OpenDesign: Analyzing Deliberation and Rationale in an Exploratory Case Study

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Abstract: The open phenomenon coming from the free-software movement has gained several fields, including services, digital and physical products. Nevertheless, some authors point out the limited availability of supporting methods and online tools to face the challenges of distributed collaboration of volunteers. They claim that online collaborative platforms are still needed for supporting co-creation. In this paper, we investigate the deliberation and design rationale in an (open) design process using the OpenDesign Platform. A case study conducted with 22 participants of a Conference illustrates the use of the platform to cope with a proposed design challenge. Results illustrated with graphical representations based on concepts of the Actor Network Theory provide a visual representation of the network constituted by both the participants and the artifacts (boundary objects) they produce and interpret. Further studies are pointed out suggesting new possibilities of features and platform enhancements.

1 INTRODUCTION

The open phenomenon to systems design comes from the free-software movement and got spread over several fields including the open data, open science, open governance, to name a few. Its origin goes back to the 1970 decade, with the political movement that occurred in reaction to the proprietarization of software source code, chaired by Stallman through the 'GNU Project' (Stallman, 1985). The open-source software, as defined by Warger (2002), p.18 "an approach to software development and intellectual property in which program code is available to all participants and can be modified by any of them", focuses on the process of software code development and intellectual property. Since then, the open concept has been widened to reach other domains, including the broad cycle of product design (Boisseau et al., 2018).

Open design, in its broader sense, has been pointed out as promising and disruptive, although acknowledged as a phenomenon that has been yet little studied by the scientific community (Boisseau et al., 2018). One of the main reasons for this effort seems to be the democratization of design; design here referring to physical as well as digital products, and services. The motivations of stakeholders to get involved in open initiatives range from ideological to the direct and indirect benefits perceived by participants. In this sense the open phenomenon shares some principles and can learn from Participatory Design (PD) practices and related issues (Schuler and Namioka, 1993). An example of this match is the user's role bringing his/her expertise to the design process, going beyond the object-for-money trade relation to other forms of contributions in the process and product of design. The tradition of participatory design is to ensure that end users are involved in the design process bringing the tacit and contextual knowledge to help shape design toward the most meaningful solution (Schuler and Namioka, 1993). However, changes in information and communication technology, consumer culture, communities of interest, manufacturing processes, economies and global markets have brought new opportunities to extend this tradition (Battarbee et al., 2008). As stated by Frauenberger et al. (2018), PD practices must be extended to increase the democratization of technology design, allowing a broader range of stakeholders to participate in the design process. Frauenberger et al. (2018) propose to understand this movement through strategies

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such as scale and dialectics. Scale asks for ways to extend PD reach without giving up on its core qualities. Dialectics is about creating and maintaining spaces for constructive conflict by networking and linking with other stakeholders, organizations and domains. These demands pose difficulties and challenges for PD practitioners and researchers to conduct practices synchronously and in a same geographical place.

Achieving larger scale and improved dialectic requires tools which, on the one hand, afford creative and collaborative behavior, fostering participation of anyone who feels affected by the proposed construct. On the other hand, such tools should avoid excessive or inadequate actions, such as having the voice monopolized by someone. Moreover, access for anyone to join the discussion at any point of time must be assured. Online Deliberation - OD - tools address the issues related to online discussion process, helping participants to clarify a subject, by separating pros and cons arguments and opinions from each participant (Kriplean et al., 2012), equalizing biases and promoting awareness of points of view.

The Socially Aware Computing – SAwC – design model (Baranauskas et al., 2014) is a theoretical and methodological framework rooted on Participatory Design (Schuler and Namioka, 1993), Universal Design (Stephanidis et al., 2001) and Organizational Semiotics (Liu and Li, 2014) approaches. Its goal is to allow a collective construction of meaning, encompassing the diverse point of views from people involved and affected by the design of an information system or a digital artifact. The convergence of opinions and objectives occurs through a series of the so-called Semio-Participatory workshops, in-place activities conducted in face-to-face meetings where discussion and expression of all interested parties are promoted and mediated.

The OpenDesign project [ref] is inspired by the Open Source philosophy, since this has provided a number of high quality software products, gathering and coordinating efforts from people with different skills and from different places. The project's objective is to formalize a community-driven design process for interactive system design, and provide tools for its accomplishment. In the context of this project, a web platform was developed, intended to enable the Semio-Participatory workshops from SAwC to be carried out in an asynchronous and distributed scenario.

In this paper, we investigate the importance of deliberation and design rationale in the (open) design process presenting a case study conducted among participants of a Conference Summer School (Informatics Research Centre, Henley Business School, University of Reading, UK, 2019) using the OpenDesign Platform tools. On the scale aspect, once it is not effective or even feasible to participate in all discussions, the platform provides frames to gather organic interests subgroups formation around an issue or idea proposal and their interconnections. To handle dialectics we provide a frame structure that affords capturing benefits and drawbacks of each proposal and also by mediating discussion into semi-structured argumentation to collaboratively elicit which pros and cons resonates more around an idea or issue.

