Dynamics in an innovation boundary context: exploring a living lab process from a community of practice perspective

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Abstract *This paper is based on studies of a living lab process, which is an open, user-centric, innovation approach, where several actors from industry, user groups and academia are involved. 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 units of analysis. The analysis identified 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 to brokering. The research highlights two different levels of brokering: i) product/service brokering; and ii) process brokering.*

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

1 Introduction

The research interest in this paper relates to 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 [1]. 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 [2], user driven innovation [3] and living labs [4] 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 [5]. This leads to an interesting challenge of crossing sectors of such kind and to understand different forms of activities and interaction taking place at the interface between different groups of stakeholders across those sectors. Hence, one way to approach the intertwining of innovation and learning is to understand boundaries and the bridging of boundaries. While such a multiplicity of stakeholders and boundaries increases there is a need to develop approaches for integrating and leveraging for such a context, i.e. a boundary context.

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 (the next of kins), and researchers from Halmstad Living Lab. From a community of practice perspective, we can see how different community groups engage in a heterogeneous interaction where a mix of different world views is to be handled [6]. We pay particular attention to boundaries, boundary objects and brokering as we take the existence of boundaries as given in the situations occurring 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 dynamic activities 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 essential mechanisms of the boundary context are vital important for facilitating interaction and learning

in a living lab process. For that reason we have distinguished several boundary objects-in-use and two different levels of brokering.

2 Living lab: communities of practice in an innovation boundary context

Learning and working are interrelated, compatible, intertwined and connected to innovating [15]. The innovation process in TFP was inspired by user-centric innovation and the living lab approach [4]. 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 [11]. The living lab approach also relates to co-creation in collaborative, multi-contextual real-world settings [11]. During the last years five key principles has emerged for the living lab approach [12]:

- 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.

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.

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. 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, where for instance [4] argues that there is no standard user, which leads to a focus on customization. The living lab activities are intended to improve a product with regards to the needs of a new customer group which will change the everyday practice of that group [1].

2.1 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 on-going basis [14]. 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 [8], which means a form of inter-community learning process [13]. The inter-community process is important [16] because it helps to overcome some of the problems the community may create for itself [15].

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 [13] and that COP is limited in addressing the power dynamics in the inter-community process [10]. Yoo, Lyytinen et al [18] discusses an innovation process from complementary social translation, which is identified as combining two previously unconnected communities [18]. 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 [17] 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 [17]. Perspective making represent the first step, in which knowledge creation is built and re-built for shared understanding and communication within a community of practice [17].

In the presented research we regard the different stakeholders (NOKD, ICTD and HLL) as three different communities of practice [8, 14]. NOKD's practice is caretaking, ICTD's practice is development of ICT products and HLL's practice is research.

2.2 Forms of boundaries and brokering

There are attempts to use the theory of brokering and boundary objects in innovation settings [13, 19, 20, 21] but they all discusses the lack of dealing with the dynamics. According to Levina and Vaast [10] 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 [17] 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 are described as a duality: i) boundary objects; and ii) brokering (activities and situations).

Boundary objects, serve to coordinate and communicate perspectives for some purpose [9]. Boundary objects play extremely important roles as shortcuts to communication, as well as playgrounds for knowledge sharing among different communities of practice [15, 16]. Brokering is the second part of the duality, made by people who introduce elements of practices from one COP into another COP [8]. Boundary objects can be used by a broker in a brokering situation. In [10] the community of practice perspective is disregarded due to limitations in addressing power dynamics. Levina and Vaast [10] 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) [8, 14]

Based on the above concepts of living lab, communities of practice, innovation and boundaries we consider a boundary context as a multi-facetted 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.

3 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 [22] which is further inspired from the clinical perspective [23, 24]. 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. This was particular appropriate for us in a living lab approach.

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.

