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CIRCULARITY INDICATORS AND TOOLS FOR PRODUCT DESIGN: A WEB-BASED VISUALIZATION AND SELECTION TOOL

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DESIGN TOOL SHOWCASE

A new add-on for facilitating and monitoring circular product design is made available on the c-indicators web-platform: <https://c-indicators.000webhostapp.com/index.php>. This online platform, including two web-based tools – the C-Indicators Advisor and the Circularity Potential Indicator – has been first introduced during the 2019 edition of the Design Tool Showcase [1]. Meanwhile, the number of circular economy indicators (covering different aspects and scales of the circular economy) continued to rise, leading both to utility and fuzziness for industrial practitioners. Among this plethora of recently developed circularity indicators, it is key to identify the ones that are particularly adapted to be deployed during the design process to foster design for circularity, as a means of operationalizing sustainability in product development. While a previous contribution started to investigate the potential value of applying four circular economy-related indicators during the design process to augment the circularity potential of products [2], the present research is more systemic and identified twelve product-focused c-indicators coming with computational tools that could be insightful and practical during the design process.

To support designers and engineers in the selection of adequate product-centric c-indicators, these twelve *ad hoc* c-indicators are mapped on a generalized five-step engineering design process (x-axis), including: (i) requirements definition, (ii) conceptual design, (iii) detailed design, (iv) designs comparison, and (v) product monitoring and communication [3]. Also, these c-indicators and their associated assessment tools are ranked according to their level of complexity or time required to be computed, in order to further inform designers or engineers,

who might use such tools for the first time, on their usability and user-friendliness. To facilitate the identification, selection, and deployment of *ad hoc* product-level c-indicators, a visualization web-based tool is proposed, mapping on an interactive two-dimensional chart these c-indicators. This web-based application has been developed using the JavaScript library React. The user interface and interactive chart have been implemented using Plotly: <http://circulareconomyindicators.com/design.php>. This web-based app is expected to be linked with an updated version of the database of circular economy indicators from the C-Indicators Advisor, as well as to provide and display infoboxes (and use cases, if any) for selected c-indicators.

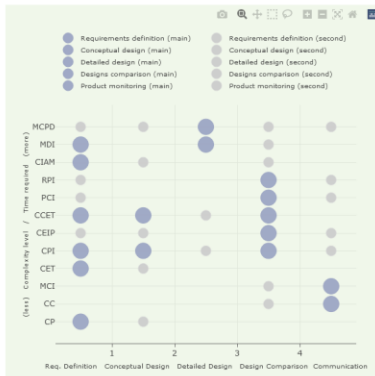
During the 2021 Design Tool Showcase, concrete examples – using e.g., the Circularity Potential Indicator (CPI), the Circular Economy Indicator Prototype (CEIP), or the (Circularity Calculator) CC – will be given on how these c-indicators can guide the circular design of products at different steps of the design process. Promising perspectives for future research will also be discussed and illustrated, such as the integration, compatibility, and combination of c-indicators with other design methods and tools, like life cycle assessment software or computer-aided design programs.

Keywords: Design for circular economy, circularity indicators, product design, design process, web-based tool.

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ILLUSTRATIONS OF THE TOOL

C-Indicators with tools mapped along the Product Design Process



www.circulareconomyindicators.com/design.php

NOMENCLATURE

CC	Circularity Calculator
CCET	Concept Circularity Evaluation Tool
CEIP	Circular Economy Indicator Prototype
CET	Circular Economy Toolkit
CIAM	Circular Index from CirculAbility Model
CP	Circular Pathfinder
CPI	Circularity Potential Indicator
MCI	Material Circularity Indicator
MCPD	Material Circularity in Product Design
MDI	Material Durability Indicator
PCI	Product Circularity Indicator
RPI	Reuse Potential Indicator

REFERENCES

[1] Saidani, M., Kim, H., Yannou, B., Leroy, Y., and Cluzel, F., 2019, "C-indicators: a web-based platform to monitor and improve the circularity potential of products," ASME 2019 International Design Engineering Technical Conferences and Computers and Information in Engineering Conference IDETC/CIE2019.

[2] Saidani, M., Kim, H., Cluzel, F., Leroy, Y., and Yannou, B., 2020, "Product circularity indicators: what contributions in designing for a circular economy?" Proceedings of the Design Society: DESIGN Conference, 1, pp. 2129-2138, Cambridge University Press.

[3] Saidani, M., and Kim, H. (2021, August). Design for Product Circularity: Circular Economy Indicators With Tools Mapped Along the Engineering Design Process. In International Design Engineering Technical Conferences and Computers and Information in Engineering Conference (Vol. 85413, p. V005T05A008). American Society of Mechanical Engineers