Living Spaces: A Participatory Design Process Model Drawing on the Use of Boundary Objects

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Abstract. This paper focuses on the study of individuals, collectives and organisations in the creative sector, experienced in participatory design processes, using media and technology. We want to discover how they introduce media and technology to stimulate the sometimes difficult conversation between different disciplines, but also between experts and users. We call the used media and technology 'boundary objects' and use the method of 'mapping' to represent good practices in participatory design in a spatial way. The boundary objects used in the studied cases are often hybrid in nature: different and sometimes strange 'things' are introduced at different moments in time and place, according to the needs in the conversation with user groups or across disciplines. The mapped spaces where conversations took place were as open as possible for input and own design (open space). This enables the prediction of the uses of the design after the design process, often through iterative design processes (meta- and agile design). In interaction with the observation of these real-world cases a participatory design model, using a hybrid set of boundary objects to collaborate with other disciplines and with 'users', is developed. This frames in a European and a Belgian research project *Living Spaces* (EFRO and IvOK).

Introduction

In this paper we ask the question how creative individuals, collectives and organisations stimulate conversations and collaboration between experts and users and different disciplines through using 'new' media and technologies. This is relevant because in our society, we are increasingly surrounded by new media technologies. This offers opportunities for designers to work outside their designlabs, for media researchers to engage in activities in the field, for technology developers to set up mobile projects in our daily spaces and for artistic entities to organise exhibitions outside the traditional art context. In other words, they work in situ, in locations and this implies that they have to take into account the communities, the public and private actors that live in and construct these locations in their everyday lives. Hybrid spaces are produced on a daily routine by hybrid forces (public and private, social and cultural). Therefore projects search for hybrid contact zones with the producers of these spaces. Cross-disciplinary and participatory work makes this possible.

We started to observe cases of (groups of) people with experience in 'hybrid' participatory design because we felt the need to share knowledge about high-quality research into the specific social, economic and cultural context of the planned interventions, new working methods and skills, feedback models for the users of these spaces and knowledge about ethical dimensions and implications of projects. We observed and will observe some good practices in using a hybrid set of boundary objects to negotiate with users and people from other disciplines. These good practices inspire:

- the development/design of a hybrid set of boundary objects that could negotiate participatory design processes in the future.
- the main question of this paper: What is the role (in space and time) of boundary objects in participatory design processes?

In what follows we will indicate how we have developed the idea of the design process model based on the mapping of real world situations. We will put this research into context through discussing related work and will finish with some conclusions. But first, we need to explain the system of mapping.

A method we used while observing collectives and artists is mapping. Mapping is used to visualise a process or situation in space and time. Mappings capture the real-world situations of participatory processes used in design and art practice. In this way, mapping is observing and analysing how individuals and organisations 'perform' in a participatory design process, in order to develop an idea of a hybrid model negotiating the participatory design process. Through the maps we analysed how participatory art and design projects develop, using different collaborative media. The observed cases were different in scale and in how they wanted to engage locations, other disciplines or communities in their work.