The paper is organized as follows: In the next section we present the background and related work context. Then, we present an overview of our proposal for the OpenDesign Platform and its boundary objects. A case study on the Platform Usage follows, with discussion on the main results. The final section concludes pointing out further work.

2 BACKGROUND AND RELATED WORK

Bonvoisin et al. (2015) argue that the spread of ICT and cheap low-size production tools like 3D-printers led to the community-based and open source development of physical products. This innovative organization of product development (open design) offers a great opportunity for continuous improvement of products as well as a potential for product innovation and in consequence incubation of new businesses. The authors also point out the limited availability of supporting methods and online tools for helping to face the organizational challenges raised by distributed collaboration of non-experts, non-professional and non-contractually engaged volunteers. They claim that online collaborative platforms are still needed with special features to build and keep the community active, providing mechanisms for the convergence of the design process, for knowledge management, and for supporting co-creation. Those features would be essential to the rise of open design.

In the tradition of PD, some efforts have been conducted with social technologies to increase people's participation regarding information production, publication, and sharing (Hagen and Robertson, 2010). Hargreaves and Robertson (2012) propose the use of social technologies (Skype video calls, screen sharing and email) to allow discussions between researchers and participants who are remotely located, and prototyping activities to occur at a distance. The interaction among participants is structured in regular cycles of reflective discussion and prototype modification. While social technologies are participatory by their nature as they require and depend on peo-

ple's involvement to take shape, they also have drawbacks. For instance, regarding power, it is not clear who exactly benefits from people's participation, how to value participation without exploitation. Problems with privacy, ownership, deletion and sharing of personal information might be some issues raised when developing participatory systems. Bringing a participatory approach to the design of such systems is critical to ensure that people have the ability to negotiate, control and understand the implications of participation as they evolve (Greenbaum, 1993).

The OpenDesign Platform, we are addressing in this work, can be seen as a purposeful social technology, where participants voluntarily interact towards a shared design goal, starting from the early stages of clarifying a design problem, by identifying the interested parties, and anticipating their potential issues regarding a prospective design solution. By 'open' we mean a design process that allows contribution of the volunteers to the product design since its conception (not only in a prototyping stage).

In a study on the open design state of the art review, Boisseau et al. (2018) illustrate that the subject of open design of products started in the early 2000s and is still a growing phenomenon. They have shown that the limited number of published papers suggests the concept has not spread over traditional design communities yet, still being restricted to a few research groups. Drawing on the design science approach, they argue that the subject that designers have to address is to provide a *plan* based on a *gap* (a design problem), through the development of a solution. Three elements are proposed to describe the product design process: a) the phases and activities that constitute the process, b) the boundary objects that constitute the information formalized and carried from one phase to the next one, and c) the participants (or stakeholders) taking part in activities of the design process. We should notice that the boundary objects are used for sharing a common understanding of the solution being constructed among the participants and that the plan is the final boundary object.

Several attempts have already been made to provide a distributed platform for online collaborative design. Most of them focus on the support for sharing the artifact being built - a prototype or a mock-up, for instance. Heintz et al. (2014) searched for tools to support such tasks, and analyzed six applications:

- GABBEH (Naghsh and Andy, 2004) mimics paper prototyping by enabling users to comment on the current design by drawing with a software tool, but its technical requirements made it too restricted.
- DisCo (Walsh et al., 2012) supports distributed PD sessions, but was not publicly available for use at the time of the study.
- Appotate (appotate.com) brings together different stakeholders, allowing them to give feedback on a prototype.
- MarkUp (markup.io) allows the user to draw and write on a website; however, it does not offer a structured way to store and retrieve this feedback.
- MyBalsamiq (mybalsamiq.com) mock-up software offers a wide range of common interface elements to create feedback on prototypes.
- Webklipper (webklipper.com) is an online application that enables the user to annotate websites and share the results.

Most of the mentioned tools mimics paper prototyping and enable users to comment on the current design. They also propose a tool that, beyond the already found features, provides a like/dislike heatmap and enhanced interactivity.

Fischer (2004) studied design communities and identified types of common barriers they must cope in order to work together: spatial (across distance), temporal (across time), conceptual (across different communities of practice), and technological (between persons and artifacts). For spatial barriers, it is straightforward to propose the use of computer-mediated communication as a solution. On the temporal domain, he stresses that "long-term collaboration requires that present-day designers be aware of the rationale behind decisions that shaped the artifact, and aware of information about possible alternatives that were considered but not implemented" (Heintz et al., 2014, p. 155). Conceptual barriers must be overcome by humans serving as knowledge brokers and by integrating diversity, making all voices to be heard.

Björgvinsson et al. (2012) discussed that a fundamental challenge for designers and the design community is a change of focus from designing objects to designing socio-material assemblies, which encompass heterogeneity of perspectives among actors who engage in attempts to align their conflicting objects of design. In their proposal, the role of non-human participants in the design process, such as prototypes, mock-ups, models, and diagrams is to act as "presenters" of the evolving object of design, supporting communication and participation in the design process, potentially binding different participants together.

