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Entitled

INVESTIGATION AND ANALYSIS OF CIRCULAR ECONOMY INDICATORS IN THE MANUFACTURING INDUSTRY

by

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Abstract

In the pursuit of sustainable development, the concept of the circular economy (CE) has emerged as a compelling and transformative alternative to the traditional linear economic model (i.e., take, make, use, dispose). The limitations of the linear economy in addressing contemporary global challenges have highlighted the urgency of adopting a more regenerative approach. Simply put, the circular economy aims to maximize the value extracted from available resources over their lifecycle, thereby ensuring the fulfillment of both current and future generations' needs. This thesis sheds light on a pivotal solution for effectively integrating circular economy principles into enterprises, thereby reinforcing sustainability. The principal objective of this thesis is to comprehensively explore and analyze key performance indicators (KPIs) associated with the circular economy, specifically within the manufacturing industry. This research serves as a valuable compass for the manufacturing sector, encapsulating KPIs that holistically embrace the triple bottom lines of sustainability: environmental, economic, and social dimensions. The framework for this guideline is meticulously constructed through a systematic process that involves the judicious selection of pertinent KPIs. Furthermore, the interrelationships among these selected KPIs are meticulously examined through an exhaustive literature review. Additionally, the study employs Social Network Analysis (SNA) to ascertain centrality measures, thereby identifying the most influential circular economy KPIs within the manufacturing industry. Drawing from the core findings, this thesis furnishes actionable recommendations for manufacturers and stakeholders to optimize the identified significant KPIs effectively. The current work presents promising outcomes by leveraging SNA within the proposed framework. Noteworthy KPIs that encapsulate various facets of circular economy development are identified within each perspective. In the realm of environmental aspects, the significant KPIs encompass product/design upgradability (PU), material efficiency (ME), eco-innovation (EI), solid waste intensity (SW), and pollutant emissions (PE). From an economic standpoint, pivotal KPIs include the productivity of remanufacturing (OR), economic motivation (EM), product level circularity metric (PM), technology investment (ROR), and sorting process (SP). Addressing the social dimension, the significant KPIs encompass social fairness (SF), strategies and initiatives (SI), remanufacturing training (RT), community complaints (CC), and documentation of products (DP). The comprehensive analysis of these fifteen KPIs culminates in aggregated circular economy indicators, primarily strategies and initiatives (SI), material efficiency (ME), productivity of remanufacturing (OR), technology investment (ROR), and eco-innovation (EI). Notably, the research offers practical industrial recommendations derived from an extensive literature review to optimize these aggregated KPIs. This thesis significantly highlights manufacturers' influence on shaping a sustainable future aligned with development goals. Its proposed guidelines and results rectify gaps in current circular economy frameworks.

Keywords: Circular Economy, Social Network Analysis, Key Performance Indicators, Sustainable Development, Manufacturing, Triple Bottom Lines of Sustainability.