Enhancing Problem Clarification Artifacts with Online Deliberation

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Abstract: Information system design demands understanding requirements from diversified stakeholders. As an initial step, the problem clarification is essential to obtain a shared view of the involved problems and solutions. Several techniques have been proposed and practiced by the systems engineering community for problem clarification. While existing literature has brought problem clarification artifacts via a online computational system, stakeholders still lack means of meaning negotiation practices that usually happen in face-to-face meetings. This paper proposes a deliberation model integrated to the online use of problem clarification artifacts. The deliberation provides a collaborative process for building common ground for reflection. The proposed model illustrates the possibilities of deliberation in statements created in three artefacts of the Organizational Semiotics: Stakeholder Identification, Evaluation Frame and Semiotic Framework.

1 INTRODUCTION

The design of information systems usually involves several people from different areas of knowledge and distinct backgrounds collaborating together. The construction of the whole system piece by piece can be facilitated when a shared understanding of meanings is built and understood by every person involved in the process. In this work, we argue that collaborative negotiation and deliberation processes are essential to achieve a common ground among a group towards understanding the problem at hand and emerging a desirable solution.

Online Deliberation (OD) is "a web-based form of reasoning that gathers and carefully considers options for actions and possible consequence of each" (Towne and Herbsleb, 2012). Usually, OD platforms address the discussion process, helping participants to clarify a subject, by separating pros and cons arguments and opinions from each participant (Gonçalves et al., 2017). Some platforms provide visual clues of arguments endorsement and opinion clusters (Kriplean et al., 2012). Often, there is some kind of proposal or issue that draws attention and guides the discussion. The summary of the proposal indicates how much discussion it has attracted and the level of consensus among the participants; the visual clues help the participants to choose proposals for further discussion.

This work explores problem clarification artifacts as presented in the the Problem Articulation Method (PAM), one of the components of MEASUR ("Methods for Eliciting, Analyzing and Specifying Users Requirements"; Stamper and Backhouse (1988)). PAM has been proved useful to: (1) articulate and decompose complex problem situations into manageable pieces and their interconnected relationships (Liu et al., 2007); (2) facilitate the requirements elicitation and to inform the design while constructing a shared understanding of a problem among all involved stakeholders (Hornung et al., 2013).

Recent efforts have brought the PAM artifacts to an online platform - the Socially Aware Design (SAwD) CASE tool (da Silva et al., 2016). SAwD supports early design activities when a problem is clarified and a solution is proposed by stakeholders in a Socially Aware Computing (SAC) approach (Baranauskas, 2014), alleviating time and geographic boundaries. Although very useful, the remote usage of PAM artifacts, by diversified stakeholders, lacks the opportunity of meaning negotiation practices that happen in face-to-face meetings, where people meet together in a physical space around physical artifacts (*e.g.* Figure 4). In our experience of the Organizational Semiotics artifacts usage, either in academic context, with students, or in the professional context, by experts, the online media favors individual work and decisions at the expense of meaning negotiation and shared understanding of the problem and of the consequences of actions. The synchronous communi-

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cation channel (chat box) provided by SAwD is still not enough to ignite structured discussions or deliberation. Also face-to-face or video-conference alternative are not always possible due to time restrictions.

In this article, we propose to include deliberation-based meaning negotiation integrated to the online use of PAM artifacts through SAwD. The goal is to bring the meaning construction, that is facilitated in the face-to-face workshops, to online SAwD artifacts, enhancing it with deliberation mechanisms. This work presents a model for including OD on three of the PAM artifacts (Stakeholder Identification, Evaluation Frame and Semiotic Framework). The model also enables to record the occurred negotiations and decisions in a system's design process. Our proposed model and interface elements were devised relying on discussions conducted among researchers from InterHAD[1], a research group, who have used both paper-based and the virtual artifacts, in addition to experience using OD platforms.

The remainder of this article is organized as follows: first we present the foundations and related work (Section 2). Afterwards, we thoroughly describe the proposed model and mechanisms for OD while filling the virtual PAM artifacts in a illustrative scenario (Section 3). Whereas Section 4 summarizes the findings, Section 5 wraps up the article and points out future research.

