

Developing a Product Circularity Index with an Emphasis on Longevity, Repairability, and Material Efficiency

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Abstract : In response to the global imperative for sustainable solutions, this article proposes the development of a comprehensive circularity index applicable to a wide range of products across various industries. The absence of a consensus on using a universal metric to assess circularity performance presents a significant challenge in prioritizing and effectively managing sustainable initiatives. This circularity index serves as a quantitative measure to evaluate the adherence of products, processes, and systems to the principles of a circular economy. Unlike traditional distinct metrics such as recycling rates or material efficiency, this index considers the entire lifecycle of a product in one single metric, also incorporating additional factors such as reusability, scarcity of materials, reparability, and recyclability. Through a systematic approach and by reviewing existing metrics and past methodologies, this work aims to address this gap by formulating a circularity index that can be applied to diverse product portfolio and assist in comparing the circularity of products on a scale of 0%-100%. Project objectives include developing a formula, designing and implementing a pilot tool based on the developed Product Circularity Index (PCI), evaluating the effectiveness of the formula and tool using real product data, and assessing the feasibility of integration into various sustainability initiatives. The research methodology involves an iterative process of comprehensive research, analysis, and refinement where key steps include defining circularity parameters, collecting relevant product data, applying the developed formula, and testing the tool in a pilot phase to gather insights and make necessary adjustments. Major findings of the study indicate that the PCI provides a robust framework for evaluating product circularity across various dimensions. The Excel-based pilot tool demonstrated high accuracy and reliability in measuring circularity, and the database proved instrumental in supporting comprehensive assessments. The PCI facilitated the identification of key areas for improvement, enabling more informed decision-making towards circularity and benchmarking across different products, essentially assisting towards better resource management. In conclusion, the development of the Product Circularity Index represents a significant advancement in global sustainability efforts. By providing a standardized metric, the PCI empowers companies and stakeholders to systematically assess product circularity, track progress, identify improvement areas, and make informed decisions about resource management. This project contributes to the broader discourse on sustainable development by offering a practical approach to enhance circularity within industrial systems, thus paving the way towards a more resilient and sustainable future.

Keywords : circular economy, circular metrics, circularity assessment, circularity tool, sustainable product design, product circularity index

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