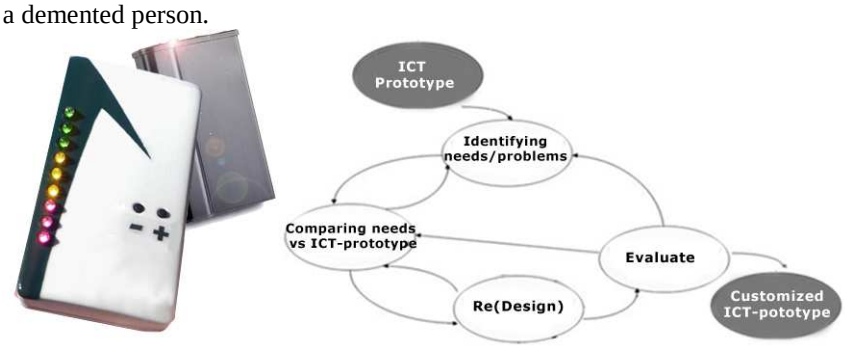

Figure 1: Left: Sender and receiver, Right: The TFP process

In the TFP, several 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 [25] and user-centric innovation [26]. 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 [27], and the ICT product was done which resulted in a list of statements and questions were 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.

Analysis of the empirical data from the TFP was made in a continuous manner during the process and also after the innovation process. 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 [10] and, brokering [8] inspired by perspective making and perspective taking and the use of boundary objects [9]. 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 within the embedded practices of a Living Lab and we have pointed out four brokering situations where different forms of brokering took place. The first sub section (4.1) is a description of the boundary context where we undertook many of the research activities. The first brokering situation (4.2) took place at the first workshop in the *Identifying needs and problems phase.* The second (4.3) and third (4.3) brokering 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 were 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 [12]. We will refer to the apartment as a boundary context where brokering situations took place during the workshops. Yoo, Lyytinen et al [18] describes a social context were 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 [12]. 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, were 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 (notes in Swidish)

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 [28] in a living lab innovation process, but also a brokering situation relating to both the ICTD's role as boundary spanner [10] in the inter-community learning process [13]. 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 on-going basis [8, 14]. In the inter-community learning process HLL act as a broker (the workshop) [8] when introducing a boundary object (the scenario-technique), the ICTD act also as a broker or boundary spanner-in-practice [10] (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.

 ...länge sen som han gick fri från ett fängelse-straff. **Kvinna hittades välbehållen** **VARBERG.** Den 73-årige dementa kvinnan lämnade sin bostad i Varberg klockan 21.40 i måndagskväll. När hon inte hade kommit hem 22.15 larmade hennes man polisen. Polisen startade upp sökandet och påträffade kvinnan några timmar senare. Kvinnan var utom fara, förutom att hon var lite nedkyld.	**Female found in good condition (12/2-2009)** 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. The police started searching for the female and fond her a couple of hours later. The female suffered from a light hypothermia and her life is not in danger.

Table 1: Newspaper clip (in Swedish) and brief summary

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 them-selves 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 [8] using a boundary object (the newspaper clip) [10]. 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 [17] 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 [13]. 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 [10]: 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.

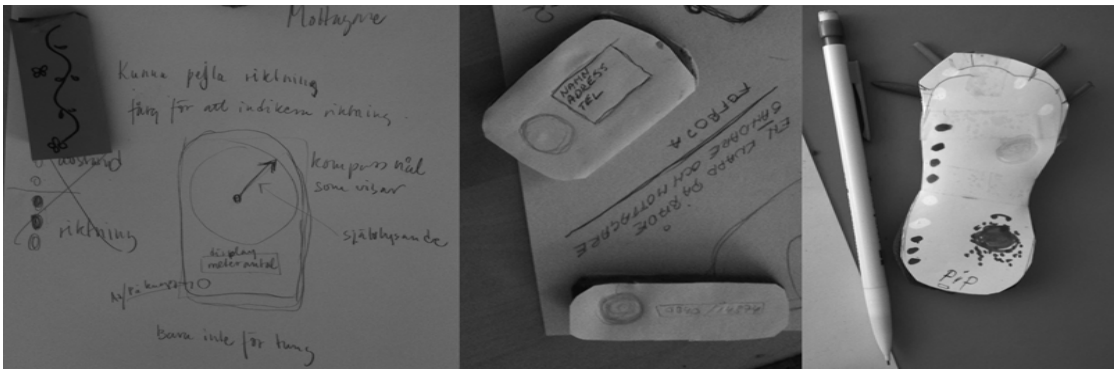

Fig 3. Left:a paper prototype of the receiver and the sender as inside a piece of jewellery. Middle the sender with a nametag and a button. Right a receiver made of paper, flower foam brick and flower sticks.

