Saving Our Oceans: Scaling the Impact of Robust Action Through Crowdsourcing

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ABSTRACT One approach for tackling grand challenges that is gaining traction in recent management literature is robust action: by allowing diverse stakeholders to engage with novel ideas, initiatives can cultivate successful ideas that yield greater impact. However, a potential pitfall of robust action is the length of time it takes to generate momentum. Crowdsourcing, we argue, is a valuable tool that can scale the generation of impact from robust action. We studied an award-winning environmental sustainability crowdsourcing initiative and found that robust action principles were indeed successful in attracting a diverse stakeholder network to generate novel ideas and develop these into sustainable solutions. Yet we also observed that the momentum and novelty generated was at risk of getting lost as the actors and their roles changed frequently throughout the process. We show the vital importance of robust action principles for connecting ideas and actors across crowdsourcing phases. These observations allow us to make a contribution to extant theory by explaining the micro-dynamics of scaling robust action’s impact over time.

Keywords: crowdsourcing, grand challenges, robust action, scaling impact

INTRODUCTION

On 1 January 2016, 193 member countries of the United Nations adopted a universal agenda aimed at tackling some of the world’s most pressing societal challenges. The ‘Sustainable Development Goals’ outline 17 ambitious targets for transforming the world by 2030. From eradicating poverty to combating climate change, over the next 15 years these goals aim to stimulate actions that are critical for humanity, shifting the
world to a more sustainable and resilient path (United Nations, 2015). While scholars and practitioners resoundingly agree that tackling such challenges requires novel solutions that combine the knowledge and resources of diverse actors (Ferraro et al., 2015; Gehman et al., 2016; George et al., 2016; United Nations, 2017a), the means by which to reach such solutions has remained a puzzle. The increased weakening of nation states (Scherer and Palazzo, 2011) and the failure of centralized initiatives to effect real change (Etzion et al., 2017) have led many to argue that tackling grand challenges requires fundamentally new approaches to manage and organize the efforts of the diverse stakeholders involved (Howard-Grenville et al., 2014; OECD, 2019).

One very promising approach gaining traction in recent management and organization literatures is that of robust action. Ferraro and colleagues introduced the robust action approach to grand challenges to address a persistent problem that other organizing approaches have yet to solve: how can local solutions of individual actors scale up to generate larger impact (Etzion et al., 2017; Ferraro et al., 2015)? Robust action offers an effective means for scaling initiatives and their impact by creating the conditions that enable diverse stakeholders to generate novelty and sustain engagement over time. Ferraro and colleagues propose that organizations employ three robust action principles to achieve these conditions: 1) provide a structure that supports constructive interactions between stakeholders over time – ‘participatory architectures’ 2) maintain the diverse perspectives of the involved stakeholders – ‘multivocal inscriptions’ and 3) support these stakeholders in taking action to develop solutions that are flexible and adaptive to the changing circumstances – ‘distributed experimentation’ (Etzion et al., 2017; Ferraro et al., 2015). Combining these three robust action principles, individual organizations can develop novel solutions that will attract the engagement of additional stakeholders. These additional stakeholders will bring along new knowledge and resources that organizations can use to pursue successively larger wins over time.

Certain developments, such as the emergence of wind power in Denmark or the growth of microcredit, provide some initial evidence that robust action principles can cultivate successful local experiments that yield greater impact (Etzion, 2018). However, a potential pitfall of robust action is the amount of time it takes for these principles to generate momentum (Etzion et al., 2017). For example, to realize the impact of wind power, it took several decades for experimentation to spread slowly across many groups of actors who eventually brought their resources to grow solutions for new markets (Garud and Karnøe, 2003). Given the urgency to address threats to the earth’s sustainability (Whiteman et al., 2013), it is clearly in the interest of organizations to find ways to scale positive impact faster.

Crowdsourcing, we argue, is a valuable tool for this task; not only does it include the widespread involvement of actors (Boons et al., 2015; Dahlander and Piezunka, 2014) who collaboratively share and combine ideas to generate novel solutions (Boudreau and Lakhani, 2015; Malhotra and Majchrzak, 2014), it also helps organizations get ideas at a much faster rate than what is possible in traditional organizational settings involving only people inside the firm (Lifschitz-Assaf, 2018; West and Bogers, 2014). It is, therefore, no surprise that organizations have recently begun to experiment with crowdsourcing to stimulate collaborative problem-solving on a range of societal issues like public health (Brabham, 2008; Brabham et al., 2014; Neumann, 2012). Organizations such as
Unilever and General Electric now boast successful crowdsourcing programs aimed at accelerating the development of environmentally sustainable solutions (GE Innovation Lab, 2016; Unilever, 2015). But there is little empirical work explaining if, and how, crowdsourcing can effectively contribute to scaling robust action.

Our contribution in this paper is to show how organizations can scale the impact of robust action through crowdsourcing. Collecting longitudinal data, we analyse an award-winning crowdsourcing initiative called Save Our Oceans (SOO) that tackled environmental sustainability challenges in the maritime industry. We found that SOO participants used robust action principles during each phase of the crowdsourcing process, which was successful for generating novel ideas, attracting the participation of diverse stakeholder groups, and building a network of resources to further develop novel ideas into sustainable solutions. Yet we also observed that the momentum and novelty generated was at risk of getting lost as actors and their roles changed frequently throughout the process. We show the vital importance of robust action principles for connecting ideas and actors across crowdsourcing phases.

A primary insight of our study is that to scale the positive impact of robust action faster, organizations need to 1) generate the engagement of new groups of actors without losing momentum and 2) sustain the novelty generated by one group of actors for use by additional actors. Organizations can achieve this through participatory architectures and multivocal inscriptions that create a context for action and anchor present experimentation with novel ideas and solutions to past and future activity. These observations allow us to make a contribution to extant theory by explaining the micro-dynamics of scaling robust action’s impact over time. Our study also contributes to the growing literature on crowdsourcing for tackling ill-structured problems (Brunswicker et al., 2017; Majchrzak and Malhotra, 2016; Taeihagh, 2017) by showing how robust action can be used in these settings to facilitate greater co-creation between participants in the crowd and relevant stakeholders who will implement the solutions.

To develop these points, this paper is organized as follows: First, we introduce robust action principles and how they can be used to tackle grand societal challenges. Second, we consider crowdsourcing as a tool for scaling the impact of robust action and explain the research context and methods we used to study this empirically. Our findings consist of a longitudinal description of how the SOO crowdsourcing initiative was adapted for robust action. We then analyse how robust action principles were critical for generating novel ideas and sustaining the engagement of diverse actors who helped develop these ideas into industry relevant solutions. We also analyse how connecting ideas and actors across crowdsourcing phases was vital to safeguard against the loss of momentum and novelty. Finally, we discuss how the insights from our study contribute to extant theory on robust action approaches to grand challenges and crowdsourcing initiatives for tackling ill-structured problems.

TACKLING GRAND CHALLENGES THROUGH ROBUST ACTION

Grand challenges, such as climate change and poverty, are large unresolved problems that have widespread impact on society. Such problems ‘resist’ easy fixes due to their complex, uncertain, and evaluative nature (Ferraro et al., 2015). Involving interactions and associations between actors that are nonlinear in nature, interdependencies are the
rule rather than the exception for these problems (Etzion et al., 2017). For example, a coal-fired power plant in the United States can produce greenhouse gas emissions that increase global temperature and cause flooding in coastal regions in Africa. Tackling this problem implies complex interdependencies between actors from multiple domains (the firm and individuals) and locations (the United States and coastal regions abroad). Yet even when many facts are known, these facts do not provide sufficient basis for action because future consequences are difficult to predict, especially since diverse stakeholders perceive such challenges differently. Climate scientists, for example, are able to link CO₂ emissions to melting ice and rising sea levels, but they cannot fully predict their impact in the distant future. Moreover, the CO₂-producing firm frames the problem by citing other natural factors that cause sea levels to rise, to reduce its responsibility, while homeowners who face flooding of their homes assign responsibility to someone else to receive restitution. The evaluative nature of grand challenges means that there are radical differences in preferences and values that make it nearly impossible to reach a consensus on the problem (Ferraro et al., 2015; Grodal and O’Mahoney, 2017). Clearly, grand challenges belong to a class of problems that are difficult to solve because of incomplete, contradictory, and unpredictable changing requirements.²

Given the complex, uncertain, and evaluative nature of grand challenges, there is widespread agreement in both scholarship and practice that to overcome formidable barriers, collaborative efforts among diverse stakeholders are required (George et al., 2016). Recently, scholars have argued that robust action is potentially a very effective approach to tackle grand challenges because it generates novel solutions and enables sustained engagement required to achieve desired outcomes (Etzion et al., 2017; Ferraro et al., 2015). While the concept of robust action originated years ago in the field of sociology (Leifer, 1991; Padgett and Ansell, 1993), it has recently gained traction in management and organization studies. Ferraro and colleagues (2015) argue that organizations can play a central role in tackling grand challenges, but not through conventional management approaches. For one, grand challenges usually go far beyond the span of formal organizational control (Cash et al., 2006) and in addition, clear hierarchy is often absent, making typical top-down approaches to management largely ineffective in resolving these problems (Etzion et al., 2017). The failure of top-down approaches makes novel and alternative solutions through distributed experimentation even more desirable, and premature termination of many organizational initiatives has shown that long-term action and commitment is required (Ferraro et al., 2015). Robust action offers a promising alternative by theorizing how organizations can sustain connection among heterogeneous actors in the face of uncertainty and complexity through three principles: participatory architecture, multivocal inscription, and distributed experimentation (Ferraro et al., 2015).

An important first principle of robust action is creating a structure that allows heterogeneous actors to engage constructively over time, called participatory architecture by Ferraro and colleagues (2015). Such participatory architecture can be established by creating rules of engagement and spaces that enable actors with different perspectives to interact meaningfully with their counterparts. Participatory architecture supports engagement between heterogeneous actors, such as experts and non-expert publics, by establishing an ‘even playing field’ where actors with different types of knowledge can interact (Callon,
Rules for interacting can be, for example, an agreement that no one who wishes to join can be excluded. Spaces can be virtual platforms and forums, or physical spaces where participants meet, for example, meetings held in dedicated locations outside the ‘home turf’ of the participating actors. Ferraro et al. (2015) suggest that such participatory architecture is effective in tackling grand challenges because it forestalls disengagement by creating room for diverse actors to voice their perspectives.

