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Is Design Thinking an effective method to generate circular economy based solutions in a socially distanced world? Experiences from an online Design Thinking workshop

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Abstract: Circular Economy (CE) is commonly proposed as a means to advance towards the Sustainable Development Goals. Design thinking (DT) has been identified as an innovative problem-solving approach, capable of addressing complex challenges, such as the CE, through multidisciplinary collaboration. Currently, the spaces for multi-stakeholder collaboration have been affected by Covid-19 restrictions, forcing organizations to develop online collaboration capabilities. Accordingly, this study aims to assess the effectiveness of the application of DT to generate CE-based solutions to address a sustainability challenge in an online setting. The assessment particularly addresses the extent to which a purposefully adapted DT process allows to conceptualize sustainability solutions, and, the user experiences in a digital collaboration environment. This research presents the findings obtained from an online DT workshop focused on proposing circular business models to improve the sustainability impacts of urban mobility in the city of Graz, Austria. The event involved 39 sustainability experts from academia, industry, public sector and NGOs, participating in five teams, each led by a workshop facilitator. Three specific activities have been elaborated to embed a focus on sustainability, which are combined with traditional DT exercises, and adapted to a digital environment. We report the outcomes of the online workshop and reflect on the adapted method strengths and weaknesses. DT is supported as a plausible method to conceptualize CE-based solutions, however, sustainability aspects need to be embedded throughout the problem-solving process.

Introduction

Reversing inefficient natural resource use has been explicitly contemplated under SDG12 – Sustainable Production and Consumption (United Nations, 2015). Circular economy (CE), a socio-technical paradigm aiming at disrupting the taking-making-disposing consumption patterns through multiple value retention options (Reike et al., 2018) has been promoted as a direct contributor to meeting SDG12 (Schroeder et al., 2019). While the paradigm is gaining momentum in global multi-stakeholder arenas, its actual transformational impact on socio-technical systems is being questioned (Blomsma & Brennan, 2017). Innovative problem-solving methods such as Design Thinking (DT) are postulated as capable of generating solutions to complex challenges in a multidisciplinary and collaborative manner (Brown, 2008; Lewrick et al., 2018). Remarkably, collaborative capabilities have been drastically transformed due to Covid-19 restrictions and have undergone an accelerated digitalization (Kudyba, 2020), and thus, the transformation of face-to-face workshops into online versions generates both challenges and opportunities (Constantin et al., 2021). Under this new scenario, this research posed the following question: *To what extent is Design Thinking an effective method for generating CE-based solutions to a sustainability challenge? How is this effectiveness impacted by a digital workshop format?* The following sections describe the method's theoretical underpinning (Theoretical background), a summary of the proposed activities (Methods), the workshop outputs (Results) and a critical reflection on the problem-solving potential of

embedding CE concepts into a DT methodology (Discussion, Conclusions).

Theoretical Background

DT is a problem-solving approach that "uses designer's sensibility and methods to match people's needs with what is technologically feasible and what a viable business strategy can convert into customer value and market opportunity" (Brown, 2008). It has recently attracted attention for its capacity to tackle complex or *wicked* problems (Buhl et al., 2019; Carlgren et al., 2016), suited for contexts of high ambiguity or uncertainty (Liedtka, 2015). It is characterized by the themes of problem framing, user focus, visualization, experimentation and diversity (Carlgren et al., 2016); leading a multidisciplinary team through a process characterized by phases of *understanding, ideating* and *testing*, each underpinned by alternative activities that stimulate divergent and convergent thinking (Liedtka, 2015).

Even though applying DT has been found suitable for sustainability-oriented innovation (SOI) processes (Baldassarre et al., 2017; Geissdoerfer et al., 2016), DT does not incorporate sustainability concerns unless the user chooses to do so (Shapira et al., 2017). Furthermore, Buhl et al. (2019) conceptually discuss how and why DT can foster SOI, offering four propositions in which DT can address SOI challenges. They encourage future research on examining whether and how DT needs to be adapted to ensure that innovation outcomes have positive sustainability effects, the primary aim of the present research.

Additional attempts to integrate DT with CE-oriented innovation or SOI can be found in the literature, most interestingly Guldmann et al. (2019) DT framework for circular business model innovation, which proposes to add introduction and realignment spaces in the process, and Shapira et al. (2017) *Integrated sustainable Design Thinking process*, which considers 20 add-ins to a conventional DT process. However, the mentioned articles are described as explorative and encourage future proposals.

