



Facilitating explication in known narrows

A workshop structure for interdisciplinarity

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SYNOPSIS:

This project investigates if it is possible to elucidate tacit collaborative knowledge of interdisciplinary teams. To elucidate the tacit knowledge a workshop structure based on product development theory is carried out on 3 separate groups. The empirical material generated through these workshops are then analysed with a focus on interactions between participants. It is concluded that tacit collaborative knowledge can be explicated by reflecting on action and analysing action, and that this explication can benefit interdisciplinary teams by augmenting participants attention to collaborative aspects of interdisciplinary work.

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2 Reading guide

The workshops that this report revolves around were held in the mother tongues of the participants; Danish. This was done to get as close to the real world situations of knowledge *transfer, translation and transformation* (terms will be explained in the Theory section). This way and immediacy is created as the participants are used to collaborate in Danish. As the interactions are the important object of interest I have chosen not to translate excerpts from the transcripts. This is done to avoid details and nuances getting lost in translation. However, I will explain the context of the interactions in English. I will also be restating or summarising what occurred in the excerpts in English. These Danish excerpts will appear in the following sections: *Facilitating the narrow participants* and *Analysis*.

3 Introduction

In this section I will introduce the main themes of this master thesis before moving deeper into the problem background. This thesis project spanned from September to December of 2017. During this time I worked with preparing and structuring workshop activities, I carried out three separate workshops and processed the empirical data from these. The workshops structure and aim were inspired from three themes: tacit knowledge, instrumental interdisciplinarity and innovation. The workshops focused on making the participants utilise tacit collaborative knowledge in regards to challenges inspired by product development theory. This thesis focuses on the interactions of the participants in the context of the workshop and how these interactions can reveal hidden aspects of behaviour; the tacit collaborative knowledge. This is done in an effort to develop a tool or workshop to engage communities of knowledge producers in interdisciplinarity and augment their behaviour in doing so.

3.1 Problem background

The problem background is that of an increasing interest from politicians and interest organisations to expand the practice of interdisciplinarity, as well as an increasing focus on the commercial viabilities of research.

3.2 Increasing focus on interdisciplinarity

As a knowledge society, Denmark relies in a large degree on research and innovation as a driver for the economy. In recent years there has been a rise in the competitiveness from other knowledge producing countries. In a report from Copenhagen Business School and the think-tank DEA, it is concluded that if Danish research should play a role, in dealing with the problems of the future,

reform is needed. The claim is that there is a huge untapped potential in interdisciplinary research (Burmeister, Norn, & Abrahamsen, 2017)

In connection with the publication of the report the chief of analysis in DEA comments on the current situation in Danish research:

“Our research system today has a tendency to deliver solution within known boundaries and regarding already known issues. There is a need to create networks and relations across the research disciplines that can result in joint research projects and applications. We do not say that it will be easy. But it would be for the benefit for society...” - Maria Theresa Norn, Analysechef (Norn, 2017)

In the report it is concluded that there have been many attempts to tap into the potential of interdisciplinary work. However these attempts have not had the desired effects due to structural barriers:

“Despite many years’ focus among policymakers, research funders and university managers on stimulating interdisciplinary research collaboration, important barriers to disciplinespanning collaboration persist. It is widely recognized that the strong disciplinary structure of the sciences can create disincentives and barriers to discipline-spanning research” (Burmeister et al., 2017, p. 8)

The report then goes on to argue that even if the local barrier of actually initiating collaborations is met, the researchers then face the barrier of the cultural differences between disciplines:

“Even if researchers manage to set up interdisciplinary collaborations – and possibly obtain external funding for it – they have yet to make the collaboration work. Among other things, this may require finding a common language and theoretical and methodological foundation that allows for joint interdisciplinary work”. (Burmeister et al., 2017, p. 8)

They then go on to argue that as the differences between disciplines increase, so does the cost of managing the barriers:

“In addition, the wider the gap between approaches and methodological approaches in the disciplines involved, the greater the costs of coordination necessary to enable the development of a “synthetic view” or common ground become” (Burmeister et al., 2017, p. 9)

In another report from DEA called *Interdisciplinary RESEARCH is key to solving society’s problems* (Visholm, Grosen, Norn, & Jensen, 2012), they claim that there are several reasons why researchers do not engage in interdisciplinary ventures:

- Interdisciplinary research can be more difficult to publish in prestigious journals
- The value of interdisciplinarity is unclear
- Research problems are defined within disciplines rather than based on societal challenges
- Disciplines often operate with a basic set of assumptions and research methods that affect their research focus
- Interdisciplinary research is uncertain and resource demanding

The last reason listed, is what I found to resonate with what I had been told, during my interviews with researchers at the HST department at AAU. The authors describe the barrier "*Interdisciplinary research is uncertain and resourcedemanding*" as follows:

"Engaging in integrative research involving several disciplines requires participants to first establish a common "language" and research method that enables them to work jointly while exploiting the potential from cross-fertilization between their disciplines. This process can be very demanding in terms of the time and energy that researchers must invest in it." (Visholm et al., 2012, p. 7)

The description of the barrier above seemed to fit into the feelings of two researchers at HST at AAU. I will elaborate on this in the chapter *Experienced boundaries and possibilities in the research laboratory*.

3.2.1 Political calls for interdisciplinarity

The call for more interdisciplinarity is not only coming from the higher educational institutes and think tanks, it is also a political goal. On both the national and supranational political stage, there has been a call for interdisciplinarity. In Denmark this can be illustrated through the FORSK2020 and the FORSK2025 catalogues.

In 2012 the Danish ministry for research, innovation and higher education published a catalogue with the purpose of providing a foundation for prioritising strategic investments in research. In this catalogue one of the 9 main points made is to encourage interdisciplinarity:

"In the centre of each of the catalogs themes is the description of essential challenges for society. The challenges go across research disciplines and invites for interdisciplinarity amongst the greater parts of the Danish research landscape" - ("FORSK2020 – Strategiske forskningshorisonter," 2012)

They argue that vital societal problems and challenges extend over several disciplines. And for the FORSK2025 catalogue a new government has taken control, but the case is the same:

“Pointers for mintage of strategic research funding: The broad range of stakeholders that have participated in the FORSK2025 process have pointed to a series of conditions that are essential to fulfil the strategical research potential for the societal value creation. Amongst the most important transversal conditions are: interdisciplinarity and user involvement in research projects ...” - (“FORSK2025 – fremtidens løfterige forskningsområder,” 2017, p. 10)

They mention five aspects of great importance for distributing grants, and interdisciplinarity is one of them. They argue that the crossing of different disciplines results in breakthrough discovery and scientific innovation being made:

“To cross research areas within interdisciplinary projects can extend the knowledge basis of involved disciplines and create unexpected results, and it is often in the meeting between disciplines that breakthroughs and scientific innovation occurs”.

To sum up we can see that there is pressure from interest groups and national political institutions to increase the practice of various forms of interdisciplinarity. We have also seen that there can be problems when trying to establish integrative research because of the demanding effort that researchers must put in to it.

3.3 Experienced Boundaries and Possibilities at the Research Laboratory

The researchers at HST Aalborg University experienced how collaboration between sub-disciplines was both meaningful and fruitful. When I interviewed one of them during fieldwork for a former project (Hansen, 2017), he told me that:

“... I’m a doctor, there is a mass spec guy, there’s a physicist, there’s an immunologist, a biochemist, really different backgrounds ... we speak different languages, but we have to make each other understand, what are the limitations? What can you do? How can we utilize each other’s differing expertise? So that we can create some synergy. It takes a different kind of energy than what you are used to, but that is the modern way of doing it!” – Researcher, HST AAU

They acknowledged the potential in collaboration. However, they also felt that boundaries existed that limited the creation of collaborations:

“When working with people from outside, there is always a plan and some money. When we work within we do it because we thought something was exciting, but it often results in time, resources and money being used for other purposes than they were meant to.” – Researcher, HST AAU

The current constellation of researchers at HST has experience in working together across disciplines. I wanted to know if it is possible to tap in to this experience and codify what was tacit in regards to collaboration. I envision to do this based on a workshop developed in an earlier project of mine (Hansen, 2017). The workshop should be seen as a tool to engage and change researchers by creating new understanding and relations between them.

4 Problem Statement

The problem analysis has presented how the increased focus on science and its institutions, as a means for societal good and problem solving, has led to an increase in trying to create interdisciplinary research constellations, and to change the culture of the mono disciplinary tendency among much of science. It has also shown how scientists see value in venturing beyond their usual confines by example of the reflections from researchers. I also presented how their experiences and frustrations, led me to the idea of an initiative that would reveal how researchers collaborate, and potentially create insights to help foster interdisciplinary work in the future. The idea is based on the concept of tacit knowledge; *that we know things that we cannot say*. As mono disciplinary research cultures might begin to transmission to an increased awareness on interdisciplinarity, I have chosen to focus this project on the development of a tool to explicate tacit collaborative knowledge, with the purpose of augmenting understanding of interdisciplinary behaviours. This augmented understanding is not only interesting to me but could potentially help researchers in the process of establishing knowledge sharing behaviours. This, in accordance with the problem analysis thus leads to the following problem statement:

How can the tacit knowledge of collaboration in interdisciplinary teams be revealed and how can such a revelation benefit interdisciplinary teams?

To answer this problem statement I have conducted three workshops with participants who have experience in collaboration. These workshops and the analysis of them will be the sole focus of the report.

5 Theory

In this section I will present the main theoretical works that I use to understand and analyse my empirical material. To answer my problem statement I want to understand 3 aspects of collaboration in knowledge production:

1. How people work together in groups – This I will understand from the perspective of Communities of Practice as envisioned by Lave and Wenger
2. How people work together across different disciplines – This I will understand from the perspective of Carlile's Transfer, Translate and Transform Framework
3. How knowledge and experience is tacit – This I will understand from Polanyi's view of tacit knowledge

5.1 Communities of Practice

To understand the social interaction of a research and educational facility I look to Lave and Wenger's *Community of Practice*. From Wenger's current website communities of practice are:

"... groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly." – (Wenger hjemmeside)

From my earlier project I concluded that the laboratory at HST was a community of practice. In that project I was concerned with one of the three dimensions of a community of practice; *Continuous development and maintenance of shared repertoire*. I questioned that aspect of the laboratory as it was the aspect I was interested in. But it only describes one out of three main parts of what makes a community of practice. Or as Wenger puts it: *"the three dimensions of communities of practice"* (Wenger, 1998, p. 90). The dimensions are described as the sources of community coherence.

Mutual commitment is described as what makes practice possible. It is that participants are engaged in actions. The practice is not abstract; it *is* because of those actions. To make the mutual commitment possible to begin with there are several requirements. One of these is being able to interact with the other participants of the group. Another is that of engaging in the activities that matter in the community. A third is that of putting in work to uphold the community.

The relations in mutual commitment bring together participants and identities that can differ from each other in various ways. However mutual commitment doesn't necessarily differentiate these further or homogenise them. Through the fact that differences exist in a community the single participant develops an attention to what they know and do not know. This partiality can be known by the participants and act as both a resource and a limitation. A participant that is a member of a complimentary community could gain an advantage by also being a member of a more homogeneous group.

The community of practice can consist of relations that span personalities and social categories. They are not necessarily without conflict and disagreement, and these can be ways of participating in the community. In most cases a display of rebellion can be a sign of grander engagement than that of passive conformity (Wenger, 1998, p. 90).

Joint enterprise is described as the process that shapes both normative statements and *ways of doing* within the context of the community. The process is controlled by negotiations within the community, but people outside the community can still affect it. The participants of a community are often restricted, they cannot do whatever they please; in most cases it would be because of employers expecting them to fulfil certain requirements. If they do not fulfil these requirements they might lose their jobs. But as long as the requirements for not getting fired are met, the participants are free to shape whatever is left besides meeting those requirements. In this leftover space, the participants have some autonomy (Wenger, 1998, p. 95).

Shared repertoire is to be understood as what happens when the engagement in an enterprise develops resources for negotiating meaning. This repertoire can be very heterogeneous, but the coherence comes from the fact that they are connected to practice in a community performing an enterprise. It reflects the history of the mutual commitment, but it is also ambiguous, it can have several interpretations. The repertoire can consist of words, stories, tools and ways of doing that have either been produced or co-opted during the community's existence. It becomes the means for the production of new meaning and negotiation of old meaning. This is made possible by combining the ambiguous and the historical (Wenger, 1998, p. 100).

To sum up, mutual commitment is what binds participation and reification. Joint enterprise can create mutual relations of responsibility without being declared as such. Shared repertoire is a resource for the process of negotiating meaning.

5.2 3T Framework

To understand how people from different disciplines or backgrounds work together I look to Carlile's 3T framework (Carlile, 2004). He presents three increasingly complex boundaries that are encountered when working on a project in groups, where the members have different backgrounds or professions.

In presenting his ideas he includes the works of many other scholars who work within knowledge management. He argues that there are three different perspectives in this field:

- The mechanistic, which looks at knowledge as a thing to be captured, stored and transferred.
- The cultural perspective, which sees knowledge as something that must be translated before being shared.
- The political, which sees knowledge sharing as a field of struggle.

Carlile attempts to integrate these different perspectives as he sees a challenge in the way that these different perspectives might contradict each other and confuse attempts to apply them to real world knowledge management. He constructs a framework based on the following three boundaries and the processes that can manage it:

- Syntactic - managed by the process of transferring
- Semantic - managed by the process of translating
- Pragmatic - managed by the process of transforming

Carlile argues that in the context of complex product development these boundaries and the management of them are especially important in the early stages of the design process. He states that:

“In product development settings, knowledge boundaries are inescapable because of the hierarchical and functional specialization of knowledge. Additionally, since all of the inputs cannot be known in advance, these boundaries are dynamic and the “collective” knowledge to produce products is based on on-going inputs that change throughout the process.” - (Carlile, 2004, p. 4)

So knowledge boundaries are inevitable, they can change over time, and the knowledge required to tackle them can change as well.

The boundary, as stated by Carlile, is defined by two properties; difference and dependence. By difference he means the difference in background and specialization between groups or individuals. Here he refers to Deborah Dougherty's concept of *thought worlds*, which state that because of differences in work-focus between groups, differences in sense making are the consequence. This difference can be attributed to the structures and routines in the organization. To counter development of these differences both structural and cultural solutions are needed.

By dependence he means that the action of one group affects another group. This aspect can be understood in varying ways, the direct and the more indirect. The direct involves power relations and resource management between interdependent groups. The more indirect dependence is understood as three different modes of task management; serial, pooled and reciprocal. However

the two aspects of dependence are only easily applicable to situations where the relations are stable, when novelty is encountered relations and dependencies between groups become unstable. This implies that the factors of resource- and task management are involved in complex novel product development.

So the differences and dependencies are what define the boundary. The three increasingly complex boundaries will be described below.

The syntactic boundary is one where two parties share a common language. However when novelty increases, in regards to a knowledge transfer situation, the shared syntax becomes insufficient as it is: *“no longer able to address the novel differences and dependencies which arise”*. This is where the semantic approach becomes relevant. Here the focus is to recognise the differences in understanding between groups and to translate and create new shared understandings together. However as this boundary is handled by creating shared meaning, and novelty continues to rise, a new type of boundary arises: the pragmatic boundary. Here it should be recognised that no matter how developed the syntactic and semantic approaches have become there are going to have to be consequences for one group or another when deciding where to send or cut resources to or from (Carlile, 2004).

“Here a complex boundary process has to be developed where current and more novel forms of knowledge can be represented, learned about, and then jointly transformed...” – (Carlile, 2004)

He argues there are three different kinds of boundaries in transferring knowledge and that to each boundary there is an approach to overcome it. But that they come at a cost, the cost of transferring, translating and transforming knowledge. However, one should view these costs as an investment, because:

“The fact that most innovation occurs at the boundaries reminds us that managing knowledge across the various types of boundaries in an organization is what lies at the source of competitive advantage.” - (Carlile, 2004)

Carlile argues that this approach has potential as it engages the organisation in a new ways and makes use of knowledge that would go unused otherwise.

5.3 Tacit knowledge

In Polanyi Michaels book *The Tacit Dimension* (Polanyi, 1966) it is argued that there is an element of *invisible to ourselves & unsayable to others*-knowing in the way in which we experience and act upon

the world. It is based on the concept of subception; that we act when confronted with X, without being aware that we perceived X and acted in response to it.

The basic point of the concept is that we “activate” a proximal term in response to a distal term.

- Proximal term: the knowledge of an object/phenomenon in the mind of the observer.
- Distal term: the object to which the knowledge is transposed to.

An example of this would be the distal term of riding a bicycle. Here the proximal terms would be how you simultaneously: steer where you want to go, hold your balance, apply force to pedals, brake etc. Your explicit attention is getting to your destination, not on keeping your balance.

Another example is the recognition of a face. The recognition of a face as belonging to someone you know is the distal term. The proximal terms is that of recognizing a constellation of shapes and colours as a face and then coupling that face to the memory of interactions with another human. As a familiar face appears in the crowd a myriad of information comes to the foreground of your attention. Their name, the nature of your relation, and so on, is projected to that face.

