a tool that facilitates wider adoption via a flexible, open-source, and free digital solution. Both quantitative (e.g., the percentage of recycled materials used) and qualitative metrics (for instance, relating to the company's social impact) can feed into the visualised assessment scores. Our digital tool can run online or locally and can be adapted to business needs and different organisation types. It is available in English and allows worldwide access. We have provided additional guidance in the application interface to assist users and organisations in understanding and familiarising themselves with the tool and the concepts of CBMs, sustainability, and circularity metrics in general.

3. Methodology

The digital tool we present here resulted from a mixed-method study on the adoption and implementation of circular business models in retail and associated manufacturing. We started by conducting a systematic literature review on CBMs [11]. Based on the reviewed CBMs, we identified the main mechanisms companies use to create circularity, the underlying reasons and motivations why companies prioritise circularity, and the main barriers they must overcome.

We also examined the leading metrics and measurement frameworks for assessing sustainability and circularity performance, focusing on organisations and businesses at the *micro* level. Our findings show that sustainability and circularity are complex to implement and measure. Companies need additional guidance and tools to measure, monitor, and communicate their genuine commitment to more sustainable economic models. Furthermore, there is little consensus on how to effectively assess circularity at the organisational (micro) level [8].

Based on our initial qualitative research, we developed a novel framework organising the elements, mechanisms, and practices that contribute to achieving more circular and sustainable business models, which we summarise in Fig. 1. We used this framework to create a low-cost digital tool, which represents a practical solution companies can use to self-assess their circularity and sustainability and explore opportunities for implementing CBMs. We designed the tool with the idea that it could complement other strategies or instruments SMEs use to monitor their sustainability or implementation of CBMs

The following two sections describe the elements of our circularity framework and the tool we developed, respectively.

4. Elements of circularity

The core concept at the centre of the framework is the goal of achieving circularity, which aligns with the aim of companies adopting more circular business models. There is limited consensus on which elements, mechanisms, or practices can contribute or must be included to create circularity. Striving to create structure and following a systematic literature review by Frei et al. [11], we developed a framework organising them into seven categories, each representing a crucial aspect of circularity. They contain different mechanisms that allow companies to build circularity in the retail and manufacturing context. The categories are as follows: i) sustainable materials, ii) sustainable operations, iii) eco-design, iv) product stewardship, v) R-terms (or R-strategies [1]), vi) strategic organisational positioning, and vii) social aspects, as illustrated in Fig. 1. Appendix 1 briefly describes each category and the different mechanisms which are adaptable to business-specific sectors.

Surrounding these seven categories are external and macro-factors that define the environment in which companies exist and influence the adoption and success of more circular business models:

- Government policies, regulations, laws, taxes: Companies' actions depend highly on the regulatory context, public policies, and the overall financial incentives underlying their operations.
- Customer demand and attitudes: Consumers increasingly hold companies accountable and demand more sustainable, responsible and ethical business practices.
- Innovation in technologies and services: Technological innovation often enables more sustainable practices and better services.
- Pressure from shareholders or business owners: Beyond the pressure to generate financial returns, shareholders and owners expect companies to operate sustainably, ethically, and responsibly.

Our framework highlights the multidimensional approach needed for retailers and manufacturers to transition towards CBMs. It emphasises collaboration, sustainability, innovative design, responsible material sourcing, and the

[1] We follow Circularise "R-Strategies for a Circular Economy" which provides a simple classification into design, consumption and end-of-life phases[13].

integration of social and operational aspects. The external influences stress the importance of supportive public policies, market conditions, technological innovation, and stakeholder expectations in driving circularity.

Fig. 1. A framework for sustainability and circularity in retail and manufacturing

5. Circularity tool

We developed an interactive web application written in R, an open-source and free programming language for statistical computing and data visualisation [5]. We designed the tool using R's Shiny package [12]. Our tool allows companies to assess and explore sustainability and circularity opportunities in a secure, user-friendly, confidential web application.

The Shiny package allows web applications to be deployed locally using R's free software, but it is also conceived to be available like any other web or mobile application. Key features include local deployment, a web interface that allows the user to specify the conditions under which computations are executed with minimal coding required, and visualisations rendered through input variables. The tool is available as an open-source licence for non-commercial use.

The digital tool can be accessed online at https://bit.ly/3SwdCE8 or downloaded for local deployment via https://bit.ly/4fxlZJx. The latter requires R and the Shiny package to be installed on a computer with any standard operating system. Once downloaded, the user can unzip and

run the app using the app.R file.[2] Appendix 2 provides a more detailed and technical description of the application's content and structure.