In consideration of the limitations of DT to fully embed a sustainability foci (Shapira et al., 2017), we propose that for a sustainability-oriented DT process, the three innovation lenses of desirability, feasibility and viability (Brown, 2008), should be complemented with a fourth lens of sustainability (Figure 4). Sustainability could be considered as an additional constrain, however, if approached as an opportunity, sustainability can drive innovation by opening up the idea space -during divergent thinking phases-, before sustainability aspects can filter proposed solutions -during convergent thinking phases- (Shapira et al., 2017; Thompson et al., 2011).

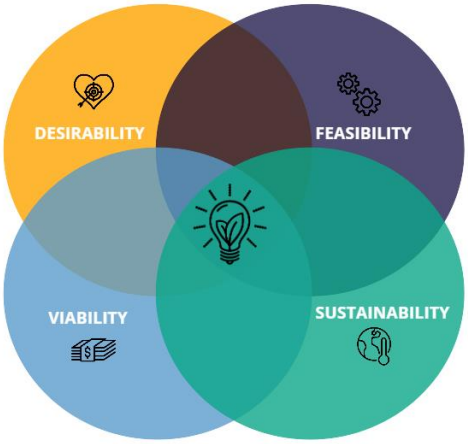

Figure 1: Four lenses of sustainable innovation. Own elaboration, inspired by Brown (2008) and Shapira et al. (2017).

Methods

Theoretical and practical development

Researchers first discussed the goal of the workshop – to have participants proposing sustainable alternatives to individual mobility challenges in Graz using circular-economy based solutions - and adopted the DT process (Lewrick et al., 2018; Liedtka, 2015) as the overarching framework for methodological development. The process phases understand, ideate and test were distributed among three researchers, and each one independently designed a practical exercise to meet the goal of the DT phase while adding a sustainability perspective. For the *understanding* phase, an Actor system mapping exercise (Schiffer & Hauck, 2010) was adapted to include the identification of sustainability issues. The *ideation* activity considered brainstorming supported by a set of six circular business model pattern cards, simplifying typologies from the literature (Lüdeke‐Freund et al., 2019). Finally, *testing* consisted of a SWOT exercise that followed a qualitative assessment of 16 mobility-related sustainability indicators, related to the sustainability principles of the Framework for Strategic Sustainable Development (FSSD;

Broman & Robèrt, 2017). The three sustainability-oriented DT exercises were refined and integrated into the DT process through 4 joint online brainstorming rounds, where the virtual workshop canvases were supported in Miro [1]. During the rounds, additional DT exercises (Lewrick et al., 2018) were added to ensure sequential consistency of the workshop and to support the workshop goal (i.e. Expert lightning talks, How might we questions, Business Model Canvas). A summary of the final exercises included is displayed in Table 1. The complete workshop was simulated in a session with seven academics, including the five facilitators of the final workshop, to adjust the format to a digital environment and adapt to required time constraints.

DT phase	Exercise	Time (min)	Description
Under stand	Expert lightning talks	20	Listen to 3 experts (5 min each) to get a deeper understanding of the challenge
	How might we (HMW) questions	20	Rephrase insights into "How might we...?" questions to turn problems into opportunities and define workshop goal.
	Actor system mapping	35	Visualisation of the key actors of a system, the flow of value and the sustainability issues within.
Ideate	Ideation supported by CE-pattern cards	40	Brainstorming session to propose solutions, finding inspiration in circular economy strategies and CE-business models.
Test	Business Model Canvas (Simplified version)	40	Prototype the solution defining the key elements of a business model: the *who, what, how* and *why*.
	FSSD SWOT	35	Simplified ex-ante performance assessment of 4 key sustainability dimensions, pre-adapted with 4 impact categories per dimension.

Table 1. Workshop overview.

Workshop preparation and execution

Table 2 summarizes all workshop materials provided to ensure participants literacy and consistency across workshop break-out rooms.