Functional structure of tacit knowing is that of attending from the proximal to the distal. An example being that of doing a summersault; we attend from the elementary movements of every muscle involved, to the joint purpose of doing the summersault.

The *phenomenal structure* of tacit knowing is that of becoming aware of the proximal term when the distal term appears. An example of this would be the awareness of the proximal term of involving all of our muscles when attending to the distal term of doing the summersault. We may not be able to describe every movement of our muscles but we are aware of the use of our bodies.

The *semantic aspect* of tacit knowing is that of the interpretive effort of applying meaning to a distal term, mediated by perception. An example of this is in the use of tools. Here we feel the wood of the hammer in our hands but our attention is on the nail, some distance from our hands. We apply an understanding of the tool, the target and effect of the strike through the feeling in our hands, to the joint goal of nail being driven into its target material.

Polanyi then deduces the ontological aspect from the other three. This is to be read as the joint understanding of the two terms; that we understand entities in relation to their particulars.

He continues to argue that we can make things act as the proximal term of tacit knowing, that we can extend our bodies to include the thing. Here the concept of indwelling becomes relevant as it

describes the process of the shift from: *awareness of a thing*, to: *awareness of an entity through that thing*. It constitutes a shift from attention on particulars, to that of a whole, a process of interiorization.

After this conclusion it follows that when we try to focus on the particulars of an entity, its original meaning to us might be lost. As it is required for us to interiorize particulars in order to understand a whole, so it is required that we lose that understanding, when in the process of exteriorizing the particulars. But it is also evident that it is not indefinitely lost, it is, however, changed when we return to an interiorized state. And in this change there is the possibility of establishing a more secure and accurate meaning of the particulars.

Polanyi also talks about what can be called the transfer of tacit knowledge:

"... the skilful conduct of a game of chess by another person is a real entity, knowable by our tacit act of comprehending it, and that this comprehension is similar in structure to that which it comprehends." - (Polanyi, 1966)

He is thereby saying that in the observation and unspoken understanding of the actions of others, tacit knowledge can be transferred from person to person.

Polanyi then relates his ideas to that of Platos Meno; the paradox of the search for the solution to a problem; *"... to search for the solution to a problem is an absurdity; for either you know what you are looking for, and then there is no problem; or you do not know what you are looking for, and then you cannot expect to find anything."* He goes on to argue that the concept of tacit knowledge solves this paradox. He does this by exemplifying the process of scientific discovery.

When looking back at the birth of a discovery it can seem predetermined, but the time before it is deeply personal and an obsession for the individual scientist.

The scientist pursues a discovery through the intimation of bits and pieces, through which hunches of a hidden truth emerge. But those hunches must be acted upon, and that requires resources. Thus there is a strong incentive in acting upon the right hunch. There exists an attention to the responsible use of those resources in mind of the scientist. This is an attention to the means of a discovery, but what about the ends?

Polanyi states in relation to this that: *"...Originality is demanded at every stage by a sense of responsibility for advancing the growth of truth in men's minds..."* He then contrasts this obligation to

the virtue of disinterestedness present in science, but argues that “... *it is in fact his craving for success that makes the scientist take the risk of failure.*” and he states that the motivation for the creative works of a scientist can come from various sources; the inherent beauty of the discovery or the professional success that comes with it (Polanyi, 1966).

To sum up Polanyi’s perspective; tacit knowledge is the foundation for how we experience the world and how we act on the world. In some cases it can be transferred. And tacit knowledge is one of the key drivers behind scientific innovations and discoveries.

6 Method

To generate the empirical material necessary to answer the problem statement I am utilizing qualitative methods. These methods have been chosen with the purpose of gaining an interactional perspective of the object of interest and elucidating tacit knowledge. In this section I will first present methodology on focus groups and participatory techniques, and after this I will present how I utilised these in the structuring and moderation of the workshops.

6.1 How to do a focus group with a twist of action

As the purpose for the workshop was twofold, elucidating tacit knowledge and changing behaviour, I am going to include both ethnographic and participatory methodology. To elucidate the tacit knowledge of the participants in relation to collaboration, I have chosen a focus group approach. This was done by facilitating a series of activities that had the purpose of making the participants utilize their tacit knowledge. To instil a possibility for change I chose activities with the purpose of reflection and directedness towards future conduct.

There are two main reasons for choosing the group workshop as my main source of data. One is the aspect of focused sociality where the purpose is to “produce data on interactions and norms in social groups” - (Halkier, 2010, p. 123). The questions and activities chosen for the focus group allow the investigator to create the setting for the interactions of the participants. The other is the intention of instilling a new found attention to the intricacies of collaboration in the participants. A big point of action research is emancipation through co-creation; here the participants develop skills and knowledge in a process of social learning. This learning occurs in the participation of creating propositions and following these to real world practical applications - (Nielsen & Nielsen, 2010, p. 113).

The methodology of doing workshops includes the choosing participants, structuring activities and moderating or facilitating the group.

6.1.1 Choosing participants

When choosing the participants you need to be analytically selective, meaning that you need to be aware of which kind of people you choose to invite, and also the prior relations between them. Who you choose will affect the results of your investigation greatly. Being aware of the properties of the participants ensures the ability to generalize analytically.

Depending on the theme of your focus group there are two important aspects to consider, *maximum variation* and *theory guided choosing* (Halkier, 2010, p. 124). Theory guided choosing demands that you set up parameters for the people participating in your workshop, and that those parameters are related to the focus of your project. Maximum variation relates to choosing participants within those parameters while differentiating the groups based on sub-parameters within your main focus of interest. This will allow for varied results if you conduct the workshop multiple times. Varied results of this kind can be relevant for your investigation if you are interested in the possibility for diverse behaviours or normativity within the theory guided parameters.

If the investigator is interested in the relational properties of participants, the focus group can act as a shortcut to participant observation if the context for the social action includes the participants knowing each other prior to the focus group and the activities or questions share themes with the nature of their real world relation (Halkier, 2010, p. 125).

6.1.2 Structuring and moderating workshops

When preparing for a focus group interview or a workshop it is important to consider how you are going to structure and moderate the process as these two factors will shape the social situation that is the source of the empirical data.

When structuring the plan for the focus group it is important to consider the process of preparing the participants for the main activities. Here the introduction that is presented for the participants is important as it sets the stage of the social space where the interactions are about to unfold (Halkier, 2010, p. 128). This approach prepares the participants for the events that are about to unfold. With the introduction you “... *signal the guidelines for the interaction that the researcher is trying to achieve*” - (Halkier, 2010, p. 128).

In some cases it will not be possible or constructive to provoke the interactions you are interested in with just questions. Here tools and activities can help to provoke the interaction fitting the theme of the investigation. *“It is just fantasy that sets the limit for what the moderator chooses to use”* - (Halkier, 2010, p. 132).

Some activities can act as ways to get the participants to talk about things they might not normally do in everyday life. Other activities can include explicit evaluation which creates a space for discussions of valuing. Through these discussions you can see normative interactions as the participants will be negotiating the valuing of entities within the theme of your investigation (Halkier, 2010, p. 132).

The activities mentioned above are mostly concerned with an ethnographic approach. But what if you don't just want to describe behaviours but change them? Here action oriented or participatory methods become relevant. To emancipate and give power to participants the focus of investigation is changed:

“Focus is on how we learn, in contrast to what we learn. With this perspective, power and learning is linked with the assumption that a lower level of participation will only have low learning outcome in contrast to high level of participation which is expected to have high and sustained learning outcome of social and human capital” – (Kanstrup & Bertelsen, 2013, p. 414)

From this perspective it is argued by Kanstrup and Bertelsen that the learning outcome in the participants is tied to the degree of participation. The degree of participation is dependent on the possibility of actually instilling change, meaning that participants should hold a certain amount of power and responsibility. Thereby saying that the participants are not only there as a source of knowledge for investigators or a token for politicians. In regards to the question of what kind of discourse is present in participatory methods the answer is a 'utopian' discourse:

“The concern is transformation from existing to improved situations and it is agreed that there is not one answer to what it means to improve a situation. Consequently, learning is situated, and meaning is negotiated. The ambition of learning in participation is sustained action that is a result of debate about change where participants are motivated to take action and implement change.” - (Kanstrup & Bertelsen, 2013, p. 414)

Here the investigators, or moderators, role is to help participants to express and enhance their own knowledge and behaviours. Kanstrup et al references studies on professional designers as they

describe the importance of reflection in design processes. Here they stress the importance of being able to move from the concrete actions to abstract reflections and back again; the ladder of reflection.

6.1.2.1 *Tuning in and checking out*

In the guide for user innovation from Bertelsen and Kanstrup 'User Innovation Management – a handbook' it is argued that participants are not always ready for action when arriving to the place of the workshop (Bertelsen & Kanstrup, 2011). Therefore it can be a good idea to organize activities that can activate the users so that they are ready for the main process, 'Tuning them in'. In UIM terminology this way of organising activities is called TFC. It starts with *Tune In* and following these are the steps of *Focus* and *Check out*. The Focus step is where the users are working on the design brief. The check out phase is where you sum up the activity and you create the room for overall reflections from the participants (Bertelsen & Kanstrup, 2011, p. 49).

6.2 **My methodological choices in structuring, choosing and moderating the workshop**

In this section I will present and explain the choices I made in preparing and carrying out the workshop.

The idea for the workshop structure started out during my 9th semester project. During that semester I was trying to understand a part of the Health Science and Technology institute at AAU. I did a series of interviews with two researchers about their work in academia and also their work industry. During these interviews I began to see a pattern of the researchers working with people who were unlike themselves in differing ways. When working in academia it would be differences in theoretical knowledge or how they apply methods in regards to the norms of natural science. In the industry they would often be working with people from outside natural science, such as business, entrepreneurship and law.

As the reason for me being there was the internship theme of the semester, I felt obliged to fulfil a need of the researchers I was interviewing. We discussed what this need could be and we agreed that it would be along the lines of "looking at how they communicate with each other". As the interviews progressed the researchers expressed that collaboration between the disciplines can be immensely powerful and insightful. However, they also expressed that the potential for collaboration at the local level is not being utilized to its fullest. Here, the local level meant the institute and researchers situated there. They mentioned differing reasons for why they thought that it might be

so. One of these was the fight for resources or an unwillingness to spend time on something outside peoples own fields. One researcher also mentioned that he learns a lot when he collaborates with people outside his own specialty and that he needs to change how he works so that it fits with the methodology of other specialties:

“It’s an eye opener for me when I see the way in which data can be analysed in other ways, and that the output can be immensely meaningful. Me and Jack can then say: this is actually how we should do this and that, this is the way that we should see it. It gives us the possibility to recognise patterns and understand what is happening, it makes you change your structure and do things differently. We kind of make sure to cross-facilitate each other.” - Researcher, HST AAU, 10/10 2016

These different aspects of collaboration that they were telling me about seemed to fit well into some of the boundaries described by Carlile as the researchers were:

- a) sharing a language of natural sciences and medicine – the syntactic boundary
- b) using learning and meaning creation, as seen in the quote above, to handle differences in interpretations – the semantic boundary
- c) experiencing that knowledge is not neutral as they encounter the fight for resources and an unwillingness to participate in projects outside researchers own specialities – the pragmatic boundary

As I wanted to contribute something back to the researchers I thought about the possibility of changing the local collaboration habits. My idea was to use Carlile’s insights about boundary processes and anthropological-design methods to do two things. One was to provoke the local researchers to confront the boundaries in a focused setting, as to change if and how they collaborated. The other was to try and capture how these researchers would behave when confronted with the boundaries. So I set out to design how this could be done and it resulted in a workshop structure that would challenge the participants in dealing with the boundaries. And that was how my 9th semester ended. For my master thesis I wanted to investigate this idea further. So before the start of the 10th I tried to gather a small group of the researchers for the workshop. But this failed. So I made the choice to go on testing this workshop structure with other people. However, as the workshop structure was designed with the researchers in mind, the people who I chose had to have some of the same properties and relations.

6.2.1 My narrow choice

As I wanted the new participants to share properties with the researchers I analysed what properties I found relevant for the researchers in regards to collaboration. As I had decided to take on the collaboration problem from the theoretical standpoint of Carlile's 3T framework, I needed to understand what kind of boundary I was working with. As Carlile describes a boundary as a difference in background and specialization between groups or individuals I looked at the literature discerning what I thought of as a kind of interdisciplinarity. Here I encountered what is described as narrow interdisciplinarity. In *The Oxford Handbook of Interdisciplinarity* the author Julie Thomson Klein maps the different kinds of interdisciplinarity (Klein, 2010). Here she argues that "*when integration and interaction becomes proactive, the line between multidisciplinary and interdisciplinarity is crossed*" (Klein, 2010, p. 18). She refers to William Newel who depicts a spectrum going from partial to full integration and that the focus can be narrow or wide. The narrow ID is defined as occurring "*between disciplines with compatible methods, paradigms and epistemologies*". So I defined the researchers as doing narrow interdisciplinarity work.

The other property I worked with was that of *prior engagement* as the two researchers had a history of collaborating. Carlile references this property when he talks about the value of a syntactical approach:

"Such a shared and stable syntax/language is constructed from previous efforts at a boundary to address the critical differences and dependencies between the two groups—and once established only the costs of transferring knowledge are faced at the boundary." – (Carlile, 2004, p. 10)

He is thereby stating that the effectiveness of a shared language comes from an earlier encounter with a boundary. I have defined the HST institute as a community of practice and one of the main properties is the continuous development and maintenance of shared repertoire. Here I assume that the researcher's carries experience or tacit knowledge, gained from their former collaborations. Below you can see how these two properties were set up as requirements for the new participants.

My theory guided parameter is that the participants:

- a) Share one part of their educational background with the others in the group. Does not share other part of educational background. (Narrow interdisciplinarity)
- b) Have some form of experience in working together. (Tacit collaborative knowledge)

My maximum variation parameters involved:

- c) Number of people participating
- d) The nature of their prior relations in working together

An overview of the parameters set up for this focus group can be seen in the table below.

	WS 1	WS 2	WS 3
Theory guided	a: Shared bachelor b: Living together as a couple	a: Shared bachelor b: Multiple semester projects written together	a: Shared candidate b: Multiple semester projects written together
Maximum variation	c: 2 people d: Working together in maintaining relationship and household	c: 4 people d: Working together in the process of writing bachelor projects	c: 3 people d: Working together in the process of writing candidate projects

Techno anthropologists were included in all of the workshops in one way or the other. Below are the educational background constellations for each workshop.

The first workshop was conducted with two participants; Jacob and Ann. Jacob have a BSc in techno-anthropology and a Cand.IT in IT Design and Application Development. Ann has a BSc in techno-anthropology and is currently studying Environmental Management and Sustainability Science. They are currently living together as a couple. I worked with Jacob on several 15 ETCS semester projects.

The second workshop was conducted with three participants; Mary, Nancy, Dorthe and Christian. Mary has a BSc in techno-anthropology and a master in Environmental Management and Sustainability Science. Nancy has a BSc in techno-anthropology and a Cand.IT in IT Leadership and Management. Dorthe has a BSc in techno-anthropology and is currently studying IT Design and Application Development. Christian has a BSc in techno-anthropology and is currently studying a MA in Learning and change processes. In their bachelors they have collaborated multiple times on 15 ETCS semester projects. I worked with all tree during some of those projects.

The third workshop was conducted with three participants; Lillian, Nattily and Morten. Lillian comes from a background as an occupational therapist and has an MSc in techno-anthropology. Nattily has a BA in Art and Technology and an MSc in Techno-anthropology. Morten has a BSc in Medialogy and a MSc in Techno-anthropology. During their masters they have all worked together in semester projects. I worked with all three during one of those semesters.

6.2.2 Structuring to explicate and reveal

I was planning to facilitate a workshop with academic staff at the institute of health science and technology. I had structured the assignments and detailed the time each would take as well as which materials would have to be present. However, as it was not possible to carry out the workshop with researchers from the institute I found other participants. The main structure of the workshop was kept intact as I was still dealing with participants whose main activity was that of academic knowledge production.

The workshops' 3 main activities were meant to challenge the participants based on Carlile's 3T framework mentioned in *Theory – 3T Framework*:

- Syntactic challenge: Language is shared and sufficient. Can we communicate?
- Semantic challenge: Interpretations and meanings are different. Can we learn from each other?
- Pragmatic challenge: Accumulated knowledge is not neutral. Can we negotiate with each other?

The ethnographic reasoning for the setup is that I assume that the activities will be sufficient in simulating how these boundaries occur in real world interactions, thereby forcing the participants to utilize their tacit knowledge in dealing with the boundaries.

