

DYNAMICS IN A INNOVATION BOUNDARY CONTEXT: EXPLORING AN LIVING LAB PROCESS FROM A COMMUNITY OF PRACTICE PERSPECTIVE

Abstract

This paper is based on a living lab process, which is an open, user-centric, innovation approach, where several actors from industry, user groups and academia are involved. The research question is: How can a boundary context, such as a living lab process, be understood and facilitated from a community of practice perspective? We aim to describe and analyze the dynamics in an innovation boundary context based on a living lab process. An action-oriented research approach was applied and the empirical results are from The Find Project (TFP), with the aim of customizing an ICT product based on the needs of a user group. The findings are analyzed from a community of practice perspective where the three different communities i) researchers from Halmstad Living Lab (HLL), ii) ICT developers (ICTD), and iii) next of kin's to demented elderly persons (NOKD) represented the unit of analysis. The analysis indicates several boundary situations that played a vital role for the innovation process. The contribution of our research to innovation theory is a process model describing the dynamics in an innovation boundary context with regard to boundary objects-in-use as well as brokering. The process highlights two different levels of brokering: i) inner-level brokering; and ii) outer-level brokering.

Keyword

Innovation, learning, boundary context, brokering situations, communities of practice

Authors

Johansson, Lars-Olof, Halmstad University, Box 823, 301 18 Halmstad, Sweden, lars-olof.johansson@hh.se

Lundh Snis, Ulrika, University West, 461 86 Trollhättan, Sweden, ulrika.snis@hv.se

1 INTRODUCTION

The research interest in this paper lays on innovation and learning and the intertwining of these during an innovation process. Generally, innovation activities could be understood as all scientific, technological, organizational, financial and commercial steps which actually lead to, or are intended to, the implementation of innovations (OECD 2005). The last ten years researchers has focused on other innovation approaches than the one performed within one particular firm or within one specific R&D department. Open innovation (Chesbrough 2006), user driven innovation (Hippel 2005) and living lab (Eriksson, Niitamo et al. 2005) are all examples where co-creation between a multiplicity of actors and stakeholders are in focus during an innovation process. Furthermore, innovation and structural change are often alleged to result from information brought into the organization by external representatives (Ancona and Caldwell 1992). This leads to an interesting challenge of crossing sectors of such kind and to understand different forms of interaction taking place at the interface between different groups of stakeholders across those sectors. One way to approach this intertwining of innovation and learning is the understanding of boundaries and the bridging of boundaries. While such a multiplicity of boundaries increases there is a need to develop approaches for integrating and leveraging boundary spanning activities within and across such organizations.

In this paper we apply a community of practice perspective on a living lab process, which is a user-centric innovation process, where several actors from industry, user groups and academia are involved. We will present findings from an ICT innovation process where an organization (the ICT developers) collaborate with a user group consisting of people not belonging to an organization, but driven by an interest: caretaking of a demented person (such as wife, husband, father or mother), and researchers from Halmstad Living Lab. From a community of practice perspective, we can understand how different community groups engage in a heterogeneous interaction where a mix of different world views is to be handled (Aldrich and Herker 1977). We pay particular attention to boundaries, boundary objects and brokers as we take the existence of boundaries as given in the situations in a boundary context of a living lab.

The research question in the paper is: How can a boundary context, such as a living lab process, be understood and facilitated from a community of practice perspective? The empirical findings result from a project called The Find Project (TFP). The aim of the TFP was to customize an ICT product based on the needs of a user group. The ICT product that should be customized consisted of a sender and a receiver that worked together in a mission to find missing objects. There were about fifteen people involved in TFP: three researchers from Halmstad Living Lab (HLL); three ICT developers (ICTD) and the group of eight next of kin's to demented elderly persons (NOKD).

The contribution of our research to innovation theory is a process model describing several implications for how dynamics in an innovation boundary context (such as a living lab process) can be understood as well as facilitated by different support mechanisms. From our findings we have found that the role of boundary context as well as boundary objects and brokering on two different levels are important for facilitating interaction and learning in a living lab process.

2 LIVING LAB - AN INNOVATION BOUNDARY CONTEXT

This section will start with an overview of the living lab approach as an example of a user-centric innovation approach where participants from communities meet and take

part in *brokering situations in a boundary context*. The rest of the section will be structured from concepts related to *brokering situations in a boundary context*. Among the concepts that we will take a closer look on is: boundary spanning (Cohen and Levinthal 1990); boundary relation (Wenger 1999); brokering situations (Wenger 1999); boundary objects (Star 1990) and related concepts such as boundary spanning-in-practice and boundary-objects-in-use (Levina and Vaast 2005).