The practice of mapping itself is also a tool for collaboration, it functions as a medium between the participants to jointly map their participatory practices. We created a low-tech mapping system, an open and extendible set of icons allowing participants to make their thoughts explicit in a visual way in the form of a map situated in space and time. Whereas the semantic space created during a participatory design events is not just visual, but also linguistic, tactile and emotional, the visual aspect of the mapping is combined with a verbal notation of the conversations triggered by the icons.
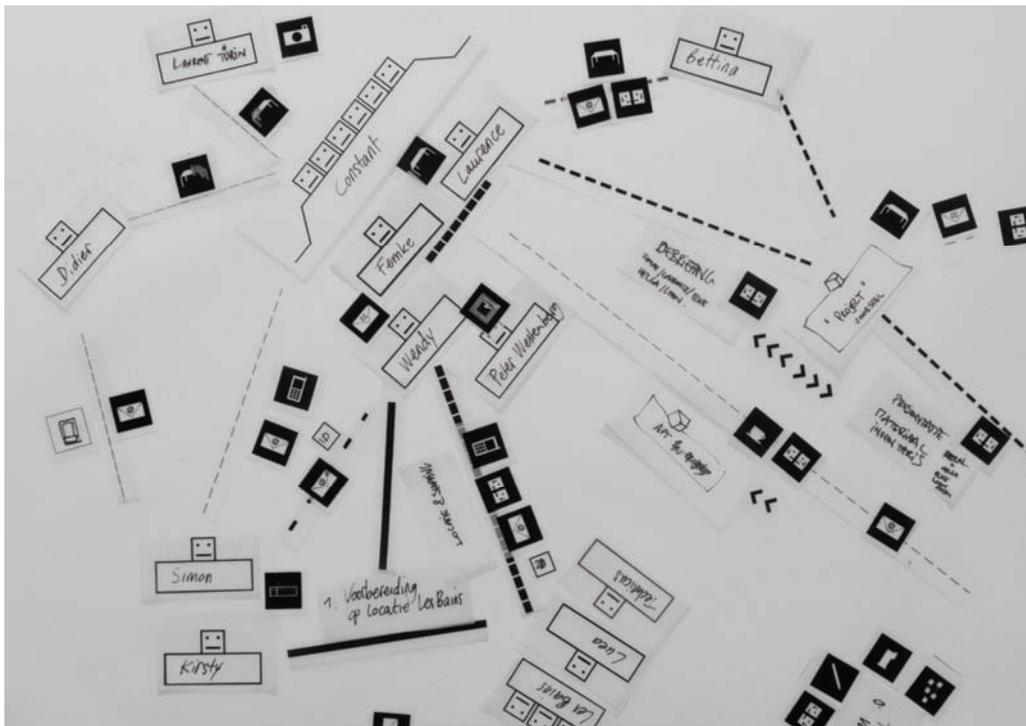
Figure 1. Enlargement of map created at Constant

The set of icons is developed as a mapping system to thoroughly analyse participatory methods used in design processes. During a mapping session, the set of icons is used to discuss the context, the people and the time and space aspects of a participatory project under scrutiny and simultaneously maps the findings of the conversations. The developed labels and icons illustrate the different elements[1]. The icon set comprises icons of people, tasks and different collaboration methods. Empty icons are also available to create new icons during discussions. In some cases, the participants draw on existing icons to specify them. In this way icons can be added and adjusted, implying that the system is never complete and open for iterative refinement. Arrows and lines are also part of the mapping system; arrows generate flow and lines indicate packages of information exchange. For instance thick lines pointing out intense non-stop

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1   Visit www.interface-our-space.be/projects/participatory-mappings to view the mapping system.

collaboration and dotted lines to illustrate collaboration on a regular base. The icons are situated on tracing paper and are jointly repositioned and re-arranged. After each phase, a new sheet of tracing paper is added on top of the previous one, which will allow for analysis of the evolution of the project in time. The icons are attached to the tracing paper with removable/repositionable glue, this connotes that a mapping is never fixed and can be modified afterward if necessary.

For example, if during a conversation about the first phase of concept development is mentioned that person X emailed five times a week with person Y, two icons of persons are placed on the tracing paper (tagged with 'phase: concept development') with their names written on the icon, a dotted line is situated between the two person icons and an email-icon and two arrows are positioned next to the dotted line to indicate two-way emailing. Another example: if during the preparation phase person A sets up a financial plan about the project with person B and C, which was a very intense period of communicating over email, Skype conferences, and collaborating on a shared document like Google Doc, the following icons are placed on the tracing paper (tagged with 'phase: preparation'): a task icon with financial plan written on it, three person icons with their names, thick lines placed in a triangle between the three persons, next to the lines a Skype icon, email icon, cc-email icon and a shared document icon (view figure 1).

