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*Published in:*  
Journal of Cleaner Production

*DOI:*  
[10.1016/j.jclepro.2021.127628](https://doi.org/10.1016/j.jclepro.2021.127628)

**IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.**

*Document Version*  
Publisher's PDF, also known as Version of record

*Publication date:*  
2021

[Link to publication in University of Groningen/UMCG research database](#)

*Citation for published version (APA):*

Greco, A., Eikelenboom, M., & Long, T. B. (2021). Innovating for sustainability through collaborative innovation contests. *Journal of Cleaner Production*, 311, [127628].  
<https://doi.org/10.1016/j.jclepro.2021.127628>

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# Innovating for sustainability through collaborative innovation contests

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## ARTICLE INFO

Handling Editor: Dr. Govindan Kannan

### Keywords:

Sustainability-oriented innovation  
Innovation contests  
Sustainability challenges  
Design thinking  
Open innovation

## ABSTRACT

Innovation contests are increasingly used by businesses as an instrument for open innovation to address sustainability related questions. However, according to the open innovation literature, one of the main pitfalls of this approach can be the mismatch between the solutions proposed by non-experts and the companies' capabilities to implement such solutions. We introduce the concept of collaborative innovation contests – where companies actively collaborate with non-experts – as a way to address this mismatch. Through participant observations, we analyse the process of a sustainability-oriented collaborative innovation contest guided by design-thinking. Our results indicated that the combination of an open innovation contest and design thinking could, through the creation of constant feedback loops, lead to increased collaboration between the contests participants, the companies proposing a challenge, and other relevant stakeholders. However, our results also highlighted trade-offs between the innovativeness of ideas, the alignment of solutions with firm capabilities and the resources needed for collaborative innovation contests. We conclude that, through the involvement of different stakeholders, their ideas and perspectives, collaborative innovation contests are a useful approach to generate a comprehensive understanding of the sustainability challenges companies face.

## 1. Introduction

Sustainability oriented innovation (SOI) can assist firms in adopting sustainable practices through the innovation of products, processes and organizational initiatives to realize sustainability objectives (Klewitz and Hansen, 2014). One way to advance SOI, especially when firms lack the capabilities to do so internally, is through open innovation. Open innovation (Chesbrough, 2006), defined as “a distributed innovation, based on purposively managed knowledge flows across organizational boundaries” (Chesbrough and Bogers, 2014, p. 12), was initially proposed to enhance competitive advantage, as a firm-centric innovation approach. However, it could also help businesses to meet sustainability goals (Behnam et al., 2018; Howard-Grenville et al., 2014; Mothe and Nguyen-Thi, 2017; Olsen et al., 2016). In particular, open innovation in the form of ‘innovation contests open to the public’ is considered effective at addressing sustainability challenges (e.g., Hansen et al., 2011) and can potentially accelerate SOI (Klewitz and Hansen, 2014). In these innovation contests, a firm facing an innovation-related problem posts this problem to a population of independent agents and then provides an award to those that generate the best solution (Terwiesch

and Xu, 2008). The main argument in favour of this approach is that organizations might have limited knowledge on sustainability-related issues (Hansen et al., 2011) and that an open innovation approach allows organizations to access the knowledge of other stakeholders (e.g., Olsen et al., 2016) resulting in solutions that organizations could not have generated individually. Additionally, involving the public in innovation contests can help firms to gain an understanding of society's needs and nurture a trust-based dialogue (Ghassim and Bogers, 2019).

Despite its popularity, many firms still struggle to manage open innovation (Vanhaverbeke et al., 2014) as they do not have the necessary capabilities to incorporate open innovation outputs into their research and development (R&D) efforts. One of the main pitfalls of the solutions developed through open innovation is a mismatch between the solutions generated and the company's actual capabilities to implement such solutions (Behnam et al., 2018; Enkel et al., 2009). We propose that this mismatch may be due to a lack of collaboration between the companies proposing the innovation contests and the independent agents who generate the ideas throughout the innovation contests. Research on innovation contests also increasingly emphasizes the importance of collaboration within open innovation contests, which can lead to highly

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<https://doi.org/10.1016/j.jclepro.2021.127628>

Received 29 November 2020; Received in revised form 19 April 2021; Accepted 21 May 2021

Available online 2 June 2021

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innovative solutions (Bullinger et al., 2010; Hansen et al., 2011).

To this end, we focus on ‘collaborative innovation contests’, which we define as innovation contests characterized by close collaborations between challenge participants (the public agents), the focal companies (hereby named challengers) and relevant stakeholders, including subject matter experts, users, and other agents who can bring knowledge useful to the objective of the contests. Collaborative innovation contests are different from traditional innovation contests, where companies formulate challenges and distribute these to the public, often via the internet, without collaborating with the public throughout the contests. We suggest that collaborative innovation contests can be a promising tool to accelerate SOI in businesses which lack open innovation capabilities. However, little is known about how such contests can be executed, including, for instance, how companies and the public interact within these contests.