Another robust action principle, *multivocal inscription* (Ferraro et al., 2015; Furnari, 2014), supports actors in using their differences productively to articulate and solve problems. This strategy is based on a style of interaction that facilitates the negotiation of meaning across different actors by using symbols that can be interpreted coherently from multiple perspectives (Furnari, 2014). These multivocal inscriptions, which can include discursive labels or material artefacts (Ferraro et al., 2015), can perform as boundary objects because they are adaptable to different viewpoints but generic enough to be useful for actors with different purposes (Star and Griesemer, 1989). In many cases, multivocal inscriptions have no inherent meaning, but rather their meaning is constituted through the interaction between participants from different domains. In the context of grand challenges, multivocality has advantages; it allows for flexible ways of organizing, perceiving, and justifying social relations (Ferraro et al., 2015). For example, the concept of ‘sustainable development’ is so successful because it means different things to different people and organizations (Robinson, 2004). Multivocal inscriptions are advantageous because they provide common ground for discussion but leave sufficient flexibility to manoeuvre, for actors who are frequently at odds. This is apparent, for example, in the case of the Kyoto protocol, which failed because it offered merely a single way of perceiving the climate change problem (Verweij et al., 2006).

The third robust action principle involves iterative actions combined with evolutionary learning, which Ferraro et al. (2015) called *distributed experimentation*. Such distributed experimental actions are not geared towards large-scale interventions, but rather consist of ‘bottom up’ iterative actions that result in ‘small wins’, often making the next solvable problem more visible (Ferraro et al., 2015, p. 377). Distributed experimentation by the Global Reporting Initiative, for example, did not provide one set standard for organizations to use in sustainability reporting, but involved user organizations developing decision-tools that experimented with different models to articulate the salient aspects of performance in the context of sustainability (Etzion et al., 2017). These models of performance were adjusted continuously and organizations learned from their local experiments. While failures are inevitable, tackling grand challenges through progress on many possible solution pathways avoids catastrophic failure due to centralized governance approaches (Dietz et al., 2003).

The combination of these three principles offers organizations an effective means for scaling impact, as novel solutions which are successful on a small-scale set into motion forces that trigger more successful solutions (Etzion et al., 2017). By generating novelty and sustaining engagement, robust action principles create the conditions for this momentum to develop over time (Hughes, 1993) as local solutions attract additional groups of actors who provide new knowledge and resources to accomplish slightly larger successes. Yet one of the recognized limitations of robust action is the time taken for scaling impact. Existing cases in which robust action principles are purported to contribute to
large-scale impact show this generation of momentum is a gradual process (Etzion et al., 2017).

The chance that robust action principles may be too slow to respond effectively to the urgency of grand challenges is a real point of concern, one which we argue that organizations can address through tools that accelerate and scale the impact of successful experiments across groups of relevant actors. Crowdsourcing can offer such a tool, which we will explain in the next section.

CROWDSOURCING TO SCALE THE IMPACT OF ROBUST ACTION

Crowdsourcing is a valuable tool for organizations to increase participation and experimentation by diverse stakeholders. Crowdsourcing is ‘a type of participative online activity in which an individual, an institution, a non-profit organization, or company proposes to a group of individuals of varying knowledge, heterogeneity, and number, via a flexible open call, the voluntary undertaking of a task’ (Estellés-Arolas and Gonzalez-Ladron-de-Guerva, 2012, p. 9). It effectively broadens the base of participants, increasing both the number and diversity of problem-solvers compared to traditional organizational settings (Afuah and Tucci, 2012). Diverse participants who collaboratively share and combine their knowledge on crowdsourcing platforms can experiment on multiple ideas simultaneously, which increases the likelihood that novel solutions will emerge (Boudreau and Lakhani, 2015). Bringing many diverse actors into one space to solve a shared problem also helps organizations get ideas at a much faster rate than what is possible in traditional organizational settings involving only actors within the firm (Lifschitz-Assaf, 2018; West and Bogers, 2014). And by connecting participants in the crowd with organizations that have the resources to realize ideas, crowdsourcing facilitates actual solutions. It is, therefore, no surprise that crowdsourcing is increasingly being used for addressing societal challenges in public health (Brabham, 2009; Brabham et al., 2014), civic innovation (Brunswicker et al., 2017), and climate change (Malone et al., 2009). Platforms such as OpenIDEO offer some clear benefits for tackling grand societal challenges by enabling many diverse participants to interact and experiment with the generation and development of multiple ideas (Fayard and Levina, 2017).

In the remainder of this study, we examine how organizations can use crowdsourcing to scale the impact of robust action. Our study will investigate a case of crowdsourcing to solve ocean pollution and show how robust action principles were enacted to not only generate novel ideas and keep diverse groups of actors engaged, but also to connect actors and ideas across different phases of the initiative to avoid losing momentum. Our analysis provides much needed empirical insight into the nature of robust action in practice while showing how the crowdsourcing process can be adapted to generate and sustain engagement to increase the likelihood of novel ideas getting implemented.

RESEARCH CONTEXT

Our research takes place in the context of an environmental sustainability initiative called Save Our Oceans (SOO), which was formed to develop innovations for the sustainable use of oceans within the maritime industry. Major industry players sought to
raise awareness of environmental challenges, improve the health of oceans and make industry practices more sustainable. Yet, they recognized a gap between their sustainability ambitions and the present reality of the industry. The total sulfur emissions of all cars worldwide equal those of only 16 of the world’s largest ships (Pearce, 2009). Changes in the industry were needed. SOO’s aim was to close this gap by bringing together expertise and resources from across the globe to scale sustainable innovation. As a multi-stakeholder, collaborative crowdsourcing initiative designed to tackle sustainability, SOO represented a particularly ‘revelatory case’ (Yin, 2009) of crowdsourcing solutions for a grand challenge.

SOO has three founding partners operating in the Netherlands: one large private commercial firm in the offshore industry (Organization A), a small non-governmental organization specializing in entrepreneurial ventures (Organization B), and a large governmental knowledge institute (Organization C). Together, these founding organizations created a foundation through which they could collectively host crowdsourcing challenges. These three founding partners were joined by nine other partner organizations consisting of two additional large governmental knowledge institutes (Organizations D and L), three small-to-medium sized enterprises in the maritime and offshore industry (Organizations F, G, and I), a large bank (Organization H), an innovation consultancy (Organization J), a large public university (Organization K), and an organization representing firms in the global maritime industry (Organization E). The founding partners aimed to create a broad and diverse network to offer the range of resources (expertise, testing facilities, employee support, etc.) needed to develop and implement sustainable innovations. See Table I for a summary of the different roles held by the organizational partners within the network.

All 12 partners supported SOO in different ways. Each partner signed a ‘partner agreement’ stipulating their expected in-cash and in-kind contributions. Although the partners contributed at different levels and fulfilled different roles, it was stressed that

Table I. Challenge roles

| Role                      | Description                                                                 |
|---------------------------|-----------------------------------------------------------------------------|
| Founding Partner          | Organizations that founded the Save Our Oceans Foundation.                  |
| Partner                   | Organizations that signed partner agreements and contributed resources to the challenge. |
| Organizing Team           | Employees of the partner organizations who planned the challenge by recruiting partners and idea holders, organizing meetings and workshops, and facilitating the problem formulation and selection processes. |
| Challenge Team            | Employees of the partner organizations who encouraged potential contributors to join and elaborate on ideas on the crowdsourcing platform. |
| Partner Representatives   | Senior managers and executives within the partner organizations who signed partner agreements and were responsible for selecting ideas. |
| Partner Experts           | Employees within the partner organizations assigned to contribute expert knowledge to the ideas on the platform. |
| Idea Holders              | Individuals who posted ideas to the crowdsourcing platform (employees of the partner organizations, entrepreneurs, and challenge team). |
all of them were equal; even the paid consultants on the project (Organizations B and J) were deemed partners and played a role in selecting and developing the final solutions. See Appendix A for a full description of the organizational types, roles, and contributions of the 12 SOO partners.

SOO was organized into five phases: problem formulation, ideation, evaluation, selection, and development. The first phase involved the formulation of the problem and challenge questions by the partners. Subsequently, an online crowdsourcing platform was launched for the ideation phase. Idea holders registered on the site by providing their names and contact information, which enabled them to upload a short idea description accompanied by a graphic or picture. Users without ideas could register and participate on the platform by voting for ideas they liked or by providing ‘enrichments’ to the ideas, which involved posing questions or exchanging knowledge for each idea.

Individuals from countries across the world, such as the United States, Canada, Greece, Germany, Norway and the Netherlands, contributed a total of 88 ideas to the platform. Among the idea holders, 33 per cent belonged to partner organizations, while the remaining 67 per cent were external entrepreneurs and employees of small start-ups and maritime organizations. Phase three of the challenge began when the online platform was closed. During this phase, the partner representatives created the evaluation criteria and the partner experts and challenge team evaluated the ideas. During the selection phase, the partner representatives vetted the 88 ideas submitted and selected the ‘top’ 16. This marked the beginning of the development phase in which the top idea holders worked closely with the relevant partner organizations to develop their ideas into investor-ready business plans. At the end of the development phase, the idea holders and partners presented five business plans to potential investors at an industry event. These plans included details on the construction and testing of prototypes and financial projections (see Appendix B for a description of SOO partner contributions to the final five solutions). See Table II for a description and overview of each phase of SOO.

The SOO challenge was considered a success by SOO partners and was recognized in the industry with several prestigious awards (Dupont, 2015). The United Nations gave it official recognition by selecting it as a frontrunner of Sustainable Development Goal number 14 – to conserve and sustainably use the oceans, seas and marine resources for sustainable development (United Nations, 2017b). In 2016–17, SOO hosted a second successful crowdsourcing challenge, and it plans to continue hosting annual challenges until it fulfils its vision for a completely sustainable industry.

METHODS

Data Collection

After an initial meeting with the founding partners, we were granted permission to: (a) observe all SOO meetings and events, (b) interview representatives of all partner organizations and idea holders, and (c) access documents created and shared by the partners. We negotiated access to the project in April 2014, after the formation of the SOO foundation but before the launch of the ideation phase. We collected longitudinal
We observed three types of challenge meetings and events: partner meetings, training sessions, and partner-idea holder events. Partner meetings were only attended by partner organizations (usually the partner representatives) to mark important milestones or make collective decisions. For example, a partner kick-off meeting was held to mark the opening of the online platform, and a partner selection meeting was held for partners to collaboratively vote on the top solutions. During the training sessions, the challenge team and partner representatives learned how to post ideas and enrichments within the platform. Finally, at partner-idea holder events, the partner representatives and the top idea holders met to present their ideas and share knowledge to develop the final solutions. At these meetings, we assumed the role of participant observers, which enabled us to gain access to insider meanings (Patton, 2002). We took detailed field notes and engaged in informal ethnographic interviews with the participants, which we documented in detail afterwards.

