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Investigating factors impairing information exchange in a Circular Economy from a stakeholder perspective

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One of the defining characteristics of the Circular Economy is postulating the closure of material loops *by intention and design* throughout the entire life-span of a product (Geissdoerfer et al., 2017). This has far-reaching implications, since it affects all stakeholders involved in the entire product life-cycle, and as a consequence, businesses in the entire forward and reverse supply chain, consumers, municipalities, governments, and international organizations become conceivable actors in the CE. The implementation of this ambitious, sector over-arching vision requires near real-time knowledge of the state of materials, components, and products across the entire life cycle of physical assets, extensive coordination between stakeholders, and timely decision-making to determine the next step in the life cycle of products and materials.

Given the above, the need for a data-driven, information sharing approach is evident. Data to suitably contextualise products need to be collected throughout their entire life-cycle and made accessible to different stakeholders, such as manufacturers, consumers, repairers, or recyclers. Moreover, especially manufacturers can leverage this kind of data to optimize their production processes with respect to energy consumption and emissions. This poses a range of issues, spanning from data exchange and storage, to data interoperability, trust, and privacy (Kintscher et al., 2021; Rossi et al., 2020). Other less technical issues, such as the lack of incentives to share data, or the lack of digital skills by the workforce have also been raised (Šipka & Hedberg, 2021).

Understanding the practical aspects of digital information exchange in a CE ecosystem is important for a range of actors. Businesses making the transition to a CE are faced with fundamental decisions regarding their strategy, digital transformation and organizational structure. Investing in a business model when the company is unable to support the necessary communication channels with other organizations can have profound consequences for its viability (Gollhardt et al., 2020). Similarly, policymakers and governments should be mindful of the actual state of digital data exchange between stakeholders in the CE, otherwise their policy interventions may not adequately influence business practices in order to achieve CE targets (Milios, 2021).

Driven by the aforementioned necessities, in this paper we investigate the factors that can impair information exchange in a Circular Economy, directing our focus to the vantage point of a stakeholder participating in a Circular Economy network through an integrative literature review. Through this stakeholder-centric approach, we frame the existing problem of sharing information between entities in the context of both the *capabilities* and the *benefits* of organizations to exchange information. The aim of this approach is to provide a conceptual framework to categorize these factors along two dimensions, namely the *degree of control* that organizations have to

address a factor, and the *importance for exchanging information* related to this factor for an organization. This results in a framework consisting of four quadrants, where each factor can be positioned according to its CE information-exchange characteristics relative to the organization, as depicted in Figure 1:

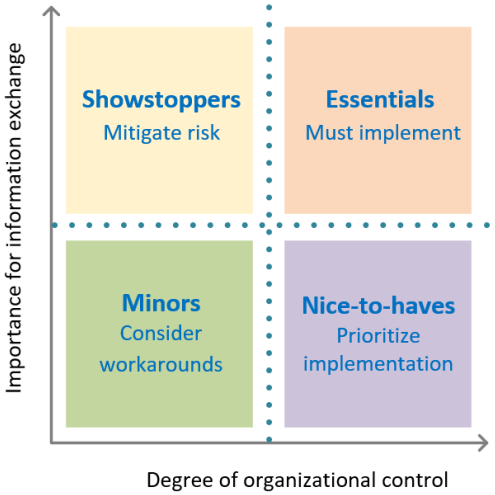

Figure 1: Stakeholder-centric conceptual framework for the categorization of factors impairing information exchange in CE

The four quadrants are indicative of the strategy that an organization should pursue to address the contained factors. For instance, a factor which fully falls under the responsibility of an organization and is crucial for exchanging information, such as i.e., the adequacy of an organization's technical infrastructure, is labelled as an *essential* factor and *must* be properly addressed by the organization in order to exchange information in a CE. On the other end, a factor where the organization has little influence and may marginally contribute to meaningful information exchange is characterized as a *minor*, and an organization can consider designing workarounds to address it.

The framework can be of value to different CE stakeholders; practitioners could gain insight into which specific factors adversely affect information exchange and thus prioritize mitigation strategies or adjust their business models; accordingly, policymakers could better identify the bottlenecks of inter-organizational communication in a CE, thereby offering targeted measures for improving CE information and material flows also from a macroscopic vantage point.

Key words: information exchange; business strategy

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