The structuring of the activities within each challenge is then meant to help express and enhance the participants' knowledge. This is done with inspiration from the ladder of reflection:

- a) One participants uses his or her knowledge in action as they present
- b) Other participants uses his or her knowledge in action as they interpret
- c) Participants come together to reflect in action as they evaluate *a* and *b*
- d) Participants steps back to reflect on action as they formulate visions for future conduct

This structure then repeats itself 3 times in the context of the 3 challenges above. This process is meant to make participants use their knowledge, evaluate it and lastly create suggestions for improvements. The presenting participant will then be able to utilise and follow through on the improvements in the context of the workshop. The participatory structure of the workshop is thus to facilitate: expression and enhancement of knowledge, co-creation of solutions, conditions for the implementation of solutions.

The purpose of the workshop was to reveal tacit knowledge of collaboratory behaviour in the participants, and also potentially change how they collaborate. The plan for the workshop can be

seen below; it was made for the facilitators eyes only. The text in parenthesis and bolded shows 3 things:

([Activity/material] [Time] [Colour of the pencil used])

The mind map method was chosen as a way for the participants to record and structure their thoughts; this was done with black pencil. The recording of thoughts then allows for the recording of places of misunderstandings; this was done with red. And lastly it would allow for the participants to point to places of improvement in how they present information to each other; this was done in green. This structure was to be followed in the first to activities. In the last activity the mapping of misunderstandings and improvements was replaced with a negotiation activity.

The three main activities and their sub-challenges were as follows:

- 1) *Can we communicate?* (The syntactic challenge)
 - a) A participant has to give a short presentation to the others about his/her current research subject. (**Present 1 minute**)
 - b) The others then have to discuss what the possibilities and prospective is for such research and then present their views back to the original presenter. (**Mind map 3 minutes - Black**)
 - c) Differences in understandings are then mapped by the whole group. (**Mind map 5 minutes - Red**)
 - d) Lastly they are asked to reflect upon *how* they presented to their peers and if they would do something differently next time (**Mind map 3-5 minutes - Green**).
- 2) *Can we learn from each other?* (The semantic challenge)
 - a) Based on the mapping from 1. c the original presenter is to give a presentation attempting to reconcile the differences in understandings. (**2 minutes**)
 - b) The others then again have to discuss the possibilities and prospective for the research if they had to utilize it for their own research, they then present their views back to the original presenter. (**New mind map 3 minutes - black**)
 - c) Differences in understandings are then again mapped by the whole group. (**New mind map 5 minutes - Red**)
 - d) Lastly they are asked to reflect upon *why* they had differences in utilization assumptions. (**Mind map 3-5 minutes green**)
- 3) *Can we negotiate with each other?* (The pragmatic challenge)
 - a) Based on the mapping from 2. c the original presenter is to give a presentation attempting to reconcile the differences of understandings in relation to utilization (resources, time, and technical plausibility). (**They look at the 2c map 1 minute and present 2 minutes**)
 - b) The others then have to discuss how they would change their response from 2. b in light of the new information. Then present this to the original presenter. (**New new mind map – 3 minutes black**)
 - c) The whole group then has to come to an agreement on a hypothetical research protocol. (**Research protocol - 5 minutes black**)
 - d) When finished they are asked to reflect on the negotiation process and asked what they would do differently the next time. (**Research protocol – 5 minutes green**)

I setup the table below as an activity schema to create an overview of the activities, the methodological purposes and the methods for each:

Theme	Activity	Purpose	Method
1. Can we collaborate and communicate? (The syntactic challenge)	<p>a. A participant has to give a short presentation to the others about his/her current research subject.</p> <p>b. The others then have to discuss what the possibilities and prospective is for such research and then present their views back to the original presenter. Possibilities on mind map in black.</p> <p>c. Differences in understandings are then mapped by the whole group. Mapping occurs on the mind map in red.</p> <p>d. Lastly they are asked to reflect upon how they presented to their peers and if they would do something differently next time. Reflections are noted on mind map in green.</p>	<p>a. What and how does presenter choose to present?</p> <p>b. How did the listeners understand the presenter and his/her profession?</p> <p>c. How do they reconcile differences in understanding? Provides participants with a sense of when misunderstandings occur.</p> <p>d. How do they agree on future conduct? Provokes reflection in regards to how they understand each other.</p>	<p>a. Method: Presenter gives short speech. Others listen and have the ability to take notes. <i>Materials:</i> pens and paper <i>Time:</i> 1 minute</p> <p>b. Method: Mind map <i>Materials:</i> Paper, black pencil <i>Time:</i> 3 minutes</p> <p>c. Method: Mind map revision <i>Materials:</i> Paper, red pencil <i>Time:</i> 5 minutes</p> <p>d. Method: Mind map revision <i>Materials:</i> Paper, green pencil <i>Time:</i> 5 minutes</p>
2. Can we learn from each other? (The semantic challenge)	<p>a. Based on the mapping from 1d the original presenter is to give a presentation attempting to reconcile the differences in understandings.</p> <p>b. The others then again have to discuss the possibilities and prospective for the research if they had to utilize it for their own research, they then present their views back to the original presenter.</p> <p>c. Differences in understandings are then again mapped by the whole group on mind map in red.</p>	<p>a. How does presenter change his speech based on what he just learned?</p> <p>b. How do they understand new speech and couple this understanding with their own specialities?</p> <p>c. How do they reconcile misunderstandings when multiple specialities are involved? Provides participants with a sense of how misunderstandings occur between specialities.</p>	<p>a. Method: Short speech <i>Materials:</i> Mind map from 1d <i>Time:</i> 2 minutes</p> <p>b. Method: New mind map <i>Materials:</i> Paper, black pencil <i>Time:</i> 5 minutes</p> <p>c. Method: Mind map revision <i>Materials:</i> Paper, red pencil <i>Time:</i> 5 minutes</p>

	<p>d. Lastly they are asked to reflect upon why they had differences in utilization assumption. On mind map in green.</p>	<p>d. How do they agree on future learning possibilities? Provokes participants to reflect on how they can learn and adapt to each other.</p>	<p>d. Method: Mind map revision <i>Materials:</i> Paper, green pencil <i>Time:</i> 5 minutes</p>
<p>3. Can we negotiate with each other? (The pragmatic challenge)</p>	<p>a. Based on the mapping from 2. c the original presenter is to give a presentation attempting to reconcile the differences of understandings in relation to utilization (resources, time, technical plausibility).</p> <p>b. The others then have to discuss how they would change their response from 2. b in light of the new information. Then present this to the original presenter.</p> <p>c. The whole group then has to come to an agreement on a hypothetical research protocol.</p> <p>d. When finished they are asked to reflect on the negotiation process and asked what they would do differently the next time.</p>	<p>a. How does presenter change his speech based on what he just learned?</p> <p>b. How do they understand new speech and couple this understanding with their own specialities?</p> <p>c. How do they come to an agreement when multiple specialities are involved? Provides participants with a sense of how negotiations occur between specialities.</p> <p>d. How do they agree on future learning possibilities? Provokes participants to reflect on how they can negotiate and adapt to each other.</p>	<p>a. Method: Short speech <i>Materials:</i> Mind map from 2d <i>Time:</i> 2 minutes</p> <p>b. Method: New mind map <i>Materials:</i> Paper, black pencil <i>Time:</i> 3 minutes</p> <p>c. Method: Research protocol <i>Materials:</i> Paper, black pencil <i>Time:</i> 5 minutes</p> <p>d. Method: Research protocol revision <i>Materials:</i> Paper, green pencil <i>Time:</i> 5 minutes</p>
Check out	Summing up the activities. "What do you think about today?"	Creating the space for participants to reflect on the process as a whole.	Casual unstructured conversation

The planned structure of the workshop can be seen in the schema above, the actual activity formulations from the workshops can be seen in appendix 1, and the workshops in their entirety can be found in the form of transcriptions if you ask the author.

6.2.3 Facilitating the narrow participants

As I had already developed a detailed plan for how the workshop was going to unfold the main job for me would be to make sure the participants understood the challenges I posed them. But first I needed to get them started.

6.2.3.1 Invitation and initiation

As I knew that the participants, techno-anthropologist, all have a prior knowledge and experience with the theme I am investigating I did not want them to know exactly what was going to unfold at the workshop. I did this as I did not want them to overthink their roles in the workshop. When I invited them I only asked them if they wanted to participate in a 'Workshop'. If they asked what it was about I answered them 'how people collaborate'. Other than that I did not tell them anything. When the day of the workshop came and we were about to start I directed them and gave them information. Here is an example from the very start of first workshop where I instruct the participants Jacob and Ann on what to do:

"You (Ann) can take notes for what he is presenting. It is more for afterwards that I want to make sure you(Ann) know what a mind map is. But you (Jacob) have one minute's time to tell Ann about your latest project." – Workshop 1 [1:31,7]

And after this I instructed Ann by saying:

"And your assignment now is to create a mind map of some ideas and possibilities, yeah, what could the possibilities be for this project? You get 3 minutes." – Workshop 1 [4:31,5]

So at this point at the start of the workshop all the participants know are that they are participating in a workshop, that it is about collaboration and that I give them assignments or tasks to fulfil. Or in other words: I signalled the guidelines for interaction. I structured and moderated it this way because I am interested in how they react and behave in this kind of situation. Therefore I try to simulate a real world situation of one person specifying elements of his profession and another person making sense of this. If I had gone more into detail about the workshop in the invitation or introduction I was afraid to colour their behaviour as I believe that techno-anthropologist would begin to reflect upon their behaviours in advance. And as I had predicted, some of the participants began to reflect on the methodology. After the warm up exercise in workshop 2 we had a small break where we had coffee, tea and bread. Here one of the participants began to reflect on what the exercises would do and what I was investigating:

M: ... men det kan sikkert give.. Det ved jeg ikke, er vi færdige med det her? Må vi snakke om noget andet? Altså om det du undersøger?

R: Nåå altså der kommer, det er jo egentlig bare en slags opvarmning. Der kommer..

M: Så venter jeg med at snakke om det

R: Ja.. Men jeg ved ikke. Jeg tænkte at det var godt med en lille pause.

Here I reacted by saying that what we had been through was just a warm up and that we were not done yet. The participant understood this as a sign to delay her curiosity. And later, during the same break, a participant asked about the first workshop:

D: Hvordan var det så at lave det med kun 2 personer?

R: Hmm. altså fint for lige at få det helt basale testet igennem på rigtige mennesker. Men jeg kunne også godt, det er jo ideelt til at man mindst er tre, i hvert fald så.. Så jeg blev nødt til at, at der var et element hvor man skulle sidde, ja det kan vi komme til, men, Ann blev nødt til at sidde og tænke højt, i stedet for at hun måske skulle have haft en at sidde og arbejde sammen med. Så jeg fik hendes indre dialog med i stedet for at jeg faktisk fik nogen der faktisk snakkede sammen med.

C: Mmh. Men var der en større sammenhæng med at det er nogen der faktisk arbejder i grupper eller har arbejdet i grupper fremfor at det var nogen forskellige fra nogle forskellige grupper?

R: ... Det kan vi lige. Snakke om bagefter. [C: "Okay, nu er jeg bare kritisk omkring dine.."] [Folk griner] Hvilket er godt. [D: "Han sidder fast i en rolle nu"]

C: "Ja det syntes jeg var meget sjov."

Here I talked about how it had been to do the workshop with just two people, during this I mentioned that we would get to an activity later where some people had to talk with each other. This talk led another participant to ask about why I had chosen specific people for the workshop. Here I felt like I needed to stop the methodological discussion. The reason for this was that, as mentioned earlier, I knew that the participants would not be entirely new to the subject of interest. I did not want them to be thinking too much about their behaviour, or *reflect in action*, for most parts of the workshop in an attempt to capture them *knowing in action*, as to reveal tacit knowledge. It seemed as though the break between the warm up and the workshop created a space that took them out of action-mode and into reflection-mode. However, when immersed in the challenges I put them through their attention was not on methodology.

6.2.3.2 Guiding and mumbling

The structure of the workshop was filled with activities for the participants and I was the one to guide them through it. I had decided that the participants should not know much about the coming activities so that they would be 'thrown into the deep end of pool' and thereby be forced to utilise their experience in dealing with the challenges. Only after each challenge would they be asked to reflect on their actions. As such, I formulated the challenges live in the workshop. I knew the

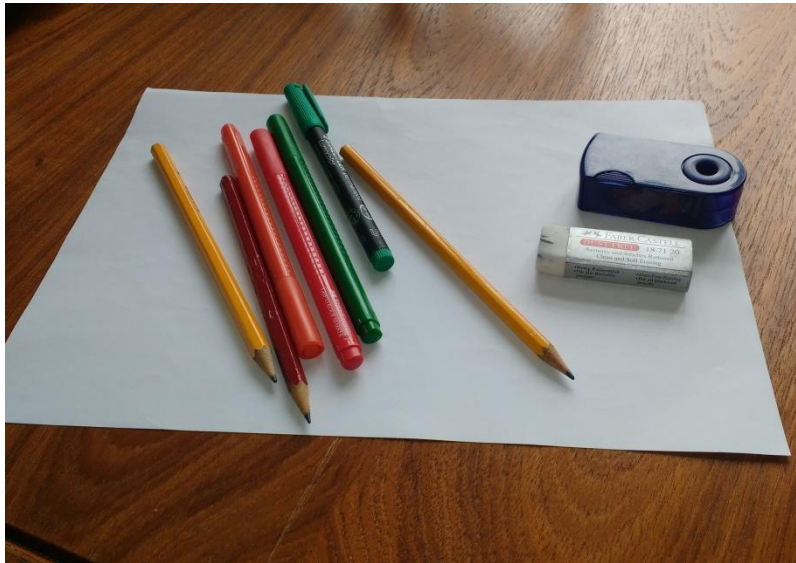
challenge I wanted to pose to them, but I hadn't prepared exact formulations of each challenge. This was done for two reasons: firstly I wanted to pursue a feeling of calm and informality. This was done to make sure everybody participated (Halkier, 2010, p. 127). Secondly I anticipated that I would have to gauge their understanding of the formulation in any case, and that I would therefore need to make a clarification. My formulations can be seen in appendix 1 – Activity formulations. As can be seen in the appendix I had a tendency to mumble when trying to formulate the activities, but I believe the participants still understood what I meant. To further create a sense of informality I chose to use my own living room as the location for the work shop. I offered different kinds of drinks and snacks as well. The setup can be seen in figure 1 below.



Figure 1 Cookies, chocolate and berries. Paper and pencils

Another responsibility of mine as a moderator was that of making sure that participants stay within the themes of the investigation (Halkier, 2010, p. 127). The different coloured pencils had two purposes. The first was to tie the assignment with a physical object: *find misunderstandings* = red pencil, *find solutions or suggestions* = green pencil. The second purpose of the pencils was that the mind maps would be used by the presenter as they prepare for next speech, by using the different

colours the presenter can quickly and easily get an overview. The markers can be seen in figure 2 below.



Figur 2 Pencils and paper

In the following example from workshop 3 I try to make the participants use the coloured pencils. The presenter is talking about what was wrong with the listeners' interpretation but was not writing anything down:

N: Hvad hvis man bare har sådan en, du ved, så har du en golfkugle der ligger på en tee med en fjeder på, så bliver den i jorden, PUNF, og så får du stadigvæk sådan at du rammer den.

M: ... Jae, ehm.

R: Men du kan i hvert fald lige starte med at skrive det ned med den røde, det du mente, ik?

M: Ja, det eh.

N: Så får du i hvert fald taktilt feedback

M: Det gør man jo. Men det er også noget med at se, hvad er resultatet af ens shot. - 33:42,8

Shortly after the participants continue to develop upon the ideas they had come up with instead of focusing on differences in understanding and I try to remind them of the purpose of the given activity:

M: ... hvis du begynder at skulle tracke baseball, jae, der er mange ting, man skal lave en masse calculations og optimering, og du skal hele tiden kalibrere systemet til hvad der er der er i gang.

L: Men det er muligt?

M: Ehh, øhh, [M fniser].

N: Bare skriv kalibrering

R: Nu vil jeg bare lige sige at denne her runde ikke nødvendigvis om at udvikle på de her ideer, det er bare for hvad Morten syntes virker urealistisk. - 34:55,9

These examples from the workshop are meant to illustrate how I attempted to moderate the participants when I decided they had gone too far outside of the premade activities.

There were other places where I felt like I needed to step in. Here I often needed to improvise, as these situations were not included in what I had initially planned. In the first workshop during activity 1c I did not see the presenter pointing out any misunderstandings with the red pencil even though he talked a lot about how the things he had presented should be understood. So before I made them move on to the next activity I asked him two times if there were no misunderstandings. I also asked the listener if what the presenter had explained coincided with her original statements:

J: ... Så ja, helt sikkert, især i remote og asynkron usability testing så er der helt sikkert noget med at spare tid der. ... Øhhh ... [J: kigger på mindmap igen]

R: Der er ikke sådan nogle decideret store misforståelser eller? [

J: "Overhovedet ikke?"]

R: Og det som i præsenterede her, det var i tråd med det du tænkte på eller?

