

Perspective

Challenges and Paradoxes in Researching in Circular Economy

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Abstract

Shaping and researching the circular economy involves multiple paradoxes and challenges hardly manageable by a single researcher or practitioner. This perspective argues for taking a more systemic viewpoint and multiple level perspective in order to better interlock skills. A systemic design of circular economy research requires multi-stakeholder collaboration and new opportunities for intervention.

Keywords: CE, Circular Economy, Challenges, Multi-level, Paradoxes, Skills, Systems Effects

1. CE INTRODUCTION

What systemic skills are necessary for CE researchers aiming to enable real-life societal change? A circular economy (CE) aims to create a resilient system (Greer et al., 2021). It needs an ongoing stipulation considering products not waste as long as they circular value. The circular value proposition is closely linked to the environmental, social and economic dimensions of sustainability to ensure sustainable circularity along the entire value chain, which often involves several economic sectors at the same time. In practice, single dimensions are neglected or enormous trade-offs need to be solved (Trento et al., 2021; Greer et al., 2021, Moreau et al., 2017). CE is often accompanied by various paradoxes and not fully reachable as reasons can be found in logistical, technical, material-related or economic ones (Stephan, 2022; Friedrich, 2020).

CE has many practical ways, e.g. lifetime extension, the avoidance of planned obsolescence, recyclability and reparability of products as a design component, reusable or deposit systems, sharing or alternative ownership models, by technical standards, etc. (see 13Rs, fig. 1). Following the 13Rs (adapted from Cheng, 2018, p. 66 – see fig. 1) is a good heuristic for fostering a circular economy. Being circular does not automatically mean sustainable - just as recyclable does not automatically mean recycled. In the case of complex products in which a large number of materials are used, recycling reaches its limits. Material wear and contamination through use and simply time also limit perfect recycling. Thermodynamics takes its toll, too: for many materials, the quality of the materials deteriorates during further processing - a constant supply of raw materials or new-value materials are needed. Other obstacles for businesses in developing marketable circular business models and innovations include a lack of access to key partners in key economic sectors, a lack of cooperation partners, insufficient cross-sector networking, product development cycles that are too long, missing or incompatible recycling systems, and a lack of access to knowledge (Moreau et al., 2017). Thus, CE researchers have a broad field of activities going beyond specific expertise. A major weakness is, CE research is often limited to particular disciplines, singular design principles or material classes although interdisciplinary and systemic perspectives and practical implementation in a net-worked field of action are necessary. This perspective reflects on systemic skills for CE researchers progressing change – personally experienced in research contexts.

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2. CE SKILLS

CE skills are closely linked to systems understanding (Toker and Görener, 2023). CE researchers often need a multi-level perspective, disciplinary and interdisciplinary knowledge operating in different roles, like analyst, moderator, knowledge keeper, process mediator, going beyond pure scientific tasks. (see fig. 1). Fulfilling these multiple roles (Arnold, 2021), systemic intervention is not easy as there are ongoing divergences of interests between CE research and practical progress. Sometimes CE researchers offer ground-breaking processes and technology for cascading uses of material and energy, but recyclable products are not sufficiently provided in practice, e.g. discarded batteries. Literature indicates various action points - up to now, CE needs political-legal, logistical, technical and human support (CEI, 2021; Moreau et al., 2017; see fig. 1). In fact, CE researchers often fail with their activities, because of the systemic impacts of changed business cases, as long as there is no consequent support by politics and global markets (Moreau et al., 2017; Hobson and Lynch, 2016).