2 BACKGROUND

Socially Aware Computing (SAC) (Baranauskas, 2014) recognizes the communication between parties as a culturally defined social phenomenon and proposes artifacts to mediate this communication to ensure their creative, collaborative and consequential involvement in design. SAC extends and articulates methods and artifacts from Organizational Semiotics (OS) (Liu, 2000; Stamper, 1973) and Participatory Design (Muller et al., 1997) into Semio-participatory Workshops (SpWs). SpWs artefacts are organized to facilitate meaning construction among participants while building a systemic and situated understanding of a problem and emerging a socially desirable and responsible system design.

2.1 Artefacts, Systems and Socially-situated Practices

Clarification of the design situation and its knowledge domain takes place during SpWs through the actions of those initially involved (primary stakeholders or interested parties), using various artefacts. The selection of artefacts is situational and depends on factors such as the process phase (clarification of the domain phase, elucidation of meanings for representation elements, *etc*.) and schedule, as well as stakeholder conditions (characterization of competences and differences between interested parties). We present briefly the Stakeholder Identification Diagram (Liu, 2000), the Evaluation Frame and the Semiotic Framework (Baranauskas et al., 2005), which are artefacts generally used at the beginning of the process. Other artefacts are shown in Baranauskas et al. (2013) and de Almeida Neris et al. (2013), which illustrate a cycle of eleven SpWs.

Stakeholder Identification Diagram (SID): Impact Analysis and Scope of the Solution. It is assumed that the stakeholders are governed by forces of information and knowledge fields, and behave accordingly. These forces are related to functions, tasks, personal values or goals, social goals, etc. The objectives of the SID are to clarify the design situation and share knowledge within the group by exploring as comprehensively as possible the technical and social scope of the project, i.e. parties directly or indirectly involved in the problem or its possible solution. It includes those initially in the group (primary stakeholders) as well as new stakeholders who might be invited to join the group.

Stakeholder analysis helps the group of participants to situate themselves, reflect on the frame and see themselves reflected, understand the posed situation and the requirements and compromises of desired solutions, through the discussion about the parties that direct or indirectly influence or suffer the influence of the situation or its solution. Figure 1 illustrates a SID template, to be filled in by a project group. The artefact distributes the stakeholders (annotated on sticky-notes during the workshop) into different categories representing different "information forces" in relation to the situation under analysis. We use the following categories: *Actors and Responsible people* — those who contribute directly to the situation or its solution or are directly affected by it; *Clients and Suppliers* — those who provide data or are a source of information in the situation or its solution, as well as those who make use of it; *Partners and Competitors* — market aspects (also figuratively) related to the design situation; *Bystander and Legislator* — community representatives who influence and are influenced by the situation in the social context (including the ones that may never use the designed solution).

Evaluation Frame (EF): Raising Questions and Solutions/Ideas. The EF is an artefact that supports the

[1] http://interhad.nied.unicamp.br/

Figure 1: Stakeholder Identification Diagram.

Stakeholders *Interested Parties*	Problems and Issues	Ideas and Solutions
OPERATION		
CONTRIBUTION *Actors Responsible*		
SOURCE *Clients Suppliers*		
MARKET *Partners Competitors*		
COMMUNITY *Bystanders Legislator*		

Figure 2: Evaluation Frame.

sharing of meanings among the participants and informs about specific issues of the interested parties and ideas or solutions envisaged that will have potential impact on outlining a design solution.

The EF extends the SID, supporting the group to consider, for each stakeholder category (Contribution, Source, Market, Community): (1) different issues they face in the current situation or see as potential problem in the prospective situation (for the purpose of design), and (2) ideas and solutions to identified issues. These two columns of the Evaluation Frame are inspired by the phases of "criticism" and "fantasy" proposed in Future Workshops (Jungk and Müllert, 1987). The technique was originally developed for the participation of groups of citizens with limited resources, in decision processes. It is a technique designed to shed light on a common problematic situation, to generate visions about the future, and to discuss how these views can be materialized. At the criticism stage, the situation is investigated critically; a brainstorming is carried out and general and critical questions about the situation are put forward. In the fantasy stage, the participants try to propose an image (without restrictions to the utopia or exaggeration) of future possibilities.