Use-case	User	Document	Objective
P	Participant	Consent form	Obtain consent for data collection
P	Participant	Invitation to the platform test session	Get participants familiarized with the online workshop platform
P	Participant	Workshop program with glossary	Ensure participants content literacy
P E	Workshop facilitators	Workshop script, exercise instructions, glossary	Ensure replicability of exercises across break-out rooms
E	Participants, facilitators	Workshop online boards	Execute the workshop exercises
E	Participants, researchers	Feedback form	Data collection

Table 2. Workshop materials used during the preparation (P) and the execution (E).

The workshop was organized on the occasion of a week-long CRESTING[2] Innovative Training Network training event. It was attended by 39 sustainability professionals: 30 researchers, 6 private sector practitioners, 2 public sector representatives and 1 from a non-profit. BigBlueButton [3] was the video conference platform used. For each exercise, the main facilitator provided instructions in a plenary, and five teams executed the exercises in breakout-rooms, using the Miro boards and supported by a team facilitator. Break time (1.5 hours in total) was distributed between the exercises to avoid screen fatigue. The overall workshop duration took six hours.

Data collection and analysis

Data collection was effectuated by one researcher using the input from feedback forms, results from the virtual boards, participation log and facilitator notes. A thematic analysis of qualitative data was performed by three researchers in a brainstorming session and categorical data from closed-ended survey questions was quantitatively analyzed.

[1] https://miro.com/
[2] https://cresting.hull.ac.uk/
[3] https://bigbluebutton.org/

Results

The preparation and execution process described above allowed to complete all workshop exercises within the planned time frame. 61% of participants stayed for the six hours, however, retention rate was considerably higher for researchers (85%) than for non-researchers (27%). Feedback form responses (n=21; 5-point Likert scale) indicated that participants regarded the DT format (logical sequence, non-redundancy and complementarity of activities) as very positive ('strongly agree' = 76%; 'agree' = 24%). When asked if the online setting (versus face-to-face) improved workshop outcomes , answers were disparate ('strongly agree' = 9%; 'agree' = 5%; 'neutral' = 62%; 'disagree' = 24%). Most respondents considered the goals of each of the activities were met ('strongly agree' = 46%, 'agree' = 40%, 'neutral' = 12%, 'disagree' = 2%) and, in average, the activities were regarded as understandable and accessible ('strongly agree' = 51%, 'agree' = 40%, 'neutral' = 9%).

Understanding sustainability – Actor system mapping

Across the five teams, an average of 20 actors involved in individual mobility were mapped, connected through 16 exchanges of value. On average, 17 sustainability issues were identified by each team.

Ideating circularity – Ideation supported by CE-pattern cards

On average, 27 ideas were produced by each team. The inclusion of circularity principles -i.e. any of the 10 r-strategies (Reike et al., 2018) or CE-business models (Lüdeke‐Freund et al., 2019)- was observed in 24% of these ideas. Out of the 5 selected winning ideas (1 per team), 3 included a circularity principle. Particularly, 4 winning ideas were dependent on public policies or based on a public-private partnership, and only one was a fully private based solution.

Testing sustainability - FSSD SWOT

From the analysis of the 16 sustainability indicators, the teams assessed on average a positive impact on 8 indicators, and, remarkably, no team reported any negative impact linked to their solution. However, on average, 5 indicators were assessed as uncertain, and 2 as neutral, indicating the difficulties of ex-ante sustainability assessment.

CE-based winning solutions

The selected ideas presented by the five groups to improve the sustainability impacts of individual mobility in Graz were:

- "Graz is grass": A publicly-funded campaign to encourage the use of public transport by promoting reusable sustainable masks made of Graz's garden waste biomass.
- "Citizen mobility as a right": Tax-funded free multimodal-eco-friendly transport to Graz citizens.
- "Moving Graz": Public transport card and app that combines all biking and public transport options, financed by a city tax on cars.
- "Lots and lots of parking lots (saved)": Corporate private car-sharing service system for employees and shareholders, including privately own cars in the pooling system.
- "Grazing to the city": Combination of an on-demand bike-sharing system at commuting hotspots and improved bicycle paths.

Discussion

This study has explored the effectiveness of an adapted Design Thinking approach in generating CE solutions for sustainability, in an online and time-constrained multidisciplinary workshop.