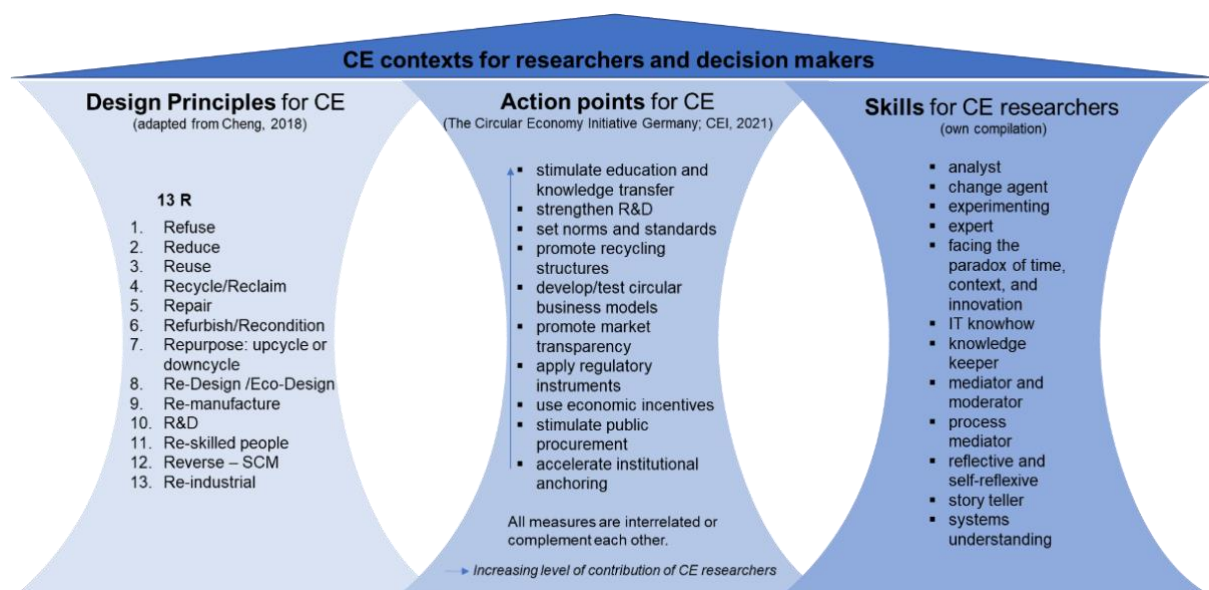


Figure 1 – Pivotal CE pillars for researchers and decision makers

Researching on design principles often means experimentation and monitoring various trade-offs, tensions and dilemmas (Greer et al., 2021) when transforming from linear to circular economy. Changing one of the 13Rs can have immense impact on other Rs. Quality losses or violations of standards limit change, too.

Compared to practitioners CE researchers can reflect criteria for complex strategic choices and have a wider or additional perspective on value chains and streams for linking new CE solutions (Trento et al., 2021), but are not fully bound to current business solutions. Inherent conflicts in transdisciplinary contexts are given: As CE researchers do not follow a clear business case, they offer radical re-design solutions than current efficiency options. Managers and CE researchers often face different understanding of CE, sustainability and CE solutions. This can end up at a glass ceiling in cooperation with practitioners. Conflicts also occur, when scientific CE ideas are monetarised by practitioners or buried if revenue streams are not quickly enough. A vivid network structure, integrating further business or initiating governmental support, is needed.

3. SHAPING CE SYSTEMICALLY

A clear understanding of **actors** and markets, value stream strategies, current and transition business models, power relations and system effects are necessary (see fig. 2; Toker and Görener, 2023; Chauhan

et al., 2022; Trento et al., 2021). Researchers have to think circular (fig. 2) and continuously face inherent rebounds, path dependencies, the paradoxes of contextualization, conservation or global/regional innovation conditions (Trento et al., 2021; Greer et al., 2021, Moreau et al., 2017; Arnold, 2021), which can only be addressed systemically. Aiming at the reduction of waste and resources in use as long as possible, CE is dependent on the production of new products and materials replacing end of life (Moreau et al., 2017). The transition from linear to circular business models is based on financial difficulties due to the costs and changed value capture strategies. A radical change in consumer behaviour is addressed (Corvellec et al., 2022), but might lead to a dramatic change in economy as sufficiency is not in line with current market mechanisms (Moreau et al., 2017; Hobson and Lynch, 2016). Besides, increasing the life span of a product through extended use may not necessarily reduce its overall environmental impact (Corvellec et al., 2022). Consequently, CE researchers have to address multiple strategies (Moreau et al., 2017), initiate network structures or clusters of multi-stakeholder cooperation – including stable partnerships with businesses and political decision-makers. Exemplarily, multi-stakeholder workshops or webinars including theory and examples can open up new perspectives in practice and governance. However, even CE scientists can be limited to their own research not recognising systemic linkages.