Conclusions drawn from the mapping will be described later. First, we will briefly describe creative collectives, organisations and artists we cooperated with.

- FoAM is an art and design collective that is reflective in character. Their projects take the form of gatherings of users, researchers, artists, ICT experts and designers in open spaces to collaborate around the theme media and ecology.
- The art collective Constant cooperates directly with communities in their daily spaces. The cross-disciplinary group develops projects to engage users to be more critical of their everyday technological environment or to stimulate the exchange in the community around certain topics.
- Frederik De Wilde is an individual media artist who collaborates with different collectives (like OKNO or Lab[au]) to develop one project in different phases. His projects do not work directly with communities in locations, but try to engage users via interactive interfaces.
- The last case is a mapping of Z33 in collaboration with Thomas Lommée. Z33 is an art centre which organises design and art projects. We mapped how they develop participatory projects with artists and designers in concrete projects. At the moment they work towards a project with designer Thomas Lommée. He develops an idea of open source architecture and will work with a local community to assemble a project.

All of the observed projects are artistic in character, but could at the same time inspire innovative designs of media, business, technology and applications. The media these artists, designers and collectives use or create to communicate with disciplines and with users are inspirational examples for the development of a model of hybrid set of boundary objects. This model has the goal to mediate the conversations in future participatory projects, in cross-disciplinary teams and with users. It is perceived as a possible answer.

Related Work

Participatory design projects do not only have a participatory output (like the work of Frederik De Wilde), they have also been developed in a participatory way. Participatory design has many variations, uses different techniques and methods of which we will not be able to provide a full overview, but we will select some insights in relation to our Living Spaces[2] project.

Participatory design is usually defined as a design process that includes end-users as full participants in activities leading to software and hardware computer products and computer-based activities (Greenbaum & Kyng, 1991; Muller & Kuhn, 1993). It is related to a series of methods like design games or performance. These participatory methods are very useful when media and technology are used to strengthen the relation between people and with specific places, online or in the physical environment. One variation of participatory design - collective design –describes the engagement a hybrid set of partners in a design process. Pelle Ehn writes about...

> (...) communities-of-practice where the situated practices are carried out in a direction towards legitimate participation and access to the communal artifacts. Such collective design communities can e.g. be communities-of-practice of professional designers, overlapping communities-of-practice between users and designers, or communities of stakeholders including not only designers and users, but also interpreters, jurors and legislators. Especially we think of collective design in terms of 'understanding others understanding' (as suggested by Krippendorff) or as "being in service" (as suggested Nelson and Stolterman) (Ehn, 2002).

This cross-over between designers, users and stakeholders creates hybrid communities of interest that co-create or produce design together. The interaction with other systems – political, social, ecological and economic – is one central aspect in this definition. Victor Papanek (1985) called this holistic approach 'social design'. Nowadays, the Design Council (UK, project RED) calls it 'transformation design' (Design Council, 2007). Both approaches champion a holistic design process, meaning that design is seen as a 'complete' happening that

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2   ' Living Spaces' is a research project funded by EFRO and IvOK. Since November 2008 art centre Z33 (Hasselt, BE), Expertise centre for Digital Media (Diepenbeek, BE) and Media & Design Academy (Genk, BE) are involved. For more information visit www.interface-our-space.be.

goes beyond visuality, functionality or pleasure. The inclusion of users in the process – a second aspect in the definition – is stressed in the 'inclusive design' approach of the Helen Hamlyn Research Centre (RCA). In other words, they and the target group design an action together and this is an impulse for certain target groups, such as the elderly, to take their lives into their own hands (www.hhrc.rca.ac.uk).