In this respect, design thinking (DT) provides a useful framework to guide collaborative innovation contests, serving as a boundary object to facilitate transdisciplinary dialogue and knowledge cocreation (Sharma and Bansal, 2020). DT is a human-centred methodology that can assist firms in engaging effectively in social innovation (Brown and Wyatt, 2010). DT facilitates cross-functional dialogue through its multidisciplinary and collaborative nature (Seidel and Fixson, 2013), which may enable companies to bring their own perspectives into the innovation contests and better tailor the outcomes to their capabilities. However, to the best of our knowledge, research has not addressed how DT approaches may help facilitate collaboration in innovation contests. Therefore, this research paper addresses the following question: *How can collaborative innovation contests, facilitated through design thinking, be used by businesses to accelerate sustainability-oriented innovation?*

To address this question, we analyse a collaborative innovation contest in which 16 companies proposed a sustainability related challenge. DT sessions, including users, students, professionals and amateurs were facilitated by company employees and professionals, over a 9-h workshop. For several days up until 4 weeks before the final solution pitches, the teams could work with the companies to sharpen their solutions. The solutions proposed by the participants were subsequently judged by company representatives and a selected jury. Through participant observations, interviews and archival documents, the authors collected data on the design, development, and outcomes of the collaborative innovation contest. Our analysis uncovered several limitations and advantages of collaborative innovation contests.

## 2. Theoretical background

### 2.1. Innovation contests as an open innovation tool for sustainability-oriented innovation

SOI is critical for the transition towards more profitable, socially acceptable and cleaner business practices (Klewitz and Hansen, 2014). SOI has been defined as ‘making intentional changes to an organization’s philosophy and values, as well as to its products, processes or practices to serve the specific purpose of creating and realizing social and environmental value in addition to economic returns’ (Adams et al., 2016). SOI is often characterized by high levels of complexity and uncertainty due to the socio-technical diversity inherent in sustainability contexts and the opposing interests of businesses and their stakeholders (Ghassim and Bogers, 2019). Therefore, for many actors, including firms, SOI is difficult to achieve. It has been suggested that external knowledge sourcing and open R&D are essential to reduce complexity and uncertainty in SOI (Garcia et al., 2019) and accelerate firms’ social (Bullinger et al., 2010) and environmental innovation (Lopes et al., 2017; Mothe and Nguyen-Thi, 2017). The argument to adopt open innovation is that it allows organizations to access the knowledge of other stakeholders (e.g., Olsen et al., 2016), resulting in solutions that the organization could not have generated individually. Despite its widely recognized importance, many firms still find it difficult to

incorporate open innovation efforts into their R&D practices (Chesbrough and Bogers, 2014; Behnam et al., 2018). Key barriers include: high coordination costs, difficulty in finding the right partners, imbalance between open innovation activities and daily businesses, lack of financial resources (Enkel et al., 2009) as well as poor networking capabilities together with difficulties in coordinating internal and external innovation efforts (Behnam et al., 2018). These barriers can impede SOI, especially when R&D departments lack sustainability specialisms (Hansen et al., 2011).

Open innovation in the form of innovation contests can aid these companies at effectively addressing sustainability related questions and accelerating SOI (e.g., Hansen et al., 2011). Innovation contests are defined as a competition between innovators who use their skills, experience and creativity to provide a solution for a particular pre-defined challenge (Bullinger and Moeslein, 2010; Piller and Walcher, 2006). Innovation contests bring many benefits to R&D departments, such as involving a broad and diverse group of stakeholders, generating multiple ideas by a pool of competitors striving to be “the best”, and increasing the capacity to generate and test high quality ideas at low initial costs (Terwiesch and Xu, 2008). Furthermore, innovation contests that involve the public can assist firms in addressing sustainability related questions as they can help firms to: (1) gain an understanding of society’s needs, ideas and expectations, (2) understand the language of the public, (3) nurture a trust-based dialogue with the public and (4) create value for all stakeholders involved (Ghassim and Bogers, 2019).

We suggest that within these innovation contests, that collaboration between the challengers and the participants is highly important. Therefore, we refer to open innovation contests involving such collaboration as collaborative innovation contests. This collaborative aspect is important as it may enable companies to co-create solutions with the public that fit their capabilities, thus better supporting their R&D efforts. While the open innovation literature acknowledges the need to integrate cross-sectoral collaboration in early stages of the innovation process (e.g., Gassmann et al., 2010; Bullinger et al., 2010; Hansen et al., 2011), it is not yet clear how firms can do so from a process perspective (Simeone et al., 2017). In the next section, we introduce DT as a human centred design approach relevant to the facilitation of collaborative innovation contests and for addressing sustainability-related questions.

### 2.2. Sustainability challenges and design thinking

In order to explain how and why sustainability problems emerge and persist, sustainability scientists have focused on understanding “the complex dynamics that arise from interactions between human and environmental systems” (Clark, 2007, p. 1737). Hence, scholars propose user-centric approaches as essential to the design of sustainable solutions (Shapira et al., 2017), including a need to understand unsustainable behaviour so as to successfully influence it (De Medeiros et al., 2018). With the objective to bridge problem definitions to solutions following a human-centred approach, DT gained popularity in different fields of environmental and social innovation (Brown and Wyatt, 2010). DT is defined as: “a discipline that uses the 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, p. 86). It can be considered as an approach that is able to connect user-centric and firm-centric perspectives.

In practice, DT consists of a stepwise process (Plattner, 2010) including three main phases: need-finding, brainstorming, and prototyping (Brown, 2009; Hargadon and Sutton, 1997; Shane and Ulrich, 2004). The main promise of DT is its suitability to address wicked problems (Buchanan, 1992). DT is also regarded as a design philosophy that offers a possible approach to complicated design problems (Liedtka, 2018) which call for radical (and incremental) innovations. The benefits of DT have already been explored in terms of its ability to enhance triple bottom line value creation (Geissdoerfer et al., 2016), for circular

business model innovation (Guldmann et al., 2019), and for SOI (Buhl et al., 2019). In particular, DT is regarded as beneficial for stimulating the creative process for the purpose of sustainable business model innovation, helping to accommodate diverse stakeholder interests (Geissdoerfer et al., 2016) and enhancing stakeholders' collaboration in green product development and production processes (Redante et al., 2019).