We conducted 28 in-depth interviews with the SOO partners and idea holders in two rounds. We conducted 23 interviews with the partners, 16 after the online platform was launched and seven after the partners selected the top ideas. During the second round, we also interviewed five idea holders whose solutions were among the top 16. As follow-up, we contacted the idea holders to learn how the top ideas developed in the two years following SOO. The interviews were in-depth and semi-structured – we followed a general guide of questions, but often expanded into different directions (Patton, 2002) – and were 25 to 70 minutes long, with an average length of 48 minutes. All 28 interviews were audio-recorded and transcribed for analysis.

Table II. Save Our Oceans phases

| Phase            | Duration | Description                                                                                                                                 |
|------------------|----------|---------------------------------------------------------------------------------------------------------------------------------------------|
| 1 Problem        | 6 months | Partner organizations collaboratively discussed what the focus for the crowdsourcing challenge should be and recruited potential partners.          |
| Formulation      |          |                                                                                                                                              |
| 2 Ideation       | 8 weeks  | Idea holders posted solutions to the online crowdsourcing platform. The organizing team and the challenge team encouraged employees of the partner organizations and the entrepreneurs to post and enrich ideas on the platform. |
| 3 Evaluation     | 1/2 month| All ideas on the platform were vetted by the partner organizations. The challenge team pre-selected the ideas on the platform.                |
| 4 Selection      | 1/2 month| The partner representatives selected the top ideas that would remain in the challenge.                                                      |
| 5 Development    | 8 months | The top idea holders were given access to the relevant partner organizations to utilize their testing facilities, expertise, and networks. Some partners and the top idea holders developed joint projects and partnerships. |
| Data source          | Phase            | Details                                                                                                                                 |
|---------------------|------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| Participant         | Problem          | • Two preparation meetings between partners (Partner Meetings)                                                                       |
| observations        | formulation      | • Challenge kick-off attended by all partner organizations (Partner Meeting)                                                           |
|                     | Ideation         | • Training event for challenge team (Training Session)                                                                                   |
|                     |                   | • Enrichment sessions (Partner-Idea Holder Event)                                                                                         |
|                     | Evaluation,      | • Challenge teams’ pre-selection meeting (Partner Meeting)                                                                                   |
| sources             | selection        | • Partner representatives’ selection meeting (Partner Meeting)                                                                             |
|                     | Development      | • ‘Challenge event’ to link selected idea holders to partners (Partner-Idea Holder Event)                                               |
|                     | • ‘Feedback      | • ‘Feedback sessions’ with partner representatives and final idea holders (Partner-Idea Holder Event)                                      |
| Interview           | ideation         | • ‘Demo Day’ for final idea holders to present investor-ready business plans (Partner-Idea Holder Event)                                     |
|                     | Development      | • 16 in-depth interviews with representatives from 8 partner organizations                                                                |
|                     | • 7 in-depth     | • 7 in-depth interviews with representatives from 5 partner organizations                                                                |
|                     | interviews       | • 5 in-depth interviews with idea holders                                                                                               |
| Documents           | Problem          | • Challenge formulation drafts (6) (Internal Partner)                                                                                     |
|                     | formulation      | • Partnership agreements (Internal Partner)                                                                                               |
|                     | • Challenge      | • Challenge introduction document (Promotional)                                                                                           |
|                     | ideology         | • Official project launch announcement (Promotional)                                                                                       |
|                     | documents        | • Promotional flyers (Promotional)                                                                                                        |
|                     | Ideation         | • Press release about launch date (Promotional)                                                                                           |
|                     | • Website        | • Website screenshots (Training)                                                                                                          |
|                     | ideation         | • Online platform registration (Training)                                                                                                 |
|                     | • Challenge      | • Challenge teams’ training slides (Training)                                                                                              |
|                     | ideologies       | • Notes from weekly challenge team meetings (Challenge Team)                                                                                |
|                     | Evaluation,      | • Terms and conditions of platform participation (Partner-Idea Holder)                                                                      |
| sources             | selection        | • SOO intellectual property framework (Partner-Idea Holder)                                                                                 |
|                     | • Partner matrix | • Partner matrix linking partners to idea holders (Challenge Team)                                                                         |
|                     | evaluation       | • Tips for sharing ideas on the platform (Challenge Team)                                                                                   |
|                     | • Partner        | • Partner briefing and updates (4) (Internal Partner)                                                                                        |
|                     | briefing         | • Enrichment guide (Challenge Team)                                                                                                        |
|                     | • Enrichment     | • Announcement to idea holders (Partner-Idea Holder)                                                                                       |
| Evaluation,         | selection        | • Draft evaluation criteria (Internal Partner)                                                                                             |
| sources             | • Selection      | • Selection process outline (Internal Partner)                                                                                            |
|                     | process          | • Pre-selection heat maps (Internal Partner)                                                                                            |
|                     | heatmaps         | • Announcement of final cohort of ideas (Internal Partner)                                                                                  |

Electronic copy available at: https://ssrn.com/abstract=3610266
We collected 65 documents produced by the partners and idea holders across all phases of the project, as well as promotional documents. The primary document types included internal partner documents, challenge team documents and partner-idea holder documents. Internal partner documents were created by the organizing team or edited by the partners, and circulated only among the partner representatives (e.g., the challenge problem formulation). The challenge team documents included notes from weekly meetings during the ideation phase where members of the organizing team and the challenge team shared updates and knowledge on how to bring new ideas to the platform and develop them. Partner-idea holder documents were produced by the idea holders for partners (e.g., business plans) while promotional documents were created by the organizing team explicitly to be shared widely among the networks of partner organizations or publicly online (e.g., press releases). Finally, to gain a better understanding of the ideas, we included text from the 88 idea submissions and 734 comments. Triangulating across multiple data sources in this way increases the reliability of the findings (Patton, 2002).

Data Analysis

Our analytical strategy combined a process approach and elements of grounded theory (Langley, 1999; Strauss and Corbin, 1998). Such inductive methods have been identified as being particularly helpful for grand challenges (Eisenhardt et al., 2016) and are well suited to address how questions related to the participant’s experiences and interpretations of events (Langley, 1999). Further, the complexity and multitude of data sources required an iterative approach in which we alternated between writing case narratives, inductive coding of the various data sources, and reading additional literature.

We started the analysis alongside our fieldwork (Locke, 2001). Based on our close reading of the observation notes, as well as interview and meeting transcripts, we created a chronological event list (Poole et al., 2000) and wrote thickly descriptive narratives (Langley, 1999). The narratives, which detailed the experiences and considerations of the people involved, drew heavily on the expressions and quotes of members from SOO partner organizations (Langley, 1999). To enhance the trustworthiness of our interpretation...
(Lincoln and Guba, 1985), we presented the narratives to the main informants and asked them to check for consistency.

As a next step, we used the constant comparative method to engage in open coding of the data (Strauss and Corbin, 1998) to uncover any challenges that the difficult nature of the problem posed to SOO’s crowdsourcing initiative. An emergent theme we identified was the involvement of different types of participants, and how, to accommodate their interests and perspectives, SOO had to introduce ambiguity in all phases of the crowdsourcing process. First-order codes in this stage of analysis included, for example, ‘participation challenges’, ‘participant diversity’, and ‘flexibility’.

Through our engagement with additional literature, we uncovered the resemblance of our codes with robust action principles for solving grand challenges (Ferraro et al., 2015), which we then used as a lens for the next round of analysis. In this step of our analysis, we followed the strategy of temporal bracketing (Langley, 1999) – we decomposed the crowdsourcing process into five phases and explored the recurrence of robust action principles. We also engaged in axial coding (Strauss and Corbin, 1998) to understand how the different elements we found within each phase interacted with one another. For example, we grouped first-order codes, such as ‘engagement through meetings’ and ‘feedback sessions,’ under the second-order category ‘participatory architecture’.

As a final step, we focused on the overall crowdsourcing process to understand how the robust action principles employed during one phase had implications for other phases. This enabled us to see how the robust action principles were essential not only within the different phases, but also across them for maintaining options and keeping the phases of the challenge open. We also noticed that as the actors or their roles changed throughout the process, they needed to be connected to the ongoing experimentation across the phases.

Our findings consist of a longitudinal description of how SOO adapted the crowdsourcing process for robust action to emerge, followed by an analytical description detailing how robust action principles in each phase of the process were successful at generating the engagement of many different groups of actors in order to develop and enrich novel solutions for more sustainable oceans. We conclude our findings with an analysis of how the actors and ideas were connected across the different phases of the crowdsourcing process to ensure that the momentum and the novel ideas built during one phase did not get lost during the transition to subsequent phases. In the next two sections, we present the results of our analysis.

ADAPTING CROWDSOURCING TO FACILITATE ROBUST ACTION

The first part of our findings consists of a description of the unfolding of the SOO crowdsourcing initiative. We have organized this description chronologically, based on the five phases of the challenge: problem formulation, ideation, evaluation, selection, and development. This section shows how SOO participants encountered hurdles in adopting crowdsourcing, but they were able to overcome these difficulties by making important adaptations to the crowdsourcing process to facilitate novel ideas and sustained engagement.
Phase One: Collaborative Problem Formulation Involving SOO Partners

The founding partners of SOO initially joined forces to tackle the global problem of plastic soup—ocean landfills that are estimated to contain 7 to 8 million tons of garbage that is destroying sea life (Greenpeace International, 2015). Given the potentially widespread negative impact of plastic soup on the world’s oceans, the founding partners shared a strong sense of responsibility to take action. They reached out to dozens of organizations in the industry and asked them to join their efforts, knowing that a diverse pool of knowledge and resources would be needed to find a solution. Yet after months of conversations with prospective partners, no new organization committed to engaging in the project. Exasperated and discouraged, the founding partners realized that the problem of plastic soup was simply too narrow to mobilize industry-wide participation:

We started approaching partners; we had many conversations with other parties in the market and through these conversations we found out that the plastic soup issue is quite narrow. We saw that there are other industry-related issues that are more relevant for these parties. (Molly, Organization B)

To generate engagement, the founding partners made an adaptation—instead of trying to convince other organizations to tackle plastic soup, they broadened the challenge: ‘Our challenge was to create a challenge definition that suits all partners and which has for everyone something recognizable and valuable in it and therefore we had to be adaptive and more of a facilitator than forcing our own vision’ (Mike, Organization B). Another partner elaborates: ‘We started with the plastic soup, then we made the topic broader. So we were looking at ‘okay we have the ocean, we have our industry, so what can we do with that?’ (Sandy, Organization A). They changed the main theme of the challenge to ‘the ocean as a shared resource’, which enabled new organizations to connect their interests to the challenge. In a series of meetings, the prospective partners were invited to participate in defining the challenge, resulting in seven iterations of the challenge problem over time (see Table IV).