Michael Muller (2002) published a interesting reflection on how participatory design methods can respond to the hybridity of the boundary zone (or third space) between software developers and end-users in HCI. We would like to stress that this boundary zone is – certainly in the observed cases – even more hybrid then described by Muller, since next to end-users and software developers, visual designers, artists, private and public partners could play an important role in the field of HCI. His work pointed out that using the concept of hybridity in participatory design can lead to more effective collaboration processes. To evaluate if a specific method answered to the hybridity of the boundary zone, the author observed it in relation to the issues of *"novelty, ambiguity, and renewed awareness of possibilities, occurring at the margins of existing fields or disciplines"*. He concluded that...

> Hybridity is thus at the heart of PD, fostering the critical discussions and reflections necessary to challenge assumptions and to create new knowledge, working practices, and technologies. When we consider HCI as a set of disciplines that lie between the space of work and the space of software development, we see that the hybrid third spaces developed within PD have much to offer HCI in general" (Muller, 2002, p. 24).

The 'experience design' approach of the Media & Design Academy (Belgium, Genk) is – like inclusive or social design – also aimed at the holistic design of actions. It explicitly starts from peoples' experience of their altered environment and therefore tries to design together with the users. This approach places emphasis on giving form to experiences, using hybridity, alienation and experimentation with new technologies as the driving force for change (Jansen, Schoffelen & Huybrechts, 2008). Next to including users, the approach interweaves design with other disciplines such as the arts and ICT. Experience design is used to generate meaning in a critical way (Shedroff, 2006). This can be achieved by approaching the known as alien, since that is where creativity lurks. This is a technique that is also used in anthropology and other scientific disciplines (Papanek, 1985). Conversely, designers also learn to think out of the box by approaching things or people that are alien to them as if they were everyday affairs. Papanek (1985) considers that such techniques can enable designers to open doors that have not been opened, since they develop an affinity for the alien. This can lead to possible answers that become permanently interwoven with society.

All of the described approaches use participatory and/or holistic models. Specific for the experience design approach is that the arts play a crucial role as a driving force in this field, because it stimulates a different view on the collaboration and that it is a concept that embraces hybridity, alienation and conflict as a driver for change.

Real World Cases

We will discuss the real-world cases - mentioned in the mapping paragraph - in relation to the concepts of boundary objects, open space and agile- and metadesign, which all inspire the design of a participatory design model.

Boundary Object

An important precondition towards participatory design is communication. Indeed, people need to understand each other and need to be willing to exchange thoughts. As is clear from the study of communication in fields like semiotics, having people understand each other is not trivial and can benefit from a structured approach. To participatory design communication for knowledge sharing, this can be an important driver to the design activity. Boundary objects are then introduced to share insights that are particular to the various participants, but also to make the conflicts visible that exist between the knowledge from different disciplines, since in this confrontation innovation lurks.

In order to allow knowledge sharing between people, we adopt the approach of 'perspective taking' (Boland & Tenkasi, 1994). Perspective taking denotes a process that allows the capturing of a relevant part of the knowledge domain (a perspective) by people who are not familiar with it. In order to allow perspective taking, perspective making is necessary, pointing to a process during which the knowledge domain of the community is made explicit. Perspective making is in itself useful to the holder of the knowledge, as it structures his knowledge domain and possibly reveals assumptions. The critical study of these assumptions can trigger double-loop learning (Argyris & Schön, 1978), during which previous assumptions are challenged and revised.

Boundary objects can be understood as the outputs of the perspective making process. The concept was originally introduced by Star and Griesemer (1989) to refer to objects that serve as an interface between different communities. A boundary object stimulates the communication between disciplines, users and professionals. According to Star and Griesemer (1989), a boundary object is an entity shared by several different communities but viewed or used differently by each of them. Boundary objects can take many different shapes (e.g., text documents, cognitive maps, spreadsheets, etc.). In general, Star (1989) discusses three characteristics of an effective boundary object: (1) it establishes a shared language for individuals to represent their knowledge, (2) it provides a means for

individuals to specify and learn about their differences and similarities across a given semantic boundary, and (3) it facilitates a process where individuals can collaboratively transform their knowledge.