We agree with Bonvoisin et al. (2015) in acknowledging the concept of open design as a significant phenomenon, supported by trends in contemporary digital technology and organization, which faces significant challenges of interest for several scientific

disciplines. For example, they cite (p. 3): *understanding the dynamics of online communities, developing motivation models for contributors, identifying business models that allow to create sustainable economic value with open source products, understanding the decision processes in horizontal work organizations, clarifying legal issues of intellectual property, identifying ways to ensure and validate product quality, liability and safety*, among others.

As for the open design of products proposed by Boisseau et al. (2018) in the three elements that constitute it (the gap, the process itself, and the plan), the authors state that the gap is contingent, and the actors of the design process have no influence on it. In our approach, the design problem addressed (the gap for Boisseau and colleagues), is open too, as it is open to the interpretation and clarification by the interested parties, as part of the design process. Although our concept of design may reach the plan (i.e. for example, the drawings of a design product), differently from these authors, we are not limiting the object of design to a (material) 'product' of industrial design. In our work, we associate to 'design' the activities that precede the code production in a digital information system design, encompassing problem discussion, deliberation and clarification, ideation of solutions, requirements elicitation, design rationale. The next section provides an overview of our proposal for the OpenDesign Platform and its boundary objects.

3 AN OVERVIEW OF DELIBERATION/RATIONALE PROPOSAL IN THE OPENDESIGN PLATFORM

In this section we present the OpenDesign Platform based on: a) the phases and activities that constitute the process (SAwC), b) the boundary objects that constitute the information formalized (the artefacts), and c) the participants (or stakeholders) taking part in activities of the design process.

The Socially Aware Computing model has inspired the process which we have incorporated into the OpenDesign Platform. Traditionally, this model is inspired by some Organizational Semiotics artefacts and consists of three phases, each guided by one specific artifact. The first phase is the elicitation of stakeholders, which is made using the artifact known as Stakeholders Identification Diagram (SID) adapted from Kolkman (1993). This artifact allows us to indicate all those who will affect or be affected by the product of the design, which can be categories of individuals (like developers, designers, etc.), or entities (such as universities or corporations). SID's graphical representation usually has five sequential layers that contain each other, like an onion, as we can see in Figure 1. The idea is that the innermost layers contain stakeholders that are more directly involved with the design product. During this phase of the SAwC process, participants discuss who they believe affects or is affected by the designed solution, and to which layer each stakeholder belongs. After ideas of several possible stakeholders are placed into the artifact, a deliberation can be conducted on whether or not the identified stakeholders are correctly named, categorized or even if they actually should be there.

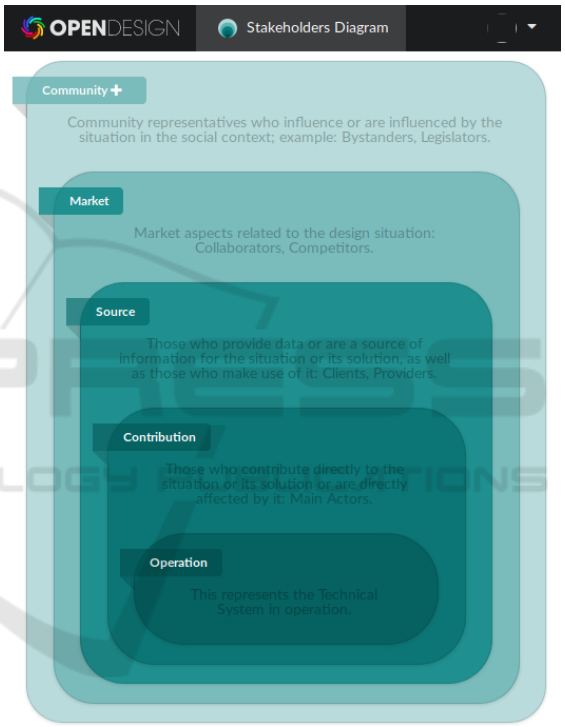

Figure 1: Stakeholder Identification Diagram.

The next phase is guided by the Evaluation Frame (EF), a table-like artifact that supports the reasoning of problems and solutions associated with each stakeholder identified in the SID adapted from Baranauskas et al. (2005). Usually, it contains one column for raising issues, and another column for solutions or ideas associated to the issues. Then, each row represents one layer of the SID. On the OpenDesign platform, such format was slightly adapted to allow users to navigate through the layers from a left-side menu, as we can see in Figure 2. In addition, the deliberation aspect of this stage is reinforced by allowing users to like or dislike entries, and to add comments justifying their votes. Hence, the platform

provides a deliberation frame (Figure 3), where participants can raise pros and cons about a solution that was placed on the EF, or they can add neutral comments. The main idea, then, is to provide a way to document the deliberation process.

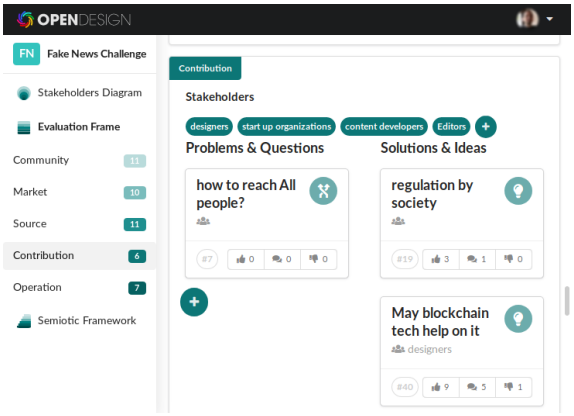

Figure 2: Evaluation Frame.