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 Product/service and process brokering in an innovation boundary context

The TFP innovation process has been described as interaction between three communities of practice [8, 14]. 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. Boundary context for establishing trust and engagement

The research indicates that innovation activities in a boundary context are about feeling comfortable with the actual environment. We saw how the NOKD actually felt comfortable in the apartment were 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 during innovation activities in a living lab process. In the literature about inter-community interaction, trust and engagement (and the underlying dynamics) needs to be explored further [13]. However, the knowledge and competence of the NOKD was truly important for the product/service 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. Product/service and process brokering in the boundary context

Herein, brokering is about alignment and creating meaning [13, 19, 20] on two different levels: *product/service and process level* (Fig 4). The product/service brokering situations could be described as a process of perspective making, perspective taking [17] between NOKD and ICTD were boundary objects was used. One example of *product/service brokering* is when Lars shows the newspaper-clip and talks about his wife. 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 *process 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 *process 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 [10]. The role can be regarded as an expert on process brokering for product/service 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 process 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

The workshops in the TFP innovation process were built around activities and artifacts' [10]. In many *product/service 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 [10] 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 *process 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 *process brokering*, 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 indicate that facilitating could be understood as process brokering for product/service brokering situations in a boundary context with

regard to trust end engagement. The process and product/service brokering is visualized together with the perspective making and taking process in the process model (Fig 4).

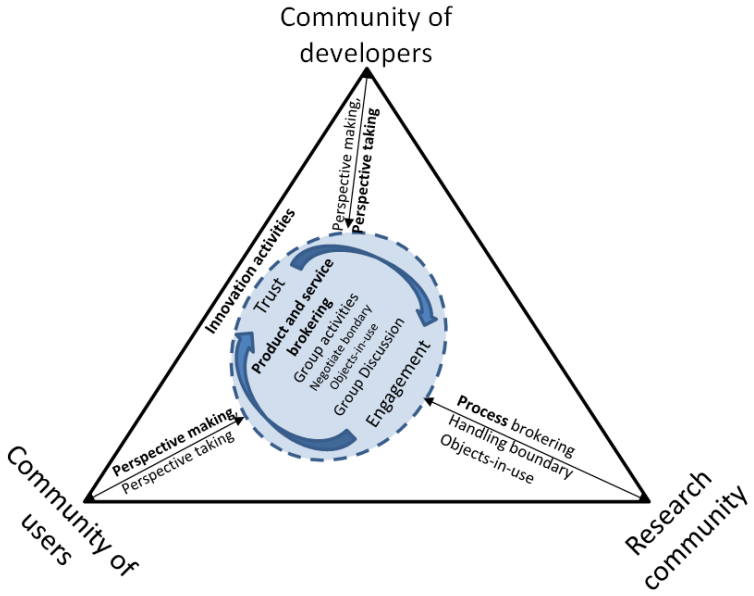

Figure 4:The process model of an innovation boundary context

6 Concluding remarks

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.

The research provided us with insights from the dynamics of the interactions that occurred between the various types of stakeholders in a 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 in order to facilitate both process brokering and product/service brokering situations for a dynamic 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, product/service and process 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 product/service and process brokering situations. We direct this process model as our contribution to innovation theory as we conceptualize the dynamics in an innovation (living lab) process from a community of practice perspective in that model. 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), were the context is between two firms or between two departments within a firm.

References

1. OECD, *Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data*. 3rd ed, ed. N. Tanaka, M. Glaude, and Fred Gault2005: OECD Publishing.
2. Chesbrough, H., *The Era of Open innovation*, in *Managing innovation and change*, D. Mayle, Editor 2006, Sage.
3. Hippel, E.v., *Democratizing innovation*2005: MIT Press.
4. Eriksson, M., V.-P. Niitamo, and S. Kulkki *State-of-the-art in utilizing Living Labs approach to user-centric ICT innovation - a European approach*. 2005.