DT involves multidisciplinary teams and uses collaborative approaches which are well suited for creating linkages between individuals across organizations and encouraging cross-functional dialogue (Seidel and Fixson, 2013). Such multidisciplinary and collaborative approaches may be well-suited for facilitating a conversation between businesses, users and the public involved in innovation contests. By bringing their knowledge and perspectives into the discussion, companies can ensure that the outcomes of innovation contests better fit to their own capabilities. In this context, the representatives of the companies responsible for the implementation of innovation contests could potentially ensure that the outcomes of these contests are tailored to the capabilities of the organization through their active participation in the collaborative process of DT.

Given the successful application of DT in social innovation, and the ability of both DT and open innovation to bridge user-centric and firm-centric perspectives, their combination in the form of innovation contests might effectively serve firms in advancing SOI. We summarize the characteristics of collaborative innovation contests in the following conceptual framework below (see Fig. 1).

### 3. Research method

#### 3.1. Case description: the sustainable innovation challenge

The context of this research is an innovation contest called the 'Sustainable Innovation Challenge', which took place in Friesland, a northern province of the Netherlands, in the fall of 2018. Organized by a consortium of private and public organizations and led by an intermediary organization, it aimed to accelerate the sustainability transition of businesses in the region. Organizations were invited to submit a sustainability related challenge they were dealing with. A total of 16 organizations proposed a challenge, indicating the intended target audience and the desired outcome. The 16 challenges were published online in August 2018 and were open to the public for registration from September until October. The challenges were clustered in three themes, held on different boot-camp days: 1) circular economy and energy efficiency, 2) social innovation, and 3) sustainable organizational initiatives (see Table 1).

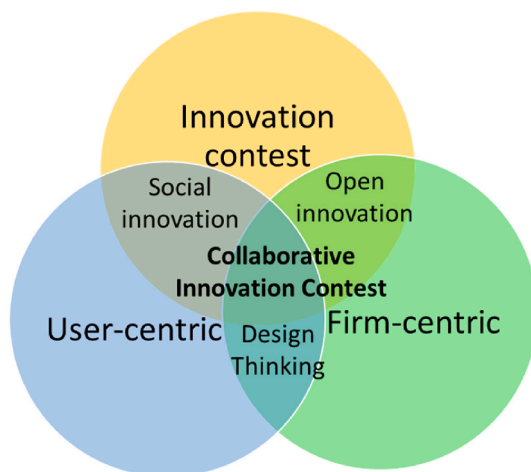


Fig. 1. Collaborative Innovation Contests combine principles of Design Thinking and Open Innovation in the form of innovation contests.

The organisers of the sustainable innovation challenge provided DT training to employees willing to be "facilitators" during the boot-camp days. DT sessions were then facilitated by members of the challenger companies or instructed facilitators, over a 9-h workshop. In total, 50 teams participated in the challenges. Each team was comprised of 3–6 people, ranging from students, professionals, users, and amateurs. Each challenge was addressed by 3–5 teams. Company representatives judged the solutions proposed by the teams at the end of each boot-camp day. The team proposing the winning concept was selected to further develop the idea in collaboration with "the challenger" to prepare for a final event. During the final event, 3 finalists were selected out of the competing 16 teams. The winning team received a prize of €1000, free office space, and coaching to work on the winning concept for a year.

#### 3.2. Data gathering

Our approach consisted of a systematic combination of abductive logic to case-study research (Dubois and Gadde, 2002). Abduction is useful to explain new and surprising empirical data through the elaboration, modification, or combination of pre-existing concepts as it confronts theory with the empirical world (Richardson and Kramer, 2006). This approach is characterized by the continuous movement between empirical observation and theoretical explanations. This research focused on the continuous interplay between the theory on SOI, open innovation contests, and DT, and our empirical observations with the aim of integrating these streams, as well as advancing knowledge, through an in-depth analysis of the case study (Dubois and Gadde, 2002). The empirical observations included interviews with the challenge participants, participant observations, and secondary data. Before starting with the participant observations, and with the intention to investigate a process-query, we used a variety of data collection methods, including official and internal documents and informal interviews. The simultaneous methodological combination of retrospective and real-time data gathering techniques is key to mitigate the bias risk of retrospective interviews and archival data collection (Eisenhardt and Graebner, 2007). The data were coded by the 1st and 2nd author, using a 1st and 2nd order analysis (Gioia et al., 2012). In the following section, we explain the different data-gathering approaches of the research.

**Participant observations and action research.** Starting from the challenge design phase, until its execution, the first author participated as a facilitator during the challenge. This implied contributing to the brainstorming of the companies' challenge questions (see Table 1), participating in DT training with the challengers' employees and providing support to the team members during the boot camp days. The second author joined as a participant (see Fig. 2), being a member of a different team on each boot-camp day. The objective was to observe both the "challenger" and "public" sides in an independent manner. During the challenge both participant authors took field notes, made pictures of the prototypes and of the visual material produced, and video recorded the final pitches.

**Interviews.** We conducted semi-structured interviews (see Table 2) with the challengers and several participants at four different moments, namely: 1. Before the start of the challenge; 2. on the day of the challenge (boot-camp day); 3. during the final pitch event; and 4. follow-up phone interviews with the challengers in September 2019 (11 months after the final-pitch event).

**Archival data and participants' evaluations.** As mentioned above, archival data was an important source for factual checks. We checked the company websites, online reports, and the sustainable innovation challenge website to study the challenge descriptions. Finally, we analysed the evaluation survey sent by the challenge organisers to the challengers and the participants.