The EF enables the stakeholders to anticipate issues and to project a situation in which the prospective object of design is already present. This exercise results in elements (expressed in sticky notes) that identify, for each category of stakeholder, their interests, main issues, and possible ideas that will impact on requirements for the technical solutions. Figure 2 illustrates the EF template, to be filled in by the project group in a SpW. Figure 4,B show the actual artefact in use in SpWs.

The Semiotic Framework (SF). From the semiotic perspective, several layers of meaning must be considered in a system design. To Morris's classification for syntax, semantics, and pragmatics (N. and Morris, 1938), which deal respectively with sign structures, meanings and uses, Stamper (1993) added three other layers: physical, empirical, and social world. The Stamper's Semiotic Framework — or Semiotic Ladder — is composed of six layers (or steps), briefly described as follows:

1. Social World layer: related to consequences of the use of signs in human activities. It deals with beliefs, expectations, commitments, law, culture, etc.
2. Pragmatics layer: regards the intentional use of signs and the behavior of agents. Issues related to intention and negotiation are objects of it.
3. Semantics layer: concerns the relations between a sign and what it refers to; signs in all modes of signification.
4. Syntactics layer: regards the combination of signs without considering their specific meaning.
5. Empirics layer: refers to the statistic properties of signs, when different physical media and devices are used.
6. Physical World layer: refers to the physical aspects of signs and their marks.

Figure 3 illustrates the SF template. The top three steps are related to the use of signs, how they work in communicating meanings and intentions, and the social consequences of their use. The bottom three steps refer to how signs are structured and used, how they are organized and conveyed, what physical properties they possess, etc.

The SF artefact has been adapted to organize requirements of the interactive system in the 6 layers of information, as well as to organize elements of system evaluation, considering aspects from its technological infrastructure (physical, empirical world, syntactic layer) to the human information system (semantics, pragmatics and social world).

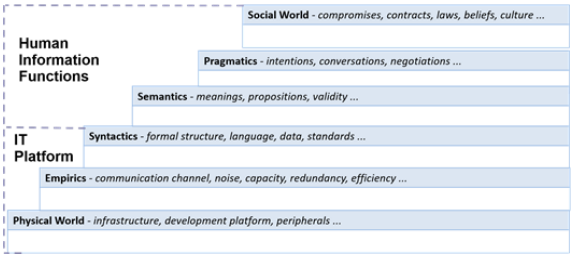

Figure 3: Semiotic Framework.

Figure 4 shows SpW conducted by researchers in a industrial setting (Buchdid et al., 2014), where various stakeholders gather around physical artifacts to fill them. SID facilitates a holistic view of the stakeholders, their roles and responsibilities that can influence or be influenced by the system design and its outcomes (Figure 4, A). EF (Figure 4, B) concentrates in anticipating possible problems the interested parties might face and generating ideas that might cope with those problems. SF (Figure 4, C) organizes requirements according to the six layers of information, ranging from the technical infrastructure (physical world) to the human information aspects (social world) with the impact the information system may cause on people directly (social interactions, understanding, feelings, beliefs, etc.). These artefacts are used in SpWs with the interested parties, who use post-its to bring up and record contributions to the discussion on stakeholders, anticipated problems, ideas of solutions, and requirements of the prospective system.

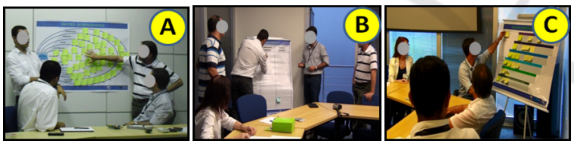

Figure 4: Physical artifacts in Semio-participatory Workshops: A. Stakeholder Identification Diagram; B. Evaluation Frame; and C. Semiotic Framework. Source: (Buchdid et al., 2014).

Da Silva *et al.* (da Silva et al., 2016) developed an online software tool to support the asynchronous use of these artifacts, namely SAwD. This system is composed by several artifacts for problem clarification. During the design and problem clarification, the artifacts available in the SAwD are filled with several statements, *e.g.*, a stakeholder which is representative of the market layer as a competitor in SID; a problem or a ideia relevant for the stakeholders in the operational layer in EF; or a feature important on the pragmatics level at the SL. Figure 5 shows a part of SAwD's SID with some stakeholders already added to it.