In the final iteration, the founding partners retained their initial concern for tackling the global problem of plastic in the ocean, while the other partners included their concerns for making local industry improvements to sustainability:

We have created room for all [partners] to be involved. We created two waves. In the first wave is impact in the short-term and solving issues that are now challenging for the industry, for example the impact of sound or the other topics [Business Improvements]. The other one, the second wave, that’s more long-term with an impact of a period, I hope within 5 years, to come up with new technology and create a proof concept and scale up [New Business]. (Mike, Organization B)

The partners’ process of defining the challenges together enabled them to identify common interests in a collaborative way:
Within the [challenge definition] process the partners are already starting to work together. This is valuable for the companies to see, ‘Ok, what is really important to us? What are we looking for and aiming for?’ So, for the companies themselves this is a valuable process, but also for us together as well because we get a better understanding of what is the core issue. (Molly, Organization B)

While a broader challenge definition contributed to a participatory architecture that would attract more diverse participants, SOO’s approach was actually counterintuitive from the perspective of crowdsourcing. The provider of the platform explained that a crowdsourcing challenge was normally supposed to be clear and focused, but while he tried to influence SOO to opt for a more focused challenge, the partners resisted. Experimenting with an unconventionally broad challenge definition was viewed as important for all partners to have a real stake in the project. At the end of problem formulation, SOO had expanded from three founding partners to a diverse network of 12 partner organizations. The partners viewed their collaboration on the challenge problem as an important accomplishment in itself. ‘I think this [SOO] is a program of small steps. The first success already is that you have the partners on board on the same subject’ (Jon, Organization C). A broad challenge definition (see Appendix C) generated the engagement of diverse partners by attracting them to join the project and commit their organization’s time and resources to it.

**Phase Two: Ideation Involving the Crowd, Partner Experts, and the Challenge Team**

After coming to an agreement on the challenge definition, at least one employee from each partner organization joined a ‘challenge team’ that would facilitate ideation on an online platform. Given that the partners had chosen a collaborative platform, launched a large media campaign, and invited experts from the partner organizations, they expected an interactive platform where participants would not only post ideas, but also collaboratively ‘enrich’ ideas. However, after two weeks, the challenge team became quite nervous – with dramatically fewer ideas and enrichments than expected, it appeared that the platform was at a standstill, threatening to bring the project to a halt.

The challenge team began reaching out to experts in the partner organizations that were designated to interact on the platform, and discovered that the lack of engagement was not due to lack of awareness; instead, many partner experts admitted they were hesitating to comment on ideas outside of their direct expertise. The partner experts explained it was better not to contribute at all than risk commenting on an idea they did not fully understand. This hesitation was amplified by the fact that the comments were visible to everyone on the platform.

Realizing that additional actions were needed to generate engagement on the platform, the challenge team made a change. Instead of focusing on moderating comments on the platform, they shifted their efforts towards activating partner experts through face-to-face ‘enrichment sessions’. In dozens of sessions held at many different partner organizations, the challenge team instructed the partner experts on how to enrich ideas on the platform. Explaining that good ideas were ‘seeds’ that could only grow with the
knowledge of others, the challenge team facilitated exercises where the experts learned to connect their knowledge to unfamiliar ideas posted by the crowd. These sessions featured group discussions that proved helpful in ‘opening’ the ideas so partner experts could generate enriching comments:

I went on the platform together with some people from Organization A [during an enrichment session] and my comments got a lot better. You have time to read things and I asked someone, ‘Hey does anybody know about this and this?’ And they went, ‘Yeah, write this!’ It went a lot better immediately. (Fred, Organization B)

Working together, the partner experts in the brainstorming sessions began imagining ways to apply their knowledge in a different context, a multivocality they had struggled to develop on their own. The partner experts also experimented with synergies for collaboration, and in some cases, even combined their ideas with those of idea holders in the crowd. ‘One of the ideas is actually a combination, so it is the idea of Idea Holder X, and it is combined with multifunctional platforms, which was posted by Idea Holder Y. So some ideas have also been put together’ (Sandy, Organization A).

Enrichment sessions generated more engagement, which proved to be a boost for the platform and the project. Ironically, towards the end of the ideation phase, there were so many idea enrichments that the experts found it difficult to keep track of the conversations. Yet reading these comments became an important source of learning for the partner experts:

| Version | Date      | Crowdsourcing question                                                                 | Challenges                                                                 |
|---------|-----------|----------------------------------------------------------------------------------------|---------------------------------------------------------------------------|
| 1       | March 21  | No question                                                                             | Onshore; offshore; ocean environment                                       |
| 2       | April 1   | How can we restore our oceans and use them as a resource for sustainable innovations and new business models? | Onshore; offshore; open water                                               |
| 3       | April 14  | How can we restore our oceans and use them as a source for a sustainable lifestyle and circular economy? | Offshore industry; ocean ventures                                           |
| 4       | April 14  | How can we responsibly use the ocean as a sustainable resource for innovations while solving current social and environmental issues? | Onshore; offshore; international seas                                       |
| 5       | April 16  | How can we use the ocean as a resource for sustainable business?                        | Onshore; offshore; international seas                                       |
| 6       | April 23  | How can we use our oceans as a resource for scalable sustainable business?             | Business improvement; new business                                         |
| 7       | May 15    | How can we use our oceans as a resource for scalable sustainable business?             | Business improvement; new business, including detailed questions (seen in Appendix 3) |

Table IV. Versions of Save Our Oceans crowdsourcing question
I think it’s [crowdsourcing platform] really good. You are making visible what the ideas are to people with high or low technical skills. I like that we can see who these people are and what their skills are. I think in terms of fuelling a cross-sector partnership, it is great. I didn’t like the one [partnership] I did before because it didn’t have a platform but just emails to each other. It becomes very difficult to keep perspective and to see what’s happening, so this is good. (Frank, Organization J)

This transparency of posts and comments on the online platform allowed everyone to see the stakeholders of the problem and the extent of their knowledge. Eventually, a ‘knowledge matrix’ was composed to provide an overview of who knew what across the partner organizations, which made it easier for interdependent experts to generate further engagement. The participants also explained that the process of enriching ideas enabled them to see the problem in new ways:

Now that the challenge [crowdsourcing platform] has launched I’m seeing a lot of people making the challenge their own. So in a sense we are going backwards, ‘Oh, this idea was submitted? Yeah, that’s what we meant, that’s the focus that we want to have’. (Fred, Organization B)

Once the challenge team learned of these benefits to SOO partners and their experts, they extended the platform phase by an additional two weeks for continued ideation with the crowd. At the end of this phase, the ideas and enrichments were celebrated as an important accomplishment for the project.

**Phase Three: Idea Evaluation Involving SOO Partners and the Challenge Team**

After the ideas were finalized, the organizing team initiated the evaluation of each idea on the platform by contacting all the partner representatives for their evaluation criteria. While they expected general agreement between the partners, what the organizing team received in response was a collection of rather vague and disparate concepts.

I have a list of five keywords: impact, innovative, business case, feasibility, scalability, and time to market. But the thing is, what is scalability? Time to market, is that a good thing? Should it have time to market or should it have a small amount of time to market, or what is impact? (Fred, Organization B)

Realizing that the partners had different evaluative judgments, the organizing team embarked upon the time-consuming task of exploring ‘desired end states’ that would satisfy everyone. In a document titled ‘Understanding the Context’, the partners were encouraged to revisit the challenge question that originally guided the overall initiative. In the document excerpt below, the SOO question was translated into a ‘desired situation’.

To define the criteria on which ideas should be selected, we have to look into the context in which they will be developed. First of all, the overall question for SOO is:
‘How can we use our oceans as a resource for scalable sustainable business?’ By rephrasing this question into a sentence that implies a current situation and a desired situation, we can get to the problem we are solving.

**Problem: Our oceans are not used enough as a resource for scalable sustainable business**

To make this desired situation clearer, we can make an assumption about what is actually meant, resulting in the following problem:

**Problem: Ocean related businesses currently fail to become scalable and sustainable, but this is necessary when we want them to succeed**

Formulating the problem like this finally brings a little focus and direction into our challenge. This is necessary because **our criteria should only be derived from what we agree we should focus on and from our perspective on a situation. It should not be an abstract list of what is right and wrong.**

(Draft Selection Criteria, Internal Partner Document, bold in original)

The organizers experimented with exercises like this to learn what the partners collectively aimed for. By re-examining the problem formulation, the organizing team identified two criteria that all the partners could agree upon and share: making an economic impact and contributing to sustainability in the industry.

While these two common criteria were useful for coordinating partners along the same evaluative lines, they failed to capture all the partners’ aims for a desirable idea. Unlike most crowdsourcing challenges that ended after selection, the SOO partners were responsible for supporting the top ideas with resources and knowledge during the development phase. The partners could also evaluate the ideas based on their organization’s ability to support them further:

I was first thinking along the lines of does it [solution] fit with what [Organization C] does. Does it fit our vision and strategy, you know. If it relates to oil and gas, it’s not for us. If it’s related to fishery, it’s really hard to give expertise on fishing, or maybe it’s too far from what we do. So thinking about that and also thinking about the fact that we had to supply some experts for the next phase. (Mason, Organization D)

To reflect the partners’ individual objectives, the organizing team added a third evaluation criterion called ‘interest for my organization’, which was explained in the selection meeting: ‘The most important criterion is how relevant it [idea] is for you’ (Partner Selection Meeting Fieldnotes). As a result, the evaluation criteria were multivocal, reflecting the collective goals of the partners while also giving each partner the flexibility to define what was an interesting idea from their own perspective (see a full list of the SOO evaluation criteria in Appendix D).

The members of the challenge team then performed the initial evaluation of all the ideas generated on the platform at a joint evaluation meeting. During this meeting, the challenge team engaged in further discussion and elaboration of the evaluation criteria when comparing these to actual ideas, which were very diverse in nature. ‘It was a
pre-ranking of the ideas in terms of what way they match with the challenge questions and in what way they are valuable to the partner network to develop further in the challenge process’ (Mason, Organization D). A pre-selection of ideas from each partner organization was compiled into a partner booklet that provided input for the partner representatives to make the selection of top ideas in the next phase.

**Phase Four: Matchmaking Between SOO Partners and Top Idea Holders**

After the evaluation of the ideas, the organizing team planned a meeting for the partner representatives to select the top ideas that would receive partner support in the development phase. The meeting focused on ideas that were evaluated highly by the challenge team, and the partner representatives were asked to vote for the ideas they wanted to pursue further. However, after the first round or two of voting, the partner representatives lamented that they missed important information needed to make this selection. Idea summaries and pre-selections in the partner booklet did not contain any information about the idea holders themselves, a point of concern for the partners. Figure 1 provides an example of the idea summaries presented to the partner representatives at this meeting.

With such limited information, most partner representatives said they were compelled to vote for ideas that were most familiar to them.