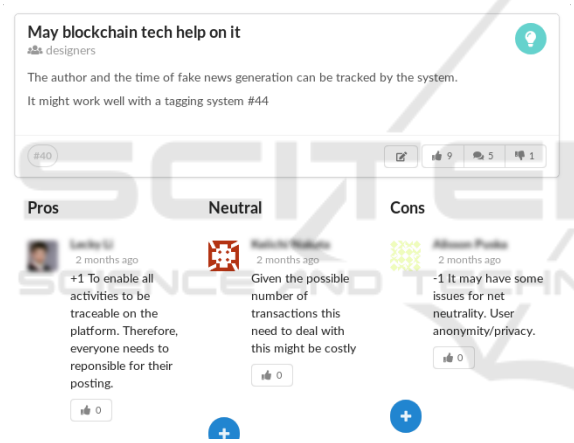

Figure 3: Deliberation Frame.

Finally, the third stage is guided by the Semiotic Framework (SF) artifact adapted from Stamper (1973), which provides six levels of knowledge, stacked on top of each other in a progressive manner, similar to a ladder, as we can see in Figure 4. The bottom three levels are related to the structure of signs, how they are organized and transmitted. In turn, the upper three levels are related to how signs are used, in terms of meanings, intentions, and social impact they have. Therefore, the SF can be a useful instrument for identifying and organizing the requirements of the design product.

Together these three artifacts provide criteria to promote the process of deliberation and rationale, where participants are engaged in discussing particular aspects of the design, which they might not think of without the artifacts. Furthermore, the platform instantiates these artifacts in a way that encourages and documents deliberation and rationale. For instance, beside designers, apprentices and domain knowledge's holders taking part in a given OpenDesign session, the participants are prompted to remember and represent the concerns and hopes of absent stakeholders. This remembering is facilitated by the SID boundary object that frames 5 distinct levels of involvement with the system, from daily operationalization to the distant community with spectators and legislators. The platform aims to give direct voice to some of these more distant stakeholders to directly participate in design and feedback about a design product, instead of being only represented.

Figure 4: Semiotic Framework.

The OpenDesign platform can be used following certain steps. First, a challenge is proposed by one or more key participants, representing each local group of users. Not all local groups participants are necessarily operating the platform online, nevertheless they participate in local discussions and may contribute to

the solutions and proposals. Besides, a video conference can create another communication channel, supporting all the activities, but mainly the selection of an issue from the EF to be worked out in the SF towards the design solutions. This dynamics is depicted in Figure 5.

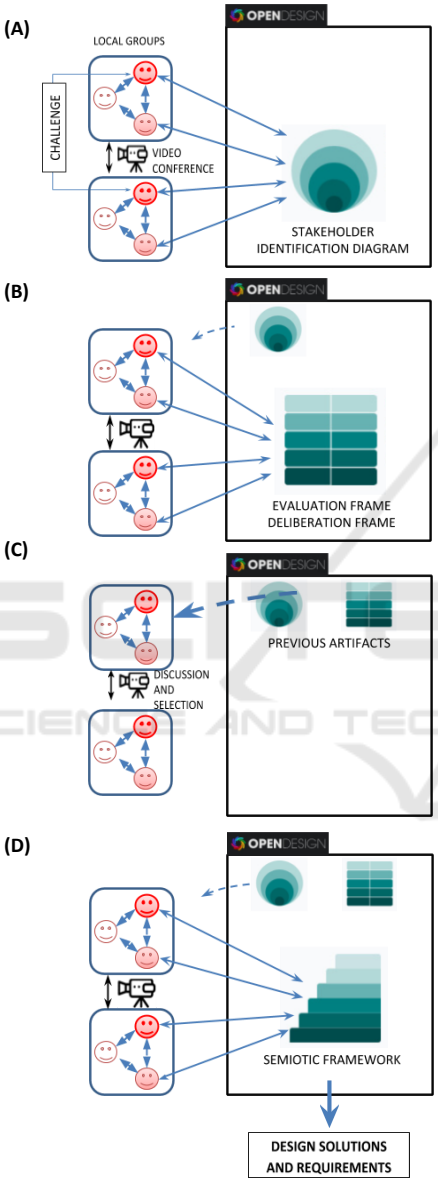

Figure 5: Open Design Semiotic Workshop dynamics: A) a challenge is proposed for key participants in each local group and then the SID is populated with related Stakeholders; B) evaluation frame and deliberation are carried out; C) based on the artifacts available at the platform, issues are discussed and a focal idea of solution is selected for the next phase; D) semiotic framework is generated, giving rise to the proposal of solutions and requirements.