**Table 1**  
Challenge descriptions and sectors.

Theme	#	Question	Description	Sector
<b>Circularity &amp; Energy</b>	<b>Challenger 1</b>	How can CO <sub>2</sub> be of value in the energy transition?	Technical and economic feasibility of CO <sub>2</sub> conversion into methanol for batteries in the mobility, industrial and energy sectors.	Biogas production and supply
	<b>Challenger 2</b>	How can we make an office like the Province house 100% waste-free?	Re-design flow of office materials beyond waste collection, tackling also employees' behavioural change.	Province
	<b>Challenger 3</b>	How do we create affordable and comfortable houses without gas for the ordinary citizen?	Matching the energy neutral measures already designed with inhabitants' wishes.	Installation and service provider in the utility, industry, government, healthcare and housing sectors
	<b>Challenger 4</b>	What will the skin of the house of the future look like?	Testing alternatives to brick walls for prefabricated houses which are durable and easy to build and maintain.	Construction company
	<b>Challenger 5</b>	How do we position existing basic furniture and office supplies in a circular fashion to furnish the working space of the future?	Concepts and methods to reuse office supply to refurbish new offices homogenously and suitably for new ways of working.	Architecture firm
	<b>Challenger 6</b>	How can we design an energy-neutral water pumping station?	Design of a CO <sub>2</sub> neutral water pumping station which operates intermittently. In the remaining time, the pumping station produces renewable energy to be saved or shared with companies in the neighbourhood. Optimal uses of excessive energy production need to be designed.	Water management
<b>Social innovation</b>	<b>Challenger 7</b>	How can we increase our visibility as a sustainable partner in 100% natural products?	Strategy and action plan to reach a wider audience to raise awareness on natural products, tailored to the different targets.	Soil and animal products supply
	<b>Challenger 8</b>	How can solar panels serve as a secondary employment condition for our employees?	The company is installing 260 solar panels on the office roof and seek business models to make this a part of the employees' benefit package.	Painting company
	<b>Challenger 9</b>	How do we reach a fossil free region?	Design of an event in which inhabitants of the region are asked to do fossil-free activities for a certain period such as the previously organized "Elfwegentocht" <sup>1</sup>	Network organization
	<b>Challenger 10</b>	How do we realize satisfied and energy-conscious tenants in our CO <sub>2</sub> -neutral homes?	Communication and participation strategies for both renovated and newly built CO <sub>2</sub> -neutral housing. <sup>2</sup>	Social housing
	<b>Challenger 11</b>	How do we combine a sustainable personnel policy with flexibility in the cleaning services?	Solutions for flexible work from different potential employees without compromising the continuity required by the company's client.	Cleaning company (including emergency cleaning, e.g., asbestos removal)
<b>Sustainable Organization</b>	<b>Challenger 12</b>	How can we incentivize our network of entrepreneurs to change and innovate?	Test of marketing strategies that stimulate entrepreneurs to change and be aware of new industry trends and disruption.	Management consulting company
	<b>Challenger 13</b>	Will paper completely disappear from our society or is there still a future for printed marketing communication?	New business strategy bridging the needs of end users and the company's customers. This follows scenario-thinking revealing what target groups might still need paper for marketing purposes.	Printing company
	<b>Challenger 14</b>	How can our college rapidly become paper free?	Research of alternatives to paper in education and the design of fundamental steps to achieve a zero-paper ambition. Thinking with students about a paperless education: from notebooks, napkins, meeting paper, magazines, test paper and even toilet paper.	Intermediate vocational education school
	<b>Challenger 15</b>	How can we optimally involve our employees in the fulfilling of our CO <sub>2</sub> neutral ambition?	Ways to involve employees (i.e., people with low employability such as disables) in the CO <sub>2</sub> neutral ambition to be achieved in 2023. This ambition includes services and production processes as well as employee's lifestyles.	Social employment
	<b>Challenger 16</b>	What role will IT play in the construction and development of high-tech offices?	Providing ways in which "internet of things" is changing the use and outlook of offices.	Office tools and supply provider

<sup>1</sup> Event in which people living in the region were asked to use fossil-free means of transport, the company is looking for a similar initiative as a follow-up. <http://elfwegentocht.nl/english-parade/>.

<sup>2</sup> A CO<sub>2</sub>-neutral house is a self-sustaining house that creates the same amount of renewable energy that it expends, therefore creating zero carbon emissions. For new homes, also the embedded energy of the construction material, and the emission of the construction process, should be neutral.

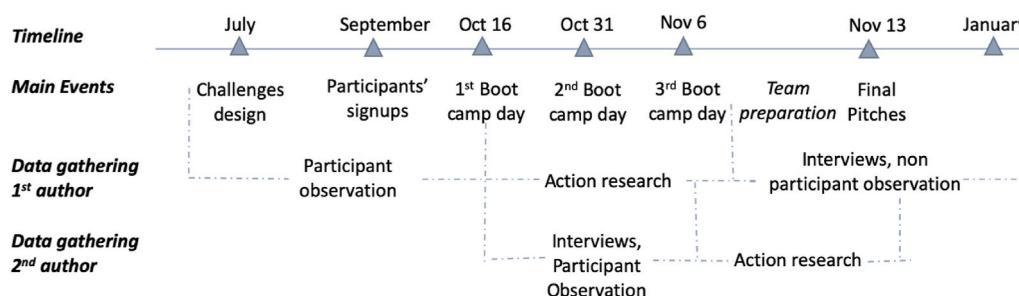


Fig. 2. Research methods timeline.