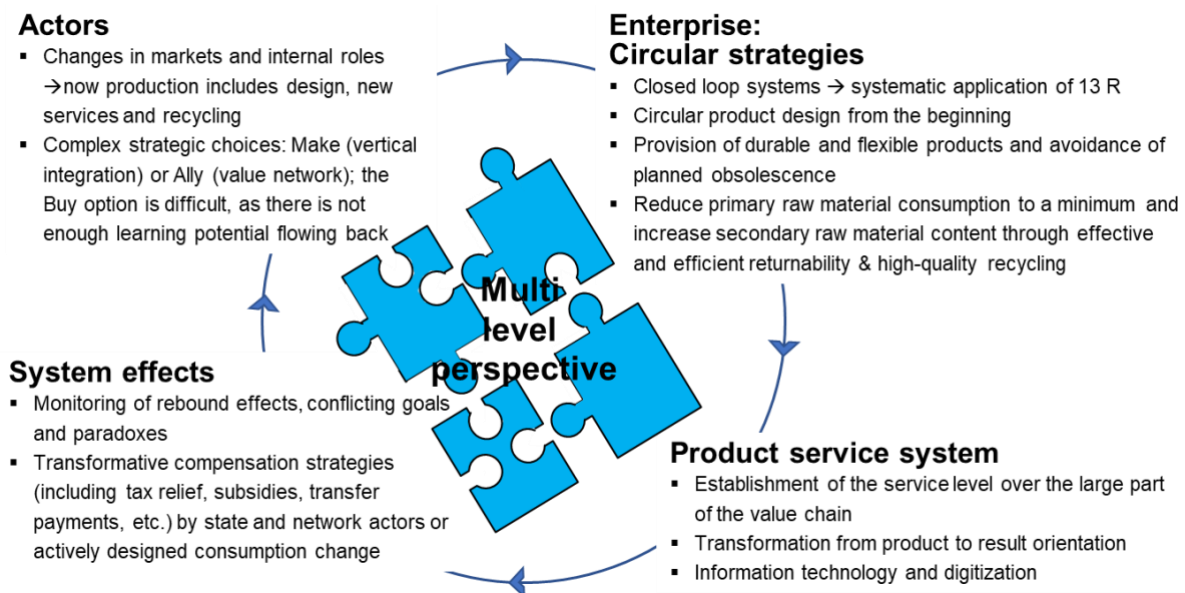


Figure 2 – System patterns of effective CE transformation

All CE activities need information provision as well as competence building of organisational members. There are always dilemmas of organisational boundaries, transparency and digital lacks of data or technology sharing and property rights (van Dorp, 2002). Problems often occur when scientists address the role of the staff as it plays a pivotal role in CE change and human-machine interaction, e.g. retrofit or cascading recycling processes. Yet, managers are not always open-minded, but want to focus on technical issues. So, CE researchers need to find indirect or other ways integrating human factors in CE change processes, which is often not effective. Final, addressing systems or planetary boundaries (Corvellec et al., 2022), systems effects and the difference of firm level and economics are an ongoing duty of CE researchers making sure full CE complexity is recognised. This addresses interdisciplinary skills that are not united in one researcher – maybe artificial intelligence can help (Roberts et al., 2022; Chauhan et al., 2022). In line with Hobson and Lynch (2016) and Moreau (2017) CE researchers must create a new economic system for systemic CE progress– so that the system patterns of effective CE transformation can result in reinforcing circular feedback.

DECLARATIONS

Competing interests The author declares no competing interests.

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