A: Ja. Særligt det med tidszoner. Da jeg skrev det tænkte jeg "det er også asynkront". Men det kan jo godt være begge.. [

J: "det er jo det"]

A: øhm. Ja og så det her [peger på mindmap] det var bare tanker. At det kunne være på flere platforme og interfaces. J: Ja det med platforme er der jo ikke rigtig nogen begrænsninger på. Det kunne være alt muligt. Det kunne din radiator dimmer.

R: Okay, så der er ikke lige nogen store misforståelser?

J: Jeg tænkte godt nok over at du bare skrev computer og du ikke skrev computerprogrammer, men bare: COMPUTER.

[begge griner] Men så tænkte jeg igen, Ja det behøver jo heller ikke nødvendigvis at være et interface på den måde. Jeg er lidt blevet uddannet i interface, altså sådan noget der er på en skærm ikke også. Der skal være nogle designmæssige regler og sådan nogle ting. men det kunne jo også godt bare være: Hvordan fanden bruger man en computer? Hvad er alle de her knapper og sådan nogle ting? Det kunne jo bare være et produkt og ikke et interface.

Thus they didn't really feel like any misunderstandings had taken place. But there had been a need to explain in detail the different concepts he had used in the speech. However, they did not feel the need to label anything in red.

The fact that they did not use the coloured pencils much made me wonder if I needed to include some form of warm up exercise. In the sub-section below I present the process of revisiting the workshop structure.

6.2.3.3 Evaluation of the first workshop

I started the workshop by introducing the two participants to their specific roles. Jacob would be the presenter and Ann would be the listener and “mind mapper”. I then told Ann that she could take notes as Jacob spoke about his latest project. Jacob was given a couple of minutes to do this. After this I asked Ann to think about what the possibilities for the research could be, and that she should write this in the form of a mind map while thinking aloud. After this they were asked to use red pencils to mark where any misunderstandings had occurred. This resulted in a joint discussion between them where they discussed what Ann had wrote, here Ann elaborated on what she had thought and Jacob elaborated on this and they came to the agreement that she had understood the basics of what his project could entail in the future. As such they only drew two small red lines on the paper. As I wanted the mind maps and the pencils to be used actively I thought ways to encourage the use of them. Thus I decided to include a warm up exercise in the next workshop.

As I wanted to introduce the participants to use the pencils of different colours and the use of the mind map I wanted to provoke situations that would force the use of all pencil colours. Therefore I created an exercise where each participant is given a secret challenge. The challenge would force some of them to use the red pencil, some the black and some the green.

To provoke a more use of pencils and warm up participants for working with mind maps in the workshop I included a 10 minute exercise: The participants are situated around a table and collaborate on coming up with solutions to a problem. They are told to list the solutions in the form of a mind map. Each participant is given a secret role. One is overly positive, one is pessimistic, and one comes up with unrealistic ideas. They have the possibility to mark solutions in black, objections in red, and suggestions in green. This exercise is constructed with the purpose of:

1. Introducing participants to the use of mind map and the different uses of the colours in the following workshop.
2. Getting the participants in the right mood for participating in the “made up” situations of the following workshop.

To ensure active participation the exercise are revolving around a theme that all participants know something about. For the researchers at the institute I came up with the following challenge:

“What would you do to solve the problem of multi-resistant bacteria? In this scenario you are leading a taskforce that is to come up with 3 prioritized suggestions. You have 2 minutes to write your own solutions and 8 minutes to minutes to come to an agreement.”

For the actual participants in the workshop I came up a challenge that I believed they would all know something about:

“During the last couple of years there has been a rise in the amount of people who have their bank, email and social media accounts hacked. What would you do to solve the problem of online safety? In this scenario you are leading a taskforce that is to come up with 3 prioritized suggestions. You have 2 minutes to write your own solutions and 8 minutes to minutes to come to an agreement.”

Each participant picks a card that they cannot show the other. On the card is one of the following sub-challenges:

- 1) Green challenge
 - a) Make sure at least one of your own original solutions(Black) are in the final 3
 - b) Make sure at least one of your suggestions(Green) are accepted, resulting in a change in a change in an existing solution
- 2) Red challenge
 - a) Make sure at least one of your own original solutions(Black) are in the final 3
 - b) Make sure at least one of your objections(Red) are accepted, resulting in the elimination of an existing solution
- 3) Black challenge
 - a) Make sure that your original suggestions are not in the final 3
 - b) Make sure that at least one each of the other participants suggestions are in the final 3
- 4) Pessimist
 - a) Don't make any suggestions
 - b) Only critique the others

In workshop two and three I included this exercise before the actual workshops. This was done to *tune the participants in*. Preparing them and warming them up for the situation and the tools of the workshop.

6.3 Observation

In the social situation of the workshop I am going to facilitate the workshops; however I am also doing participant observation. The social situation is by Spradley defined as consisting of the three following elements: place, actors and activities (Spradley, 1980). The social situations are usually happening in the real world and not in a designed space as I am doing with the workshop. Usually the

researcher must take what he can get when he can get. But in my situation I have tried to artificially create the situation I am interested in.

When doing participant observation the researcher will find himself localised at a place, observing actors whose activities he is participating in (Spradley, 1980). In real world day to day situations people act as ordinary participants in different social situations. This means that they participating in activities without thinking about how they act. The researcher will however be attentive to the cultural rules and behaviours that the ordinary participant might not be attentive to. In the case of the workshop I have tried to make the participants act as ordinary participants by neglecting to tell them the focus and purpose of the workshop and by giving the participants activities to fulfil that simulate real world situation.

Spradley presents several differences between an ordinary participant and an observing participant. One of them is: Double purpose. An ordinary participant has one purpose when participating in a social situation. An observing participant has two: participating in the situation and observing. Another difference is the explicit attention. The participating observer must increase his attention so that observations that are normally dismissed become visible to the participant observer. An ordinary participant will block out these observations to avoid being overloaded by inputs (Spradley, 1980). In my case I am participating in the situation by facilitating the process while also observing and my attention was on the how they collaborated.

7 Analysis

In this section I will analyse the empirical material generated from the workshop and the interviews. The analytical methodology will be that coding. Coding is done through labelling specific parts of the empirical data, and through this labelling you break down the material and then synthesise it in new ways that allows the you to see new patterns that may not have visible before. Coding can be done in many different ways, but there are mainly two very different ways of doing it; data driven and theory driven (Tinggaard, Lene & Brinkmann, 2010, p. 47). When doing data driven coding the researcher inductively create the codes through the repeated readings of the material. In theory driven coding the codes are decided beforehand and based on hypothesis or theory from existing literature.

In the first part of the analysis I am going to code based on Carlile's 3T framework and show how the participants interact. This process will elucidate how participants act when confronted with the boundaries, or in other words: their tacit collaborator knowledge.

In the second part of the analysis I will analyse based on learning outcomes. I will code based on the participants own reflections, their normative statements and their propositions for future conduct. This process will show how the workshop performed as a tool for change.

Lastly I will create a synthesis of the theory used in the report. This synthesis will then be combined with the analytical points made.

7.1 Crossing Boundaries

In this part of the analysis I am going to use theory driven coding to identify interactions that fit the description of Carlile's three boundaries. These interactions are then going to be broken down through meaning condensing. In some cases I will restate the interactions in segments of abstract actions. This process reveals the how the participants manage to cross the boundaries and allows for generalising statements to be made.

I have looked through the transcriptions of the workshop looking and coding for the following theory driving categories:

Syntactic behaviour - managed by the process of *transferring*

- Speech is given and understood

Semantic behaviour - managed by the process of *translating*

- Misunderstandings occur and shared meaning is created

Pragmatic behaviour - managed by the process of *transforming*

- Negotiations occur and transformation occur

I structured the activities to create situations that can create the boundaries. I did this by increasing the novelty of each activity by use of the following challenges:

- What are the future possibilities of the project?
- How could you make elements from the speaker's project usable in your own project?
- Create a hypothetical project together that includes aspects from all of your professions.

The participants then utilised their tacit knowledge in dealing with them. In the words of Polanyi I activated their proximal terms; their knowledge, by creating the distal terms; the situation of a boundary.

7.1.1 Syntactic behaviour - managed by the process of transferring:

In this section I will be looking at situations of sending and receiving information. I will do this by looking at the sender's use of technical terms and the receivers' understanding of said terms. Or as Carlile would say: situations where *differences and dependencies are clear at the boundary*.

7.1.1.1 Workshop 1 - activity 1a and 1b

During the first activities of workshop 1 we see the interaction of Jacob giving a speech about his latest project to Ann. In the excerpt below Jacob is using the following technical terms: *Remote, Asynchronous, Interface and Usability*. When introducing these technical terms he is also providing short explanations to some of them as he knows these are unusual terms that Ann doesn't know that well.

J: "... Og det er så i sammenhæng med at teste user interfaces af softwares. Så den del som mennesker interagerer med når de interagerer med et system. Det vil sige en skærm og det, ja, det interface der er der. Og den nye måde det var noget der hedder remote og asynkron usability testing og det betyder at dem der tester systemet er fjert væk fra dem der skal evaluere det. Og da det er asynkront er det heller ikke samtidigt. Så de kan godt teste på et andet tidspunkt end evaluatorene skal evaluere på. ..." – WS1, 2:41,7

When given the challenge to give her thoughts about the prospects of his project she uses the technical terms and contextualise them using her own descriptions:

REMOTE: *Og der kan man jo sige at remote metoder, og i og for sig også asynkront, men i hvert fald remote, der kan man jo sprede det ud så det bliver meget globalt. Øhm. Og man kunne sidde i forskellige lande og gøre det*

ASYNKRONT: *Asynkront, det kan man sige det er så også hvor man kan, ja, det giver noget frihed at man ikke behøver at sidde fuldstændig samtidig sammen med testerne*

INTERFACE: *at det er interfaces. Det syntes jeg også gør at man kan putte det på mange forskellige ting. Det kan både være på apps og spil [Skriver ned]. Det kan være på computere [Skriver ned]*

USABILITY: *Noget af det jeg syntes der gør at man fokuserer på usability det er at man sparer tid. [Skriver ned] Man kan hurtigt finde ud af hvad man har brug for, og så undgå designfejl.*

In this situation we see the listener use her knowledge when given the challenge to explain possibilities of the speaker's latest project. In this challenge it can be said that the differences are clear and the syntax is sufficient for the novelty encountered.

7.1.1.2 Workshop 2 - activity 1a and 1b

In the following interaction from workshop 2 we see a similar process as the one analysed above. However, the novelty of the challenge meant that syntax between the speaker and the listeners was

not sufficient. Below Mary gives her speech and uses several technical terms. She explains some of them and provides context:

M: Ja. Jamen altså i mit seneste projekt som så er mit speciale, har jeg arbejdet med bæredygtigt byggeri med udgangspunkt i den certificeringsordning man bruger i Danmark, som hedder DGNB. Og har så arbejdet med hvordan man kan øge den sociale dimension af bæredygtighed når man taler bæredygtig byggeri, fordi det er den dimension der er sværest at håndtere, og sværest at arbejde med, så det er også den der let bliver glemt når man arbejder med bæredygtigt byggeri. Og det har jeg så gjort ved at involvere aktører fra alle led i en byggekæde, eller hvad man skal kalde det, både entreprenure, bygherre, arkitekter, konstruktører, og selvfølgelig også slutbrugerne. Og så prøve at samle det til hvordan man så forbedre den sociale dimension. Og det er i høj grad noget med at tænke værdi som noget mere end penge, og så den værdi, den menneskelige værdi der opnåes ved at have nogen gode bygninger. Og så arbejde med netop noget co-creation og få inddraget alle aktører i løbet af processen når man bygger. øhh. ja. Det tror jeg at det var det. – WS2, 54:03,0

The listeners are challenged to explain what they believe the prospects for the project could be. They then use the technical terms in their discussion and they ask for additional details:

C: ja. Fordi, muligheder inden for bæredygtigt byggeri kan jo være mange ting. Men når vi snakker social dimension det kunne jeg godt tænke mig at få udpenslet.

N: Mmh. Ja hvad ligger der i det? Det kunne jeg også godt. For det der. Hvad handler det om? Hvad er det for en værdi? [C: "Ja, hvad er det for en værdi vi snakke om også? og.. "] For det enkelte menneske eller hvad?

C: Fordi der er jo både noget social dimension i, du er lidt inde på, hvordan vi bygger og bor tæt sammen og sådan nogen ting, men også, ligesom hun snakkede om med, hele den der byggekæde som er involverede i et byggeri, hvordan er samspillet deri? Og i forhold til slutproduktet og slutbrugeren. Eller..

N: Og nu sagde hun også begrebet co-creation. Uden helt at vide hvor den co-creation, hvem er det der er involveret i den? Er det den der byggekæde vi snakker om? eller er det slutbrugerne, hvor der også skal være noget co-creation eller noget? [Kigger på Mary imens hun spørger] [D: "Kigger lidt appelerende ned til bordenden" Alle griner] – WS2, 57:56,4

In the quote above we see the participants discuss the two technical terms that the speaker used. They show that they are knowledgeable about the terms by discussing what the details and the context of the terms was in the speaker's project. But they wish to know more details: "What kind of social-dimension?" and "Who participated in the co-creation". They do not express that they do not understand the terms, but that they want more details before they can properly give an answer to the challenge. As a result their response to the 1b challenge of finding suggestions for the potential of speaker's project is vague and broad. This can be seen in their mind map where what they noted was: "Building Greenland", "Possibilities within sustainable building" and "Good possibilities in involving the entire building-chain".

I will now reduce the interactions to the abstract actions each participant:

M: Presents her project. Includes several technical terms; only one of these (Building chain) is given a short explanation

C: States that technical term (Sustainable) is broad. Wants details on other technical term (Social dimension)

N: Wants to know sub-category of technical term (Value), and who it applies to

C: Wants to know which context a technical term (Social dimension) has been applied to

N: Wants to know which context a technical term (Co-creation) has been applied to

In this case the syntax between speaker and listeners were not sufficient enough for the listeners to solve or deal with the challenge posed to them, but it was enough for them to understand that they needed further context, and most importantly what kind of context they needed.

7.1.2 Semantic behaviour - managed by the process of translating

In this subsection of the analysis I will look at situations where differences and dependencies are not clear at the boundary and where participants succeeds in specifying differences and thereby create shared meaning.

7.1.2.1 Workshop 1 – activity 2c and 2d

The interaction below shows a situation where the participants encounter a boundary of differences, however they succeed in specifying their differences. From this new found meaning they are then capable of seeing new possibilities.

In the following example we see Jacob and Ann in the process of noting where they encounter differences in understanding as per the challenge of 2c:

J: "What say", hvad betyder det?

A: Altså hvad de siger de gør i forhold [J: "Ah ja"] til hvad de faktisk gør. Øhm, ja, det er sådan det som vi tit støder ind i når vi laver interviews og tests og sådan noget, at de altid er ohh så bæredygtige, men det er de så bare ikke, kan man se.

J: Den forstod jeg ikke, sammenhængen der.

A: jamen jeg tænkte lidt på hvordan man fik testet usability af ting, altså hvad folk bruger, ikke nødvendigvis om det er god brugbarhed men bare hvordan er brugbarheden. [J: "Mmh"] Og det kan være mange ting ikke også, det var det jeg lige sad og hang lidt fast i, hvordan man lige kunne putte dine erfaringer... Men i hvert fold noget omkring det der med en kontrolleret testgruppe og en ikke kontrolleret. Og hvad man så kunne gøre i en ikke kontrolleret testgruppe. Og så tænkte jeg på at give dem simple opgaver og så få det dokumenteret på en eller anden måde, ehm...

J: Og hvad med den der? [Peger på mindmap]

A: Det var bare, de hænger sammen.

J: Det har jeg lidt svært ved at forstå.

A: Jeg syntes også at det var svært. Men denne her [Peger på mindmappet] det var bare lige imens jeg tænkte ehh, hvordan

jeg kunne få det ind. Det her er sådan dilemmaet i mit studie, det ved jeg ikke om det er i dit. Så man kan sige, det er ikke fordi de siger at de gør noget men så gør noget andet.

J: Altså i forhold til mit studie så er det her måske lidt rødt, men for hendes kunne det godt være at det var relevant. - ws 1, 23:58,1

In the interaction above we observe Jacob being unsure of what Ann meant, when she said that his profession could be used in regards to one of her problems. Ann explains her intentions, and Jacob responds by dismissing her idea on the grounds of what he believes his methods to be capable of.

A couple of minutes later and after being given the challenge of reflecting upon why the differences had occurred they create shared meaning. Through some discussing back and forth they come to an agreement where they conclude that Jacob's methods could be used if Ann worked on a project that involved the use of computers:

A: Jeg tror at den største det er det her med at det er computerprogrammer vs virkelige handlinger. [J: "Ja"] Altså mine brugere de sidder ikke ved computeren, at de laver deres ubæredygtige valg. Altså.