**Table 2**  
Semi-structured interview scheme followed during participant observation.

Interviewees	Context	Key questions	
Challenger	Prior the start of the boot-camp	Why are you participating in the challenge?	
		What's your ideal outcome?	
		How is the solution to the challenge you propose crucial for the success of your business?	
		Are you currently working on the challenge or is this something you plan to work on the (near/far) future?	
		How are you planning to integrate the outcome of this challenge in your R&D efforts?	
		What are your selection criteria for the "best" project?	
		What's the impact you want to achieve by taking this challenge?	
		Are you/your company familiar with design thinking? If yes, how and when do you use it?	
		During the boot-camps	What's your impression of the process?
			Do you have concerns about the process?
			Do you think the challenge is well-formulated?
		Final pitch-event	Are you satisfied with challenge? Why?
What did you learn?			
11 months after the final pitch-event		Are you going to continue to work on this challenge with the participants? How?	
		What do you think of the challenge?	
		What did you learn from the challenge?	
		What are the main sustainability challenges your R&D department is facing right now?	
		Are you still following up on the solutions developed during the contest?	
		How are you using the outcome of the challenge?	
		Why are you participating to the challenge?	
		What's your ideal outcome?	
		Are you familiar with design thinking? If yes, how and when do you use it?	
		How are you experiencing it?	
Participants	Prior the start of the boot-camps	Is the challenge clear?	
		Do you feel like you can contribute to this challenge?	
		How was the design thinking process?	
		Are you happy with the outcome?	
		What was hard about the challenge?	
During the boot-camps		What did you learn from the challenge?	
		How was the design thinking process?	
		Are you happy with the outcome?	
After the boot-camp		What was hard about the challenge?	
		What did you learn from the challenge?	
		What did you learn from the challenge?	

**4. Findings**

**4.1. Drivers to participate in the sustainable innovation challenge**

The drivers identified ranged from a variety of challengers' needs, including: idea generation and novelty, validation of ideas, networking and business survival (see Table 3). Idea generation drivers identified in the analysis mostly referred to the generation of radical new ideas and perspectives. For instance, the manager of challenger 1 mentioned: "We hope to get creative out-of-the-box ideas that we didn't think of ourselves yet". Validation was also mentioned by the manager of challenger 1: "My objective today is to see if what we do makes sense and works also for people who are not busy thinking about it all day".

Network drivers identified referred mostly to the need to find new partners and students to collaborate with, gaining exposure in the region, and to respond to the participation requests from business partners. For instance, the manager of challenger 7 highlighted the network as a cause for their organizations participation: "I wouldn't have thought about doing this challenge myself. If I would not have been asked by one of the partners to participate, I probably would not have been here".

Finally, business survival drivers included mitigating the effects of disruptions and the financial viability of sustainable business model innovation. Challenger 13, a printing company, provided an example of

**Table 3**  
Participant's reasons to join the Sustainable Innovation Challenge.

Interviewees	Interviewee's descriptions	Category (2nd order)		
Challenger	New perspective (out of the box thinking) Alternative technical solutions New ideas and possible scenarios How to realize sustainable innovations Does it make sense what we do now? Would you use it? Should we do it differently? Finding partners to collaborate with Finding students willing to work on it Gaining exposure in the region Invited by business partner How can we adapt our business to avoid disruption? How can we keep up with technological change?	Idea creation and novelty		
		Validation		
		Network		
		Participants	New employment/field shift Study project/internship New field of interest Part of study trajectory Entrepreneurial ideas Interest in sustainability issues Solving environmental and/or social issues	Business survival
				Personal or (owned) company exposure
				Learning
				Sustainability motives

mitigating potential disruption, by seeking scenarios in which their company would still be valuable when paper is not being used anymore. As stated by the company's director before the beginning of the DT boot camp: "we are busy surviving with our daily tasks and although we are aware of the fact that our business might soon come to an end, we don't know how to stop and think about new ways of working (...) I hope the people participating today can help me figure this out".

Participants in the challenge mentioned multiple drivers, including personal or company exposure –for small business owners–, learning, and sustainability motives (see Table 3). Personal or company exposure drivers referred mostly to the potential of finding a new employer or new company assignments. Learning drivers referred to learning more about the topic of sustainability and issues in the region. For instance, as mentioned by a participant: "I want to get new knowledge on sustainability challenges and discuss with others how to solve these challenges". Furthermore, multiple participants entered the challenge as part of their education and/or to help solve sustainability issues in the region: "I really want to do something good for the world and help solve sustainable problems in the region".

**4.2. Collaborative process**

The boot-camp days of the Sustainable Innovation Challenge included multiple phases following DT principles (Fig. 3). Within these phases, collaboration between the participants and challengers was facilitated in different ways. Collaboration was most apparent in the challenge presentations, the facts check, and final pitches. In these phases the participants were able to ask questions to the challengers and received feedback on their ideas. However, collaboration was involved in all the other phases as well, as the challengers facilitated the teams and could join them in their brainstorm activities. Within all of the phases the participants were encouraged to collaborate and ask questions to each other, the users, the challengers and experts in the field. We identified three main issues in our analysis of the collaborative process in the innovation challenge: 1. the interplay between challengers and participants; 2. the fit between the DT (collaborative) process and the type of sustainability challenge; and 3. time pressures. We explain these themes below.