In design processes these boundary objects can be introduced to make people playing various roles and work together. Boundary objects – in the definition of Star – are not only introduced to establish a shared language, but also provide a means for individuals to specify and learn about their differences. We learn from our case studies, that conflict, difference and alienation are key elements to design for change. Boundary objects should not only transgress differences, but also shift the view of every participant from the everyday to the strange, and the strange to the everyday (Papanek, 1985). To make some invisible aspects in the collaboration project visible, designers like to introduce boundary objects like strange objects in a conversation: objects that create friction and controversy. This added value of friction and controversy is introduced in theories like 'design for social friction' (Jensen & Lenskjold, 2004), the 'dramaturgy of the interface' (Zielinski, 2006) and 'design noir' (Dunne & Raby, 2001).

In line with Star and Griesemer's description, the individual icons and the maps they form could be considered as a boundary object. It is even better to state that the icons and the maps are boundary objects 'in development', because the icons and the maps are open for iterative refinement. They will constantly be adjusted to eventually become a hybrid set of boundary objects, an inspiring and stimulating set for the mediation of participatory processes.

In one case Peter Westenberg (member of Constant collective) tried to question how public technological networks are in the city and how they are used to control or restrict us. Westenberg organised a number of 'network walks' through the city of Hasselt. The company I-City Hasselt, one of the organisers of the wireless networks in the city, the inhabitants of the city, the artists and the more regular visitors of the art centre Z33 could explore the networked space with a pair of 'intelligent' shoes, equipped with simple cameras, microphones and metal detectors to detect/discern technological networks in a number of ways. Also they could use inexpensive consumers electronics such as a receiver to hack into the intelligent and seemingly impenetrable surveillance camera system of a shop. With this receiver, the walker can receive images, but also bring his/her images into the system. These shoes and receivers could be regarded as boundary objects, because they make the conversation about the public character of the internet (a difficult and abstract subject) between public, artists and ICT experts/owners possible. The work of Westenberg actively seeks out the mentioned 'friction'. The people who walked together with Peter became engaged in the problematic of privatised internet space and played – together with the artist – creatively with the given tools. Although temporary, the artists, the company members, visitors of Z33 and the inhabitants of the city made their networked space together.

This artistic case uses a hybrid set of boundary objects in a participatory design process. This event took place in a few phases. More phases with different partners could have lead to a design proposal for a city network, designed in a more participatory way. We conclude from this and other cases that participatory projects need different work packages to become a sustainable process.

Figure 2 proposes the creation of a hybrid set of boundary objects with a hybrid set of partners in different work packages (events). At each event, the participants are able to physically engage in modifying existing boundary objects and creating new ones.
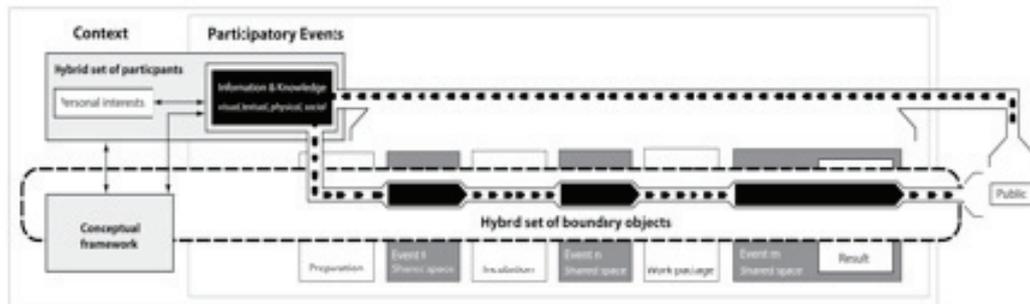
Figure 2. Participatory design model

We revealed this need for hybridity in objects and partners by mapping real world cases. We make the use of boundary objects in different phases of the cases visually explicit through our own 'low-tech' mapping system. The information and knowledge held by the different participants is a vital input of the boundary object creation, but is also altered by the boundary object manipulation (i.e. in the case of the mapping, adding new icons to the existing icon set). This produces a constructivist learning process during which perspective making within a work package takes place, but can also stimulate perspective taking between work packages. Note that the arrows flowing from the information and knowledge box are placed before the first meeting, to indicate that the participants should have a way to gather and package their information and knowledge in a way that is ready to be used during the first design meeting. In this way, participants are given 'home work' which, if performed, will make the initial open space meeting and the subsequent meetings more efficient.