J: I min verden der er det fordi at det er lidt mere specifikt det jeg laver. Det er sådan lidt mere inden for ET område, det er virkelig, computersystemer eller apps eller sådan noget med devices. Dit det er lidt mere en værdi nogen gange som er i en eller anden organisation eller en sammenhæng. Så den kan bruges på mange måder, det kan godt være noget i systemer. Men det kan også godt være i forbindelse med mennesker eller samarbejde med andre organisationer eller på globalt plan, politik eller sådan noget.

A: Altså jeg kunne godt forestille mig hvis der nu var en eller anden arbejdsplads hvor at container systemet var hooket op til en computer, og at den så var ubrugervenlig det program, at det så gjorde noget for hvad der ville ske med skraldet. Der kunne man sige at der kunne man gå ind for at teste hele det system, der kunne man bruge din...

J: Ja helt sikkert, for der jo noget, der er en del af dine arbejdsområder som mit også passer ind under, men det er ikke rigtig omvendt, dine kunne ikke passe lidt ind under mine, for din verden er lidt større end min føler jeg. - WS 1, 28:08,3

This was done by Ann introducing a hypothetical container system into the discussion. The interaction can be reduced to the actions of each participant:

A: Our fields are different; our research objects are very different

J: My field is specific and concrete. Ann's is broad and fluffy

A: What if the object of interest included both interfaces and sustainability in this hypothetical situation?

J: Yes. In such a case our professions could work together.

Through the use of a hypothetical scenario they come to the conclusion that there are situations where their professions could interact. To begin with, Jacob is sceptical about the value that his methods could bring to Ann's research field but in the end he has seen a scenario where it could be

possible. Through this process they go from the normative statements of “Our fields are very different” to a new statement of “Our fields are different but they can bring value if combined”. They were able to specify the difference and together create shared meaning.

7.1.2.2 Workshop 2 – activity 1c and 2c

In the ensuing quotation we will see how the participants encounter a barrier of differences. In the excerpt from activity 1c we see one of the listeners ask the speaker if what they suggested in activity 1b had anything to do with what she had been working with. She answers by saying “... sure, generally... I just worked with sustainable building.” Another participant then lets her know that she is not sure what that means, and that she would like her to elaborate, by saying: “But what does that mean?” This leads the speaker to specify the meaning of one of the technical terms she had used in her presentation; the certification:

C: Hvad med i forhold til dit projekt var vi inde på noget af det, noget af det du har beskæftiget dig med eller? Eller hvad for en gren af det du har?

M: Jamen altså, generelt, jeg har jo bare arbejdet med bæredygtigt byggeri.

C: "I bred forstand.."

N: "Men hvad vil det sige?"

M: Jamen det er også derfor jeg siger det med DGNB, der findes en certificeringsordning idenfor bæredygtigt byggeri, så den kan i læse op på, Der er øhh, fem forskellige kvaliteter, plus en sjette som så ikke tæller med. alle mulige parametre inden for de forskellige kvaliteter, og dem måler man så på, og så definere man hvor bæredygtigt det er, og du kan kan så få en bronze sølv eller guld. – WS2, 1:06:03,2

However, this was still not clear enough for the listener, so she asks what one of the sub-terms of the technical term could be. This leads the speaker to begin to explain some of those sub-terms, but she ends up making the point that the human needs are not properly included in the certification:

N: "Hvad kunne en af de ting være foreksempel?"

M: Jamen så er der noget der hedder social og funktionel kvalitet, så er der noget der hedder teknisk kvalitet, så er der noget der økonomisk kvalitet, så er der noget der hedder, hvad hedder det, så er der også en der hedder udenoms kvalitet, eller hvad kan man sige [N: "Mmh" C: "Mmh"], og det er så den der skal måles men egentlig ikke tæller med i selve vurderingen, og så er der.. altså så er det at man arbejder med de her parametre, men inde i de her parametre der ligger der ikke særlig meget hvor man tager hensyn til de mennesker der skal bruge bygningerne. [C: "Okay"] Selvom man jo rigtig gerne.. altså så taler man om, nå okay, 'fungere ventilations systemet?' Og det kan man sige, altså når vi regner på det, så fungerer ventilationssystemet. [N: "Mmh"] Erfaringerne er bare, indenfor byggeri, der er ikke noget, alt det du regner på teoretisk fungerer lige indtil at du sætter mennesker ind i bygningerne. [C: "Lige præcis"] Så når menneskerne begynder at interagere med bygningerne, så alle de beregninger man har lavet, dem kan man skide hul i, altså. [C: "Ja."] Også er der ingen der går ind og så efterevaluere, og så spørger de mennesker der så bruger bygningen, 'Hvordan er her rent faktisk?',

skal vi regulere på den ventilation, er der nogle ting der skal forbedres eller et eller andet, så er man videre til næste projekt, man lærer ikke af de erfaringer man har. Og... - WS2, 1:06:11,4

The listener concludes this interaction by stating her understanding of what the speaker had just said, and the speaker confirms her understanding by making a clear point involving the technical term.

N: Så det du har beskæftiget dig med, det er egentlig at få den dimension mere ind i de der bæredygtige..?

M: Fuldstændig indkorporeret bedre i DGNB systemet, ja. [M: "Okay" C: "Mmh"] – WS2, 1:06:03,2

The interaction above shows how shared meaning is created and thus closes a gap in the semantic differences. The listeners now have a clearer idea of what exactly the presenter has been working on.

To summarise the interaction of creating shared meaning I have reduced it to the actions of each actor:

A: Listener. B: Speaker

- 1) A noticed that they were unsure of a term.
- 2) A asks B to elaborate.
- 3) B elaborates on term.
- 4) A is still unsure, asks B to elaborate further.
- 5) B elaborates further.
 - a) During elaboration B reflects in action and changes the focus from explaining the technical term to focus on explaining what she believes to be wrong with the technical term.
 - b) In explaining what she believes is wrong she provides contextual information.
- 6) A formulates her new found understanding of B's work in a question for B to confirm.
- 7) B confirms question and clarifies by using the technical term.

To recap we saw how the participants specify their differences by creating shared meaning. This newly created shared meaning can now become part of the shared syntax between them. The process that allowed this was that of the listeners being able to identify missing knowledge and communication this to the speaker, and then for the speaker being able to see their missing knowledge, and explain in an informal manner that provides context that the listeners can easily relate to.

Later during the same workshop we see another case of the participants being able to specify their differences. In the situation described above we saw the listener being the one make the initial push

for the differences to be specified. In the following situation we will see the speaker being the one to identify the difference and then to specify and make the difference clear. The excerpt is from activity 2c where we see how a discussion leads to the creation of shared meaning.

N: Præcis, for det du snakker om som der er vigtigt, det er jo vigtigt altid. [M: "Ja"] At man har menneskerne med, og man har menneskerne med på alle niveauer [M: "Mmh"]. Og de skal forstå hvad der sker.

M: Ligenu er det bare helt ekstremt i byggeri, fordi det går så travlt og folk tænker kun på at tjene penge, at det overhovedet ikke er noget der er nogen der overvejer ret meget. Så hvordan skaber man..

C: Det kunne have været spændende at have haft en med fra byggebranchen indeover sådan en diskussion her. [M: "Mmh"] Altså sådan en hardcore..

M: Mmh. Men man kan sige, Jeg har talt med rigtig mange hardcore ingeniører, så det de hele tiden siger, de siger; Hvordan kan vi måle det? [C: "Ja"] Altså det er deres udgangspunkt, Hvordan kan vi måle det? Hvordan får vi vist at der rent faktisk er.. [N: "Mmh"]

D: "De vil have noget konkret"

M: Ja, de vil have nogle tal vil de. [C: "Ja"] ... – WS2, 1:24:01,9

In the interaction we see the conversation shift from agreements on the normative statement that *"people should be included"* to the speaker providing context and nuance to that statement. I have reduced the interaction to the actions of the participants to show how this change happened:

N: Normative statement: "People should be included"

M: Provides context: "The industry is busy. People involved think about money, not much else."

C: Reacts and reflects on context given: "Fun if building people were in this conversation"

M: Knows what building people probably would say. Provides further context based on experience: "They might agree, but they want numbers"

After this interaction the normative statement has been nuanced and a new one has been created: "People should be included, but to do that numbers are needed". In this case the speaker was able to specify the difference because she was situated in the situation of the listeners making normative statements about her field of study and knowing that the normative statement needed nuancing. Once again they were able to identify their differences and create shared meaning.

7.1.3 Pragmatic behaviour - managed by the process of transforming

In this section I will be looking at situations where negative consequences have to be resolved at the boundary. In these situations the participants will identify differences and then adjust their knowledge to accommodate other fields or methods. These situations are characterised by the participants' willingness to entertain the thought of change in their way of performing their own knowledge.

7.1.3.1 Workshop 1 – activity 3c

The interaction below shows how they are able to cross the pragmatic boundary by Jacob allowing a change to be made to one of his methods. The situation comes from activity 3c where they are working on the research protocol:

In the interaction they start by agreeing on the fact that they can both investigate the app, but what they agree on sounds like two separate studies: Ann can do her own investigation in regards to the potential of eco-awareness and Jacob can do his own usability evaluation. Ann then tells Jacob what her main interest is:

A: ... Og så skal der testes. Og jeg går ud fra at det er dig der har en tilgang der. [J: "Ja"] Fordi jeg ville umiddelbart bare lade dem bruge den. [

J: "Ikke have nogen opgaver?"]

A: Øhh, altså for mig er det spændende det er: hvad fortæller den viden de får, efter de har brugt den, så får de jo ligesom et eller andet. Hvad fortæller den dem?

J: Og det ville du kunne vide mest om hvis de bare bruger den så naturligt som muligt?

A: Ja, dels så ville jeg snakke med dem, dels så ville jeg lade dem have appen i lang tid og så se om der skete noget med deres køb. – WS1, 48:49,1

Jacob then lists some possibilities for how he could do his part of the investigation:

J: Mmh, okay. Så fastlægge en remote asynkron usability testing [A: "Ja"] i et eller andet tidsrum, ikke også. Øhm. Men det der så ligger inde under det er så, hvordan, hvilken remote asynkron usability? Der er jo super mange, det behøver jo ikke være dagbog eller optag af skærmen eller sådan nogle ting. Det skulle man så også finde ud af. Altså skulle de skrive noget i en lille dagbog af hvad de oplever af fejl og hvad de tænker omkring det og sådan noget. [A: "Det tænker jeg at du ved bedst."] Eller skulle de have et forum på internettet hvor de kan skrive med hinanden og snakke om hvad er det for noget det her? – WS1, 49:42,9

Ann proceeds to tell him how she envisions the app. This leads Jacob to suggest that by changing one the methodological techniques from his profession they could allow for aspects of Ann's interest to be elucidated:

A: Altså umiddelbart er den ret nem at bruge. De får, ligesom de går ind i deres bankapp, så når de har købt noget i butikken, så kommer det jo: Netto minus 200 et eller andet, og så ud fra det ville der stå 5 kilo CO2. Og det er så den, hvor man er sådan, okay, hvad siger det dig som forbruger? [J: "Ja"] Og så kunne vi også, eller vi lavede også en funktion hvor at de så kunne gøre, altså at når de så stod nede i butikken, kunne de også via den app scanne produkter og så få et estimat. [J: "Mmh"] Sådan at de viste det inden de havde købt.

J: Der er jo ret meget brug i den. Der kunne godt ske ret mange usability fejl i den, tænker jeg.

A: Det er de to funktioner: en oversigt og en scanner.

J: Så det er en telefon app, det gør det lidt mere kompliceret hvis man skulle lave en skærm optagelse af det, med at de

brugte det. Det tror jeg ikke at vi kan. Men så skulle det være sådan noget med at de skulle nedskrive problemer. Men der kunne man så godt udvide det, sådan ikke kun med hva de finder af usability problemer, men hvad får de ud af det og hvad har de lært. [A: "Jaja"] Sådan lidt mere deres holistiske tanker omkring det ikke også? [A: "Mmh"] Okay. Øhm.

A: Så det ville være noget dagbog eller hvad? [J: "Ja"] Opgaver. man kunne jo godt sige: du skal gå ned og finde ud af hvor den her mælk har.

J: Ja det kunne man godt ja. Man kunne godt lave nogle enkelte opgaver. Man kunne lave sådan lidt noget miks. Både bruge den sådan almindeligvis, men også give dem nogle enkelte opgaver. [A: "Ja"] Dagbogsformat, [J skriver ned] både naturlig brug og opgaver. – WS1, 50:22,3

To sum up the interaction above I refer to Carlile's description of the process required to manage the pragmatic boundary:

"The third characteristic required to manage knowledge across a pragmatic boundary is that the process or tool can be used to alter or transform the knowledge being used at the boundary. In cases where negative consequences exist, the groups involved must be able to change the knowledge that they are currently using to "try on" alternatives and make trade-offs to create new knowledge that accommodates the novelty identified." - (Carlile, 2004)

I include this section of Carlile's statements as the excerpt from the workshop above is particularly fitting.

What happened in the interaction above is that the *novelty encountered* was the challenge of the creation of a joint research protocol. The process for managing this novelty was:

- 1) Jacob presents a vision for how he could test the app using his methods
- 2) Ann presents her vision of the app and what she would ask participants.
 - a) By using analogies to personal banking apps and describing the envisioned app's two main functions
- 3) Jacob suggests a change to his methods that could allow for Ann's needs to be met

Thus the key to managing the process was the mental picture of a hypothetical app that Ann created combined with Jacob's understanding of Ann's needs .

A little later in the discussion on how to design the research protocol we see how Jacobs expresses knowledge on how his suggestion will not harm Ann's aspect of the investigation. Like in the situation above we see how they first encounter the *pragmatic boundary* and then find a solution to it. But there is a small difference. In the situation from above we saw how Jacob was sceptical, but he suggests a way to incorporate Ann's methods. But in this situation we see how it is Ann who is

sceptical. We see how Jacob has identified a risk where mixing their methods could have negative consequences for Ann's part of the investigation. He makes the promise that he would design his method in such a way as to avoid such a situation.

J: Jeg vil faktisk, i sammenhæng med det her interview, så vil jeg også foreslå et interview med dem før de begynder testen. Altså efter vi har givet dem, efter vi har introduceret den og hvad det handler om det her. Altså hvis du nu er bruger så fortæller jeg til dig hvad du skal gøre og vi giver dig appen og sådan nogle ting, og sender dig et stykke papir med de opgaver du lave og sådan nogle ting. Og så vil der jo lige gå en dag, og så vil jeg interviewe dig; hvad skal du gøre? For det var det vi ikke gjorde på forrige semester, og der gjorde de ikke de som de skulle gøre. Så hvis vi lige havde lavet sådan en...

A: Okay, men ikke i forhold til om de er bæredygtige eller ej?

J: nej nej nej. Bare sådan omkring opgaven, altså selve testen. Så man lige bliver synkroniseret og bliver sikker på og afklaret med om at jeg som evaluator ved hvad du ...

A: Ja, okay. så man ikke om en uge står med resultat som man ikke kan bruge til noget.

J: Lige præcis, og det er bare noget der ikke har en risiko for noget. Altså det giver ikke noget bias eller noget sådan. [A: "ja"]
Så interview .. – WS1, 54:07,5

To clarify what occurred in the interaction above I have condensed it to the actions of each participant:

J: States that he will perform an interview to ensure the quality of the data

A: Wants to know if the interview will include aspects of the object of interest

J: Ensures Ann that the interview will exclusively concern the instructions of the participants

A: Ann acknowledges by stating what she thinks would happen if they didn't do this

J: Ensures Ann that the interviews will not risk creating bias towards the object of interest

The interaction shows that Jacob knows Ann's methods and that he was able to convince her to change her usual way of carrying out a project even though there might be a negative consequence on her end of the investigation. In these interactions we saw the participants being able to represent, negotiate and transform their knowledge.

7.1.3.2 *Workshop 2 – activity 3c*

In the following excerpt we see that the participants were maybe too alike. I did not manage to identify any aspects of the pragmatic boundary posing a challenge, leading to negotiation that resulted in the changing of knowledge. The following shows how they discuss the intricacies of method. Their discussion is not centred around changing methods, but more on choosing methods for investigating the object of interest:

C: Hvis det var mig, jeg kunne godt have brugt altså gået ind og så se, på noget mindre feltarbejde, hvad er det for et praksisfællesskab, hvad er det for en kultur? Hvordan er det de snakker? Noget diskurs. og hvordan kan man så udlede en eller anden form.. Hvordan skal man snakke til de her folk for at de kan forstå hvad det er man selv mener. Vi er jo igen forskellige faglighder der skal prøve at blive..

M: Men en diskursanalyse, ville det så ikke også kunne være en metode? [C: Jo lige præcis.] Det kan vi jo bare skrive på

D: Men men. Det er igen det jeg mener, en ting er at, at du stadigvæk snevre det ind til at sige at det er noget med IT at gøre. men igen. Det er stadigvæk meget konkret. [

N: Hvad der giver mening at gøre

C: Ja, man kan gøre det på sygt mange måder].