2.1 Multi-contextuality in Living Lab

The innovation process in TFP was inspired by user-centric innovation and the living lab approach (Eriksson, Niitamo et al. 2005). One of the main motives behind the approach is that during the TFP process we wanted the NOKD to be active in the process not only as a reference group but more as co-producers. One of the underlying ideas in the Living Lab approach is that people's ideas, experiences and their daily needs of support from products, services, or applications, should be the starting point in innovation (Bergvall-Kåreborn, Holst et al. 2009). In the TFP we started with a product with an intention to customize it according to criteria's from the NOKD. This approach is also in line with the living lab approach, (Eriksson, Niitamo et al. 2005) argues that there is no standard user, which leads to a focus on customization.

The living lab approach also relates to co-creation in collaborative, multi-contextual real-world settings (Bergvall-Kåreborn, Holst et al. 2009) which has similarities with the context of the TFP process. During the last years five key principles has emerged for the living lab approach (Ståhlbröst 2008):

- Continuity: Cross-boundary collaboration that builds on trust.
- Openness: As many perspectives as possible in the innovation process.
- Realism: Involvement of real users, co-creators, in real-life situations.
- Empowerment of users: The innovation process should be based on human needs and desires.
- Spontaneity: The ability to detect, aggregate, and analyse spontaneous users' reactions and ideas over time.

The main reason why we refer the TFP to an innovation process with a living lab approach is that the activities in the process is intended to improve a product with regards to the needs of a new customer group which will change the everyday practice of that group (OECD 2005) and relates to the key principles of living labs. In the presented research the customer group is the next of kin's to demented elderly persons (NOKD), will be regarded as one particular community of practice in the research. The source of innovation lies on the interface between an organization and its environment (Hislop 2004). In a Living Lab process, based on the five key principles, the innovation process takes place in a more social context, where relations and connections of several people and activities crosses various types of boundaries in a multi-contextual environment.

2.2 A communities of practice perspective

A community of practice (COP) is a group of people that share a concern (or a set of problems) and deepens their knowledge by interacting on an ongoing basis (Wenger, McDermott et al. 2002). Learning is described as an ability to negotiate new meanings within a COP, to create engagement in COP and to deal with boundaries between COP's (Wenger 1999), an inter-community learning process (Hislop 2004). Learning and working are interrelated, compatible, intertwined and connected to innovating

(Brown and Duguid 1991). The inter-community process is important (Cook and Brown 1999) because it helps to overcome some of the problems the community may create for itself (Brown and Duguid 1991).

Some critics about the inter-community process has been raised: the dynamics of inter-community knowledge sharing processes has been neglected in much COP-literature (Hislop 2004) and that COP is limited in addressing the power dynamics in the inter-community process (Levina and Vaast 2005). Hislop (2004) states that the dynamics of knowledge sharing within and between COPs are likely to be qualitatively different, the sharing of knowledge between communities being typically more complex and more difficult. However, Boland & Tenkasi (1995) argue that the beauty with COPs is that they are not limited to specific contexts and organizations but transcend boundaries. In order to understand this complex inter-community process of learning they develop the concepts of perspective making and perspective taking (Boland and Tenkasi 1995). Perspective making represent the first step, in which knowledge creation is built and rebuilt for shared understanding and communication within a community of practice (Boland and Tenkasi 1995).

2.3 Innovation and boundaries

Boundary spanning activities are activities that gather information at the interface of the firm's external environment and translate and communicate that information to managers and employees internal to the firm (Cohen and Levinthal 1990). It is connected to the organizational level where certain boundary activities are integrated and performed as boundary spanning. In similar ways, Yoo, Lyytinen et al (2008) discusses an innovation process from complementary social translation, which is identified as combining two previously unconnected communities (Yoo, Lyytinen et al. 2008). There are other attempts to use the theory of brokering and boundary objects in innovation settings (Hislop 2004; Lundkvist 2004; Manville 2004) but they all discusses the lack of dealing with the dynamics. Furthermore, literature, within in the work practice research, recognizes boundary spanning as essential to learning. Innovation is closely related to boundary spanning and learning is related to boundary relations of various kind. Therefore it becomes natural to explore an innovation process from a community of practice perspective (Lave and Wenger 1991).