Our circularity metric is a guided self-assessment tool in which businesses evaluate their progress in the seven elements of circularity from 0 to 100. Where 0 translates into no progress in the specific dimension, and 100 implies an optimal level of achievement based on the company's potential. Although the evaluation process would typically be led by a single individual or department within an organisation, the inputs and evaluation process should be aligned throughout the organisation.

As displayed in Fig. 1, each element includes different sub-components that together can provide overall progress in each of the seven dimensions. Thus, our tool comes with a pre-defined set of 45 sub-components identified through extensive research and a thorough literature review. Importantly, our tool is flexible and adaptable, allowing businesses to modify the number of sub-components and the individual metrics (names) attached to them. This will enable companies of different sizes, markets and sectors to adjust the tool to their specific needs and particular business models. To ensure consistency, each sub-component is measured on a scale from 0 to 100. The tool also allows companies to add additional elements of circularity beyond the ones incorporated in Fig. 1.

We allow two main approaches for using the circularity tool (described in the "How to Use" section of the user manual attached to the tool). The recommended option involves, after assessing the interface (locally or through our web interface), the following simple four steps:

- Navigate to the "Calculate" window.
- Input the values for each sub-component within each dimension. The tool allows the user to exclude those not applicable to the business.
- Calculate the inputs by clicking 'Calculate Inputs' to compute the scores for each dimension using a simple arithmetic mean.
- Access the generated circularity chart on the 'Circularity Metric' page using the navigation bar. This chart can be downloaded as a Portable Network Graphic for record keeping or further use.

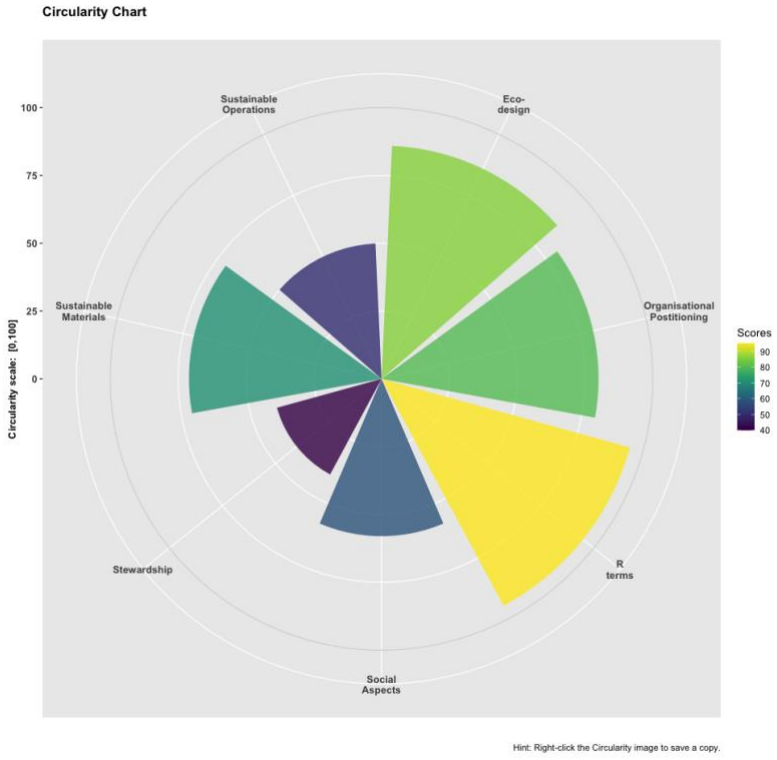

Fig. 2. Circularity Radar chart example

[2] Additional guidance on running a Shiny application can be found here: https://shiny.posit.co/r/getstarted/shiny-basics/lesson1/index.html.

An alternative option allows companies that already have a complete assessment of each of the seven elements of circularity to skip steps 1 to 3 by directly going to the 'Circularity Metric' page using the navigation bar and using the slider to provide the score in each of the seven elements of circularity that responsively update the circularity radar.