So what you see now is only a small percentage of the ideas that we have in our selection are not partner-related… I am a bit disappointed because for us, it is about sharing and helping the people who need knowledge and who are sometimes unable to acquire it. Then I don’t think it is a matter of just spending those hours on your own ideas. (Mason, Organization D)

After this relatively disappointing selection, the organizing team realized that they needed to take corrective action to ensure that none of the novel and potentially valuable ideas were lost in the process. The organizing team returned to the online platform to review comments and look for clues of an idea holder’s credibility. In the Figure 2 below, an idea is featured in its evolution form on the platform. In this form, it was clearly visible that an idea holder unfamiliar to many of the partners had actually received attention from other community members and was actively responding to their suggestions and comments. Fourteen comments beneath the top-level post revealed that the idea holder was engaged in a conversation regarding his solution, something that had not been visible in the partner booklet.

If idea holders received attention from other participants and were actively responding to comments on the platform, the organizing team took notice of these as ‘active’ idea holders. ‘Juan [idea holder] was really active in the platform… you want the really active participants to get selected’ (Sandy, Organization A). Activity on the platform, and specifically engagement with other participants, was perceived as an important indicator of the idea holders’ commitment to realizing their ideas in the development phase. After reviewing such interactions on the platform, the organizing team included several new ideas in the cohort of top ideas that they felt had been overlooked in the original selection meeting.
After seeing that solutions had been selected that shouldn’t have been selected, we tried to fix that. It is actually matchmaking 2.0. I saw that [an idea holder] doesn’t have the time or the ambition to work on this, then I asked him to contact the lady from Australia [with a similar idea] to see if she is willing to take more the lead in this idea. (Sandy, Organization A)

Reselection was a form of ‘matchmaking’, which involved the selection of novel ideas based on an estimate of how receptive an idea and its idea holder would be to support from SOO partners. While matchmaking did not lead to reselection of every idea, it was especially useful for verifying novel ideas that were evaluated highly but were unfamiliar to the partners. Interestingly, this process of matchmaking did not necessarily result in only well-developed ideas being selected. Rather, several of the top ideas were still in a concept phase but were considered highly valuable nevertheless because they showed a real potential to grow with the SOO partners’ inputs. Furthermore, matchmaking was a process that seemed relatively unconcerned with limiting the number of ideas. Instead of choosing a few winners, which is typical in crowdsourcing challenges, SOO’s matchmaking process resulted in 16 top ideas, ensuring that there were multiple options to pursue during the development phase, and each idea was supported by more than one SOO partner. A member of the organizing team explained that matchmaking was a way to ‘get a coalition of partners around every selected idea that is committed to deliver support during the [development] phase and to also arrange commitment for further development after the Demo Day’ (Mike, Organization B). With an array of partners to choose from, idea holders had multiple options to pursue for the further development of their ideas.

Figure 1. Idea in summary form in the partner selection booklet [Colour figure can be viewed at wileyonlinelibrary.com]
Phase Five: Work on Idea Development by SOO Partners and Top Idea Holders

The efforts of SOO partners and idea holders in the last phase of the challenge were geared towards the development of top ideas into viable solutions. In this highly anticipated phase of the project, the partners expected that eager and motivated idea holders would take advantage of the knowledge and resources of the SOO partner network to take their ideas to the next level. An event was held to showcase and celebrate the top ideas; it was aimed at giving idea holders an opportunity to approach partners to discuss the support they needed. After this event, it was up to the idea holders to make contact with specific SOO partners and pursue their support. As a partner explained, ‘We really put it [development] into the hands of the idea owners’ (Mike, Organization B). They emphasized that idea holders should take responsibility for extracting what they needed from the partner network.

However, after several months, the organizing team received some disappointing news: only a few idea holders had advanced their ideas. Many of them admitted they were unsure about the next steps for realizing their novel ideas, or believed the effort required for developing their ideas was too great:

I saw the struggle of idea owners, because giving good support also needs idea owners that have clear questions for support or have good knowledge of what they are lacking. That was not always clear for us, but also not for the idea owners. (Mike, Organization B)

Realizing that idea holders were struggling to forge their own paths, the organizing team devised a series of feedback meetings to generate engagement between the idea holders and SOO partners.
and the SOO partners. At recurring meetings over the course of several months, the idea holders were asked to present progress updates, after which the partner representatives gave them individualized feedback. From these feedback sessions, the organizing team learned that many ideas had common weaknesses. For example, most idea holders lacked the financial planning necessary to convince investors of the value of their ideas. The partners then organized a set of workshops on developing financial plans and other topics of interest. While the feedback sessions made some idea holders realize their ideas were not feasible and they subsequently dropped out of the challenge, these sessions resulted in sustaining regular contact between other idea holders and SOO partners. As one idea holder explained: ‘We had good contact with Organization B, Organization C and Organization A. Also on a regular basis on how to prepare the next meeting and this was really good’ (Eric, idea holder). The idea holders who sustained regular engagement began to develop their ideas in directions that were of interest to themselves and the involved partners. After several months, many idea holders shifted from presenting ideas as their own, to presenting them as a joint effort with partner organizations: ‘Edgar (idea holder) introduces their newest partner, Organization I, in their project. He also mentions Organization A as new partner’ (Fieldnotes, Feedback Session). Later in this same meeting, one of the other partners suggested that Edgar should change the material he was using for his prototype, to which he explained that he did not want to change the materials ‘because he wants Organization I as a partner and the composite material comes from them’ (Fieldnotes, Co-creation Meeting). Once the organizing team realized this process was leading to more rapid development of ideas, they extended the phase for an additional two months to give the idea holders and partners more time to co-create.

Ultimately, the organizing team invited a handful of top ideas to be presented to the public at the SOO ‘Demo Day’ event. Since the Demo Day, many of the top ideas have continued to make significant progress. A successful pilot project turning plastic waste into useful products was implemented, while a scale prototype for renewable wave energy was successfully launched and tested at open sea. An investment of over seven million euros has been made to realize sea vessels with no emissions. Table V provides a detailed overview of the progress made on the top ideas since the end of the challenge.

In addition to these innovations for a more sustainable ocean, the SOO initiative also reaped a number of other benefits. The challenge was credited for raising awareness of sustainability within SOO partner organizations and the broader industry. People working on ocean sustainability from diverse angles also became connected through the process.

I guess there are a number of ways to define success [of the challenge]. The simple way is that at least one of the ideas is implemented and delivers an improvement for the challenge but there’s also another way. What we see happening in many cases is that people get connected to each other through the idea challenge, so it creates networks. (Molly, Organization B)

Establishing a network of diverse actors who remain committed to tackling the same problem was a valuable outcome, creating a pathway for impacting ocean sustainability within a historically unsustainable industry.
Our results so far have shown how the entire SOO crowdsourcing process unfolded across the different phases of the challenge and how the actors followed robust action principles to adapt this process. In the next section of our results, we provide a more focused analysis of the three robust action principles and how these resulted in dynamics that successfully generated momentum to involve diverse groups of actors in growing novel solutions. We then identify a potential impediment to keeping the momentum going across changes in actors and phases of activity and highlight how SOO overcame such obstacles by connecting actors and ideas across time.

APPLYING A ROBUST ACTION LENS TO THE SOO CROWDSOURCING PROCESS

In this section of our analysis, we highlight how the three principles of robust action contributed to SOO’s success: engagement through participatory architecture, coordination through multivocal inscriptions, and progress through distributed experimentation (see Table VI for an overview of the robust action principles used in SOO’s crowdsourcing process). We show that using robust action principles in each phase of the crowdsourcing process resulted in dynamics that attracted many different groups of actors and sustained their engagement to develop novel solutions for more sustainable oceans. However, as the actors and their roles changed throughout the process, any momentum built during one phase was at risk of getting lost. For this reason, using crowdsourcing to scale the impact of robust action faster required forging connections between the actors and ideas across different phases of the initiative.

Using Robust Action Principles in Each Phase of the Crowdsourcing Process

For robust action to occur, it is critical that diverse groups of actors get involved in the challenge through participatory architecture (Ferraro et al., 2015). SOO organized the participation of many diverse groups of actors through a combination of online and offline forums. An open online platform, which was successful in quickly attracting diverse participants from outside the partner organizations, was combined with frequent face-to-face feedback sessions and meetings where participants could discuss and negotiate their interests. In addition to these meetings, the SOO process also featured multiple events in which SOO partners, idea holders, and other relevant actors in the industry discussed and showcased ongoing solutions. This combination of online and offline forums played an important role throughout the initiative to attract new actors across different stakeholder groups and keep them engaged by creating a space for many diverse participants to meaningfully engage.

To facilitate coordination between a large number of heterogeneous actors, many of whom have little or no prior knowledge of one another, the ability to express diverse views while still working together towards a common goal is important (Olsen et al., 2016). Scholars agree that this can be accomplished through the use of multivocal inscriptions (Ferraro et al., 2015; Furnari, 2014). Turning to our case, we indeed saw that the organizing team framed the purpose of participants’ activities broadly enough so
that different participants were able to interpret it in very different ways and enact it accordingly. During problem formulation, the partners were prompted to make a challenge definition by thinking about the sustainability challenges that their organization and industry faced. Participants from different organizations could define sustainability on their own terms, which provoked additional engagement through which the various stakeholders were able to develop common ground. This common ground, in turn, enabled the diverse groups of participants to become familiar with each other’s perspectives. In the ideation phase, ideas were framed as ‘seeds’ that needed to grow, rather than as completed solutions (Bennet et al., 2016). Such framing opened all the ideas for improvement, regardless of their stage of development, encouraging participants to work together to further enrich them. Moreover, within all the phases of the challenge, the organizing team emphasized that multivocal inscriptions would evolve and participants could discover shared interests over time.