According to Levina and Vaast (2005) boundary spanning could be described as a sharing of expertise between boundaries. They describe a kind of role of a change agent, boundary spanners-in-practice, who produce and uses artefacts, boundary objects-in-use. During such boundary spanning the boundary spanner uses several artefacts such as scenarios, physical prototypes, design drawings and other types of documents in order to communicate and collaborate organisationally. Similarly, Bolan and Tenkasi (1995) say that in order to have an inter-community interaction different forms of objects (boundary objects) or subjects (brokers) are needed. These can serve the boundary spanners when to support meaning creation and bringing in new perspectives in a brokering processes, between communities of practice. Thus, boundary relations is described as a duality: i) boundary objects; and ii) brokering (activities and situations).

Boundary objects, serve to coordinate and communicate perspectives for some purpose (Star 1990). Boundary objects play an extremely important roles as shortcut to communication, as well as playgrounds for knowledge sharing among different communities of practice (Brown and Duguid 1991; Cook and Brown 1999). Brokering is the second part of the duality, made by people who introduce elements of practices from one COP into another COP (Wenger 1999). Boundary objects can be used by a broker in a brokering situation. In (Levina and Vaast 2005) the community of practice

perspective is disregarded due to limitations in addressing power dynamics. Levina and Vaast (2005) and Lindgren, Andersson et al (2008) address boundary objects from boundary spanning, but not from communities of practice perspective. Within communities of practice boundary bridging is described as boundary relation which consist of two intertwined parts: boundary objects (artefacts) and brokering (activities and situations) (Wenger 1999; Wenger, Mcdermott et al. 2002)

Based on the above concepts of living lab, communities of practice, innovation and boundaries we consider a boundary context as a multi-faceted arena, or place, where several co-existing actors or communities of practices play out their organisation and interaction for a common goal, for instance such as a living lab project. We integrate the set of facts and physical conditions or circumstances that surround a situation, which might help to determine interpretation of a given interaction. The *brokering situations in a boundary context* is described as the intertwining of: boundary spanning-in-practice (Levina and Vaast 2005) and, brokering (Wenger 1999) inspired by perspective making and perspective taking and the use of boundary objects (Star 1990).

3 RESEARCH APPROACH

The living lab approach is not only an example of a user-centric innovation approach but also have similarities to a specific research approach. Our underlying methodology was in accordance with an action oriented research. In action oriented research, there is always a balancing between involving in the change process (the problem solving) and the research process (McKay and Marshall 2001) which is further inspired from the clinical perspective (Schein 1987; Schein 1995). Herein, Schein argues that the process should be client driven, i.e. the needs of the client is more important than the needs of the researcher. So, the focus should be on client's issues rather than involving the client in the researcher's issues.

3.1 Data gathering - the TFP innovation process

The TFP innovation process was initiated at a meeting between the ICTD and representatives from HLL. At the meeting the ICTD demonstrated their product and they also raised some doubts about their product. They were uncertain if their product corresponds to the needs of the next of kin's to demented elderly persons. The main idea in TFP was to learn more about the needs of the kin's in order to customize (in this paper customization is interpreted as significant improvements to an existing product) the ICT product based on the needs.

The ICT product that should be customized consisted of a sender (Grey in Fig 1) and a receiver (white in Fig 1) that worked together in a mission to find missing objects (in the TFP a missing person) according the ICT developers (ICTD). When the ICTD developed their product they had a broad perspective on a missing object, it could be almost anything: a stolen car, a missing container of goods or a demented person.

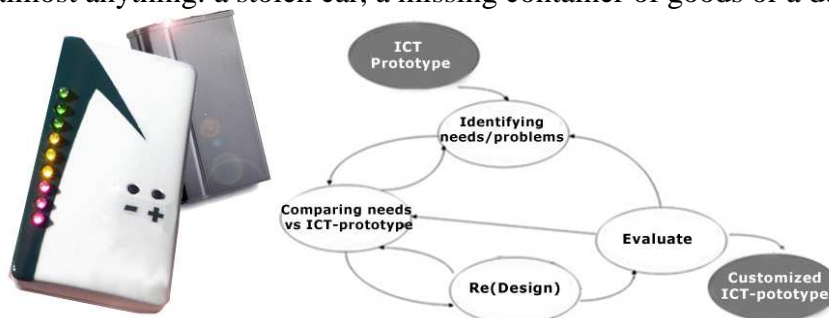


Figure 1: Left: Sender and receiver, Right: The TFP process

In the TFP, the workshops were held in an apartment that has been a meeting place for next of kin's to demented and also demented people. The apartment is an example of real-life context which is addressed in the Living Lab key principle realism. The TFP innovation process (Fig 1) was inspired by principles from user-centred design (Preece, Rogers et al. 2002) and user-centric innovation (Svensson and Eriksson 2009).