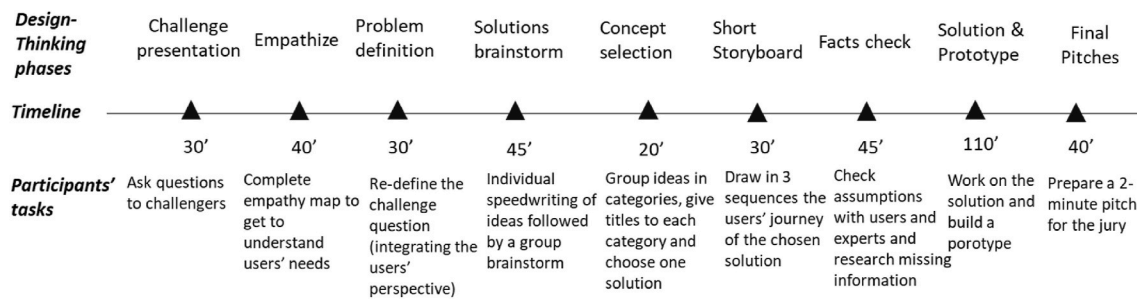


Fig. 3. Timeline (with phases, sessions duration, and tasks) of the DT process adopted for sustainable innovation challenge boot-camps.

#### 4.3. The interplay between challengers and participants

We identified multiple advantages of the active involvement of the challengers in the challenges. First of all, their involvement helped the teams deal with ambiguity and uncertainty within the challenge, enabling participants to interact with challengers, asking questions and checking progress. For example, participants asked questions like “Is this what you were looking for?”, “Can your company work with this?” and “Is the direction we are thinking in valuable for you?”. Secondly, the involvement of the challengers helped the teams to develop solutions that were better suited to the companies. For instance, the member of the organization team noted that: “Ideas are worth nothing, everybody has ideas. Creative ideas might seem promising but when the company tries to implement this idea, they do not know how to do it. Either they discover that they do not have the resources or that the idea is not feasible for some other reasons. With DT this should not happen because people can already think about the implementation stage together with the companies”. Also, the challengers felt that their input facilitated the ideation and communication process, as the manager of challenger 10 mentioned: “My input was important to the team. I have 25 years of experience[...] My role therefore was to help the team to reflect on the ideas and to reduce the enthusiasm of the teams if things that were proposed would not work for us.”

On the other hand, the active involvement of the challengers also appeared to have downsides. Firstly, active involvement of challengers required a lot of time and investment on their side, as was mentioned by a member of the organization team: “The initial investment of time and resources of being physically there is a lot. I know we are asking a lot from these companies”. It was noted that not all companies, especially those with limited resources, might have the ability to be actively involved in the process. Secondly, we found that the active involvement of the challengers may limit the generation of creative and radical ideas. Through their input, challengers sometimes discharged new ideas prematurely, made it difficult for the participants to brainstorm, and in some instances even took over the entire process, as was mentioned by one of the participants: “The conversation was mostly between the challenger and the user, leaving limited room for our team to ask questions and generate new ideas”. In some cases, the active involvement of challengers, users and experts even shut down the creative process, confusing or overwhelming teams, as was mentioned by a participant: “It was very difficult as each time new challenges were mentioned by the company representative. I was afraid we wouldn't come up with anything and I did not know what to focus on.”.

#### 4.4. The fit between DT and the type of sustainability challenge

Some of the challenges designed by the companies seemed to be easier to tackle than others. The challengers and the participants mentioned two types of reasons for this: 1. the participants' background, knowledge and experience and, 2. the type of challenge. As can be seen in Table 1, some challenges were technical or product-oriented, whereas others were more service or process-oriented. Our data suggest that participants experienced difficulties in relating the human-centred

approach of DT to the technical requirements of the product-oriented challenges. For instance, a participant mentioned: “I do not know how to relate such a technical problem to the person”. Even when the initial challenge called for a technical solution, the participants often worked on process and people-oriented solutions instead. For example, one of the participants mentioned: “We [the team of participants] are still not designing anything that is about a specific product they [the company] could use, I thought that was their question. We are now focusing more on the process.” Secondly, participants had difficulties in solving the technically oriented challenges due to time constraints in the design-thinking process, which restricted the ability to engage with in-depth technological knowledge. For instance, the manager of challenger 3 noted: “I thought the groups would be able to search and implement more technical knowledge through their own knowledge and their ability to contact experts. Now I see that there was no time for that”.

On the other hand, the DT approach seemed to fit well to the challenges that included a people-oriented aspect, such as the challenge of the housing associations (Challenge 10: How do we realize satisfied and energy-conscious tenants in our CO<sub>2</sub>-neutral homes?). Within these challenges, working with the users helped the teams to test and evaluate their ideas, as was mentioned by a participant in the housing association challenge: “It was very nice and valuable for our work to be able to discuss with the tenant about it” Furthermore, these people and process related challenges seemed more suited to the characteristics of the teams: diverse backgrounds and broader, less technical knowledge bases.

Time pressures During the process the problem of “limited time” was often mentioned by the participants: “When I finally felt like I was getting on to something I was asked to switch to the next phase”. These time pressures were often intensified by the inclusion of multiple different parties with different viewpoints including the challengers, the users and experts in the field, as was mentioned by a participant: “Involving the experts took a lot of time and their ideas did not really fit to our ideas and the wishes of the challenger.”.

The time pressures experienced by the teams meant their focus sometimes drifted away from the user due to limited time to ask for and implement their opinions. Oftentimes, the participants felt that the involvement of users slowed down the process: “We had a lot of conversations with the user, which was interesting in the beginning, but stopped us from getting to a more specific question in time because a lot of different problems were mentioned. We continue ending up with the same problems, what about the solution?”.