As a practical example, Fig. 2 illustrates the output of a circularity chart that can be produced with the tool. In this example, we have simulated a hypothetical SME's assessment in which, for example, the organisation obtained the highest score in the R-terms or R-strategies dimension because they have implemented a well-functioning system for repairing, remanufacturing and reselling their products, which are made with recycled materials. The evaluation involves assigning a score from 0 to 100 in each sub-component in this dimension, which includes i) Reuse, ii) Rethink, iii) Reduce, iv) Reuse, v) Repair, vi) Refurbish, vii) Remanufacture, viii) Repurpose, ix) Recycle, and x) Recover (see Appendix 1 for details). For additional guidance, the Circularity Radar further groups the sub-components into three categories: design, consumption, and end-of-life phase, as proposed by [13]. On the other hand, the example organisation scored lowest in the product stewardship dimension for this illustrative example, as they do not sufficiently support some of these strategies. The Circularity Radar's stewardship sub-components include i) Renting, Leasing, and Sharing, ii) Maintenance, iii) Enabling repair and upgrade, iv) Reducing returns and obsolete stock and v) Product as a service (see Appendix 1 for details). Our example company does enable repairs and maintenance, but does not offer leasing, renting or product-as-a-service options. They also identify opportunities to improve their management of product returns and obsolete stock, by engaging in secondary market channels.

Overall, the circularity chart provides a visual aid in the form of a radar plot. It displays the seven elements of circularity on a scale from 0 to 100, using an adaptative colour scale that automatically adjusts based on the minimum and maximum values obtained in the seven dimensions. The chart offers a comprehensive picture of the company's strengths and weaknesses in its operations, helping to guide strategic decisions. For instance, suppose a small company receives the lowest score in sustainable operations. In that case, the tool can provide valuable insights into aspects that require improvement by examining the sustainable operations' sub-components and highlighting the areas where they need to focus their efforts. The tool also highlights the strongest areas and visualises how far SMEs are from reaching their full potential.

Finally, companies can use this initial assessment to explore additional steps for future sustainable development, such as additional instruments or strategies needed to advance in the circularity transition. Our tool has a dedicated tab that presents alternative tools and circularity metrics to direct users towards further reading and best practice guidance to assess their progress regarding more CBMs. To improve accessibility, we have selected non-commercial tools that are available in multiple languages. SMEs can find information, including a brief tool description, measurement typology, ownership, languages, and useful links.

6. Conclusions and future work

We urgently need to reconsider how we design things, source materials, make products, use and reuse them, and what happens to them at the end of their (first) lifecycle. Transitioning to more sustainable and CBMs is not just a long-term and future goal but an urgent need. Yet, we are still behind in large-scale and worldwide implementations. Given the complexities involved in achieving circularity, businesses require additional guidance and tools to implement measurable changes effectively.

In this paper, we propose a theoretical framework for achieving circularity and its implementation in a digital tool that can assist SMEs and practitioners in retail and manufacturing industries in assessing their sustainability transition. Companies can use our literature review [11] to reflect on the drivers of their transition towards circularity and to identify which obstacles they need to overcome when implementing a CBM.

The interactive web application can assist companies in assessing the mechanisms for achieving circularity. Once an initial self-assessment of the status quo is completed, they can strategise on what additional mechanisms they may want to implement to increase their circularity score.

Furthermore, companies can use the tool to explore additional ways to measure and monitor circularity opportunities through more specific instruments at different levels below and above the organisational one, including product level, interfirm level, industrial parks, and supply chain, among others.

Our study also contributes to the CBM literature by categorising and transforming the parameters and elements identified in the circularity literature into a practical and accessible digital tool, moving beyond theoretical discussions.

This research also has important implications for managers, as it enables companies to begin using a low-cost, private, and confidential application to assess circular and sustainable opportunities. Similarly, policymakers can employ our conceptual framework to identify and guide future regulatory opportunities.

A current limitation of the Circularity Radar is that it provides guidance on which circularity and sustainability

dimensions the user should assess, but it does not yet define standards for how each dimension should be scored; for instance, what constitutes a poor, average, good or outstanding implementation of refurbishing? Our ongoing work examines how to define systematic scoring scales.

Future versions and iterations of the tool should also promote research, discussions and analysis that lead to consensus on the best practices for measuring, monitoring, and communicating more sustainable models. One way is to incorporate widely recognised and low-cost tools, like the Ellen MacArthur Foundation's "Circulytics" case, which provides a framework of indicators for tracking circular economy performance [14], into the application.

Moreover, the tool's self-assessment nature at this stage allows the user broad discretion, which could affect honest and realistic implementations. We consider that tools like the one we propose should evolve into more quantitative-based metrics, maintaining some flexibility to facilitate and incentivise their implementation. Nevertheless, we also believe that proposing a flexible initial assessment through our digital tool is a valuable starting point for businesses, especially those facing additional financial or operational constraints like SMEs.