The first phase in TFP, *Identifying needs and problems* (Fig 1), consisted of three main activities: planning; workshop and a follow up meeting. The workshop consisted of presentations, demonstration of the ICT product, creating scenarios in groups and follow up discussions. The main reason behind the scenario inspired technique was to get a rich description of the life-situation and caretaking among the NOKD.

The second phase in TFP, *comparing needs vs ICT prototype* (Fig 1), followed the same structure as the first phase. At the planning meeting a comparison between the needs of the next of kin's, presented in mind map (Buzan 1995), and the ICT product was done which resulted in a list of statements and questions where it seemed to be a difference between the functionality and design of the ICT product and the actual needs of the next of kin's. When the list of statements and questions was adjusted and approved by the next of kin's we started the second part of the workshop, individually prioritize the most important statements and question on the list

The third phase in TFP, *(Re)Design* (Fig 1), followed the same structure as the first two phases. The workshop started with a presentation of the design activity, followed by the actual group-work and ended with a presentation of the group prototypes.

3.2 Data analysis

Analysis of the empirical data from the TFP was made in a continuous manner during the process and also after the innovation process. During the analysis we deepened our insights and concepts of brokering situations and communities of practices were used. Thus, we regard the different stakeholders (NOKD, ICTD and HLL) as three different communities of practice (Wenger 1999; Wenger, Mcdermott et al. 2002). NOKD's practice is caretaking, ICTD's practice is development of ICT products and HLL's practice is research. From the findings we identified situations that affected the innovation process in a greater extent in terms of brokering situations and its consequences for further actions and learning in the project. A process model was developed, in order to conceptualize the various forms of interactions.

4 BROKERING SITUATIONS IN A BOUNDARY CONTEXT

We have distinguished features in the practices of a Living Lab, where acquisition, interpretation, and meaningful use of context information was best described as emergent, interactive situations involving individuals or groups who tried to accommodate interests of various forms. We pointed out four brokering situations where different forms of brokering were identified from the embedded practice in a Living Lab project. The first sub section (4.1) is a description of brokering context. The first situation (4.2) took place at the first workshop in the *Identifying needs and problems phase*. The second (4.3) and third (4.3) situations took place at the workshop when we were *comparing needs vs ICT prototype* and the fourth (4.5) situation took place *at the (re)Design* workshop.

4.1 The brokering context – the apartment

The workshops in the TFP were held in an apartment that has been a meeting place for next of kin's to demented and also demented people. The apartment is equipped with

tools and artefacts especially designed for demented elderly people. The apartment also serves the purpose as a kind of test laboratory for NOKD where they can try, test and also borrow (for a shorter period) different tools and artefacts.



Figure 2 The apartment

The apartment is also designed according to principles based on helping elderly demented people; each room is painted in special colour, green room, red room, etc. The colours are chosen to be in a strong contrast to what's on the wall for instance a light switch, to the left in figure 2.

Before the first workshop started the HLL and ICTD got a guided tour around the apartment by the NOKD. It was obvious during the guided tour that the NOKD gained in confidence in the relation with the HLL and ICTD, for many of them this was the first time they have met researchers and ICT-engineers. In a sense we were very close to the real-life context situation of the NOKD's, which is crucial in the living lab approach (Ståhlbröst 2008). We will refer to the apartment as a boundary context where brokering situations took place during the workshops. Yoo, Lyytinen et al (2008) describes a social context where actors from different communities negotiate and mutually adjust to other's perspectives which influences the innovation process as a "trading zone". The trading zone and the boundary context has much in common but there is one difference, the empowerment of the users which is addressed in (Ståhlbröst 2008). The guided tour in the apartment could be understood as an empowerment activity, relating to the forthcoming brokering situations.

4.2 The scenario brokering situation

At the first workshop the researchers from HLL had introduced *scenarios* as a technique for capturing ideas and needs for the ICT product and the ICTD demonstrated their product. The brokering situation took place when the NOKD were working with the scenarios. They discussed quite loud and wrote down a question (Fig 3a): "If a demented person disappear, where will I start to look?" They also wrote down a note (Fig 3a): "Direction indication! Use the internet to get an indication where the person is." They also underlined some of the statements that they had written on the paper.