Throughout the crowdsourcing process, SOO encouraged participants to create and maintain a large scope of different options through distributed experimentation, an important step for robust action to happen on a broad scale (Ferraro et al., 2015). We found that in SOO this experimentation went beyond the independent parallel

| Top ideas | Developments |
|-----------|--------------|
| Recycle plastic waste into useful products | • Unsuccessful first pilot spurs changes to technology for greater consistency of plastic products  
• Successful second pilot gains local government support and significant clean-up of plastic bottles in the coastal region of a developing country  
• Large European city purchases recycled plastic products for use in building a large public event facility  
• New technology is developed to automate the production of recycled plastic products and expand to new markets in developed countries |
| Deep sea renewable wave energy | • Scale prototype successfully launched at sea  
• Testing and research to connect wave energy to the electricity grid of a municipality in Europe  
• Grant pursued for the construction of additional wave energy generators |
| Sea vessels with no emissions | • Established official company  
• Patented the technology to use wave energy  
• Seven million euros raised towards outfitting a vessel with no emissions technology |
| Slowing and solving corrosion of offshore structures with protection from natural sources | • Research conducted on the feasibility of the concept  
• Still pursuing potential customers to further finance the project |
| Renewable wave energy | • Original project halted due to retirement of the idea holder  
• Partners continue to develop other renewable energy projects using innovative technologies |

Table V. Developments of SOO top ideas
Table VI. Overview of robust action principles in the SOO crowdsourcing process

| Phase | Engagement through participatory architecture | Coordination through multivoal inscription | Progress through distributed experimentation | Resulting dynamics |
|-------|-----------------------------------------------|-------------------------------------------|-----------------------------------------------|-------------------|
| Phase 1: Inclusive problem definition | • Meetings involving all prospective partners  
• Every partner contributes to writing the challenge definition | • Open approach to the problem as both partner specific and shared sustainability challenges | • Writing multiple iterations of the challenge definition  
• Continuing until all the partners are satisfied with the definition  
• Creating a broad challenge definition for the platform | • Process facilitates discovery of shared and individual interests across partners  
• Generates a novel, more holistic understanding of problems  
• Inclusiveness and mutual awareness of interests generates engagement, resulting in the commitment of resources |
| Phase 2: Interactive idea enrichment | • Open online platform  
• Brainstorming sessions for partner experts  
• Knowledge matrix  
• Champions moderating platform | • General guidelines to approach ideas as seeds that grow | • Enriching every idea  
• Iterating on ideas with multiple enrichments  
• Combining ideas  
• Extending the phase for more time to enrich | • Complementary expertise and divergent perspectives are harnessed for the development of ideas  
• Interactivity generates familiarity between participants, fostering their engagement  
• Understanding of problems is maintained and further enhanced throughout the process  
• Novel solutions are generated, shared and recombined across diverse participants  
• Experience and novel insights about the problem-solving process are generated |
| Phase 3: Reflective evaluation | • Request all partners to contribute to the evaluation criteria  
• Activities for reflection on desired aims  
• Challenge team evaluation meeting | • Evaluation based on both partner specific interests and the collective desired situation | • Iterating on multiple versions of the criteria  
• Scoring each idea on multiple criteria  
• Creating a pre-ranking of ideas | • Process enables participants to articulate and refresh their individual and collective aims  
• Reflection about ability to support ideas refreshes partners’ engagement  
• Reflection about solutions further enhances the understanding of problems and vice versa  
• Joint engagement of partners and champions ensures that novel solutions generated during ideation are sustained for later phases |

Electronic copy available at: https://ssrn.com/abstract=3610266
| Phase                  | Engagement through participatory architecture | Coordination through multivocal inscription | Progress through distributed experimentation | Resulting dynamics                                                                 |
|-----------------------|-----------------------------------------------|---------------------------------------------|-----------------------------------------------|-------------------------------------------------------------------------------------|
| Phase 4: Provisional matchmaking | • Deliberation meetings engaging all partner representatives • Visibility of contributors on the platform | • Approach to selection as individual and collective partner support for an idea | • Reviewing ideas from pre-selection • Reviewing unfamiliar ideas on the platform • Deliberating on the meaning of selection • Revision of choices; choosing multiple ‘top’ ideas | • Process further refines shared interests across partners which helps to sustain engagement • Interaction with platform data ensures that partners learn about unfamiliar idea holders and relevance of their ideas, sustaining novel ideas for development • Process ensures that both the partners and the idea holders have multiple options to pursue for further development |
| Phase 5: Partnering through ideas | • Feedback sessions to link partners and idea holders • Workshops to support idea holders • Events to showcase and demonstrate top ideas | • Development of ideas as joint effort of idea holders and partners to take the idea further | • Multiple iterations showing the ideas’ progress • Tailored support of ideas by partners • Development of top ideas into joint projects • Extending the phase for more time to develop ideas | • Process generates engagement by facilitating collaboration and discovery of shared interests between the partners and the idea holders • Complementary expertise and divergent perspectives are harnessed for further development of solutions • Reflection about implementation further enhances the understanding of both the problem and the solution • Joint commitment of partners and idea holders ensures sustained engagement required for solution development |
development of ideas typical for crowdsourcing; in fact, experimentation was a feature of all phases of the challenge. Continued iteration was an important element of experimentation that enabled different participants to work towards shared meaning. In the problem formulation phase, for example, seven iterations of the challenge definition were created before landing on a final version, with each iteration working progressively towards shared meaning. Moreover, the multiple facets of the problem definition were embraced by the participants, and the crowdsourcing process was adapted to allow for simultaneous work on multiple problems. Similarly, during the development phase, the SOO partners and idea holders experimented with many progress updates in countless feedback sessions, with each iteration building on previous partner feedback, working progressively towards joint projects. To accommodate these iterations, SOO was flexible with the process. Rather than sticking to a strict timetable, several of the challenge phases were allowed to continue until all the participants were satisfied with the outcomes. Distributed experimentation in every phase of the challenge created a highly adaptive process that supported different groups of participants in acting while learning.

Our observations suggest that the combination of robust action principles in each phase resulted in dynamics that increased the potential for scaling impact. SOO’s inclusive problem definition attracted diverse partner organizations and enabled them to align the evolving problem definition with their shared and individual interests. This move not only contributed to a more holistic understanding of the problem but also generated a mutual awareness of interests, which ensured the engagement of the diverse groups of actors and their commitment of critical resources throughout the process. Co-creation also occurred in the subsequent phase, when experts from partner organizations and idea holders collaborated to develop ideas through interactive idea enrichment. As partner organizations contributed complementary expertise and divergent perspectives to emerging ideas, which often required them to rethink and better understand the original problem, participants were able to share and recombine ideas to generate novel solutions. Moreover, these interactions generated confidence and trust between the idea holders and the SOO partners, essential for maintaining the SOO partners’ engagement throughout the process.

The reflective evaluation phase pushed partners to articulate and refresh their collective and individual aims, informed by their interactions with the idea holders in previous phases, a process that enhanced their understanding of the problems, possible solutions, and how they could engage meaningfully with promising ideas. SOO’s provisional matchmaking allowed the partners to further engage with ideas and explore options before committing to them. SOO partner organizations could go back to the platform to explore the ideation activity in order to identify idea holders for continued participation in the project. Finally, a process of partnering through ideas allowed SOO to move towards the implementation of promising ideas. Multiple iterations in this process allowed the top idea holders and SOO partners to make progress while discovering how their interests intersected. This co-creative experience fostered connections between different groups of actors, which was necessary to grow promising ideas into industry relevant solutions.
Connecting Actors and Ideas Across Phases

While robust action principles within each phase of the crowdsourcing process contributed to the sustained engagement of participants as well as the generation of novel solutions for sustainable oceans, maintaining the momentum was a challenge. As actors and their roles changed throughout the process, the momentum generated during one phase was at risk of being lost during the transition to subsequent phases.

Every phase of SOO called for bringing in new actors who had to be oriented about the process and the developments from previous phases. For example, for partner experts to start enriching ideas, they first had to be taught how to connect to the crowd to make their expertise relevant for ideas outside their domain. And once a phase came to an end, it was not always clear what the roles of these actors would be throughout the remainder of the process, and whether valuable ideas and progress made in one phase would get carried over to other phases. For example, during idea selection, SOO partner representatives initially overlooked novel ideas in favour of more familiar ones because they had not been sufficiently involved during the ideation phase. Therefore, to avoid such a detrimental loss of novel solutions, the SOO organizing team connected the different actors and emerging ideas across phases.

With regard to idea selection, the organizing team accomplished this connection across phases by revisiting the online platform and reviewing the interactions that unfolded among participants during the idea enrichment process. Making the ideation activity persistent and visible for the actors in the later phases informed subsequent experimentation efforts by enabling participants to follow interactions they were not directly involved in. Connecting ideas across phases was also important for novel approaches to understanding the problem. For example, to articulate the evaluation criteria during the evaluation phase, SOO partner representatives needed to refresh their understanding of the problem by reviewing the problem statement that was created during the phase of problem formulation. This enabled the SOO partners to build on past insights about the problem in their present efforts to evaluate ideas, creating a memory that helped bridge the different groups of actors across the phases.

In addition to connecting with actors and ideas from previous phases, SOO made deliberate efforts in the present to facilitate connections to subsequent phases. For example, in the early phases, an inclusive definition of the problem attracted diverse stakeholders who could provide the necessary expertise and resources for ideation, selection and development. Similarly, during the provisional matchmaking, SOO partner representatives deliberated upon which ideas to select based on their collective ability to support the idea in the subsequent phase. This engagement around idea selection was linked to future activities that would become important for growing the ideas to have a broader impact for the industry.

DISCUSSION

In this study, we aimed to understand how organizations can scale the impact of robust action through crowdsourcing. Our empirical observations revealed that building robust action principles into the crowdsourcing process enabled SOO to generate novel
ideas and sustain the engagement of diverse actors in various phases of the initiative. However, we also observed that rapid changes in actors and roles across the different phases threatened the successful scaling of robust action; to mitigate this risk, it was essential to connect the different actors and ideas across phases. In this section, we discuss how our findings contribute to a more sustained robust action approach that ensures that the valuable momentum built during one phase of an initiative does not get lost during the transition to another. We then discuss how our insights are valuable to understand other types of robust action initiatives and to a growing literature on crowdsourcing for ill-structured problems that exhibit similarities to grand challenges like the ones confronted in our case.

Extending the Robust Action Framework

Extant theory on robust action argues that robust action principles are valuable for tackling grand challenges because they foster conditions that generate novel solutions and the sustained engagement required to accomplish desired outcomes (Ferraro et al., 2015). Local, small-scale efforts by individual organizations can grow to have large impact because novel solutions attract additional stakeholders who contribute their diverse knowledge and resources to pursue even greater successes. Sustaining the engagement of diverse actors over time means that successful experiments continue to grow, slowly building momentum and increasing the scale of impact (Etzion et al., 2017).

Our analysis provides much needed empirical evidence to support and add nuance to the theoretical insights of robust action. Indeed, our findings illustrate how the various phases of SOO involved a participatory architecture that allowed diverse groups of actors to contribute their perspectives. Multivocality ensured that actors with particular interests kept engaged throughout the challenge while still finding common ground. This enabled, and motivated, participants to experiment with novel solutions for the challenge while developing a refined understanding of the problems at hand. Within a few months, promising ideas attracted valuable resources and support necessary for further development, and a network of actors evolved that became committed to scaling sustainable solutions for the industry. But the impact of the initiative did not stop here; SOO has continued its efforts with an even larger second challenge already completed, and a third one underway.