Generation of CE solutions

The results of the workshop suggest that the methods used and the digital collaboration setting allowed participants to conceptually develop circular solutions tackling specific sustainability issues related to the mobility systems in Graz, in line with previous research (Baldassarre et al., 2017; Buhl et al., 2019). Moreover, the solutions were not only focused on private companies, four out of five solutions were a mixture of public-private initiatives. This could be explained by the decontextualized setting and the profiles of the participants, which were mostly sustainability academics. As a consequence, they focused on the development of more radical innovations for sustainability, which consider a wider integration of stakeholders beyond value chains such as governmental institutions, research centers, NGOs, etc. (Farla et al., 2012; Raven, 2005).

Three out of five of the solutions integrated CE strategies as the main component of the proposals. We assume this could be related to

the nature of the HMW questions and objectives in the understanding phase. The teams that did not integrate CE strategies on their concepts focused on social challenges rather than technical challenges. Moreover, the feasibility, desirability and viability of the conceptual solutions developed in the workshop are questionable, as these were not presented to key stakeholder groups of Graz mobility. Further validation and iteration stages are necessary.

Participants experience working on an online collaborative platform

The feedback survey results indicate that the majority of workshop participants (62%) felt neutral regarding the positive influence of the digital collaboration outcomes of the workshop when compared to a face-to-face scenario. In addition, comments collected by the survey indicate that virtual collaboration could be positive when compared to a face-to-face format as it can enhance the engagement of participants with introverted personalities. Some of the negative perceptions of virtual collaboration were related to the quality of discussions and the mental tiredness of interacting virtually. Certain participants expressed that engagement in face-to-face discussions could have resulted in better outcomes. In addition, some negative downsides were also related to the technical issues caused by unstable internet connection.

Recommendations for improvement of online collaborative workshop and methods

The outcomes of the workshop were highly influenced by the quality of the problem definition on the understanding phase. Defining a proper goal scope or problem statement before the workshop -not too narrow, not too broad- is crucial for a successful workshop development (Buhl et al., 2019).

We consider that the actor system mapping activity could have been done after the expert lightning talks and before formulating the HMW questions. The main assumption is that the mapping activity is good for visualizing and understanding a problem within a system and selecting a specific issue to improve.

Digital platform literacy is vital for ensuring group members participation. Having previous sessions or sending tutorials on the digital platform to be used is recommended.

Limitations of Design Thinking

The results of the workshop suggest that the DT approach is suitable for the development of sustainable business model concepts for sustainability and the CE. However, some of its limits should be remarked. The first one is related to the fact that some groups tended to think about the solutions rather than the problems for formulating the HMW. Participants by nature wanted to develop solutions without having a proper understanding of the problem. Thus, we suggest that DT approaches should emphasize the importance of having a good understanding of the problem before jumping to ideation and further phases, to improve the quality of the outcome. The second limitation of the DT approach is the lack of reflection on the type of participation of stakeholders in the sessions. Usually, there is a tendency of assuming that all stakeholders will participate during all phases of the process. However, the integration of stakeholders might be improved when the roles of the actors in the different phases are identified in advance. In our experience, this consideration would have improved the participation of the stakeholders that participated in a limited amount of time.

Limitations of the study

There is limited generalizability of results, as only one full workshop was conducted. However, five independent working groups allow us to compare their outcomes. Also, it is relevant to highlight that it was a decontextualized workshop, meaning that it did not involve relevant stakeholders of the Graz mobility system and that concepts developed were not validated with real users, a critical step in DT. This limitation is also enhanced by participants previous knowledge and experience -having an overrepresentation of sustainability academics- and thus, potentially biasing results. The workshop format should be further tested within specific business or policy contexts, answering to a real challenge and involving both direct and indirect stakeholders. Finally, the quality of outcomes could have been improved if more time were assigned to each phase.

Conclusions

We suggest that DT offers a plausible approach to develop CE-based conceptual solutions to sustainability challenges, however, to attain this goal, sustainability aspects should be embedded in the problem-solving process, adapting activities and guiding the problem

framing phase. Leveraging on sustainability aspects to open the possibility space, and to further filter potential solutions, is therefore suggested as a key enhancer of the sustainability-oriented DT process.

No major conclusions can be drawn regarding the effectiveness of an online format versus a face-to-face workshop.

The present research contributes to the theoretical integration of CE and sustainability into the innovation and design research fields, and provides practitioners with an actionable framework and set of tools to support the operationalization of the CE.

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