Figure 3a and 3b A scenario note and a brokering situation

After the NOKD had written down the notes and the questions they asked for one of the ICTD representatives and several more additional questions arise, such as: “Is it hard to get an indication of the direction?”, “Is it possible to connect the sender/receiver to Internet and get a position on a map?” The representative for the ICTD answered the questions but also started a dialogue asking follow up questions (Fig 3b): “How do you mean?”, “What do you mean by location of direction?”. During the dialogue the ICTD placed himself in the sofa and took part in the following work with the scenarios, at several times he stated “this is really interesting and useful input”.

The workshop were the scenario brokering situation took place is regarded as user-centric innovation activity (Bergvall-Kåreborn, Eriksson et al. 2009) in a living lab innovation process, but also a brokering situation relating to both the ICTD’s role as boundary spanner (Levina and Vaast 2005) in the inter-community learning process (Hislop 2004). The three different groups: NOKD; ICTD and HLL are interpreted as three different communities of practice. Each one of the COP’s share a set of problems, a mutual concern and within the COP they interact on an ongoing basis (Wenger 1999; Wenger, Mcdermott et al. 2002). In the inter-community learning process HLL act as a broker (the workshop) (Wenger 1999) when introducing a boundary object (the scenario-technique), the ICTD act also as a broker or boundary spanner-in-practice (Levina and Vaast 2005) (when presenting the product and taking part in dialogue) and their product as a boundary object-in-use. It is interesting to notice that the brokering and boundary objects presented by HLL were used in the inter-community relation during the innovation activity between the NOKD and the ICTD. HLL acted as a brokering for brokering situations.

4.3 The newspaper-clip brokering situation

The second brokering situation was initiated by Lars (a member of the NOKD) when he presented a clip from a newspaper (Table 1). HLL had started the workshop and presented a mind map as a summary of the last workshop. Lars raised his voice and said he wanted show us something, Lars showed the newspaper clip (Table 1) and described what has happened to him and his wife, rather recently.

<p>... länge sen som han gick fri från ett fängelsestraff.</p> <p>Kvinna hittades välbehållen 12/3 09</p> <p>VARBERG. Den 73-åriga dementa kvinnan lämnade sin bostad i Varberg kllockan 21.40 i måndagskväll. När hon inte hade kommit hem 22.15 larmade hennes man polisen.</p> <p>Polisen startade upp sökandet och påträffade kvinnan några timmar senare. Kvinnan var utom fara, förutom att hon var lite nedkyld.</p>	<p>Female found in good condition (12/2-2009)</p> <p>The 73 year old demented female left her apartment in Varberg at 21.40 on Monday. When she did not return at 22.15 her husband (Lars) called the police.</p> <p>The police started searching for the female and found her a couple of hours later. The female suffered from a light hypothermia and her life is not in danger.</p>
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Table 1: Newspaper clip

He also explained that similar accidents have happened afterwards. Lars had a two-folded purpose by showing the newspaper clip. Firstly, he wanted us (HLL and ICTD) to get a deeper understanding of the life situation of a NOKD. Secondly, one essential need, according to Lars, was to point out that most situations when demented persons get separated from the NOKD is close to their homes or, when the NOKD is rather near the demented but cannot find her or him. He described two other occasions. The first one was when they were at an airport and just before they were boarding the airplane she suddenly disappeared. The second occasion was at Gothenburg Opera and in the break between the acts, she was also missing. These two situations were extremely stressful for both Lars and his wife.

One of the representatives from ICTD started to ask follow up questions like: “How far away did your wife go?”, “What is the maximum reach of the sender and receiver?” During the discussion the NOKD supported his ideas and recognized themselves in the description from Lars. The NOKD claimed that the maximum reach of the sender and receiver should be 500 meters, longer reach is not necessary. After the brokering situation the ICTD started a discussion and their opinion was that this input from Lars was really important. “Maybe this is the first time we really understand the life situation of a NOKD”. I asked Lars why he did as he did and the answer was: “Because the ICTD and HLL listen to our opinion and to some extent are engaged in our wellbeing.”