4 A CASE STUDY ON THE PLATFORM USAGE

4.1 Context and Participants

To evaluate the proposed platform we conducted a case study in the context of a Summer School in the Organizational Semiotics Conference (Informatics Research Centre, Henley Business School, University of Reading, UK, 2019). The case study took place as a 3h15' hands on activity, co-located in two research centers in two countries (UK and Brazil). Two conference rooms (9 and 12 participants, respectively) connected also by videoconference, and one more participant connected from home. The participants goal was to learn and practice socially aware design, instantiated in a pre-given common problem amplified by technology pervasiveness without corresponding human development and training - *the fake news global challenge*. Participants of diverse countries and languages, with backgrounds mostly on business and computer science, worked in the same problem, sharing ideas along the hands on activities, through the OpenDesign Platform.

To the proposed 'problem' (the fake news global challenge), the platform was previously loaded with 24 stakeholders, 13 issues and 7 proposals of solutions, filled by 9 volunteers (5 co-located and 4 digitally-located) in a 1 hour warmup, one week before the event.

The use of the collaborative platform was organized into phases: clarifying the problem, raising the main interested parties, raising issues the interested parties might have, proposing ideas of design solutions for facing the issues, discussing and selecting one potential solution to carry on, and organizing requirements for the selected solution idea. At the end, participants were invited to express their opinion on the experience with the Platform. Table 1 illustrates the Agenda of activities carried out in the 3h15' hands on meeting.

Table 2 synthesizes the participants' main contributions using the platform before (warmup) and during the workshop. Some participated (6) in both moments, while in the workshop some participants did not interact through the platform (4), although they exchanged ideas with collocated colleagues. The deliberation (arguments) and SF filling (requirements) was performed only during the workshop.

Table 1: Agenda for the Hands on Meeting.

Boundary Objects	Time spent	Activity Description
Videoconference	20	Greetings; platform overview and challenge presentation
Stakeholder Identification Diagram	20	Making sense of previews entries and raising new Stakeholders
Evaluation Frame 1	35	Raising most issues and arguments
Evaluation Frame 2	30	Creating solution proposals and arguments
Semiotic Framework 1	10	Discussing and selecting ideas from the EF to SF
	30	Coffee-Break
Semiotic Framework 1	15	Discussing and selecting idea of solution from EF to SF
Semiotic Framework 2	25	Filling the SF with requirements
Videoconference	10	Wrap-up and invitation for the Evaluation Questionnaire

Table 2: Participants and information they formalized into the platform.

	Warmup	Workshop	Total
Participants	9	22	25 (6 in both)
Active in Platform	9	18	24 (3 in both)
Duration	1h	2h45min	3h45min
Stakeholders	24	26	50
Issues	13	12	25
Solution Proposal	7	13	20
Arguments	–	61	61
Requirements	–	23	23

4.2 Data Analysis

Social networks are not just made up of persons, they consist of people who are connected by the so-called social objects (Engeström, 2005), which we are understanding as content in boundary objects. From this perspective, Engeström (2005) argues that what causes the failure of many social networking sites is the lack of shared objects acting as hubs for people's interaction (Avram, 2005).

In order to understand the interplay between people and non-human entities in a social scenario, the Actor-Network Theory (ANT) proposes to study social phenomena as heterogeneous networks where both human and non-human can contribute (Latour, 2005). This approach allows one to acknowledge the mediation role of objects that propagate human intentions. Such heterogeneous social networks can provide a visual representation of both the participants and the artifacts they produce and interpret. For instance, scientific social networks are mediated by publications, and by analyzing both entities together we can highlight structures of scientific communities (Prado and Baranauskas, 2016).

In our study, this approach is employed to illustrate the interactions between participants and the diverse artifacts (boundary objects) used in the Semiotic Workshops. Whenever a participant creates or edits a stakeholder on the Stakeholder Identification Diagram, an issue on the Evaluation Frame, or a requirement in the Semiotic Framework, a bond is established between them. Moreover, issues of the EF related to each stakeholder are also linked together. Social relations between participants arise also when a participant makes an argument on the issues created by another person. These structures allow us to evaluate the interactions afforded by the platform. For instance, the presence of cliques (short loop with a single participant) or many disconnected vertices may indicate a poor discussion, leading to less representative design proposals. Conversely, a richer discussion can emerge from associations with no single hubs, nor disconnected sub-groups.

The visual representation of these social interactions and the mediating artifacts are represented in Figure 6 through the QUID tool [ref]: participants are depicted as red circles, stakeholders from SID as blue circles, issues and solutions pointed out in EF as blue squares and Semiotic Framework items as white circles. For the arguments, drawn in green, triangles mean positive, diamonds mean neutral, and crosses mean negative.

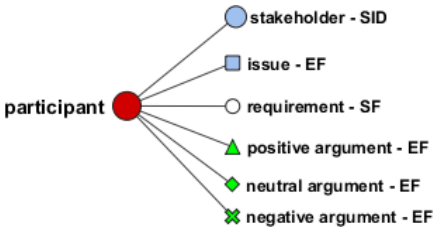

Figure 6: Visual representation for the network of interactions between people and types of artifacts created on the platform.

After the hands on activity, the participants were invited to give feedback about their experience with the platform through an online questionnaire to understand the platform's boundary objects capacity to promote deliberation, rationale and awareness, from the point of view of participants.