#### 4.5. Observed impact

**New partnerships.** The interviews conducted one year after the innovation contest revealed that multiple companies continued investing in the solutions developed during the challenge. The ones pursuing the concepts mentioned feasibility, fit with their mission, and possible implications, as main reasons, as illustrated by these example quotes from some of the challengers: “This was an idea that was close to our values and therefore could be worked out well. In addition, it was innovative but also feasible because the initiative fits in perfectly with our sustainability ambition

[...] *The development of this innovative and distinctive idea can help us, on the one hand, to retain employees and, on the other, to unburden clients to the maximum. In addition, we are responding to the social trend of flexibility.*" (Challenger 11). *"We developed this idea because it has been risen in the political agenda and it is crucial according to public opinion"* (Challenger 8).

The winners and the finalists of the challenge were among the companies that decided to further invest in the outcome of the challenge. They invested in different ways, for example by hiring one of the participants to further investigate the development of a product and test it inside the company, or by offering employees the opportunity to work during their working time on developing the challenge further and, by outsourcing the development of the challenge to a different partner/company. For example, two of the finalist challengers partnered to finance the solution proposed by the winning team: *"It turned out that we were a good match with challenger 15, and we are now working together to give people with a distance to the labour market a chance for a long-term job in cleaning"* (Challenger 11).

**Deeper problem understanding.** However, the majority of the companies did not pursue the proposed solutions, mentioning a lack of innovativeness as the main reason: *"this was not really a very new idea, but we had not thought of it ourselves"* (Challenger 14). Yet, other benefits were mentioned, including a deeper understanding of the sustainability problem within the company, which was mentioned by multiple challengers: *"That doesn't mean we weren't happy with the challenge. We got inspired and more familiar with the subject [...] I was surprised to find out how much paper we consume and also to know how many colleagues were concerned with sustainability issues, I had no idea. [...] Our supervisory board now takes the problem more seriously. "The challenge did help to boost this [sustainability question] internally as well [...]. (Challenger 14). "What this challenge did to us was to increase awareness inside our company about the problem. I would not say it brought us a ground-breaking solution, certainly not, but the challenge has helped us to see what is going on among young people, so that gives new insights"* (Challenger 8).

## 5. Discussion

The innovation contest analysed in this study combined an open innovation contest with a DT approach. Thus far, the combination of open innovation contests and DT has received little attention in the literature. Our investigation of this empirical context indicated that the combination of an open innovation contest and DT could lead to increased collaboration between the participants of a challenge, the companies posting a challenge, and other parties with relevant information for a challenge including users and experts in the field. We refer to such contests as collaborative innovation contests. Through this analysis, we demonstrate how a collaborative innovation contest, facilitated through design thinking, can be used by businesses to accelerate sustainability-oriented innovation, providing an answer to our research question. Our in-depth analysis of a collaborative innovation contest, facilitated by DT, led to several additional insights and indicated multiple opportunities and challenges for such contests.

### 5.1. Collaborative innovation contests involving design thinking to match solutions with the capabilities of firms

Our study highlighted the importance of the collaboration between challengers and participants in innovation contests, and the specific factors that can successfully facilitate it. Through the use of DT, company representatives were able to become involved with the teams working on the challenges and assist them in creating valuable solutions. The importance of co-creation has been emphasized within SOI, as it aids to the development of mutual understandings of sustainability problems and better matches proposed ideas with a company's capabilities (Enkel et al., 2009). However, the literature has been unclear about how increased collaboration and co-creation can be facilitated in open innovation contests (Simeone et al., 2017). Our results indicate

that DT can fulfil this role, by facilitating collaboration between company representatives, challenge participants, and other relevant actors such as users and experts in the field. Our results showed that DT can create constant feedback loops between challenge participants and company representatives. This allowed participant ideas to be better aligned to the company and its context, as participants were able to constantly test and update their ideas. These feedback loops are critical as they can increase the value of externally acquired knowledge for the SOI of firms (Ghassim and Bogers, 2019).

Collaborative processes, enabled through DT, can help companies to view the public as an important co-creator for SOI, creating new collaborative relationships and developing a trust-based dialogue where shared value is generated (Ghassim and Bogers, 2019). However, our results also showed that the creativity, and thus potential innovativeness of ideas, may be constrained, due to the time limited nature of the innovation contest and the (overly) extensive involvement of company representatives. As such, our case highlights that trade-offs may exist between the innovativeness of ideas and resources needed (in terms of time) for collaborative innovation contests. This may especially be the case for product/technically-oriented sustainability challenges, as our results showed that within the contest not enough time may be available for engagement with in-depth technological knowledge. These time constraints were intensified due to the involvement of participants, users and company representatives with diverse (non-designer) backgrounds. Additional trade-offs may also exist in terms of innovativeness and the alignment of solutions with firm capabilities. These potential trade-offs are important for companies to consider when designing innovation contests. Although the generation of new ideas is a main premise of open innovation (Olsen et al., 2016), our case showed that collaborative innovation contests may not be the optimal vehicle for the generation of radically new solutions.

### 5.2. Innovation contests using design thinking as a problem investigation tool

Although an important driver for companies to participate in the innovation contest was to generate new ideas, the contest oftentimes did not facilitate this process as well as initially expected by the companies. This may have been caused by several different factors including time limitations, the multidisciplinary composition of the teams, the involvement of company representatives, and the lack of technological knowledge from the participants. However, our study highlighted that the contest did assist the companies in generating more insights into the sustainability problems they faced. Despite not being as effective at proposing new solutions, the contest did help increase understanding and awareness of the sustainability problems experienced by the challengers.