Open Space

From the cases we studied we saw a lot of projects emerge from an open space. For FoAM this is a key way of working, Constant also starts from open meetings, workshops, walks, etc. to generate ideas with the communities they make projects for. The Open Space Methodology (Owen, 1985) is a self-organising process where equal participants create and manage their own agenda through parallel

working sessions. In open space meetings the topics of conversation are not pre-arranged, as is the case in other types of meetings. Instead, the topics of conversation are allowed to emerge by consensus from the meeting's participants. After a number of conversational topics have been set, a space is defined in the venue for discussing each topic. Participants are allowed to move about freely between different spaces.

An example: FoAM organises an open space meeting in Singapore to enrich the public debate around environmental sustainability, ethical living and eco technology to create a more luminous green world. They invite participants from various disciplines that do not meet that often, such as artists, designers, academics, activists, social entrepreneurs, economists and policy-makers. FoAM started with asking all the participants to email ideas, texts, drawings,... The sent material was not actually used in the workshop, because the participants could not use a laptop. In the open space meeting people had to propose topics for the meeting and choose a table, related to a topic. One of the topics raised, for example, was the sustainability of flying all the international participants to Singapore. Overall, the workshop was a rich discussion that generated a lot of ideas in the form of maps, drawings, texts and soundfiles. After the workshop some of the participants proposed to produce texts about the workshop.

We find the open space paradigm to correspond well to the problem of participatory design. It is especially in the early stages of design, where the problem is often still ill defined, that the grassroots approach of the open spaces method can be useful. Leveraging the wisdom of the crowd attending the participatory design meeting and channeling the creative energy through a structured process can result in a better understanding of the design problem at hand. One of the advantages is that it allows people without previous acquaintance to collaborate in a semi-structured way. However, communication between strangers can be hard and people from different disciplines use different ways to communicate (e.g. in a verbal or visual way). In the FoAM workshop a set of boundary objects was used to answer to these communication issues. People were emailing information, people used tables, people were making maps and people were processing maps afterwards.

Since tables were often used in the observed cases to gather different disciplines, users and experts around certain topics, we started to think about the concept of the table. A lot of information is lost on the way because the 'physical' maps on the 'wooden' tables are not produced in a digital way. Our observations[3] also showed that when the information and knowledge flow is mostly verbal. During face-to-face workshops, the use of a digital table could be a solution. It would not only keep traces of the information and knowledge exchanges, but would allow a richer communication, facilitating equal participants to work and

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3 ' Luminous Green' by FoAM, ISEA2008 in Singapore (Huybrechts, 2008) and 'Space Cowboys' by Z33 & MDA (KHLim) in Hasselt (Belgium).

discuss on both a verbal level as well as a visual one, enriching the communicative possibilities. In addition, working around a table and seeing each other face-to-face is conductive to the establishment of trust which is fundamental to the establishment of prolonged collaboration. The different profiles, backgrounds and expertise participating in the workshop do not necessarily share the same 'language'. Adding a visual layer, that is open and adjustable to all participants, creates a different dialogue and enables everyone to join the conversation. Furthermore, conducting collaborative acts around a table is a very familiar situation and we therefore believe it to be a good mediator for a creativity support environment. As explained by Roy Ascott (p.173):

> "Within the table-top, a horizontal creative arena, we can fully engage in analogue modelling, speculative restructuring of systems, contemplation of the rich interconnections of events and the infinite pathways between bonded meanings. Table-top behavior enables us to invent and rehearse alternatives, to exploit the fecund ambiguity of new relationships and the dynamic uncertainty of movements of meanings."