From a COP perspective Lars acted as a broker (Wenger 1999) using a boundary object (the newspaper clip) (Levina and Vaast 2005). The effects of the brokering and boundary object was twofolded: i) a deeper understanding of the life situation (ICTD) and, ii) a design guideline (a reach of 500 meters and near the home range). Lars presented the newspaper clip at a group meeting, attended by three different COP's, which lead to a process of perspective making and perspective taking (Boland and Tenkasi 1995) involving all three COP's. The dynamics in the brokering situation involved many people from three COPs, many ideas and some boundary objects, this is not that well described in the literature (Hislop 2004). At the end of the brokering situation, the ICTD could answer questions like: “Why their product is important?”, “Where their product should work?”, “What it should do?”, “And to some extent how it should work?” The discussion had an impact on ICTD and the continued development of the ICTD product. When Lars described why he did as he did, he described that the brokering situation is dependent on earlier brokering situation, that a kind of trust has been established during the engagement in the scenario brokering situation.

4.4 The questionnaire brokering situation

The third brokering situation took place when the NOKD was asked to fill out a questionnaire. In the questionnaire there were seventeen statements and The NOKD should rank the statement from the most important “1” to the least important “6”. They were not allowed to rank all statements - they had to choose six out of the seventeen. After the NOKD had filled out the questionnaire the HLL made a quick summary and presented the result (based on the score) to ICTD and NOKD (Table 3).

The result started a rather loud discussion between members of the NOKD and also between NOKD and ICTD. One of the most frequent comments between members of the NOKD was: “Did you choose that statement?”, “I didn't, but I think that it is important.” Most of the questions from the NOKD to ICTD included: “Is it possible to have that function?”, “Does it cost any extra?”, “How exactly will you do this?”. The NOKD was very curious about how the ICTD should develop the new improved prototype. After the discussion I talked to the ICTD and asked: “What did they think

about the result?” The answer was: “we take the result seriously; mostly dependent on that we had been involved in the process. If we had not been involved there is a chance that the result could end up in the bottom of my desk drawer.”

The next of kin should be able to control the geographical position of the demented.	1
It is important that the sender and receiver should be simple and easy to use, with few functions.	2
Indication of the battery status.	3
The receiver should indicate direction.	4

Table 3: Ranking from the questionnaire

In the above described brokering situation there were boundary objects-in-use (Levina and Vaast 2005): the questionnaire and the result of the questionnaire. Notable is that the boundary objects were related to each other in the brokering situation, i.e. what happened in one situation affects the other situation. Both the ICTD and NOKD were in a sense brokers by actually ranking statements and discussing the statements. Trust appeared to be really important and trust was built by taking part and being engaged in the process of perspective making and perspective taking. The ICTD was involved in the making of the questionnaire and they had also been involved when Lars was telling his story, and participated in an open dialogue with the NOKD. A trust that was established in the process affects the trustworthiness of an object that could be a boundary object-in-use. Notable is that the 500m limitation of the sender was not among the high ranked statements, which indicates a need of a follow-up process on relation between brokering situations.

4.5 The prototype brokering situation

The fourth and last brokering situation had the main objective to build and design a low-fi prototype (Fig 3). At the workshop the NOKD had to their help: paper, pencils with different colours, flower foam bricks, scissors, sticky tape, post-it notes and scalpels. The instructions was just: “lets get creative in the designing of a low-fi prototype”. Before the workshop HLL and ICTD had a discussion about “How will the workshop go?”, “How will the NOKD react to this workshop?”, “Will they be engaged?”. Most of the NOKD’s members were over 65 years. When the workshop started they really started to work, there was absolutely no reason for our earlier concerns. They discussed different solutions, draw sketches and used the scalpel in cutting the flower foam brick and laughed a lot. After about 90 minutes they presented their low-fi prototypes of the sender and receiver. A loud discussion started during the presentation of their different ideas and the ICTD had a lot of questions. One of the groups presented a receiver inspired from a compass which should show the indication of direction (Fig 3). The sender would be inside a piece of jewellery and there were mainly two reasons behind this solution: the demented should want to wear the sender and for a demented person routines are important and it is easier to learn a new routine if the demented wants’ to wear the sender.



Fig 3. Left: a paper prototype of the receiver and the sender as inside a piece of jewellery. Middle the sender with a nametag and a button. Right a receiver made of paper, flower foam brick and flower sticks.

The other group presented a low-fi prototype of the receiver (to the right in fig 3) that should be easy to grip, light-emitting diodes in the top indicating the direction and to the left indicating the distance. The prototype also contained a speaker that responded when a person pushed the button on the sender. The sender should have a nametag (middle fig 3), the main reasons behind this are that a demented person can forget their name and the space on the sender was unused.

After the workshop the ICTD was surprised by the engagement, the quality of the prototypes, the ideas and that the process has worked out so well. This was the first time that they had really worked together with users (creating artefacts and taking part in group discussion) during a longer process. In other innovation processes they had used the users as a control group of ideas.