In SAwD, each artifact is composed by layers and

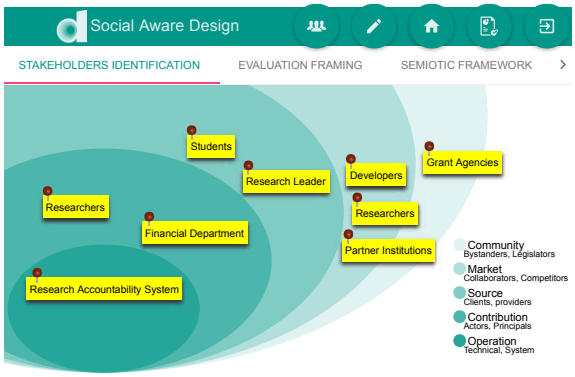

Figure 5: SAwD's interface showing SID filled with some stakeholders.

statement views. SID has five layers (Operational, Contribution, Source, Market, Community) and each statement, *i.e.*, stakeholder, has three fields to be filled (Stakeholder, which is the name of the stakeholder, Description and Values). EF also have five layers and in each layer all stakeholders are listed. When clicking in a stakeholder, the user needs to fill out two fields (Question/Problem and Idea/Solution). In the SF we have six steps (Physical World, Empirics, Syntactics, Semantics, Pragmatics and Social World); each step contains a list of features inserted by users.

Although relevant, SAwD still lacks means to discussion and deliberation about raised statements proposed in it's artifacts, as it would happen in a face-to-face use of the artifacts in SpW. Although the system provides an asynchronous global chat tool, it does not include a deliberative model.

2.2 The ConsiderIt Model of Deliberation

In previous investigations, we have conducted a comparative analysis on OD platforms for the support of academic deliberation (Gonçalves et al., 2017). Aligned with the literature (Gao et al., 2013), we defined academic deliberation as a collaborative process of building common ground for reflection. The goal is to enable developing critical thought and arguing with quality when challenged by new and contradicting information, and ideas from others.

ConsiderIt (Kriplean et al., 2012) is a socially enhanced personal deliberation platform. Users are encouraged to reflect upon a issue by considering tradeoffs, as the discussion is framed by arguments featured as pros or cons. People can position themselves in a free-scale with extremes in "agree" and "disagree" and contribute with pro or con points that indicate the rationale behind that opinion (Figure 6).

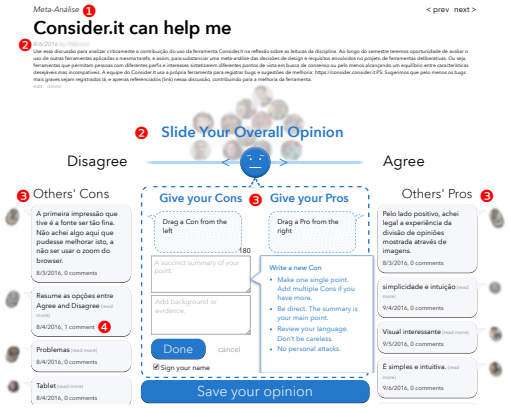

Figure 6: *ConsiderIt* main interface: (1) proposal category; (2) proposal statement and opinion slider with others' opinion pictorial histogram; (3) new arguments entry in the center and draggable arguments of others in the interface borders; (4) comments to the argument. Source: (Gonçalves et al., 2017).

The deliberation category (1 in Figure 6) groups related proposals. It allows users to navigate through proposals in the same group. The proposal and opinion slider (2 in Figure 6) consist of a statement, its author and details. The slider allows users to choose in a continuum between "disagree" and "agree". The user may move a blue "face" icon which varies from "unhappy" to "happy" depending on the agreement level. Over the slider there is a pictorial histogram that represents the stance from other users. In another view, this histogram is used to explore others' opinions by segments, highlighting the arguments of users' clusters with similar opinions.