More specifically, the table will be used to create boundary objects in a collaborative way. One cannot predict the shape of a boundary object after it has been created and one should not restrict the semantic space in which the boundary object is to be constructed.

Furthermore, we concluded that the observed art and design collectives work on an international basis, with an international public and cannot always meet physically in a face-to-face situation. Therefore we decided to search for a way that face-to-face open space meetings can be continued online afterwards.

The digital table could be a hub to trigger conversation in face-to-face meetings and facilitate creative and cross-disciplinary participatory processes. Since these processes are often stretched over large periods of time and happen in different spaces, a mediating hybrid system could allow for multiple access points and a circulating information and knowledge flow across the participatory design process. The system under development could strive for online social media spaces to integrate with physical places. It could be web-based in the sense that participants should be able to manipulate the boundary objects online in the periods between design events, yet during the events, there should be a physical co-design mode.

In our design model under development (figure 2), the open space method will be used as a first way to engage in participatory design. In order to facilitate the first *n meeting*s in the design process, the web-based part of the hybrid set of boundary objects will allow people to contribute information at forehand.

In figure 2 the open space method is applicable to event 0 and remains applicable to subsequent events until an actionable work package structure is achieved. It is not necessarily the case that consensus on an actual work package decomposition is achieved during the first meeting. The number of events needed

to achieve closure in terms of work packages is expected to depend on the complexity of the design problem, the quality of the synergy between the event participants, how well the problem has been defined and the effectiveness of the boundary objects used during the events.

Agile & Meta-Design

The introduced participatory design model can be described as meta-design (designing a designprocess). "Meta-design is a conceptual framework defining and creating social and technical infrastructures in which new forms of collaborative design can take place" (Fischer & Giaccardi, 2004). Meta- design includes an iterative design process, related to agile methods found in software design and project management. With agile methods, meta- design shares that "it is grounded in the basic assumption that future uses and problems cannot be completely anticipated at design time, when a system is developed" (Fischer & Giaccardi, 2004).

Agile methods have emerged from the field of software development to counter the waterfall model of "requirements, design, implementation" which had proved useful, but also has some inherent flaws (Larman & Basili, 2003). Especially complex development projects, in which design questions are often ill defined, make it hard to look ahead. When the design process only holds a single requirements and design phase and the project has a long life span, the waterfall model can result in an output that is not adequate to the needs of the audience for whom the design process has been undertaken. When designing socio-technical systems, for example, the co-evolution between the social and technical parts of the system is continuous, constantly re-defining the socio- technical gap. It has therefore been argued (Schwaber, 2003) that an iterative approach to design and implementation is preferable to the one-pass waterfall model.

Agile development manifests itself in the iterative way of working, but also in the fact that people are very important. In an agile approach, the requirements and the design are re-evaluated iteratively. This can be done by people performing the different roles that are – according to literature and observation – necessary in the whole design process. A general trait shared in all participatory design projects is the presence of designers and prospective users. However, due to the hybrid nature of design processes, the design approach should not be restricted to these two essential roles. Indeed, design processes occur in a hybrid context and should therefore include knowledge input from other relevant societal areas. In doing this, insights can be obtained on more peripheral topics like the economic, political or juridical aspects of the design problem. An open space meeting aiming to support a participatory design process could therefore have the following roles: prospective users, designers and context advisers. The definition of the roles played by the different participants is to be done during the open

space meetings, knowing that one person can play multiple roles. We believe the above three roles present a good starting set of roles in an open space participatory design meeting, but do not want to limit the nature and the number of roles that are available. Indeed, a design event for a particular design problem may very well require new roles to be defined.