In the above described brokering situation all of the low-fi prototypes were boundary objects-in-use (Fig 3). The discussion in the groups between NOKD and ICTD is an example of brokering, were it was rather unclear who the broker was. If we compare the prototypes with the result from the questionnaire and the newspaper-clip it became clear that there were contradictions, but also consistencies in the process. The first contradiction was that in the questionnaire “simplicity”, “easy to use”, “few functions” were very high ranked. But the actual prototype was complex with new functions (speaker) and many light-emitting diodes. The second contradiction was that geographical position (visualized on a map by mobile or web), was mentioned in the scenario as well as high ranked in the questionnaire but, was not mentioned in the presentation of the prototypes, neither by the ICTD nor the NOKD. The prototype was consistent with the earlier results: indication of direction and intended to be used 500 m within home range.

5 INNER AND OUTER LEVEL BROKERING IN AN INNOVATION BOUNDARY CONTEXT

The TFP innovation process has been described as interaction between three communities of practice (Wenger 1999; Wenger, Mcdermott et al. 2002). One of the COP’s involved in the innovation process was the ICTD. Their main motive for taking part was the need of new external information, assimilate it and apply it (Cohen and Levinthal 1990) to the sender and receiver in order to commercialize the product. Therefore the analysis is to a great extent influenced by the dynamics in brokering situations in an innovation boundary context, including brokering and boundary objects. We will highlight the following three considerations and implications for understanding and facilitating an innovation boundary context in a living lab process.

1. The boundary context, establishing trust and engagement in the inner level brokering:

The research indicates that activities in a boundary context are about feeling comfortable with the actual environment. We saw how the NOKD actually felt comfortable in the apartment where their demented family members and next of kin's usually met. The physical layout and facilities in the functional areas within the factual room space played a vital role for establishing a familiar environment for the brokering situation. By making the environmental prerequisites and conditions highly visible and present as a boundary context in the living lab process have led to that the NOKD feel their interests were accommodated more effectively. Also, it was in this room, or apartment, where the NOKD had all their meetings and performed much of their daily activities together. By being in their space might empower the NOKD group and makes them more accountable for important input (perspective making) in the living lab process.

In order to meet a user group's need for more convenience in a brokering situations, we argue for consider the importance of the boundary context when dealing with trust and engagement in a living lab process. In the literature about inter-community interaction, trust and engagement (and the underlying dynamics) needs to be explored further (Hislop 2004). However, the knowledge and competence of the NOKD was truly important for the inner level brokering in the innovation process (Fig 4). It was necessary to bridge the gap between their problems and needs of the ICT product as well as their related use of it in the later run.

2. Inner level and outer level brokering in the boundary context:

Herein, brokering is about alignment and creating meaning (Hislop 2004; Lundkvist 2004; Manville 2004) on two different levels: *inner level and outer level* (Fig 4). One example of *inner level brokering* is when Lars shows the newspaper-clip and talks about his wife. The inner level brokering situation could be described as a process of perspective making, perspective taking (Boland and Tenkasi 1995) between NOKD and ICTD where boundary objects was used. In a sense it was more of perspective making and less perspective taking from NOKD and the opposite from ICTD (Fig 4). The underlying reason why he did it, he described as trust "the developers listened" and that he had become engaged in the process.

The *outer level brokering* aims to facilitate that constant iteration, feedback and reflections are undertaken as an interactive dialogue during and between group activities, which is considered important for innovation from a more process-oriented view. Herein the *outer level brokering* is an iterative process which aim's to facilitate reflections and creations of perspective taking and engagement activities. For this purpose we have identified the need and necessity of an emergent boundary spanning competence. The appearance of a new role took place (Levina and Vaast 2005). The role can be regarded as an expert on outer level brokering for inner level brokering situations. We could see several situations where the role was undertaken by the HLL community members, by their engagement in developing a common viewpoint that adequately captured the dynamics of relations between the other communities of practice. This role was played out both spontaneously and intentionally by the HLL community members. The aim of this role-taking was primarily to break boundaries in order to reach to mutual understanding between the various communities of practice. The outer level broker can help maintain the legitimacy of the organization by providing information to important client groups, stakeholder groups or communities.

3. The role of boundary-objects-in-use during inner level brokering and outer level brokering:

The workshops in the TFP innovation process were built around activities and artifacts' (Levina and Vaast 2005). In many *inner levels brokering situations* the activities, such as creating scenarios, were intertwined with the artefacts used, boundary-objects-in-use, for instance, a discussion between COP's, during a group activity. The idea's of boundary spanners-in-practice and boundary objects-in-use (Levina and Vaast 2005) are supported by the empirical data.