A opinion may be supported by arguments (3 in Figure 6). Others' arguments are presented in the interface borders and can be dragged into a personal argument list in the center. In this list, the platform enables users to write new pros and cons composed by a succinct summary, and details of the argument that might include evidences backing the argument. Once published, new arguments become available to others. Authors are represented by avatars on the side of the argument balloon. When someone else appropriates the argument, *i.e.*, gets behind it, this person's avatar appears behind the author's avatar. By clicking on the supporters' avatar cluster, the platform presents their different stances in the histogram. Users can also post comments (4 in Figure 6) to an argument. They are displayed within the arguments details when the summary balloon is clicked.

3 BRIDGING PROBLEM CLARIFICATION AND ONLINE DELIBERATION

Each of the statements created in the artifacts by using SAwD are potential candidates for deliberation and shall benefit from the views and arguments from diverse stakeholders. By introducing the possibility of using a deliberation model as part of the creation/edition of statements, we may redeem the benefits provided by deliberation.

We integrated each statement created in SAwD to a ConsiderIt proposal to arouse deliberation. This way users can hop into deliberation while navigating through the artifacts. A deliberation section is added in each of the statements. This work proposes improvements in the statement views in the SAwD case tool. These improvements refine the statement with an organized and succinct view of deliberations.

Figure 7 presents an overview of the flow in which deliberation is achieved combining SAwD artifacts and ConsiderIt. The user creates a new statement in the SAwD, *e.g.* a stakeholder, a problem or a feature; SAwD then creates a new proposal for that statement in ConsiderIt. Afterwards, SAwD statement view is updated with a summary of the deliberation status represented by the Opinion Slider. If a user decides to join the deliberation, by clicking the Opinion Slider, SAwD redirects him/her to ConsiderIt, where users can deliberate by presenting Pros and Cons arguments in relation to that statement. What is deliberated upon depends on each statement, *e.g.*, the representativeness of a stakeholder in a layer. In the following, we present how deliberation is achieved in different artifacts.

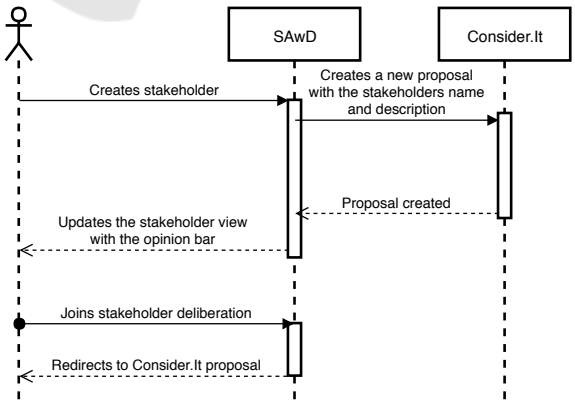

Figure 7: Flow of information when creating a new statement for deliberation.

Deliberation in the Stakeholder Identification. In SAwD's stakeholder view detail, the deliberation

prompt is located below the stakeholder's values section (Figure 8). Representativeness is what is deliberated for this artifact. This is understood as deliberating about the roles, responsibilities and stakeholder's values related to its inserted layer. In ConsiderIt, a category is created for each layer in SID with the the following name "Stakeholder Identification - *Name of the layer*". Inside each category a new proposal is created for each new stakeholder inserted in SAwD. In ConsiderIt, the stakeholder's name becomes the title of the proposal and its description the summary of the proposal. The proposals are composed by the opinion slider and a list of Pros and Cons as shown in (Figure 9).

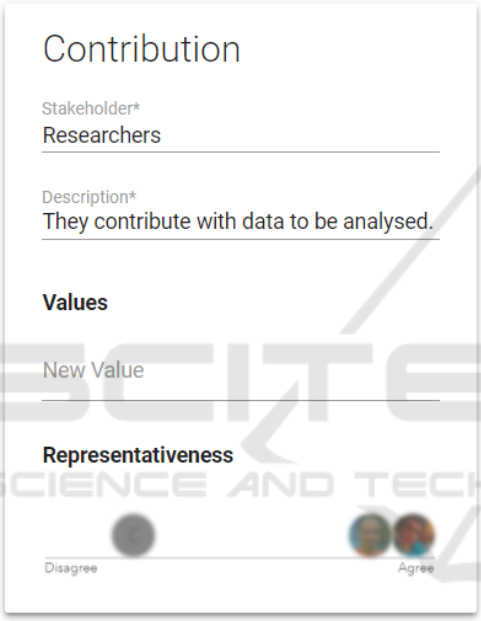

Figure 8: Stakeholder identification: Stakeholder view with Opinion Slider (adapted from SAwD and ConsiderIt).