D: Det kan også være at individet slet ikke kan fungere i et interview. Altså ham her kan simpelthen ikke, han er ikke god til at verbalisere det han tænker oppe i hovedet, så jeg er simpelthen nødt til at skulle følge ham. Altså. [

C: Ikke for at være sådan helt stereotypisk tænkende men. Folk griner]

D: Det er svært at sige lige nu her hvad det er der vil fungere bedst.

N: Man kan sige at i og med at vi siger at vi gerne vil have et eller andet på forskellige nivåer så giver det også mening at vi har nogle forskellige metoder vi gerne vil tage i brug. Sådan at, lederen, der vil det give god mening at have nogen interviews. Og så vil det give mening at følge nogen i deres praktiske arbejde. Whatever that might be. ...

D: Men Marys workshops eller også hvis man gerne vil se mere på samarbejde. Så ville det være en god måde også..

N: Også for at få afprøvet det værktøj. [Alle Mmh] hvad man er nået frem til.. [N skriver]

C: Det er jo lidt spændende som du siger. Det er også bare lidt min egen erfaring at, hvis man tog nogen a dem fra Thule og satte i kontekst som hed workshop eller interview. Så tror jeg virkelig næsten at der kommer jeg til at skulle foretage en samtale, altså virkelig hårdt, og få hevet noget ud af folk. Fordi, det er måske ikke på den måde at de er vant til at tænke. Altså og. At tænke over de ting de gør. [D: Det er det]

N: Der ville det gøre mere mening at spørge til hvad de gør, imens de gør det. [C Ja] [D Ja det er såå]

C: De gør de ting der står på papiret og så er det det. Altså, der ligger ikke så mange tanker i det. I hvert fald ikke ved de fodfolk der er på jorden. Men oppe i ledelses området der er det måske nemmere at have en dialog omkring noget mere humanistisk.

D: Så det er vigtigt at vide ligepræcis hvem det er man har med at gøre når man skal sådan noget her. [C Mmh] – WS2, 1:40:45,1

The interaction above is a representation of a lot of the other interactions that took place during this workshop. There is much discussion about how the methods should be used, but not any discussions or explanations about said methods. The reason could be found in the fact that they not only share the same bachelor's degree, their candidate degrees are all quite similar except for Dorthe's. Her candidate degree involves skills such as coding and usability test. However, at the time of the workshop she had only finished the first two semesters and thus she wasn't as experienced in those aspects of her education. Dorthe was the only one who differed from the others in terms of their educational backgrounds. I see two ways for her difference to be utilized. The first one was if she had been the presenter throughout the workshop. This would have forced them to talk about entirely different methods as she would present her latest project. The other is that I should have facilitated

or structured the workshop in such a way that would have made her more likely to contribute with knowledge from her IT technical perspective.

The result of this homogeneity resulted in the participants being aware of their slight differences. They had the language to be able to represent each other's knowledge, thus handling the syntactic boundary. When differences in interpretations occurred they were able to specify that difference and create shared meaning, thereby handling the semantic boundary. But the participants were never challenged in such a way as for them to encounter the pragmatic boundary. The novelty at the boundary never increased to such a degree to provoke a situation where they had to change their own approach or include methods unknown to them.

7.1.3.3 *Workshop 3 – Activity 3c and 3d*

In the following excerpts we are not only looking at the interactions but also including the reflections of one of the participants.

The context of the next quotation is that the participants are being challenged in the activity of completing a research protocol. In the interaction we see how they are trying to design the method of their project. Morten and Nataly's bachelors have much more in common with each other than they have with Laura's. Between Nataly and Morten, Morten is the one in the with the most IT technical skills. Laura's background differs the most, as she was an occupational therapist. They have decided to try and deal with a problem from Laura's field; ADHD and learning in schools, with the tools from Morten and Nataly's field; computer vision and interactive installations or software:

M: ja der er noget med at prøve at se hvor de skal være børnene. Der skal indsamles en masse data der. Det er jo bare ud og måle. og finde ud hvordan det ser ud på forskellige skoler. Institutioner. Skoler er også institutioner. Den værste form af dem... Og hvad har vi så? Hardware. Software. Det kan køre sideløbende med hi-fi. Men i hvert fald skal der i hvert fald nok en måneds tid til at starte ud med..

N: Ja ik også? En halv til en hel måned. Tænker jeg i hvet fald. en måned er nok ikke helt skidt. fordi. det virker sgu aldrig

M: Nej. Det tager lidt tid..

L: Og for at ramme selve effekt analysen så skal vi huske at starte med en baseline, inden vi starter. [

N: Altså jeg tænker det er noget i den der [N peger på behovsafdækning]

L: jae. selvfølgelig. Og så skal vi også bruge en månedstid til at analysere de ting vi har fået ud af det. [M: mmh]

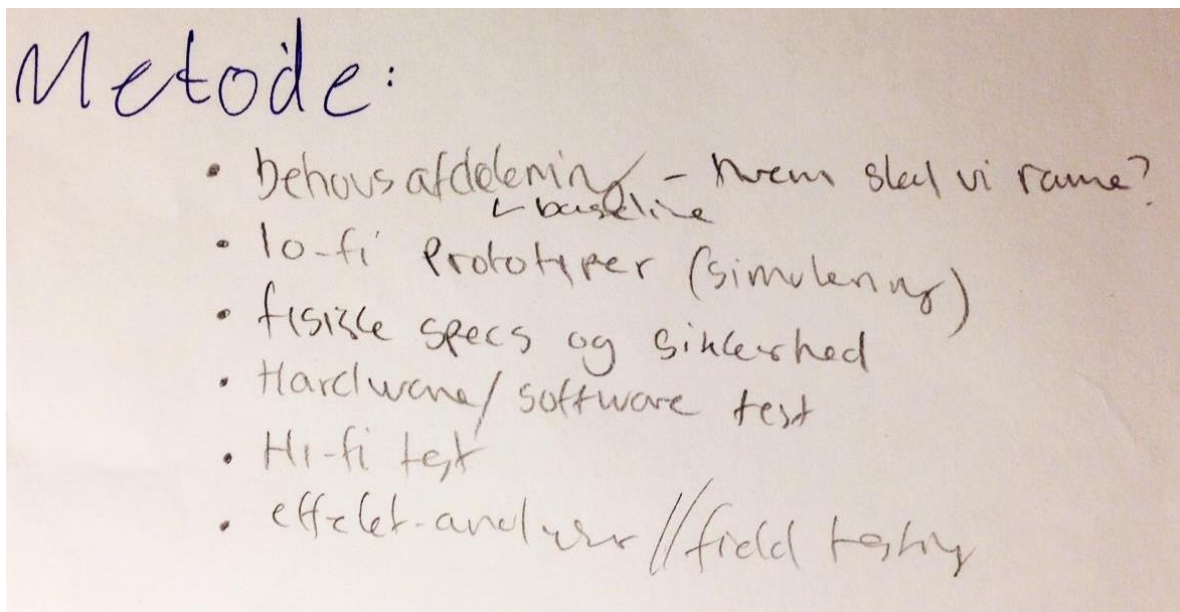
M: Hifi test. [N: Det tager lang tid] Ja det gør det nemlig. Det er også der hvor vi skal have det der i mente ik. med hensyn til.. [R: tyve sekunder] Så.. puhh. Det er nok ofte det der tager længst tid ikke. Uden at være skrap.. [N skriver] Og ...

N: hvor lang tid sagde vi til det. 3? 4?

M: jeg vil sige 3. Fordi man skal også behandle data fra det her nede. Hvis man skulle kunne vise at der er en effekt. Og det er jo det man sådan ville kunne udbrede på i sidste ende. [L: Mmh] Det er jo at det rent faktisk virker. [L: Mmh]

N: Okay. Så tager vi den her, og så er vi færdige. RESTEN. [Alle griner] – WS3, 1:20:55,7

It should be noted that at this point of the workshop, I was trying to get them to finish the activity within the set amount of time I had planned for the participants to complete it in. The context and problem for their imagined research project had been explained by Laura, but she had yet to contribute with any methods to the research protocol. Morten and Nataly were dominant in that part of the discussion. In the interaction above she mentioned that they must remember to include a baseline investigation for the effect analysis to be doable. However, as the time was short they did not have the time to discuss what it entailed. And as a result the baseline and effect analysis are added to the protocol as quick add-ons. In figure 3 it can be seen that the baseline investigation has been added as an afterthought under the needs assessment.



Figur 3 Workshop 3 research protocol

So the participants didn't have time to discuss the intricacies of Laura's methods. But when asked to reflect upon the process of creating the research protocol during activity 3d one of the participants states that the aspect that she thought most difficult to handle was the prioritisation of each of their disciplines when deciding upon what to do when and how to do it:

N: Altså jeg syntes at det sværeste det er den der, ja, forhandling af hvornår er det min faglighed der skal prioriteres over din faglighed. [L: "Ja hvad er vigtigst"] Er det vigtigt at vi får udviklet hardware delen først eller er det den her effekt der skal måles på, altså sådan hvad får vi ud af det og baseline og alt sådan noget. [L: "Jaer"] Hvor starter vi henne? [M: "jaer"] – WS3, 1:23:18,2

And later, after the workshop, during the checkout phase and after the activities were done I asked them if it was easy to complete the method segment of the protocol activity. Nataly answered:

N: Jeg tror også at man bare lidt må stole på at når der kommer en med en eller anden specifik faglighed og siger at inden for mit der er det vigtigt at vi husker den der baseline for eksempel. Så må man jo respektere det og sige: det ved hun sgu nok lidt mere om end jeg gør, så det kan godt være at vi skal huske at tage det med! - WS3, 1:27:09,3

Nataly was able to identify that a change had to be made to include the methods of Laura. But the choice was based on trust in Laura's knowledge of her own profession; it was not based on understanding. However, they did end up including the baseline investigation in the needs assessment and including the effect analysis in at the end of the protocol, thus changing their methods.

Here the novelty did increase to such a degree that the participants had to make a decision to transform their knowledge. However the transformation was superficial, as it only involved the inclusion of methods into a codified research protocol. Neither Morten nor Nataly really knew what and why the baseline investigation and the effect analysis were to be included. No shared meaning was created to ground the decision on; it was only trust.

7.1.4 Summary of crossing boundaries

In the syntactic behaviour analysis we saw the case of the speaker introducing technical terms but also providing short explanations to some of them as he knew the terms were unusual for the listener. We also saw how a group of listeners had a hard time sufficiently completing the challenge posed to them. However the cause of their troubles is likely to be found in their inability to make a decision or the vagueness of the facilitator's formulation of their challenge. Their knowledge was enough for them to understand that they needed further context, and most importantly what kind of context they needed.

In the semantic behaviour analysis we saw the case of the participants' use of a hypothetical scenario to come to the conclusion that there are situations where their professions could interact. We also saw other participants being able to identify missing knowledge and communicate this to the speaker, and then for the speaker being able to see their missing knowledge, and explain in an informal manner that provided context that the listeners could easily relate to. We then saw how one of the speakers was able to specify the difference because she was situated in the situation of the listeners making normative statements about her field of study and knowing that the normative statement needed nuancing. In several places we have seen how the participants specified differences and created shared meaning.

In the pragmatic behaviour analysis we saw the case of how the participants were able deal with negative consequences. The key to managing the process was the mental picture of a hypothetical app that Ann created combined with Jacob's understanding of Ann's needs. We also saw how Jacob identified a risk where mixing their methods could have had negative consequences for Ann's part of the investigation. He made the promise that he would design his method in such a way as to avoid such a situation. In another group we saw that when differences in interpretations occurred they were able to specify that difference and create shared meaning, thereby handling the semantic boundary. But the participants were never challenged in such a way as for them to encounter the pragmatic boundary. Lastly we saw how one group's transformation was superficial, as it only involved the inclusion of methods into a codified research protocol.

This part of the analysis has explicated various techniques and behaviours used by the participants in dealing with the challenges of the workshop. These explications show that it was possible to explicate some of the participant's tacit collaboratory knowledge.

7.2 Learning and Change

In this part of the analysis I will focus on learning and change. First I will look at how the speeches changed as they progressed through activity 1a, 2a and 3a. After this I will look at places of articulated reflections.

7.2.1 Changing the speech – a comparative analysis

In the table in appendix 2 I listed the speeches from all three workshops, creating a means for comparing changes. The coding was inductively data driven and was done through repeated readings of the speeches. I colour coded to create a visual representation of how the speeches changed.

Through the coding process I saw three characteristics of the 1a speeches compared to the others. The first thing I noticed was the relationship between the use of academic or technical terms and the explanation of said terms. In the speeches from 1a there is a tendency to use many technical terms and only little effort in explaining them, as can be seen in the relationship between yellow and green markings in appendix 2 or as seen in figure 4. The other characteristic of the 1a speeches is the lack of informal language, as in the use of: figure of speech, slang, cursing, rhetoric questions, and imitations. And the third characteristic is the absent of negative language, as in the use of: "Only", "But" and "not" in regards to plausibility and limitations.

Activity 1a	Activity 1a	Activity 1a
161	<p>Måske kan jeg prøve at gøre det lidt mere formelt, men det er vigtigt at være tydelig på de vigtigste punkter. Hvis I har brug for mere detaljer, så er det også vigtigt at være tydelig på de vigtigste punkter. Hvis I har brug for mere detaljer, så er det også vigtigt at være tydelig på de vigtigste punkter. Hvis I har brug for mere detaljer, så er det også vigtigt at være tydelig på de vigtigste punkter.</p>	<p>Måske kan jeg prøve at gøre det lidt mere formelt, men det er vigtigt at være tydelig på de vigtigste punkter. Hvis I har brug for mere detaljer, så er det også vigtigt at være tydelig på de vigtigste punkter. Hvis I har brug for mere detaljer, så er det også vigtigt at være tydelig på de vigtigste punkter. Hvis I har brug for mere detaljer, så er det også vigtigt at være tydelig på de vigtigste punkter.</p>
2	<p>Det er vigtigt at være tydelig på de vigtigste punkter. Hvis I har brug for mere detaljer, så er det også vigtigt at være tydelig på de vigtigste punkter. Hvis I har brug for mere detaljer, så er det også vigtigt at være tydelig på de vigtigste punkter. Hvis I har brug for mere detaljer, så er det også vigtigt at være tydelig på de vigtigste punkter.</p>	<p>Det er vigtigt at være tydelig på de vigtigste punkter. Hvis I har brug for mere detaljer, så er det også vigtigt at være tydelig på de vigtigste punkter. Hvis I har brug for mere detaljer, så er det også vigtigt at være tydelig på de vigtigste punkter. Hvis I har brug for mere detaljer, så er det også vigtigt at være tydelig på de vigtigste punkter.</p>
3	<p>Det er vigtigt at være tydelig på de vigtigste punkter. Hvis I har brug for mere detaljer, så er det også vigtigt at være tydelig på de vigtigste punkter. Hvis I har brug for mere detaljer, så er det også vigtigt at være tydelig på de vigtigste punkter. Hvis I har brug for mere detaljer, så er det også vigtigt at være tydelig på de vigtigste punkter.</p>	<p>Det er vigtigt at være tydelig på de vigtigste punkter. Hvis I har brug for mere detaljer, så er det også vigtigt at være tydelig på de vigtigste punkter. Hvis I har brug for mere detaljer, så er det også vigtigt at være tydelig på de vigtigste punkter. Hvis I har brug for mere detaljer, så er det også vigtigt at være tydelig på de vigtigste punkter.</p>

Figur 4 Colour coding

In a combination of these characteristics I deem the 1a speeches to be formal, academic and technical speeches. An example of explaining the terms can be seen in the following excerpt:

”remote og asynkron usability testing og det betyder at dem der tester systemet er fjert væk fra dem der skal evaluere det. Og da det er asynkront er det heller ikke samtidigt. Så de kan godt teste på et andet tidspunkt end evaluatorene skal evaluere på.” – Jacob, workshop 1, 2:41,7

The 2a speeches shared the characteristics of the introduction of a lot of informal language and the increase of explanations of terms and contextual knowledge. For sharing these characteristics I deem the 2a speeches to be informal storytelling speeches. When I say storytelling I mean that the speakers explain their projects by starting out by ‘setting the scene’ and use in the use of: figure of speech, slang, cursing, rhetoric questions, and imitations when explaining terms and providing contextual information. An example of this can be seen in the following excerpt:

”... post-occupants evaluations. Hvor man netop ved; 'Okay, vi har bygget den her bygning nu, nu skal vi til at bygge en ny bygning, så tager vi udgangspunkt i de erfaringer vi har fra den her bygning, og så bygger vi ovenpå, så man kan sige at hver gang vi bygger, så bliver vi klogere og klogere og klogere og klogere. Fremfor at vi tænker, altså det siger de selv, branchen mener selv at de på

nuværende tidspunkt der starter de fra Adam og Eva hver gang, Og man kan sige, hvorfor helvede gør de det? Det koster jo også en masse penge. Så også det der med at ja, Ville sine erfaringer, og ikke bare tænke nyt projekt, så starter vi forfra ...” – Mary, workshop 2, 1:12:54,5

The 3a speeches shared the characteristic of standing out from the others by having a high frequency of negative language, as in the use of: “Only”, “But” and “not” in regards to plausibility and limitations. An example of this can be seen in the following excerpt:

”... Man kan sige, det er sådan den største svaghed der er lige nu og det der egentlig er rigtig relevant at finde ud af. Så vi netop rykker noget, og ikke bare sådan, igen, sådan teoretisk sidder og finder frem til 'Nå jamen det er en god ide at gøre sådan her'. [N: "Mmh"] ... tænker jeg. Så ja, fundet frem til en masse spændende resultater og sådan noget, men altså, det er jo fint nok. Men, hvad så? ...” – Mary, workshop 2, 1:29:02,1

This part of the analysis has showed that the speeches changed as they progressed through the activities. It has showed that the changes were similar across the three workshops. Furthermore the speeches were categorised into the following:

Activity 1a – Formal, academic and technical speeches

Activity 2a – Informal, storytelling speeches

Activity 3a – Realistic and pessimistic speeches

7.2.2 Reflections on action

In this section I will show where reflections occurred. Reflection has long been touted as one of the great ways of learning. A quote from Confucius is highlighted in a recent study on the effects of reflection in learning:

“By three methods we may learn wisdom: First, by reflection, which is noblest; second, by imitation, which is easiest; and third, by experience, which is the bitterest.”