Several boundary objects were used, produced and re-produced with the particular focus on innovation of the product. For instance, one such boundary objects-in-us negotiated in the living lab process was the scenario that was related to the mind-map, which in turn was related to the questionnaire and the prototype. This is an example when *outer level brokering* is about handling and preparing boundary-objects-in-use. Another example was about the consistency and contradictions between the boundary objects-in-use, which then were needed to be handled in the *outer level brokering process*, including negotiating boundary objects-in-use.

In this section we have presented three implications for understanding and facilitating an innovation boundary context in a living lab process. These three implications indicates that facilitating could be understood as outer level brokering for inner level brokering situations in a boundary context with regard to trust end engagement. The outer level and inner level brokering is visualized together with the perspective making and taking process in the process model (Fig 4).

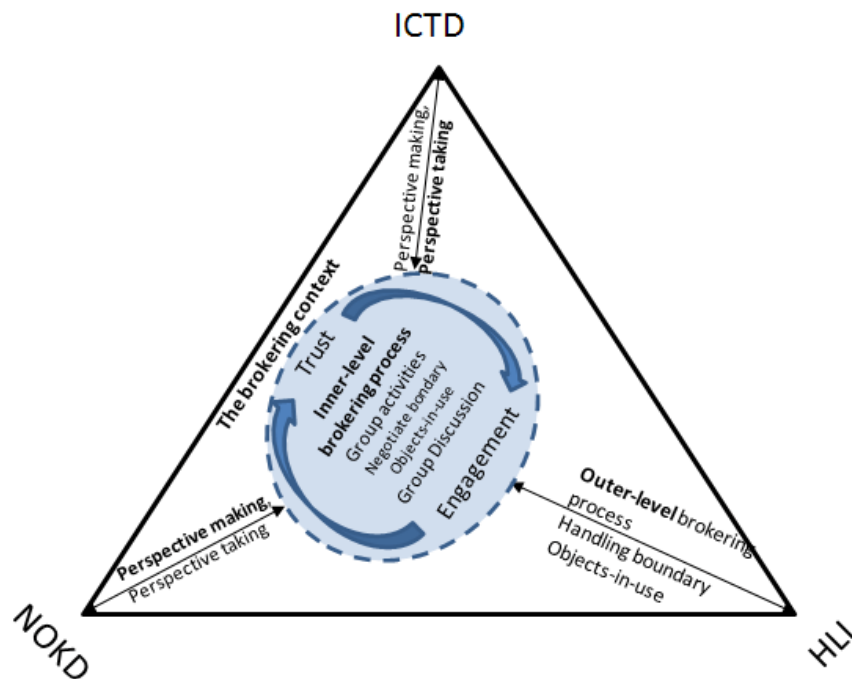


Figure 4. The process model of an innovation boundary context

6 CONCLUDING REMARKS

The research provides us with insights from the dynamics of the interactions that occurred between the various types of stakeholders in an living lab innovation process. The dynamic interactions are described in a process model (Fig 4), which consists of a number of essential activities and functions that were considered important for facilitating, outer level brokering for inner level brokering situations, for an innovation boundary context. The boundary context, within which the activities occurred, played a vital role for the overall concern of boundary interaction and learning. Herein, boundary

objects-in-use, inner level and outer level brokering was connected with other issues such as empowerment and trust in an intertwined process. Thus, we consider the process model (Fig 4) to be a conceptual description of an innovation process, consisting of intertwined inner level and outer level brokering situations.

Our results clearly indicate that a boundary context has impact on the innovation process. First of all, these activities led to actions and consequences that were important to the subsequent phase in the innovation process, i.e learning from iterations and actions. The emergent properties of distinguished actions undertaken by the different community members formed a good basis for interaction and learning across community boundaries. Members from the three communities combined and transformed different views as well as objects of concern for the innovation process, such as problem motivation, scenario descriptions, prototypes etc, things and views that someone thought of as being important for motivating the project, for reaching the goal, for taking the “right” action.

In sum, the contribution of our research to innovation theory is a process model describing the dynamics in brokering situations during an innovation process from a community of practice perspective. The innovation process context for our research is the innovation process with three different COP's. This differs from the innovation process context in the article by Levina and Vaast (2005), where the context is between two firms or between two departments within a firm.

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