5. Ancona, D.G. and D.F. Caldwell, *Bridging the boundary: External activity and performance in organizational teams.* Administrative Science Quarterly, 1992. **37**(4): p. 634-665.
6. Aldrich, H. and D. Herker, *Boundary Spanning Roles and Organizational Structure.* Academy of Management Review, 1977(2): p. 217-230.
7. Cohen, W.M. and D.A. Levinthal, *Absorptive Capacity: A new perspective on learning and innovation.* Administrative Science Quaterly, 1990. **35**(1): p. 128-152.
8. Wenger, E., *Communities of practice: learning, meaning, and identity*1999, Cambridge: Cambridge University Press.
9. Star, S., *The structure of ill-structured solutions: boundary objects and heterogeneous distributed problem solving.* Distributed artificial intelligence, 1990. **2**.
10. Levina, N. and E. Vaast, *THE EMERGENCE OF BOUNDARY SPANNING COMPETENCE IN PRACTICE: IMPLICATIONS FOR IMPLEMENTATION AND USE OF INFORMATION SYSTEMS.* MIS Quarterly, 2005. **29**(2): p. 29.
11. Bergvall-Kåreborn, B., M. Holst, and A. Ståhlbröst. *Concept Design with a Living Lab Approach*. in *Proceedings of the 42nd Hawaii International Conference on System Sciences - 2009*. 2009.
12. Ståhlbröst, A., *Forming Future IT - The Living Lab Way of User Involvement*, in *Department of Business Administration and Social Sciences*2008, Luleå University of Technology: Luleå.
13. Hislop, D., *The Paradox of Communities of practice:Knowledge sharing between communities*, in *Knowledge Networks:Innovation through Communities of practice*, P.M. Hildreth and C. Kimble, Editors. 2004, Idea group: London.
14. Wenger, E., R. Mcdermott, and W.M. Snyder, *Cultivating communities of practice*2002, Boston: Harvard Business School Press.
15. Brown, J.S. and P. Duguid, *Organizational Learning and Communities-of-Practice: Toward a Unified View of Working, Learning, and Innovation* Organization Science, 1991. **2**(1): p. 40-57.
16. Cook, S.D.N. and J.S. Brown, *Bridging Epistemologies: The Generative Dance Between Organizational Knowledge and Organizational Knowing.* Organization Science, 1999. **10**(4): p. 381-400.
17. Boland, R. and R. Tenkasi, *Perspective Making and Perspective Taking in Communities of Knowing* Organization Science, 1995. **6**(6): p. 350-372.
18. Yoo, Y., K. Lyytinen, and R.J. Boland. *Distributed Innovation in Classes of Networks*. in *Proceedings of the 41st Hawaii International Conference on System Sciences*. 2008.
19. Lundkvist, A., *User networks as sources of innovation*, in *Knowledge Networks:Innovation through Communities of practice*, P.M. Hildreth and C. Kimble, Editors. 2004, Idea group: London.
20. Manville, B., *Building customer communities of practice for business value:Success factors from Saba Software and other case studies*, in *Knowledge Networks:Innovation through Communities of practice*, P.M. Hildreth and C. Kimble, Editors. 2004, Idea group: London.
21. Lave, J. and E. Wenger, *Situated learning: legitimate peripheral participation*1991, Cambridge: Cambridge University Press.
22. McKay, J. and P. Marshall, *The dual imperatives of action research* IT and People, 2001. **14**(1): p. 46-59.
23. Schein, E.H., *The Clinical perspective in fieldwork*. Qualitative research methods serie1987.
24. Schein, E.H., *Process consultation, action research and clinical inquiry: are they the same?* Journal of Managerial Psychology, 1995. **10**(6): p. 14-19.
25. Preece, J., Y. Rogers, and H. Sharp, *Interaction Design: Beyond Human-Computer Interaction*2002: Wiley.
26. Svensson, J. and C.I. Eriksson. *Challenges with User involvement in a Living Lab context*. in *eChallenges 2009*. 2009. Istanbul.
27. Buzan, T., *The MindMap book*1995, London: BBC Books.
28. Bergvall-Kåreborn, B., et al. *A Milieu for Innovation – Defining Living Labs*. in *ISPIM 2009*. 2009. New York.