In the study they compare participants learning outcomes. One group is told to reflect on their experiences and the other is not.

“Results from our studies consistently show a significant increase in the ability to successfully complete a task when individuals are given the chance to couple some initial experience with a deliberate effort to articulate and codify the key lessons learned from such experience” - (Stefano, Gino, Pisano, & Staats, 2016)

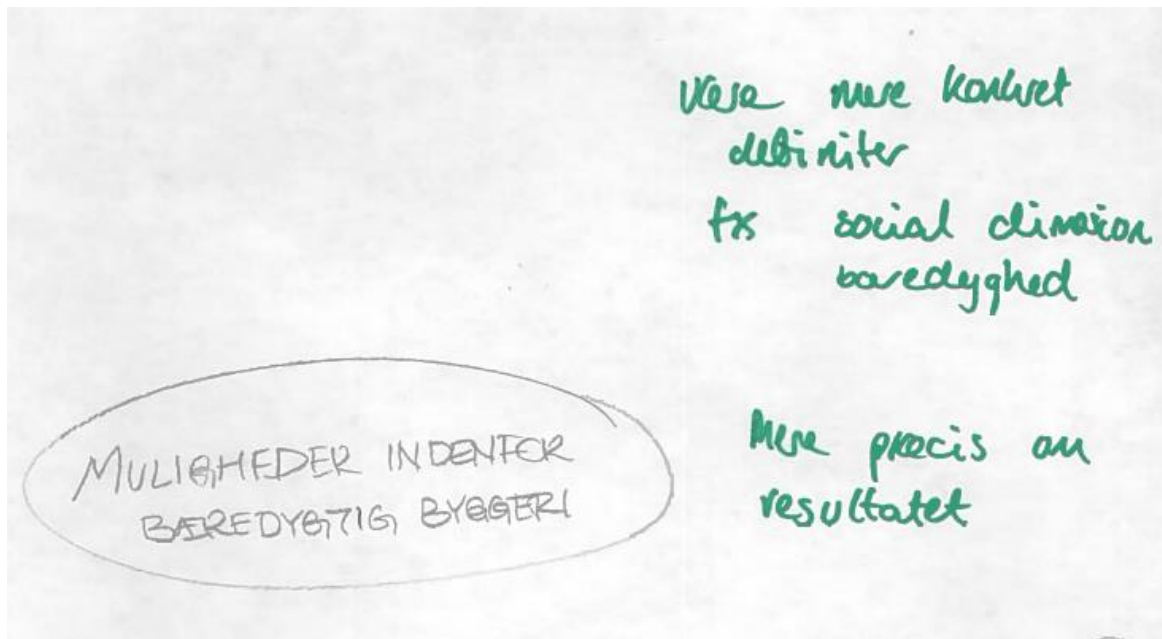
In the activities 1d, 2d and 3d, the participants were asked to reflect on their actions in regards to speeches. They were given a green pencil to note down what they came up with. Below I will show excerpts of reflections being articulated and in some cases codified on paper.

In the following excerpt we see Mary in the process of handling the challenge 1d: reflecting on how she presented and if she would do something differently next time. Here she expresses what she observed as she listened to the other participants discuss what her project could be used for:

M: Jamen altså man kan, man sige at det der var meget tydeligt da i sad og diskuterede, det er jo måske at være mere klar på, altså, hvad kan man sige, mere konkret i også, definitioner. Det var en ting der gjorde jer meget usikre [C: "Mmh" N: "Mmh"]. Det var; Hvad er det hun mener når hun siger bæredygtig, hvad er det hun mener når hun siger social dimension, altså. ... Og det jo en ting, at hvis bare i havde vidst det så havde ikke siddet og knap, og været så tøvende eller, hvad kan man sige. [N: "Mmh" C: "Ja"] Og så også, det var noget jeg sad først at tænkte, det var, jeg har lagt det, det er alligevel nogle måneder bag mig det her. Men også mere konkret hvad det er vi sådan helt præcist har gjort, hvad er det HELT PRÆCIST vi har fundet ud af. Det er igen det der med at være konkret, fordi når i så siger, Hvad er mulighederne med det? Det ville i jo også bedre kunne sige hvis i vidste hvad det var jeg også helt præcist havde fudnet frem til. [N: "Mmh" C: "Ja"] Så også bare den del altså. Ehh, hvad hvis man siger.. [N: "Mere klar om resultatet, på en eller anden måde"] Ja, mere præcis om resultaterne. [M skriver ned med grøn]. – WS2, 1:10:05,4

After having seen them discuss she has gained an understanding of the way she introduces her project. It was her attention to the fact that the listeners were slow and held back as they were unsure on the details of many of the aspects that she had presented in her speech. In this reflection she identified several points where she could do something differently in the future: Being more concrete in definitions, what does she mean when she says X and Y, what they exactly did and what did we find out, more clear on the results.

Mary noted these thoughts in green on the mind map as can be seen in figure 5.



Figur 5 Workshop 2, mind map 1

In this next reflection from workshop 3 we see Morten dealing with challenge 1d. After hearing how one of the listeners understood and responded to his first speech Morten reflects on what he would have said if he could do it again:

R: Godt. Jamen så må du gerne sætte låget på den røde og tage den grønne i hånden. Og så lige tænke lidt over, måske også i samarbejde med pigerne, hvad du altså, nu kan du se at der er opstået nogen misforståelser eller et eller andet [M: "Jaer"]. Så hvis du skulle have givet den tale [M: "Mmh"] igen, hvad ville du, er der noget du ville have uddybet eller sagt anderledes [M: "Ehh jeg ville have.."] det må du gerne skrive ned.

M: Her på eller? [R: "Jae det bestemmer du selv "] Jae. Altså helt klart det der det er realworld. Altså det må ikke være simuleret. Det skal være på en golfbane, en fysisk golfbane. [L: "ja"] Det er er en driving range, altså. Hvad hedder det på dansk? [N: "Udslagsbane"] Udslagsbane, nå ja. N: Hvis man er golfspiller så siger man driving range [M: "Ja"] [L: "Okay, golf genier"] Hallo man jeg arbejde på en golfbane i fem år nu syntes jeg nok lige.. [M: "det gør man altid i vestjylland. Ej"] Det er fordi de kører en eller anden Open, en eller anden international golfturnering. Fun fact. M: jaer. Jeg ville prøve at holde den på primært golf, ehh, og sørge for ikke at kører den på andre sportsgrene. Fordi, man inddrager hele software systemet hvis man skal til at ændre på det. Og også selve det fysiske sted, hvor sætter man kameraet? Og sådan noget. Jeg tror også jeg ville have lagt mere vægt på det fysiske udstyr. Udstyr [M skriver ned] ehm. [L: "Tænker du det med det fysiske setup?"] Ja [L: "Ja for det var det jeg ikke lige var med på."] Og så, eh, måske lidt mere computervision. Hvad er kravene til det? Fordi det kan godt være lidt sådan. at hvis man bare høre om det. Og selve systemet, det er det største problem. [L: "Mmh"] Så det ville jeg nok have lagt lidt mere vægt på. Altså stadigvæk holde samme.. Ehm ja. ... Jeg tror det var det jeg ville have puttet på ekstra. altså til min tale. [L: "Til din salgstale"] – WS3, 41:58,3

Morten reflects upon the fact that he would have made it very clear that it is of huge importance that the activity he was talking about is to occur in the real world due to the importance of feeling

the strike and seeing the result just as it happens. He also wants to state that he would have gone more into detail about how fragile sensors and algorithms are to configurations and change. Lastly he felt like he should have provided explanations for more technical terms. In this case Morten saw how the listeners reacted to his speech by observing them trying to deal with the challenge of noting down possible future prospects of his project. These observations provided the experience for him to reflect upon his way of telling others about his project.

From the first workshop we hear Jacob reflecting out loud on what he thought while observing Ann trying to make sense of his speech:

J: [10 sec tænker] Det ved jeg ikke, Jeg tænkte på om jeg var konkret nok sådan. Om jeg fortalte dybdegående nok hvad det var vi testede. [A: "Mmh"] Og i hvilken sammenhæng og sådan noget. Det var meget generelt syntes jeg. Men det er også svært når man kun har 1 minut. Så bliver man krafædemig nødt til at holde sig til noget generelt for at nå det hele. Efterfølgende følte jeg at jeg havde brugt 30 sekunder på bare at fortælle at vi havde lavet et foregående studie for det hele. Det tror jeg at jeg ville have cuttet lidt ned. Og så bare hurtigt sige at vi har lavet et foregående studie for at teste om det overhovedet er noget der er validt. Og så mere snakke om det her studie... - WS1, 12:57,9

Jacob would have liked to be more concrete and would have liked to focus on what it was that they were testing. Jacob says that his biggest challenge was that of explaining his project in such a short amount of time. However he feels like he used too much time trying to explain an aspect of the project that in his mind was not a large part of the essence of the project. Jacob was able to reflect on the experience he had just gone through and find aspects of his performance that he would have done differently.

7.2.3 Summary of Learning and Change

In the section 'Crossing boundaries' in the analysis above the focus was on the explication of tacit collaborator knowledge. The explication process was done by me, the researcher, through analysis of their ways of dealing with the boundaries. However, in this part of the analysis I have focused on the immediate learning outcome of the participants as they encountered the reflection activities. In those situations the participants were the ones to explicate their knowledge, I only facilitated.

In this part of the analysis I have shown that changes did occur in the way that the speeches were given. I have also shown that the participants reflected on their own behaviours. The activities resulted in the participants reflecting on their behaviours, thus laying the foundation of learning. This is vital if the people participating in the workshop will be able to benefit from the workshop as a whole.

7.3 A synthesis and an augmented tool for collaboration

In this section I will construct a synthesis of the theory used in the report. This synthesis will then be combined with the analytical points made thus far. Through this combination I will show how some of the methods and techniques developed in this report have the potential to reveal and change behaviours in interdisciplinary teams.

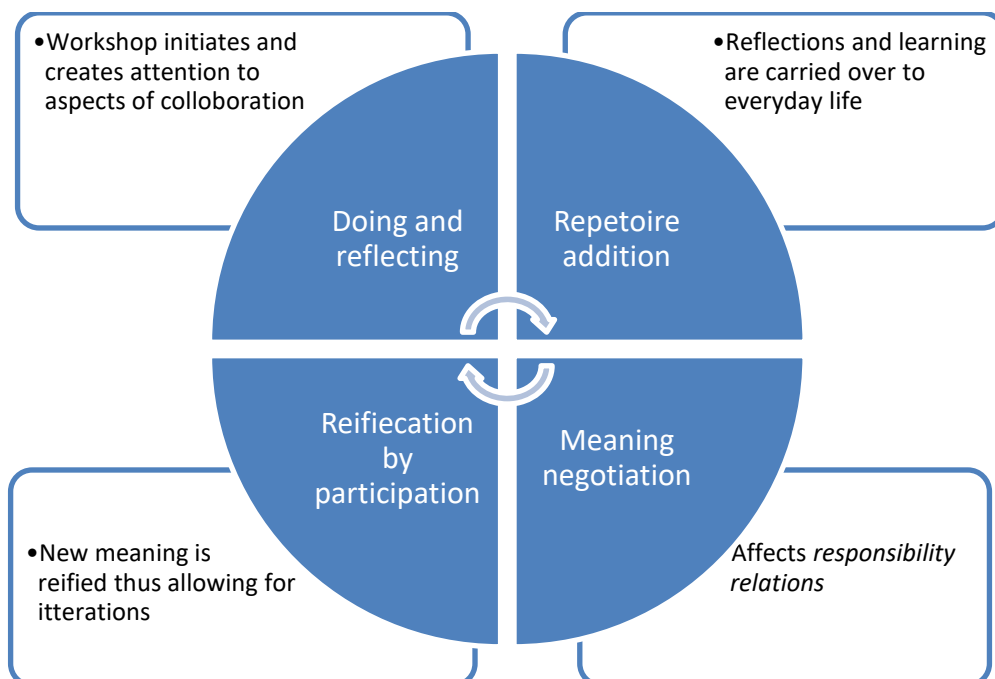
7.3.1 A synthesis of philosophy, product development and social learning

In this theoretical synthesis I have mixed philosophy of science; tacit knowledge, product development theory; 3T framework, and social learning theory; communities of practice.

Polanyi states that some tacit knowledge can be externalised, this can be done through the exteriorisation of particulars. It can also be shared through mimicking, participating and observing.

Carlile presents his 3T framework with an iterative fourth step. He argues that the gap between groups can only be closed through iterations of dealing with the three boundaries. That through each iteration they develop a more sufficient way of managing differences and dependencies.

Wenger details the intricacies of dimensions of the community of practice. He argues that mutual commitment is what binds participation and reification. Joint enterprise can create mutual relations of responsibility without being declared as such. Shared repertoire is a resource for the process of negotiating meaning.



Through doing and exteriorising the participants in the workshop make their tacit collaborative knowledge visible and sharable. Through this process a new phenomenon or knowledge has been included in the community's shared repertoire. This allows for the negotiation of meaning. This meaning might decide and influence the relations of responsibility. If these new or changed meanings and relations are reified by participation, the community has been changed.

7.3.2 Towards a tool for new relations and learning

For the workshop to have a real impact for the participants it should be followed up by another activity. This activity would be similar to the already presented workshop structure. This follow up workshop would be different in two ways:

- 1) The elucidated tacit collaborative knowledge of the participants should be presented back to them.
- 2) At the end of the workshop the participants are to create their own rules, mantras or guidelines for future conduct

The follow-up workshop would thus introduce a second round of reflection on their previous actions. This time the basis for their reflections would not be new speeches and reactions to these, it would be the analytical conclusions from the effort to reveal their tacit collaborative knowledge. The workshop activities would be structured as shown below:

- 1) Can we communicate?
 - a) The context, mind maps and analytical points of semantic behaviour are presented before the participants
 - b) The participants are to create a mind map that lists *what they would do if they were to give the speech again*
- 2) Can we learn from each other?
 - a) The context, mind maps and analytical points of semantic behaviour are presented before the participants
 - b) The participants are to create a mind map that lists *how they would handle differences in understanding if they encountered them again*
- 3) Can we negotiate with each other?
 - a) The context, mind maps and analytical points of pragmatic behaviour are presented before the participants
 - b) The participants are to create a mind map that lists *how they would represent and negotiate if they were to do it again*

- 4) Can we change?
 - a) Each participant is asked to write down at least 3 guidelines for future conduct in regards to talking and collaboration
 - b) Lastly they are asked to come to an agreement on a set of rules, mantras or guidelines for future conduct based on the personal lists from 4a

This follow up workshop creates the possibility for greater attention to the intricacies of interdisciplinary collaboration in the participants. They will re-experience their actions from the last workshop through the original interactions and analytical points. Based on this they will engage themselves in the activity of designing guidelines for themselves. Through this process of reflection they will learn and gain the autonomy to recognise boundaries and reflect on how to deal with them.

8 Reflections on validity

In this section I will reflect on the validity of methods, theories and results. But before I move on I would like to make a case for two factors of interdisciplinary work that affects the initiation and outcome of interdisciplinary projects. The first is that of initiating the project; it needs funding and this can be hard to obtain as interdisciplinary projects are often broad in scope and results and success rate are uncertain. The second is that of the project management when the project is already initiated as coordination can be difficult for people who come from different departments and institutions. However, I have chosen to ignore these elements of the problem and focus on the knowledge management and cultural aspect. I have done this as this is where I see the techno-anthropological skill set being of value. In this case that of interactional expertise and anthropology-driven design.