4.3 Results and Discussion

From the interaction logs collected by the platform and processed by the QUID tool, it was possible to visually represent who contributed and, from the social objects perspective presented earlier, how their work build up to the workshop outcomes. Figure 7 shows the main artifacts with which the participants interacted, and the paths of interactions they create, prior to the deliberation phase.

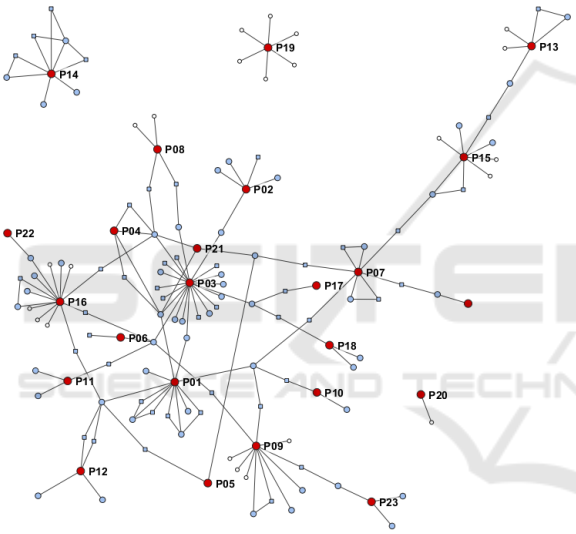

Figure 7: Complete graph of relations between participants (red circles, randomly numbered and labeled as P*nn* to anonymize participants), stakeholders they raised or edited (blue circles), problems and solutions pointed out (blue squares) and Semiotic Framework items (white circles).

The main feature of this graph of relations is the presence of a major connected component comprising most of the vertices, depicting the variety of interactions provided by the platform. Except for P14, P19, and P20, all other participants engaged in interactions with the content created by others, creating paths of associations linking most of participants. This suggests a successful sharing of ideas and concepts among users. Although many participants interacted with their own content - for instance, adding a problem to a stakeholder proposed by themselves, creating the "triangles" on the graph - they also contributed to others' contents. Also noticeable is the lack of correlation between the physical location of users during the workshops and their placement on the graph; for instance, although P03 and P16 were on different places, they are closely attached on the graph, as they constructed collaboratively some content, along with P04 and P06.

Figure 8 shows a detail of the complete graph, for the sake of a better understanding of what is being represented. The participant P04 raised the "Public Figures" stakeholder in the Stakeholder Identification Diagram; afterwards, participants P21, P03 and P01 edited it, complementing or clarifying its description. In the next activity, through the Evaluation Frame, P04 attached the issue "Negative impact on the person's life" to the shared stakeholder.

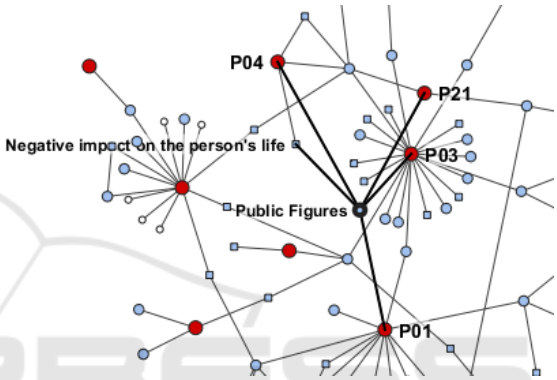

Figure 8: Detail of the graph of relations, focusing on an identified stakeholder and the other entities related to it.

Regarding the deliberation phase, Figure 9 brings a view on how each argument is related to the issues and solutions raised in the Evaluation Frame, and to their authors as well. Node sizes are proportional to the number of arguments attached to it, revealing the most active authors and, according to their interaction, the most interesting subjects.

It is noticeable that most commented problems and solutions were not proposed by the most eloquent users, suggesting different profiles of participation, and showing that the tool provided a balanced discussion environment. Authors also did not try to overemphasize solely the positive aspects of their proposals.

The graph including the requirements in the Semiotic Framework (white circles) highlights the interaction of the participant P17 who contributed with the main idea ("May the blockchain tech help") for the final phase. This participant registered only this proposal, after engaging in deliberation with other 5 issues and ideas proposed by 4 other participants with 3 positive and 2 neutral arguments Figure 10. This same behavior is shared by other participants (P16, P09, P15, P13) while other participants were more engaged in deliberation (P22, P21, P23, P12) and oth-