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8. References

[1] W. R. Stahel, "The circular economy," *Nature*, vol. 531, no. 7595, pp. 435–438, 2016, doi: 10.1038/531435a.

[2] D. Zhang, R. Frei, G. Wills, E. Gerding, S. Bayer, and P. K. Senyo, "Strategies and practices to reduce the ecological impact of product returns: An environmental sustainability framework for multichannel retail," *Bus Strategy Environ*, vol. 32, no. 7, pp. 4636–4661, 2023, doi: https://doi.org/10.1002/bse.3385.

[3] N. K. Sharma, K. Govindan, K. K. Lai, W. K. Chen, and V. Kumar, "The transition from linear economy to circular economy for sustainability among SMEs: A study on prospects, impediments, and prerequisites," *Bus Strategy Environ*, vol. 30, no. 4, pp. 1803–1822, 2021, doi: https://doi.org/10.1002/bse.2717.

[4] "About Circulytics | Ellen MacArthur Foundation." Accessed: Jul. 25, 2024. [Online]. Available: https://www.ellenmacarthurfoundation.org/resources/circulytics/overview

[5] R Core Team, "R: A Language and Environment for Statistical Computing," 2022, *Vienna, Austria*. [Online]. Available: https://www.R-project.org/

[6] "The European Green Deal - European Commission." Accessed: Jul. 25, 2024. [Online]. Available: https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en

[7] D. Brozovic, "Business model based on strong sustainability: Insights from an empirical study," *Bus Strategy Environ*, vol. 29, no. 2, pp. 763–778, 2020, doi: https://doi.org/10.1002/bse.2440.

[8] K. Valls-Val, V. Ibáñez-Forés, and M. D. Bovea, "How can organisations measure their level of circularity? A review of available tools," *J Clean Prod*, vol. 354, p. 131679, 2022, doi: https://doi.org/10.1016/j.jclepro.2022.131679.

[9] M. C. Chrispim, M. Mattsson, and P. Ulvenblad, "The underrepresented key elements of Circular Economy: A critical review of assessment tools and a guide for action," *Sustain Prod Consum*, vol. 35, pp. 539–558, 2023, doi: https://doi.org/10.1016/j.spc.2022.11.019.

[10] M. Saidani, B. Yannou, Y. Leroy, F. Cluzel, and A. Kendall, "A taxonomy of circular economy indicators," *J Clean Prod*, vol. 207, pp. 542–559, 2019, doi: https://doi.org/10.1016/j.jclepro.2018.10.014.

[11] R. Frei *et al.*, "Circular Business Models in Retail: Mechanisms, Drivers, and Barriers," Submitted to: Journal of Cleaner Production., 2024.

[12] W. Chang *et al.*, "shiny: Web Application Framework for R," 2024. [Online]. Available: https://CRAN.R-project.org/package=shiny

[13] "R-Strategies for a Circular Economy." Accessed: Sep. 03, 2024. [Online]. Available: https://www.circularise.com/blogs/r-strategies-for-a-circular-economy

[14] "Circulytics: Measuring circular economy performance." Accessed: Jul. 25, 2024. [Online]. Available: https://www.ellenmacarthurfoundation.org/resources/circulytics/resources

Appendix 1

Elements and sub-component of the framework for sustainability and circularity in retail and manufacturing:

Strategic Organizational Positioning:

- **Intra-organizational collaboration:** Coordinated efforts and communication within different departments to promote circular practices.
- **Senior management commitment:** Active involvement and support from top management is crucial for implementing and sustaining circular business strategies.
- **Inter-organizational collaboration (with suppliers and others):** Collaborating with external stakeholders, including deep-tier suppliers, to promote a more circular economy.

- **Partnership with customers:** Engaging with customers to understand their needs and encouraging them to participate in circular initiatives.
- **Long-term contracts:** Establishing lasting agreements with partners to ensure stability and long-term cooperation in circular practices.

Product Stewardship:

- **Reduce returns and obsolete stock:** Minimizing wasteful product returns and optimising excess inventory effectively to reduce waste. It also involves better returns service models, e.g., implementing efficient systems for handling product returns to maximise value recovery, enabling new pathways for returned items, and preventing product returns from happening in the first place.
- **Enable repair and upgrade:** Providing options for repairing or upgrading products to extend their lifespan.
- **Renting, leasing, and sharing:** Offering products as rentals, leases, or through sharing models to optimise resource use (e.g., Facilitating the resale of used, unwanted or unfit-for-purpose products to extend their lifecycle through secondary markets).
- **Maintenance:** Providing services to enhance the durability and functionality of products.
- **Product as a service:** Shifting from selling products to providing them as services, focusing on usage rather than solely ownership.