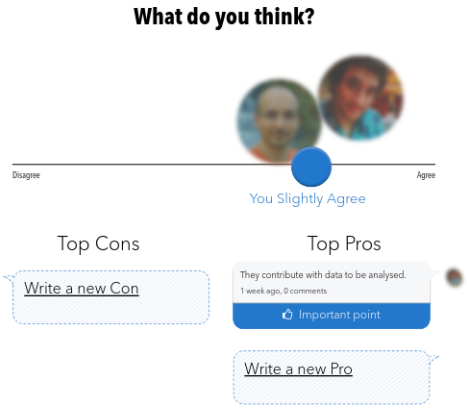

Figure 9: ConsiderIt arguments regarding a given stakeholder from the SAwD.

In the SAwD's SID (Figure 10), we added color coding to the stakeholders to invite deliberation. The stakeholder color changes according to the Opinion Slider strength towards agreement or disagreement. When a new stakeholder is added its color is white (see Research Leader and Developers in Figure 10). When participants start deliberating about that stakeholder, color and opacity may vary; if the level of disagreement of a stakeholder is too high, *i.e.*, most of the participants are disagreeing with its representativeness in a given layer, the stakeholder view starts to be become transparent to indicate that the stakeholder is losing its "place" in that layer (see Students and Researches in Figure 10). The more participants agree with a stakeholder position (layer), it starts to take a yellowish color (see Financial Department in Figure 10) until fully yellow (see Researchers, Research Accounting System, Partner Institutions and Grand Agencies in Figure 10). This represents that the stakeholder became fully part of that layer and the majority of the participants agree with its representativeness.

Deliberation in the Evaluation Frame. In the EF, users add problems and ideas related to SID's layers and stakeholders. At this stage, the relevance a problem to the stakeholders in that layer is deliberated, as is the agreement around a idea to improve stakeholders life. As many problems and ideas may be proposed by participants, deliberation plays a vital role in deciding which are the most pressing issues, and which ideas gather more consensus among the participants. Problems, ideas and deliberations are presented as title and opinion slider in ConsiderIt, following the bubble effect to visually reveal the most relevant one, *i.e.*, the most agreed problem or solution, moves upwards (Figure 11). In ConsiderIt, a category is created for each EF's layer to group proposals for each problem or idea statement with a clear and concise summary of it, much like occurs for stakeholders (*cf.*, Figure 9).

Deliberation in the Semiotic Framework. For the SF we have an enumeration of features in the steps of the ladder, from physical artifacts, passing by semantic meanings to social world necessities and impacts. These are deliberated regarding whether or not these features and requirements are used/caused/expected in the context of the design. For each statement in each layer of the SF, a new deliberation is proposed and represented by the opinion slider after each statement in a similar way as seen in Figure 11, but with only one column called features. In ConsiderIt, a category is created for each SF's layer to group the proposals created for each feature inserted in SAwD (like Figure 9).

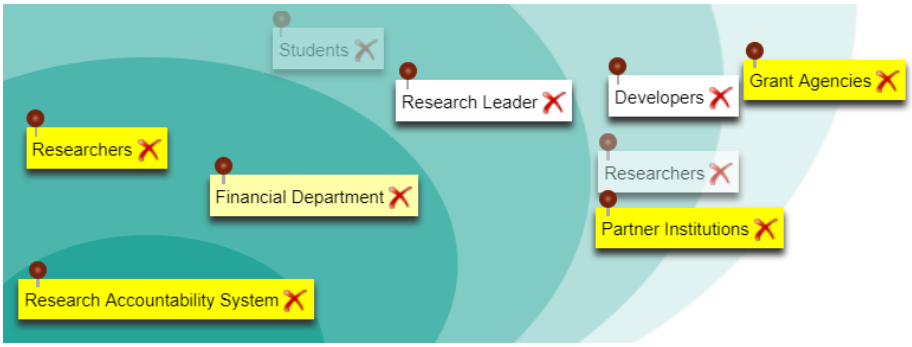

Figure 10: SID: Color coding to represent deliberation aspects of stakeholders. Adapted from SAwD.