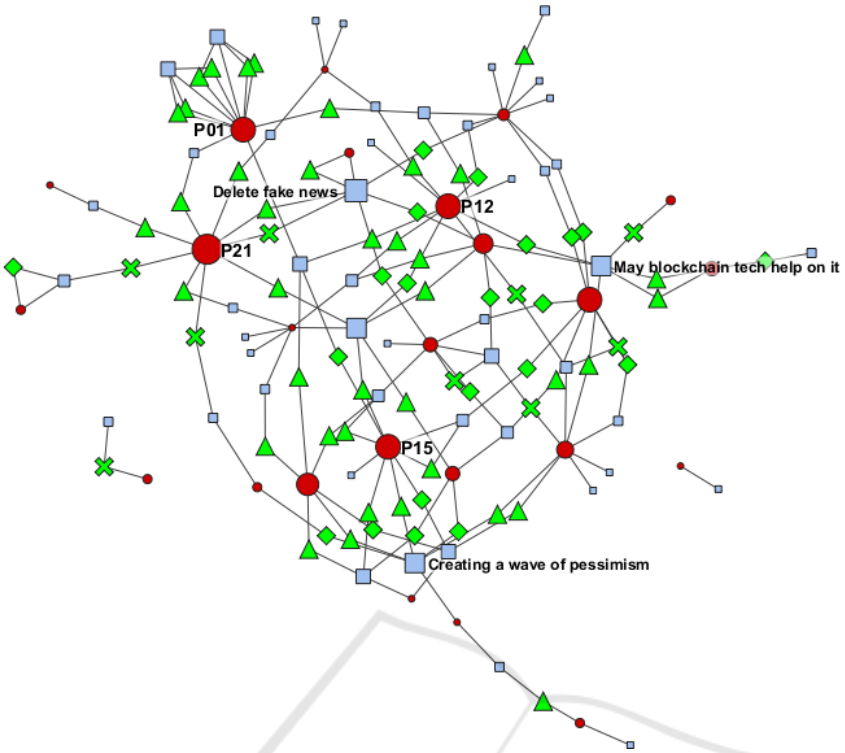

Figure 9: Relationship between authors (red circles), problems and solutions (blue squares) and arguments (green shapes). Positive arguments are depicted as triangles, neutral ones as diamonds, and negative arguments as crosses. The vertices with greater number of arguments are labeled.

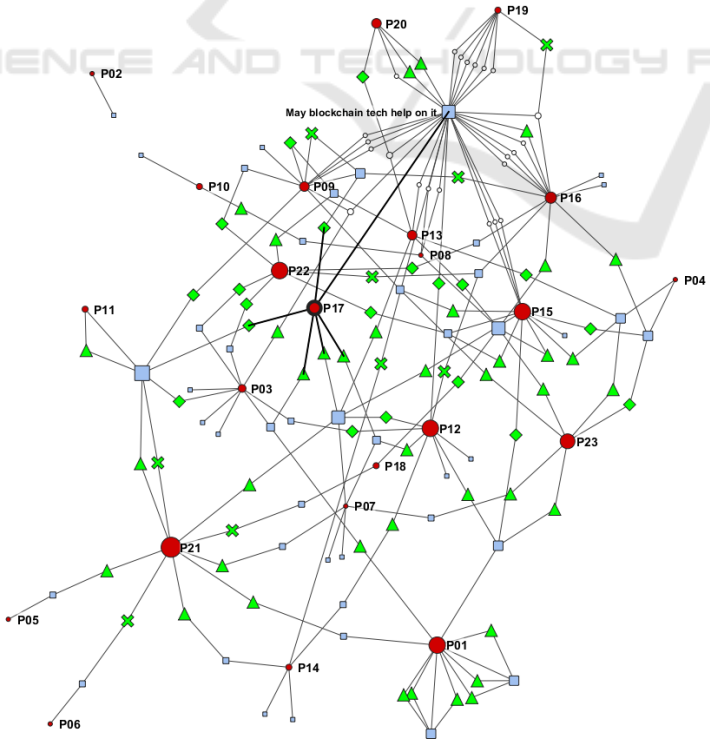

Figure 10: Complete graph of interactions after the Semiotic Framework and Deliberation phases were carried out. In bold, highlight of the interaction of the participant who contributed to the idea selected as the focal point in the SF.

ers contributed more to SF but not in the deliberation (P19, P8).

4.3.1 Getting Feedback through the Questionnaire

Regarding the platform usage evaluation, after the activities carried out through the platform, an invitation was made only for those in one of the two groups, not involved with the OpenDesign Project or its platform design, development or test. Eight volunteer participants answered the evaluation questionnaire. The objective of this questionnaire was to understand the ability of the platform artefacts to promote deliberation, rationale and awareness, from the point of view of activists and the hands-on course participants (platform users).

The questionnaire encompasses 28 questions organized into two different parts. Part 1 with 19 questions regarding Deliberation, Rationale, and Awareness, and Part 2 with 9 questions regarding Feelings and Usability. The questions in Part 1 used a 9 point Likert scale ranging from 'completely disagree' to 'completely agree' for 13 questions, and included 6 open questions. The questions in Part 2 used a 5 point Likert scale ranging from 'completely unhappy' to 'completely happy', using a manikin with different facial expressions for expressing the feeling.

The closed questions of Part 1 resulted in the following mode values (Table 3).

For the Part 2, in the 9 questions related with feelings and usability, in a 5 points Likert scale of satisfaction with different aspects of interaction (e.g. collaboration, self presence in the solution, facility of use, feeling able to contribute, etc.), five (of eight respondents) gave the highest value (5) to them. The lowest value attributed to an item was 3 (in 5). In summary, the mode of the responses for the questions in Part 2 are as follows (Table 4).

As for the open questions of Part 1, the main findings regarding deliberation,rationale and awareness were:

Table 3: Mode of the answers for the Part 1 closed questions.