To explore the iterative interaction between the different roles participating in the design process mediated by boundary objects, we introduce the concept of "informance" (Laurel, 2003). Informance is a fusion of 'information' and 'performance'. Design researchers start out from people in real-world situations and interpret that information by means of empathy. Therefore designers can perform in order to perceive the world as the people they are studying. Thus, design research is based partly on empirical facts, but also uses the imagination, since the people for whom we are designing frequently cannot fully express their needs in words (Huybrechts & Jansen, 2007). In observing and trying out how people 'perform' in a situation where a boundary object is introduced and changing roles between designers, users and software developers for example, researchers and users can adapt a set of boundary objects together to improve its role of stimulating collaboration and communication between hybrid partners in an iterative way.

In figure 2 the agile nature of the design process is reflected in the various events taking place and in the hybrid set of participants. As was discussed above, the first n meetings are organised as open spaces, until a stable work package structure is formulated. Between each open space meeting is a period of incubation during which participants can alter boundary objects using a web-based interface. Additionally, the knowledge and information shared during the initial event is processed and reflected on, and new ideas are generated. Having the boundary object that was used during a previous event at hand (e.g. using a web-based interface) can be useful to call to mind connections and topics raised during the previous event. After this initial open space stage, n meetings take place that are organised using a more ad hoc methodology and in which the various participants engage in the creative boundary object. Through informance the designers/researchers can observe and experience through role-playing how the object mediates the interactions and how they can make improvements.

Evaluation and Conclusion

The mappings capture the real-world situations of participatory processes used in design and art practice. In this way, mapping is observing and analysing how individuals and organisations 'perform' in a participatory design process, in order to develop an proposal for a set of boundary objects. In a later developmental phase, the hybrid set of objects will be introduced in their daily work routines.

Subsequently, observing their 'performances' we can observe how the set of hybrid boundary objects mediates the participants' interaction. The conclusions drawn from these observations will in turn lead to the iterative adaptation and improvement of the boundary objects' functions.

Since the used mapping method is recently developed, we will describe some essential remarks based on the four cases:

- The participatory manner of the mapping and the physical act of gathering around a table and jointly placing and positioning icons while discussing how a project evolved, has several advantages. By naming tasks, phases and participants and identifying them with icons, the collaborative and participatory processes become visible and tangible. This makes the discussion and mapping more accessible and makes participants sharing their thoughts and opinions easier. The table set-up goes along with body language and tone and exposes more information about the relationships and emotions between participants in the project organisation.

- The method of mapping only works when it is properly facilitated, with someone leading and provoking questions, especially in the beginning. Through the mapping process the participants become comfortable with the mapping system and realise the value of the mapping and their active participation. The interaction between the participants changes too. In the second half of the mapping sessions the interaction between the participants changes. The participants showed more comfort and were eager to have an opportunity to share their experiences of a project they were heavily involved in.

- The mapping workshops often shifted towards a debriefing of the organisation of a project. The debriefing is mostly skipped because organisations want to work on new projects and is often lacking structure and a critical view. This mapping method gives the chance to add structure to allocate time and put participants in a situation where critical reflection is possible. In this debriefing of their work they were not only sharing positive experiences, also grievances and disagreements during the project. These negative comments could have potentially positive implications for future projects, by redefining roles, opening up communication and learning from past mistakes.

- The interaction between the participants and the resulting maps were still too biased by 'social desirability'. By introducing more 'strange objects' in the conversation – as mentioned when we talked about the role of friction in collaborations – we could improve the mapping system. This will be researched further.

- The analysed projects are all collaborative in nature. A lot of collaborative work still involves individual working periods whereas many details are not shown.

We have focused on the role of boundary objects in participatory design processes. In order to do so, we have discussed participatory design models, the role of boundary objects, open spaces and agile development in relation to four observed cases. Hybridity, friction, role-playing, iterative design and possibilities to process information between work packages played a central role. To put these observations into practice, we are designing our own hybrid set boundary objects. In the upcoming period of the research project, we aim to build, test and refine it (in an iterative way) in the observed real world cases.

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