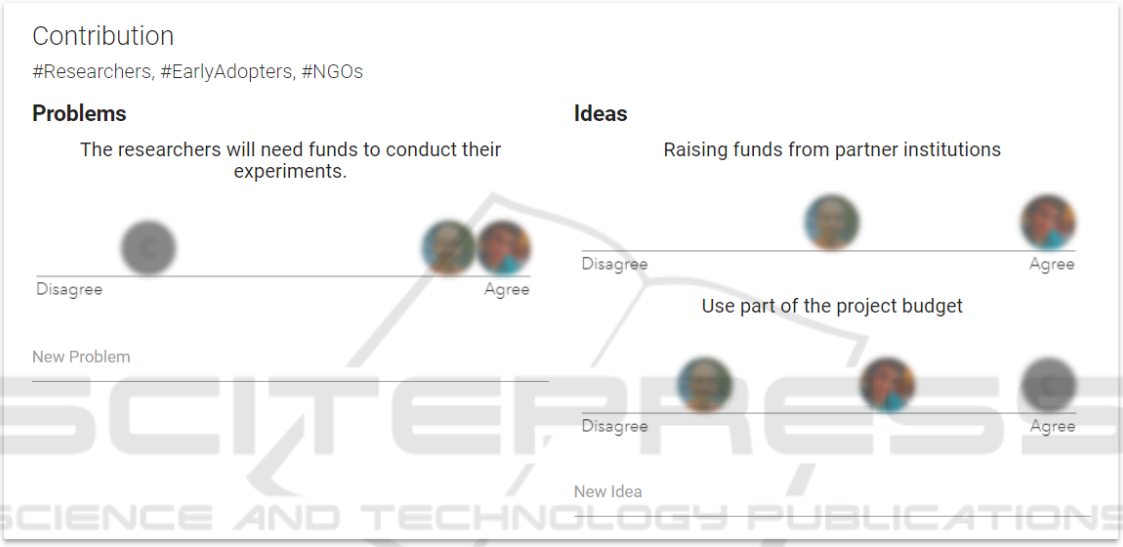

Figure 11: Contribution layer of Evaluation Frame (EF), problems and ideas from stakeholder point of view. Adapted from SAwD and ConsiderIt.

4 DISCUSSION

The structured arguments shared among the participants may work as a formal way of visualizing meaning construction and sharing. This could be enriched with more social elements and emotional cues like pictures, testimonies, and emoticons reactions. The contribution of this work involves incorporating the Consider.It deliberation model into the SAwD system, which allows participants to start a deliberation session, being able to bring their arguments to discussion, endorse and vote about any statement inserted in a artifact in an asynchronous way.

By observing the way people behave in the face to face meetings using the artefacts, whenever participants were suggesting ideas and filling the artifacts, other participants could question the relevance of those ideas or ask for clarification. A deliberative session, where people present arguments pros or cons leads to the enrichment of meaning represented by each item in the artifacts. Although we might observe that these deliberation sessions occur in a manner of displaying pros, cons and reaching a consensus, there is a model behind this behavior. This model guides the deliberation session to enable stakeholders to reach an agreement, sintetize what was deliberated and take action.

The rationale behind the process, *i.e.*, the way the deliberation starts, how the arguments are exposed, the meaning of accepting or endorsing arguments from others, the way the synthesis occurs, how the action are decided, *etc.* are hard things to track in a face to face deliberation session. The definition of a deliberation model in an online environment enables to record the deliberation sessions and build a rationale upon it. This benefits problem clarification with deliberation and applify the learning in the process.