The collaborative and multidisciplinary nature of DT facilitated this through the involvement of different needs, ideas, and perspectives of a diverse group of stakeholders. Furthermore, the involvement of the users in the challenges helped the participants to evaluate the problem from the user-side. Bringing new insights into the problem is highly important in DT and innovation in general, since focusing on the solution to the wrong problems can be catastrophic. Furthermore, Hansen and Große-Dunker (2013) stress the importance of problem definition in SOI and argue that, despite its importance, this phase is often neglected. Our study provided insights into how firms can, through collaborative innovation contests, gain more insights into the problem definition phase of SOI. This can be a useful approach for companies lacking innovation capabilities to generate a comprehensive understanding of the sustainability problems they face, ask the right questions and, consequently, find fitting solutions.

#### 5.2.1. Practical recommendations

Our study offers multiple insights which can be valuable for organisers of collaborative innovation contests and managers engaging in



such contests. First, managers should recognize the importance of becoming involved in collaborative ecosystems which can enable them to participate in collaborative innovation contest and gain an increased understanding of the sustainability problems they are facing. Without being involved in these ecosystems, managers may not be able to individually set up collaborative innovation contests due to the need for the involvement of multiple different stakeholders and perspectives in these contests. Furthermore, intermediaries involved in collaborative ecosystems can assist managers in organising and managing collaborative innovation contests.

Second, managers and contest organisers should reconsider collaborative innovation contests as problem investigation tools. Through setting the right expectations, managers and organisers can facilitate an openness among employees, challenge participants, users, and other relevant stakeholders to work together towards a better understanding of the sustainability problems companies are facing. Furthermore, setting the right expectations may help avoid disappointment in later stages of the contest over a potential lack of radical new solutions developed.

Third, managers and organisers should carefully consider potential trade-offs between the resources needed for collaborative innovation contests, the level of involvement of the challengers in the contest, and the creativity of ideas resulting from the contest. On the one hand, a significant amount of time and resources is needed to collaborate with challenge participants and successfully design new solutions that fit their capabilities. On the other hand, managers need to carefully consider their level of involvement in collaborative innovation contests in order to balance their ambitions of designing radically new solutions and of developing solutions that closely fit their capabilities. While collaboration is highly important for designing solutions that fit to the organization's capabilities, managers should restrain from getting overly involved in the contest and dominating the process.

Fourth, it is important for managers and organisers to define and present challenges that are appropriate for (non-expert) individuals participating in the contest. For instance, technical challenges might not be appropriate for participants without technical backgrounds. Furthermore, a careful consideration of which stakeholders to involve at which stage, can enhance the outcome of the contest.

### 5.3. Limitations & future research

The limitations presented in this study are multiple and typical of single case study research approaches. Here we discuss these and suggest directions for future research.

First, our data suggested that companies perceived better results for the process-orientated challenges than for the product-oriented challenges, which were considered either “too technical” or “the time too short”. These considerations fuel the debate on the suitability of DT for specific types of challenges and/or to specific types of (non-designer/lay) team members (Seidel and Fixson, 2013). However, we were not able to systematically evaluate why DT would be better suited for process-oriented innovations compared to product-oriented innovations, as this may have been influenced by team sizes, composition, background or the challenge topics. Future research is therefore needed to investigate these aspects in more detail. Furthermore, future research could investigate if the DT phases could be arranged differently to facilitate different types of challenges.

Second, during our data collection and analysis, it seemed that innovation contests fulfilled different roles depending on whether the company was large or small. For instance, it is possible that for small companies, innovation contests could provide a learning experience, providing awareness of new ideas and problems, but not providing solutions, due to a lack of implementation capabilities. Contrarily, for larger companies, innovation contests could function as change catalysts, as larger firms might already have the capabilities to put the idea into action. Due to the focus of our study and the limited number of large

companies involved in our case, we were not able to investigate these differences in detail. Further research is therefore needed to study the differences between larger and smaller companies. Furthermore, most companies included in our case did not operate in high capital cost industries. Companies operating in these industries may benefit from collaborative innovation contests as well, however operating in high capital cost industries may intensify challenges related to time limitations and the limited technical knowledge of non-experts. Future research is therefore needed to investigate if and how collaborative innovation contests can be useful for companies working in these industries.

Third, future research could systematically test the involvement of company representatives on the outcomes of innovation contests. Future research could for instance investigate what the optimum level of involvement would be through statistical methods. Subsequently, whether the lack of new idea generation was mostly caused by the active involvement of the challengers, time constrains, team composition or the type of challenge, should be further investigated. Future studies could further investigate the effect of the user involvement in different stages of the DT process during collaborative innovation contests. Finally, future research is necessary to investigate how companies can initiate and engage in collaborative innovation contests.

### 5.4. Conclusions and highlights

This research contributes to the literature by providing insights into how firms can use collaborative innovation contests for SOI and by strengthening the implicit link between the literature on SOI, DT and open innovation contests. First, our study indicated that the collaborative process of collaborative innovation contests, facilitated by DT, can potentially bridge the mismatch between open innovation outcomes and company capabilities to adopt such innovation. Second, our study also revealed trade-offs in terms of the innovativeness of the proposed solutions on the one hand, and the alignment of the solutions to firm capabilities and the number of resources needed for the contest on the other hand. Third, our findings highlighted that collaborative innovation contests may be particularly useful for improving a company's understanding of the sustainability challenge addressed in the contest. This is important, as problem definition is antecedent to the design of effective sustainable solutions. Therefore, we conclude that collaborative innovation contests, facilitated by DT, can be a promising catalyst for SOI.

### CRedit authorship contribution statement

**Angela Greco:** Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Data curation, Writing – original draft, Visualization. **Manon Eikelenboom:** Methodology, Software, Validation, Formal analysis, Investigation, Writing – original draft, Visualization. **Thomas B. Long:** Validation, Writing – review & editing, Visualization, Supervision.

### Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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