While our analysis indicates that robust action principles helped SOO achieve impact in a relatively short time, we found that it confronted significant challenges within a multi-phase crowdsourcing process. While it was valuable that each phase received new participants, SOO had to prevent the loss of momentum that occurred because of frequent changes in actors and their roles. In each phase, SOO had to ensure productive engagement would re-emerge. It also had to safeguard against the loss of novelty that could occur when actors not engaged in previous phases failed to appreciate the novel ideas that had already been generated. If left unaddressed, these issues could mark a potential weakness of robust action, one that could lead to well-intentioned efforts having very little or perhaps even no impact at all. In the following sections, we reflect on these challenges in relation to existing theory and suggest how organizations can use robust action principles in a multi-phase crowdsourcing process to scale impact (Etzion et al., 2017).
Generating engagement. Prior work on robust action has emphasized the importance of organically evolving groups of actors to ensure that successful solutions have sufficient time to grow and develop. Etzion et al. (2017) describe the process by which scaling of impact through robust action occurs as a series of small wins that slowly build momentum. A ‘group of actors responsible for the successful local experiment will have additional resources flow to them [emphasis added] so that slightly larger successes can be accomplished’ (Weick, 1984, p. 43). Because this scaling of impact is a relatively slow process, it is key to keep actors engaged over time, so that additional interested actors can join the organically growing community.

However, if organizations want to scale impact faster, they need to proactively involve new groups of actors who can grow successful experiments. In other words, generating the engagement of new participants becomes equally important as sustaining the engagement of existing ones. Generating engagement is vital to attract the right actors and encourage them to experiment with ideas to better understand and solve grand challenges. This includes initial efforts to get robust action off the ground (Ferraro et al., 2015; Garud and Karnøe, 2003), such as the way in which SOO partners engaged diverse stakeholders in co-creating an inclusive problem definition. But generating engagement may also entail getting new actors involved throughout the process, such as ideators and experts who participate in the enrichment of ideas, or stakeholders who help to implement and legitimize solutions in the industry (Olsen et al., 2016). In addition, actors involved at one point in time may need to be re-engaged in subsequent efforts, which can pose non-trivial challenges, as the example of the SOO evaluation phase illustrates. Continuously generating engagement is a focal concern for organizations seeking to scale impact through robust action.

One way that organizations can generate engagement is through participatory architectures and multivocal inscriptions that connect present experimentation to anticipated futures. The SOO founding partners’ experimentation with the problem definition attracted additional partners who had valuable resources to bear on the development of ideas in later phases of the challenge. This temporal coordination mechanism helps actors navigate uncertain futures that are characteristic of grand challenges (Garud and Gehman, 2012) by encouraging experimentation that is inclusive of the actors who will potentially be important for experimentation in the future. In this way, the seeds are sown for proactively attracting different groups of relevant actors to become involved, an important step for generating transformative change (Bennett et al., 2016; Dietz et al., 2003).

Participatory architectures and multivocal inscriptions can also be valuable because they support many actors in quickly learning about the context of experimentation that has emerged throughout the process (Dietz et al., 2003; Garud and Karnøe, 2003). For SOO partner experts to make a valuable contribution to ideas on the platform, they had to learn how to connect their expertise to new and unfamiliar ideas. Given the evaluative nature of grand challenges (Ferraro et al., 2015), what counts as a contribution is dependent on the other actors involved and the evolving purpose of experimentation. Keeping up with these rapid developments can be a daunting task in settings like crowdsourcing, where many different actors get involved in a relatively short span of time. The SOO partner experts were keen to get up to speed by reviewing the enrichments that
had accumulated on the platform so as to learn about the actors and ideas connected to sustainable oceans both inside and outside their industry. Since it enables a transparent dialogue among diverse actors and preserves these interactions over time (Brunswicker et al., 2017), a collaborative crowdsourcing platform is both a participatory architecture and a multivocal inscription. While it facilitates the co-creation between participants improving ideation, it also creates simultaneous awareness of other participants and increases familiarity with their views (Malhotra and Majchrzak, 2014).

Sustaining novelty. One consequence of engaging many different actors in a relatively short time is that this multitude of actors has the potential to generate a large quantity of novel ideas. This notion of distributed experimentation, which capitalizes on the heterogeneity of diverse actors, is a key aspect in extant robust action theory (Ferraro et al., 2015). Novel solutions developed by a broad base of actors are more likely to satisfy a wider range of stakeholder interests (Brunswicker et al., 2017) and, in turn, attract new groups of stakeholders who can contribute further resources to developing promising solutions (Etzion et al., 2017). While the emphasis on novelty generation is insightful, it fails to appreciate the importance of retaining and implementing valuable ideas. This becomes even more apparent in settings like ours, when generation, evaluation and development of ideas are organized in different phases. As our analysis of SOO shows, novel options are at risk of being left behind if ongoing problem-solving efforts span multiple phases and new actors can’t relate to the valuable ideas generated in previous phases.

Our study shows the importance of keeping novel ideas alive, so that actors in subsequent phases can take them up in their experimentation efforts. In other words, in addition to generating novelty, scaling impact through robust action also requires that novelty is sustained. This became apparent in SOO when partner representatives, who had not been involved during the ideation phase, at first overlooked many of the valuable ideas generated by ideators and partner experts. Ironically, the risk of getting lost is even greater for highly creative solutions than for ideas that are more familiar to stakeholders (Piezunka and Dahlander, 2015).

Organizations can sustain novelty through participatory architectures and multivocal inscriptions that anchor experimentation in the present to the past in order to enhance and capitalize on earlier ideas (Garud et al., 2016). Such ‘reaching back’ in order to go forward is precisely what happened when SOO reintroduced the crowdsourcing platform as a resource for idea selection. When SOO partners were selecting the top ideas, experimentation from the ideation phase became an important indicator for matching partners with novel ideas. The SOO partners relied on a close read of the platform interactions in order to identify novel ideas they could continue to support. In fast growing initiatives like SOO, there is not that much time for newly involved actors to ‘connect the dots’ (Garud et al., 2016) and interpret from past activity what is novel and worthy of being sustained in present experimentation. A collaborative crowdsourcing platform can be a valuable collective memory by enabling new participants to review and reflect on past experimentation. Threads of all contributions, as well as the dialogues that have evolved around them, can easily be accessed by other participants without involving actors from the past (Malhotra et al., 2017). Collaborative platforms contain these important ‘design
traces’ that aid collective memory by allowing new participants to build on promising past experimentation (Garud et al., 2008).

Also other participatory architectures and multivocal inscriptions can serve as collective memory. The documentation of reflections that was created during the inclusive problem definition, for example, allowed SOO partners who had not been engaged between two phases to refresh the nuanced understanding of the problem created during the inclusive problem formulation. Continuity with the past is a temporal coordination mechanism that provides the actors involved in present experimentation with resources drawn from the past (Garud and Gehman, 2012), so that new groups of actors can pick up on important threads of novelty that were previously generated by others. Such iteration and continuous learning is vital for robust action to scale and generate impact (Dietz et al., 2003; Etzion et al., 2017).

Scaling impact through robust action. Our study contributes to extant theory by explaining the micro-dynamics of the process that scales impact through robust action. We offer a model that provides an overview of these dynamics in Figure 3. Our model shows that in addition to generating novelty and sustaining engagement, robust action must also generate engagement and sustain novelty in order to maintain and further build momentum over an extended period of time. Specifically, generating engagement brings in additional groups of diverse actors and connects them to those who are already engaged. Generating engagement raises the number and diversity of actors making valuable contributions, thus increasing the scale at which distributed experimentation can happen. Sustaining novelty, on the other hand, ensures that novel ideas are kept alive across phases that are marked by changes in actor groups and their roles in the process. By connecting new groups of actors with novelty that has emerged throughout the process, sustaining novelty increases the likelihood that these actors use their complementary knowledge and resources to build upon promising ideas, and develop them to the next level. That way, sustaining novelty enables a cumulative process that will generate impact faster and on a larger scale than a process that fails to build on intermediary outcomes of the robust action process.

While the frequent changes in actors and phases of activity are typical for initiatives involving crowdsourcing, what we have learned from this case about robust action can be generalized to other contexts. In virtually any robust action setting, engagement needs to be generated to get the initiative off the ground; and if robust action efforts stall or fail, which is endemic to many sustainability journeys (Garud and Gehman, 2012), it is important to reenergize participants to start again. Many firms have been criticized for their inability to tackle grand challenges because such initiatives tend to lose momentum over time (Wright and Nyberg, 2017). We reckon that robust action principles for generating the engagement of new actors with diverse perspectives is particularly useful to build bridges across organizations with different purposes and stimulate the creation of important cross-sector innovation networks (OECD, 2019).

Our findings can also be beneficial to the many efforts at tackling grand challenges that fail because of missing links between local, regional, and global efforts (Cash and Moser, 2000; Etzion et al., 2017). For example, while we know that regional land use and loss of local biodiversity can trigger global scale effects on the earth’s planetary boundaries
(Whiteman et al., 2013), many local scientists and policymakers observe that global climate policy misses the crucial consideration of specific local, social and environmental conditions (Cash and Moser, 2000). We reckon that under such conditions, robust action principles for sustaining novelty across groups of actors operating at different scales will be critical for building upon local knowledge and developing global solutions. Sustaining valuable local knowledge creates more linkages between actors, which increases the chances that solutions at different levels are connected in ways that are complementary and reinforcing (Williams et al., 2017) and can, therefore, leverage local changes for greater impact (Etzion, 2018).

Robust Action as a Strategy for Crowdsourcing

While our study focused on the question of how crowdsourcing could be used to scale robust action, our empirical analysis of the SOO initiative offers insights that can be of interest to crowdsourcing scholars and practitioners. Specifically, our findings show the usefulness of robust action strategies in crowdsourcing initiatives for tackling ill-structured problems, which typically require the co-creation of solutions by diverse participants (Majchrzak and Malhotra, 2013; Riedl and Woolley, 2016). Co-creation results in superior solutions of ill-structured problems, because multiple participants looking at the problem from diverse perspectives are more likely to understand it in its entirety and come up with elements to produce solutions than individual participants (Brunswicker et al., 2018).

Figure 3. Scaling impact through robust action [Colour figure can be viewed at wileyonlinelibrary.com]

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et al., 2017; Majchrzak and Malhotra, 2016). However, co-creation in crowdsourcing typically only takes place in the ideation phase, during which participants from the crowd are encouraged to interact with one another (Malhotra and Majchrzak, 2014). Other relevant stakeholders, like the organizations that own the problems and interdependent partner organizations required to implement a solution, are not involved in this process. Typically, the remaining phases of the crowdsourcing process hardly involve any co-creation at all.