5 CONCLUSION

Online deliberation can favor the collaborative design of systems, but there is little support to enable stakeholders to discuss the design clarification phase. In this paper, we proposed a way of incorporating a deliberation model into problem clarification artifacts in an online system. Our proposal benefits deliberation throughout the steps required to stakeholders create a shared view of the involved problems and solutions in the underlying system design. Our model can lead to refined requirements because it enables meaning clarification among the participants. The proposed solution enables to report and document decisions based on informed discussions, which is hardly accomplished in online-mediated case support tools. Future work involves extensive case study conduction to measure the potential improvements in requirements elicitation.

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REFERENCES

Baranauskas, M. C. C. (2014). Social awareness in hci. *Interactions*, 21(4):66-69.

Baranauskas, M. C. C., Martins, M. C., and Valente, J. A. (2013). *Codesign de Redes Digitais: tecnologia e educação a serviço da inclusão social*. Penso Editora.

Baranauskas, M. C. C., Schimiguel, J., Simoni, C., and Medeiros, C. (2005). Guiding the process of requirements elicitation with a semiotic approach. In *11th International Conference on Human-Computer Interaction*, pages 100-111.

Buchdid, S. B., Pereira, R., and Baranauskas, M. C. C. (2014). Creating an idtv application from inside a tv company: a situated and participatory approach. In *International Conference on Informatics and Semiotics in Organisations*, pages 63-73. Springer.

da Silva, J. V., Pereira, R., Buchdid, S. B., Duarte, E. F., and Baranauskas, M. C. C. (2016). Sawd-socially aware design: an organizational semiotics-based case tool to support early design activities. In *International Conference on Informatics and Semiotics in Organisations*, pages 59-69. Springer.

de Almeida Neris, V. P., Almeida, L. D. A., de Miranda, L. C., Hayashi, E. C. S., and Baranauskas, M. C. C. (2013). Collective construction of meaning and system for an inclusive social network. *Information Systems and Modern Society: Social Change and Global Development*, page 171.

Gao, F., Zhang, T., and Franklin, T. (2013). Designing asynchronous online discussion environments: Recent progress and possible future directions. *British Journal of Educational Technology*, 44(3):469–483.

Gonçalves, F. M., Duarte, E. F., dos Reis, J. C., and Baranauskas, M. C. C. (2017). An analysis of online discussion platforms for academic deliberation support. In *International Conference on Social Computing and Social Media*, pages 91-109. Springer.

Hornung, H., Baranauskas, M. C. C., et al. (2013). Conceptual frameworks for interaction design: Analysing activity theory and organizational semiotics contributions. In *ICISO 2013-Proceedings of the 14th International Conference on Informatics and Semiotics in Organisations, IFIP WG8. 1 Working Conference*.

Jungk, R. and Müllert, N. (1987). *Future Workshops: How to create desirable futures*. Institute for Social Inventions London.

Kriplean, T., Morgan, J., Freelon, D., Borning, A., and Bennett, L. (2012). Supporting reflective public thought with considerit. In *Proceedings of the ACM 2012 conference on Computer Supported Cooperative Work*, pages 265–274. ACM.

Liu, K. (2000). *Semiotics in information systems engineering*. Cambridge University Press.

Liu, K., Sun, L., and Tan, S. (2007). Using problem articulation method to assist planning and management of complex project. In *Project Management and Risk Management in Complex Projects*, pages 3-13. Springer.

Muller, M. J., Haslwanter, J. H., and Dayton, T. (1997). Participatory practices in the software lifecycle. In *Handbook of Human-Computer Interaction (Second Edition)*, pages 255-297. Elsevier.

N., E. and Morris, C. W. (1938). Logical positivism, pragmatism and scientific empiricism. *Journal of Philosophy*, 35(5):133.

Stamper, R. (1993). A semiotic theory of information and information systems. In *Applied Semiotics. In Invited Papers for the ICL/University of Newcastle Seminar on" Information.*

Stamper, R. K. (1973). *Information in Business and Administrative Systems*. John Wiley & Sons, Inc., New York, NY, USA.

Stamper, R. K. and Backhouse, J. (1988). Measur: method for eliciting, analysing, and specifying user requirements. In *Computerized assistance during the information systems life cycle*. North Holland.

Towne, W. B. and Herbsleb, J. D. (2012). Design considerations for online deliberation systems. *Journal of Information Technology & Politics*, 9(1):97–115.