R Terms or Strategies:

- **Reuse (Design Phase):** Utilizing products or materials more than once.
- **Rethink (Design Phase):** Re-evaluating current productive practices to integrate circular principles, including both product designs and business models (e.g., through an access-based model or economy).
- **Reduce (Design Phase):** Minimizing resource use and waste generation.
- **Reuse (Consumption Phase):** reusing products when conditions are adequate (e.g., second-hand markets).
- **Repair (Consumption Phase)**: Fixing products to extend their usability.
- **Refurbish (Consumption Phase):** Renovating and restoring used products for resale or secondary markets.
- **Remanufacture (Consumption Phase)**: Rebuilding products to like-new condition.
- **Repurpose (Consumption Phase):** the use of discarded products or parts in alternative products.
- **Recycle (End of life):** Converting waste into reusable materials.
- **Recover (End of life):** Extracting valuable materials or components from waste.
- **Refuse (Additional - Design Phase):** Avoiding products or practices that are unsustainable, like excessive and fraudulent product returns.
- **Redesign (Alternative - Design Phase):** Creating products with circularity in mind, emphasising sustainability and resource efficiency.
- **Regift (Additional - End of life):** Allowing social platforms to facilitate passing on unwanted items to others who can use them.

Social Aspects:

- **Supporting communities:** Engaging in activities that benefit local communities and promote environmental awareness.
- **Equitable employment:** Ensuring fair labour practices that incorporate the highest standard in terms of labour and human rights conventions.
- **Equitable sourcing:** Procuring materials and services in a manner that supports fair trade and ethical practices.

Sustainable Materials:

- **Locally sourced:** Using materials from local suppliers to reduce transportation emissions and support local economies.
- **Biodegradable:** Choosing materials that can break down naturally without minimal environmental harm.
- **Recycled:** Using materials that have been used to create new products.
- **Recyclable:** Selecting materials that can be reprocessed and reused in the new and circular production cycle.
- **Responsibly sourced:** Ensuring materials are obtained in an environmentally and socially responsible manner.

Sustainable Operations:

- **Restorative, regenerative:** Adopting practices that restore and regenerate natural systems.
- **Sustainable logistics:** Transportation and distribution to minimise environmental impact.
- **Sustainable manufacturing:** Implementing production processes that reduce waste and conserve resources.
- **Sustainable energy:** Utilizing renewable energy sources and improving energy efficiency.
- **Avoiding waste:** Implementing strategies to minimise waste generation across companies' operations and supply chains.

Eco-Design:

- **Upcyclable:** Designing products that can be creatively reused or repurposed.
- **Easy dismantling:** Creating products that can be easily taken apart for reuse, repair, recycling, etc.
- **Modular, upgradeable:** Designing products with interchangeable parts that can be upgraded or replaced for upgrading.
- **Repairable:** Designing products that can be easily repaired to extend their life.
- **Extending life cycle (durability):** Ensuring products are long-lasting and have a prolonged functional lifespan through various strategies.

Appendix 2

We provide a more detailed and technical description of the application's structure below:

Libraries and packages:

- The core package to run the application is “shiny.” We also use the following packages: “shiny themes” (appearance), “tidyverse” (data manipulation and plots), and “Cairo” (graph quality), which provide the necessary tools to support the UI, radar chart, and data manipulation.
- User-driven customisation and extensions: The code allows the user to define or rename the dimension and sub-components, allowing different organisations to tailor the application if necessary.

UI Structure:

- Navbar Layout: The app uses a “navbarPage” layout, which organises the interface into multiple tabs.
- Tabs include a combination of Shiny’s “titlePanel,” “fluidPage,” and “sidebarLayout” that describe the app content, explaining the page’s purpose and providing user guidance regarding the tool.

Server Logic:

- The server function contains reactive expressions and observers to process user inputs, calculate dimension-specific scores, generate radar charts, and update the UI based on dynamic interactions.
- The app uses reactive values to manage state, store inputs, calculate scores based on sub-components and update visualisations dynamically.
- The application also allows dynamic sliders if the user wants to manually adjust or update the dimensions' values.

Customisation:

- The source code includes detailed comments explaining various sections, particularly around the customisation of input names, variable lists, and visual components. These comments help users understand how to modify the app to suit specific needs.