Our findings show how robust action strategies facilitate the involvement of diverse types of participants right from the beginning of the initiative. For example, during enrichment sessions, the SOO partner experts contributed valuable feedback to emerging ideas, generating alignment of promising solutions with the individual and collective interests of the SOO partners. Recent work on crowdsourcing for ill-structured problems points out that achieving such alignment, which in typical crowdsourcing initiatives only occurs after the ideation phase, is critical for successful implementation (Brunswicker et al., 2017). The proactive engagement of crowdsourcing sponsors with crowd members provides them with valuable feedback and information about the ideas that stakeholders value (Dahlander and Piezunka, 2014). This can also create more meaningful engagement, in which the crowd members feel valued, so they give better input which improves the quality of outcomes (Taeihagh, 2017). Also, by co-creating with participants, stakeholders get a better understanding of the emergent ideas, and learn more precisely how they are able to support the development and implementation of an idea. In many cases, stakeholders may be able to provide relevant knowledge and valuable support during ideation itself. By proactively sharing knowledge with the crowd, it becomes easier for stakeholders to entice external participants to submit their ideas for solving the problem (Dahlander and Piezunka, 2014).

But our findings also show the benefits of using robust action strategies in other phases of crowdsourcing. As our study of SOO demonstrates, involving a stakeholder network during the problem definition helps to ensure the availability and commitment of these organizations throughout the crowdsourcing process, until the development phase. Moreover, shaping the problem definition to reflect the shared and individual interests facilitates a richer understanding of the problem, an important aspect for solving ill-structured problems (Brunswicker et al., 2017; Majchrzak and Malhotra, 2016). Finally, by stressing the importance of a strong stakeholder network for development, crowdsourcing initiatives can provide a critical signal that seeds implementation as a concern in the process from the beginning, and thereby attracts a larger crowd and additional partner organizations with important resources and capabilities for implementing a promising solution.

Our study also shows the value of connecting actors and ideas across the different phases of crowdsourcing. In many initiatives, the various phases of the crowdsourcing process are clearly separated (Terwiesch and Xu, 2008), and there is typically no back and forth between them because there is little overlap in the actors involved in the problem definition, ideation, evaluation and selection, leaving few rich connections across the subsequent phases (Dahlander and Piezunka, 2014). The SOO initiative, by contrast, effectively broke this linear pattern by blurring the clear separation between phases.
Drawing on the design literature studying the solution of ill-structured problems (e.g., Rittel and Webber, 1973; Simon, 1973), we argue that such a less linear crowdsourcing process is more appropriate for tackling grand societal challenges. The process of solving ill-structured problems is inherently non-linear because solvers do not understand the problem until they develop a solution. Every potential solution exposes a new aspect of the problem, requiring further adjustments of the solution (Conklin, 2006). Such co-evolution of the problem and the solution is impossible if the problem definition is finalized upfront, as is typically the case in crowdsourcing. The approach that we have seen at SOO, by contrast, resonates with the problem-solving process propagated by design scholars. The multiple iterations of the challenge definition reflect the learning process that SOO partners underwent as they reflected about potential solutions. But more importantly, by making sure the problem definitions were multivocal, the partners were able to avoid closure of the problem definition, so that it could easily be revisited later in the process. In other words, the problem definition was left incomplete by design (Garud et al., 2008).

While crowdsourcing initiatives typically finalize the evaluation and selection criteria before filtering submitted ideas (Afuah and Tucci, 2012; Dahlander and Piezunka, 2014), the understanding of ill-structured problems often changes drastically in the light of emergent solutions. And similarly, co-created ideas continue to evolve even after the ideation phase has technically come to an end. As we describe in our SOO study, tackling grand challenges can benefit from revisiting the ideation phase and bringing back the rich context surrounding ideas in order to evaluate their potential. That way, it is possible that multiple understandings of the problem and possible solutions continue to evolve even across phases until viable ‘need-solution pairs’ emerge (von Hippel and von Krogh, 2015). Designing the crowdsourcing process in such a way that options can be developed and maintained across phases provides the flexibility that makes problem-solving robust (Hargadon and Douglas, 2001).

CONCLUSION

Organizations have a vital role to play in tackling some of the world’s most pressing societal challenges (United Nations, 2017a). Yet the power of organizations to effect real change will continue to fall short unless alternative forms of organizing and generating impact are better understood. Our research makes vital progress in this regard by providing an empirically grounded model for how organizations can initiate and scale robust action through crowdsourcing. An exciting takeaway from our study is that bringing together diverse stakeholders and combining their knowledge and resources to develop novel and impactful solutions does not necessarily need to evolve through decades of slow and steady progress. Rather, we have shown that combining robust action principles with digital crowdsourcing platforms offers a powerful means of connecting small-scale experiments with diverse groups of actors who have important resources to generate impact. A key theoretical insight of our study is that this process calls for an extension to the robust action framework to include the micro-dynamics of generating engagement and sustaining novelty.
Our framework also suggests a more optimistic outlook on the role of organizations in tackling grand challenges than previous management research. While previous research has shown that initiatives by private firms tend to prioritize profit-oriented motives over time (Wright and Nyberg, 2017), our framework indicates that this tendency might be counteracted through initiatives that span corporate boundaries and engage stakeholders that prioritize different interests and values. Scaling robust action through crowdsourcing is a potentially powerful mechanism for private firms to gain exposure to more diverse stakeholder perspectives and learn how to harness such diversity towards creating novel solutions.

While crowdsourcing offers great promise for scaling the impact of robust action, it is important that organizations avoid the trap of technological determinism. A key managerial implication of our study is that crowdsourcing for robust action calls for adaptations of the crowdsourcing process. Applying robust action principles in all phases of the crowdsourcing process enables stakeholders and crowd participants to deal with the ill-structured nature of grand challenges and to build a sustainable network of support to ensure the development of promising ideas. The realization that such a crowdsourcing initiative cannot be easily determined upfront will enable reflective practitioners to build in options and flexibility that can transform crowdsourcing into robust action.

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NOTES

[1] This is a pseudonym to protect the anonymity of our participants.
[2] The design literature refers to this class of problems as ‘wicked problems’ (Rittel and Webber 1973).
[3] Plastic waste accumulates in 5 ocean garbage patches, driven by so-called gyres or vortexes (i.e., huge circular current systems) in which all floating objects are slowly sucked into the middle.

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Appendix A. Save Our Oceans Partners

| Partner | Organization type | Challenge role(s) and contributions |
|---------|-------------------|-------------------------------------|
| Organization A | Large private commercial firm; supplies equipment for offshore and onshore maritime operations | Founding partner (financial support; expertise in the offshore industry); organizing team; challenge team; partner representative |
| Organization B | SME; connects large firms to entrepreneurs | Founding partner (expertise in linking to entrepreneurs); paid consultant; organizing team; partner representative |
| Organization C | GKI; performs benchmarking and research; develops technology and sells licenses | Founding partner (expertise in sustainable energy; testing facilities and feasibility assessments); partner representative |
| Organization D | GKI; performs applied research; brings innovations to market | Partner (expertise in topics related to the maritime and offshore industry; testing facilities and feasibility assessments); challenge team; partner representative |
| Organization E | International network organization representing 80 small and large firms in the global maritime industry | Partner (access to a large member network) |
| Organization F | SME; creates and sells products from recycled plastic waste in the ocean | Partner (expertise in upcycling plastic waste); challenge team; partner representative |
| Organization G | SME; supplies equipment for offshore and onshore maritime operations | Partner (expertise in the offshore industry); challenge team; partner representative |
| Organization H | Large bank; focuses on sustainable performance | Partner (expertise in sustainable business plans); partner representative |
| Organization I | SME; supports innovations in the maritime and offshore industry | Partner (expertise in new sustainable materials; testing facilities); challenge team; partner representative |
| Organization J | Consultancy firm on idea and knowledge management | Partner; paid consultant (expertise in ideation; provides the crowdsourcing platform); organizing team; partner representative |
| Organization K | Large public university specializing in knowledge sharing and innovation | Partner (expertise in cross-sector collaboration and crowdsourcing); challenge team; partner representative |
| Organization L | GKI; performs research on the ocean with a sustainability focus | Partner (research expertise on sustainability); partner representative |

Note: GKI: Governmental knowledge institute; SME: Small-to-medium enterprise

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### Appendix B. SOO Partner Contributions to Final Solutions

| Idea description                                          | Link to partners                                                                 |
|-----------------------------------------------------------|----------------------------------------------------------------------------------|
| Deep sea renewable wave energy                            | Organizations A and I partnered with the idea holder; Organizations B and H reviewed the business plan; Organization D provided engineering support |
| Slowing and solving corrosion of offshore structures with protection from natural sources | Worked for Organization C; formed a ‘joint industry project’ with Organizations C, I and L |
| Build fishing vessels with zero emissions                 | Organizations B and D reviewed the business plan; idea holder partnered with another idea holder on the platform with a similar idea who is now a co-founder of the venture |
| Recycling plastic waste into useful products              | Organization A became a partner; Organizations C and F provided testing for health risks and prototype development |
| Renewable wave energy                                     | Formed a ‘joint industry project’ with Organizations C and D                      |

### Appendix C. SOO Challenges

![Challenge Definitions Diagram](https://ssrn.com/abstract=3610266)
APPENDIX D. Save Our Oceans Evaluation Criteria

SOO Partner Shared Criteria

Scalable

- The start-up provides an ROI for involved third parties
- The start-up will sell its solution in several different countries
- The start-up can bring its solution to market within the duration of Save Our Oceans
- The start-up can sustain itself financially
- The solution can be implemented in any market without any adjustments

Sustainable

- The start-up establishes a change in the health and cleanliness of the ocean that 9 out of 10 people rate as ‘positive’
- The start-up can function without harming the ocean or those dependent on it
- The solution is rated ‘new and creative’ by 9 out of 10 people when asked to name key characteristics of the solution
- The solution is rated ‘environmentally and socially sustainable’ by 9 out of 10 people when asked to name key characteristics of the solution
- The solution is rated as having ‘a positive impact on morals locally, and for social entrepreneurs globally’ by 9 out of 10 people when asked to name key characteristics of the solution

SOO Partner Individual Criteria

The solution can be implemented using the technical resources and/or resources available from our different partners:

- The solution can be implemented in international locations such as where Organization A is operating (Organization A)
- The solution uses knowledge and/or resources used in the business of installing oil rigs (Organization A)
- The start-up can make use of the resources that Save Our Oceans provides (Organization B)
- The start-up uses knowledge and/or resources used in the business of ocean farming (Organization C)
- The solution uses knowledge and/or resources used in the business of renewable energy (Organization D)
- The solution uses knowledge and/or resources used in the offshore business (Organization D)
- The solution solves the problem of underwater noise pollution (Organization E)
- The solution solves the problem of data collection (Organization E)
- The solution generates an amount of nylon 6 that can be used for manufacturing (Organization F)
- The start-up uses knowledge from the onshore and offshore business (Organization G)
- The start-up uses knowledge and/or resources used in the banking business (Organization H)
- The start-up uses knowledge and/or resources used in maritime business-related product development (Organization I)
- The start-up uses Save Our Oceans platform (Organization J)