Statement	Mode
The format of the argumentation (Pros/Neutral/Cons) is useful for collective decision making	7
The format of the argumentation (Pros/Neutral/Cons) facilitates collective decision making	8
Voting (Like/Dislike) is useful for collective decision-making	9
Voting (Like/Dislike) facilitates collective decision-making	7
I discussed with another workshop participant regardless of the platform	9
I recorded the result of a face-to-face discussion on the platform	8
I considered arguments recorded on the platform to build my own opinion	7
I can easily relate a requirement to a stakeholder	6
A solution proposal is always related to the problem that it seeks to solve.	7
It was easy to relate a requirement on the Ladder to the proposed solution that gave rise to it.	8
Arguments of other participants influenced my opinion about the importance of a problem	8
Arguments of other participants influenced my opinion about the importance of a stakeholder I had not considered	9
Arguments of other participants influenced my opinion about the value of a solution	6

Deliberation Aspects

- All respondents somewhat agree that those in the same physical location have discussed regardless of the platform, but some agree their discussion was moved by the artifacts and they have recorded the results of the face-to-face discussion on the platform. The recording is necessary and hopefully sufficient to make what happened out of the platform to become a fact capable of impacting those who have not participated in that particular face-to-face discussion.
- All respondents agree that the artifacts in the platform allowed them to deliberate on the proposed ideas. They emphasized the structure of the platform as a key aspect to orient, provide sequence and overview of contributed information, keeping good flexibility and interaction among people. Besides structure, they mention aspects of flexibility of use, visibility of ideas and of thinking processes, e.g.: *"They facilitate the visualization of the ideas", "ideas and thinking stimulation"*.
- When asked how deliberation and decision-making could be improved, they pointed out that consolidation still happens depending on video conference support and that could be improved with mechanisms such as: digital mediator, discussion turns, focus groups.

Table 4: Mode of the answers for the Part 2 questions.

Question	Mode
Did you feel like collaborating with others?	4
Did you feel represented in the discussion?	4
Did you feel the presence of others in the discussion?	4
Did you feel you achieved something collaborative?	5
Did you feel you were able to contribute?	5
Did you feel you free to express your ideas?	4
Was the collaboration spontaneous?	4
Would you use the system to solve another problem?	4
How easy-difficult was it to use the platform?	4

Rationale Aspects

- Most respondents agree to be easy to relate a requirement to a stakeholder, a solution proposal to the issue it seeks to solve and in lesser degree to link a requirement on SF to the proposed solution that gives rise to it. Regarding the artefacts, "*They contribute to build a more complete perspective of what is being discussed, in different dimensions that may not have been considered.*"
- When asked what other mechanisms could be more appropriate for making the rationale visible, they suggest "*schemas, maps, visual mind maps*","*It will be helpful if there is a graph network can show the relationships between different solutions*". This last aspect is something an integration of the QUID tool to the Platform could offer, visually facilitating a global view of the human and non-human actors in the solution tracking, as the Figures 7 to 10 show us.

Awareness Aspects

- According to the respondents, the platform collaborates to understand the others point of view, making visible their arguments in a non biased way. Visibility of all ideas and their influence on the others is mentioned by the majority of respondents, e.g. "*The ideas are all shown on the platform, which are easy to check out.*" Nevertheless, they acknowledge there is still room for improvement:"*Yes, in some way because we can see productions (stakeholders, problems..) of other people and their comments. We can see how problems, ideas and other productions are related as well. But the artifacts can improve to make awareness even better.*

These results, added to the content generated through the platform during the activity, has shown the use of the platform was smooth, and the boundary objects were valuable as mediators along the process that initiated with a challenge and ended up with requirement specifications of an elected idea of solution.

5 CONCLUSION

The concept of open design, with origin in the open source code for software, has been acknowledged as a significant phenomenon, supported by trends in contemporary digital technology and organization. The nature of open design presupposes the interaction of diverse people towards a co-creation of the design product (e.g. a plan, a drawing, a requirements list for the intended product or service, etc.), and with different motivations (e.g. to influence the final result, to voluntarily contribute in the process, to get a benefit of it, etc.). The lack of online platform tools to support interaction and co-construction in open design has been pointed out by the research community.

In this work we presented the OpenDesign platform, characterizing it by its boundary objects (artefacts), participants and design process. The OpenDesign platform draws on artefacts of the Organisational Semiotics and Participatory Design, to conduct a socially-aware design. A case study was carried out with participants in two geographically distant sites attending a summer school, interacting through the platform artefacts to discuss a proposed challenge and to evolve together a design solution.

Data from the design process, generated through the platform artefacts, were analysed under the lens of the Actor Network Theory, through a graphical representation in which both the participants as well as the boundary objects are part of the same network. This representation allows us to reveal the different paths the participants weave along the interaction through the platform, the tracks they leave while discussing, proposing ideas, deliberating, interacting with the others mediated by different boundary objects. Also, answers to a questionnaire on the use of the platform show the participants had a perception of the deliberation, rationale and awareness in the use of the platform. A very positive feedback on their feelings and usability were also observed.

Further studies involve analysis of suggested enhancements in the artefacts, and the integration of the tool used for providing the visual map of the net-

work of participants and boundary objects in mediation along the (open) design process.

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