8.1 Reflections on methods used

Focus groups and workshops are not authentic real world situations, so even if you have structured activities to simulate the real world activities that you are interested in there will be factors that can never fully replace the social mechanism that occur in the real world. You miss out on existing social contexts from the real world and focus on the artificial situation of the workshop (Halkier, 2010, p. 124). But by creating a setting close to that of the everyday lives of the participants the focus group setting can become a proxy to participant observation.

Negotiation is hard to simulate in a 2 hour workshop. In the real world aspirations for careers, salary and prestige create conflicts. In the workshop the consequences are not as dire as I imagine that only

disciplinary pride might be a source of motivation to risk altering the social bonds between the participants. I.e. when negotiating the research protocol the participants are trying to find a solution to the problem I gave them: "To create research protocol that involves all of your professions". They are acting together to fulfil the demand instead of fighting to win money, prestige or career opportunities. One way to counteract this could have been to make this part of the workshop contest based. They all have one vote each. They are given a set amount of units of time/funds that they have to administer to each participant and they all get a secret mission card that tells them that if they win the most funds they win a price. But then again, it could be the other way around, in the real world perhaps some of the participants would have gladly led an assignment go to the next in line.

However, at one point in workshop 2 the speaker started to reflect on how her collaboration with engineers had made her more pragmatic:

Ja. Men jeg syntes alligevel at, ja, det ved jeg ikke, det har jeg kunnet mærke i løbet af kandidaten, der blev jeg udfordret, der blev jeg hel tiden mødt med den der [N: "Mmh"]; vi kan jo ikke bare arbejde efter utopi hele tiden, vi er nødt til også at se, hvad kan lade sig gøre. Og jeg tror også alligevel at jeg har nået en vis pragmatisme, jeg ved godt, vi kan ikke lave alt 100 procent grønt, men så stadigvæk så har jeg det der i mig, okay men så grønt som vi kan gøre det, og så gå til grænsen der hvor vi kan. Altså, Det syntes jeg så bare er vigtigt at man så hele tiden er sådan okay; Hvor langt kan jeg så gå i det her projekt. [D: "Skubbe grænserne"] ja netop. Og så stadigvæk vide at, okay, der er også nogen der rigtig gerne vil tjene så og så mange penge, og samtidig, [D: "business"] der er kun dem. Ja. Der er det her budget eller, okay jeg ved at jeg får ikke overbevist alle i den her gruppe om at man skal gøre sådan her, hvis vi bare får, altså det her med babysteps, det giver også mening. – Mary, WS2, 1:26:26,5

So even though the real world interactions might not have been fully simulated I got a glimpse at a real world example of the pragmatic boundary being dealt with, she has changed her approach to accommodate the methods of very different people. In the situation Mary describes she is very much in an interdisciplinary situation, she is trying to convince builders to consider her humanistic conclusions. Of course this is just a reflection from Mary on a project she did months ago, but it provided context for the other participants in regards to the difficulties of her project.

8.2 Reflection on Theories used

Carlile's 3T framework made on the basis of investigations into product development in large organisations. Thus his focus lies on that of the interactions between groups. What I was interested in were the interpersonal relations in research teams or communities of practice.

8.2.1 Evaluation of tacit knowledge

In regards to tacit knowledge I am dealing with something which is not entirely agreed upon in literature. In my journey through literature on the subject I have encountered several different analogies of different aspects of the term.

One of these is Yu Zhenhua who discusses how you deal with something that is by definition hidden. Here he refers to Grimen and states that:

“The transference of tacit knowledge relies more on first-hand experiences and guided instructions of a master. Again, to criticize verbally articulated knowledge, we can examine the statements of knowledge, but in order to criticize tacit knowledge, we must appeal to action or practice” - (Zhenhua, 2003)

He reflects on how to criticise tacit knowledge by comparing it to articulated knowledge. He argues that the statement of the articulated knowledge can be examined. But when criticising tacit knowledge one must examine action or practice. Meaning that in order for me and the participants to criticize their tacit knowledge we must look at their actions or practice.

But from here the term becomes even more intangible the aspects of tacit knowledge are nuanced. Below I have gathered some of the arguments and analogies arguing for these nuances.

8.2.1.1 Heavy and light

In ‘A Critical Analysis of Nonaka's Model of Knowledge Dynamics’ Constantin Bratianu refers to M.E. Nissen who argues that tacit knowledge is heavy (Bratianu, 2010). With this analogy he is trying to bring across the point that tacit knowledge takes a long time to develop and to be transferred:

“Nissen is using a metaphorical approach, introducing the concepts of “light mass” and “heavy mass”. In his view, tacit knowledge would correspond comparatively to “heavy mass” in the context of knowledge dynamic, which means a slow flow and a long flow time.” - (Bratianu, 2010)

He argues that it is heavy and that it could potentially take days or years to move:

“life cycle and flow time. According to Nissen, “Life cycle refers to the kind of activity (e.g., creation, sharing, application) associated with knowledge flows. Flow time pertains to the length of time (e.g., minutes, days, years) required for knowledge to move from one person, organization, place, or time to another”

Thus the focused workshop may not extensively reveal tacit knowledge as it is last only somewhere between one and two hours. Furthermore the interactions I analysed never lasted more than a couple of minutes. Research projects in the real world can stretch over months or even years. Carlile based his 3T framework on an extended fieldwork in the automotive industry.

8.2.2 Reflection on the results

Here I will discuss the results of the project. Most importantly believe that a major weakness in my results stems from the fact that I only relied on people who had either a bachelors or a candidate degree in techno anthropology. They have been trained to reflect on and observe how humans act in groups and in certain situations. If I had done the workshops with participants from other disciplines I would most likely have had other results. But, the main activities of the workshop and the purpose of it would not change. The activities are not discipline specific. If some other participants had been properly facilitated they would not have a hard time in:

- 1 Speaking about their latest project
- 2 Trying to understand someone describing their latest project
- 3 Hearing how their speech was received and comment on it
- 4 Giving themselves advice for next time

Given that there is some difference between the participants the only ways for this process to fail is if the participant does not have any kinds of comments in 3, or if they do not have any kind of reflections in activity 4. I believe such a scenario to be unlikely if the circumstances are right; informal setting, relaxed and 'warmed up' participants, and a facilitator to guide.

9 Conclusion

The purpose of my project was to investigate the tacit collaboratory knowledge of people who have experience in working together and to see if this revelation could benefit the ones whose tacit knowledge I was revealing. In other words I wanted to answer the problem statement:

How can the tacit knowledge of collaboration in interdisciplinary teams be revealed and how can such a revelation benefit interdisciplinary teams?

I attempted to answer this by challenging participants to utilise their tacit collaboratory knowledge in dealing with syntactical, semantic and pragmatic boundaries that occur in product development. This process was manifested by the structuring and facilitation of a series of workshops.

Through the workshops we have seen that the participants utilise tacit knowledge when trying to deal with transferring, translating and transforming their tacit knowledge. I have shown that some of the tacit collaborative knowledge of interdisciplinary teams can be revealed by simulating different phases of a product development process. Through workshops the participants were forced to act out their tacit collaborative knowledge in a focused setting. Through this act they made their knowledge visible to observation. These observations could then be processed and their interactions could be analysed. The analysis explicated various techniques and behaviours used by the participants in dealing with the challenges of the workshop. These explications show that it was possible to explicate some of the participant's tacit collaborative knowledge.

The revelation that these workshops made possible can be beneficial to the participants in two ways. Firstly it benefits them by their participation in the activities, especially the reflection activities as it this process of doing and reflecting creates a great learning outcome. Secondly the participants can benefit from the analytical points made of their behaviours. This can be done through a second round of activities as described in the workshop structure section towards a tool for new relations and learning. The process of participating in the two workshops would focus their attention to aspects of collaboration.

I conclude that the tacit knowledge of interdisciplinary teams can be explicated through the use of a workshop. The teams can benefit from this process by gaining an augmented understanding of the knowledge management process of interdisciplinary work.

10 Perspectives and future research

10.1.1 Baseline, workshop and effect

The goal of the workshop was to transform tacit knowledge of interdisciplinary communication to explicit knowledge in such a way as to potentially benefit the interdisciplinary teams participating in it. If some degree of explication was achieved I was interested to see if this will affect the participants' communication habits. However I did not include any ways to measure this change. To do this I could have made a baseline 'measurement' and an effect analysis through pre- and post-surveys. Such an investigation would have been structured like this:

Overview of sources for generation of empirical data:

- 1) Pre-survey

- a) Qualitative
 - i) Semi structured 15-30 minute interviews with each participant
- 2) Workshop
 - a) Qualitative (2-3 hours' workshop)
 - i) Participant created materials, visuals and text.
 - ii) Audio and/or video records of the activities (transcribed).
 - iii) Post workshop thoughts, critique and comments.
- 3) Post-survey
 - a) Qualitative
 - i) Semi structured 15-30 minute interviews with each participant

The pre-survey interview guide could have been based on the interview guide below:

Research Question	Interview question
Is the participant aware of how and why he communicates in the context of interdisciplinary cooperation?	How are your experiences on collaboration with people outside your own discipline? - Have you encountered any difficulties in understanding others/in making yourself be understood? - (If so) Did you reflect on why this occurred? - (If so) Did you act on your reflections in any way? Were you ever exposed to the prospect of interdisciplinary work in training/study programmes? - Were you aware this would be a possibility at the end of your studies?

10.1.2 Facilitating or participating

Before conducting the workshop I was wondering if I was going to participate in addition to facilitating. If I participated in a workshop consisting of participants from STEM I was going to introduce an element of the humanities and responsibility into the workshop, thereby making it broad interdisciplinarity. To do a baseline investigation of the other participants I could have made a series of interviews based on the following interview guide:

Research Question	Interview question
Responsibility: Does the participant have any axiological considerations in regards to the local/global production of knowledge?	What drives you as a scientist? - Was it the same when you were studying? (Has it changed?) What do you think about the current condition of how research is done? (funding, publishing, focus of attention) - Has it changed since you started your research career?

	- Did the work as a researcher live up to the expectations you had beforehand? (As a student)
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12 Appendix 1 – Activity formulation

Theme	Ws 1 – Articulation	Ws 2 - Articulation	Ws 2 - Articulation
1	<p>a. [1:31,7] <i>"Super. Nå men jeg tror bare at vi tager udgangspunkt i jeres studier [...] Men du [J] får et minuts tid til lige at fortælle Ann om dit seneste projekt."</i></p> <p>b. [4:31,5] <i>"Godt. Du [A] fulgte lidt med forstod måske noget af hvad han sagde. Og din opgave nu er at lave et mindmap over nogle ideer og muligheder, ja hvad kunne mulighederne for det her projekt være? Så det får du lige en 3 minutter til. Og du [A] må gerne snakke højt"</i></p> <p>c. [8:11,5] <i>"Jamen så syntes jeg at i skal tage plads her [R peger mod to stole i midten af bordet]. I sætter jer sammen her, og du [A] tager mindmappet med. Og så, hvis I kan bruge de røde her til at skrive ned og finde steder hvor især dig [J] hvor hun [A] måske har misforstået noget, eller hvor der var noget hvor du tænkte "arh okay"."</i></p> <p>d. [12:33,4] <i>"Okay, nu så du.. nu sad du og observerede Ann mens hun reagerede på hvad du lige havde fortalt. Hvis du nu skulle have fortalt noget, hvis du kunne gøre det igen, ville du have fortalt noget andet eller, havde du angrebet det på en anden måde?"</i></p>	<p>a. [51:42,8] <i>"Ja, så det starter egentlig med at du gerne skal præsentere de andre for dit seneste projekt, ja, forsknings projekt, hvad skal vi kalde det? [M: "Mit speciale måske?"] Ja dit speciale! lad os kalde det det! Og bagefter, får i en lille opgave men, det kommer selvfølgelig til at omhandle hvad Mary lige har snakket om."</i></p> <p>b. [55:18,4] <i>"... nu får I [C, D og N] at diskutere; hvad er mulighederne inden for Marys, altså inden for det studie, hvad er mulighederne for hendes forskningsprojekt?"</i></p> <p>c. [1:04:55,3] <i>"nu må i så gerne snakke om hvor, hvad var det, har de andre misforstået noget eller? Ja. Og så må i gerne bruge de røde her [Røde tusser], til lige at skrive ned enten om det ik lige spicificikt ikke passer nogle af de ting de har skrevet. har de måske misforstået noget måske, eller så lave et nyt punkt hvor de måske. Hvis du nu lagde mærke til nogle generelle ting de misforstod."</i></p> <p>d. [1:09:34,0] <i>"ud fra den her lille snak, og øhh, det du hørte før da de diskuterede, er der så nogen, ... Altså er der, du snakker om at, at du nævnte det lige hurtigt, at hvis du havde vidst hvad din præsentation skulle bruges til [M: "Mmh"], så havde du måske gjort det anderledes. [M: "Mmh"] Hvad ville du så gerne have gjort anderledes, og det må du gerne skrive med</i></p>	<p>a. [24:05,1] <i>"jeg bad de andre om at tænke over et tidligere projekt. [M: "Mmh"] Altså i dit tilfælde [M: "Jaja jeg kan godt huske det"] er det fra medialogi. [M: "Ja, jeg tager mit bachelorprojekt"] Okay. Ehm. Du får nu, ja du får lige en tredive sekunder hvis du har brug for det [M: "Ja"]. Men ellers har du et minut udover det. Til lige at præsentere for pigerne her hva det gik ud på."</i></p> <p>b. [25:55,0] <i>"er jeres opgave at, ehh, indenfor Mortens felt, hvad er mulighederne indenfor medialogi og hvad er mulighederne så for det her projekt, hvordan kunne de måske have gået videre med det, eller hvad kunne de have brugt det til?"</i></p> <p>c. [32:17,1] <i>"hvis du så mener at der er noget de har sagt som måske ikke lige lyder forholdsvis, ehh eller, urealistisk, eller, i forhold til hvad dit projekt gik ud, eller om de var helt ude af en sidetangent, så må du gerne skrive ned, ehh, ja, enten, ja."</i></p> <p>d. [41:33,5] <i>"Jamen så må du gerne sætte låget på den røde og tage den grønne i hånden. Og så lige tænke lidt over, måske også i samarbejde med pigerne, hvad du altså, nu kan du se at der er opstaaet nogen misforståelser eller et eller andet [M: "Jaer"]. Så hvis du skulle have givet den tale [M:</i></p>

		grøn."	"Mmh"] igen, hvad ville du, er der noget du ville have uddybet eller sagt anderledes [M: "Ehh jeg ville have.."] det må du gerne skrive ned"
2	<p>a. [15:56,0] "Ja du får lige den her [R giver J mindmappet fra før] Så tænk, og bare lige sidde og kigge lidt på den i forhold til at du skal, i en ny runde, prøve at forklare noget mere omkring dit projekt. Måske noget som du ikke har forklaret endnu eller noget som Ann misforstod"</p> <p>b. [19:28,1] "jamen så tier Jacob stille og så vil jeg gerne have at du igen laver et mindmap men denne gang ud fra hvordan du vil kunne bruge elementer fra hans projekt i dit eget arbejde"</p> <p>c. [23:16,1] "... Så ligenu er det sådan dig som skal prøve at pege på om hun så måske... var der noget der virkede lidt urealistisk eller et eller andet, et eller andet som hun måske havde misforstået i forhold til hvordan du ser at det kan benyttes."</p> <p>d. [29:51,2] "I må egentlig gerne skrive, nu har i så fundet lidt frem til hvorfor i har de her forskellige forestillinger om, så det må i gerne lige skrive ned med grønt, hvad fandt i frem til der?"</p>	<p>a. [1:11:37,3] "... hvis du nu igen kan give en tale, næsten [Folk smågriner], og ja, en ny tale [M: "Om mit projekt eller hvad? [R: "Ja"] Som om jeg aldrig havde fortalt om det før eller, mere bare sådan uddybende i de punkter jeg mener skulle være mere uddybende?"] I hvert fald bare, at kravet her er at det er en ny lille tale på omkring et minut halvanden, og baseret på de erfaringer hun nu herfra."</p> <p>b. [1:14:52,6] "I skal tænke over et af jeres tidligere projekter. Det kunne være dit [N] speciale, ... Jamen altså, ja. Hvor at. Altså, hvilke muligheder ville det have hvis i skulle indkorporere nogle af de her aspekter i, eller ja, ja. Kunne I gøre det? I jeres egne tidligere projekter. [N: "Skal vi diskutere det eller?"] Ja."</p> <p>c. [1:21:56,2] "Og du tager fat i den røde. [Røde tus] Øhm. Jo så.. [M: "Misforståelser eller hvad?" Folk griner] Ja eller i hvert fald præciseringer eller, ja, diskuter hvad du kunne se af, altså, blev der ramt plet? Blev der ramt lidt ved siden af? Eller var der en mulighed du måske kunne se? ... Og I må jo også gerne indvende, hvis der var noget i var i tvivl om dengang i snakkede om det."</p> <p>d. [1:25:14,6] "I må egentligt gerne skrive ned med den grønne, Hvorfor var der, så nu har i snakket lidt om det, altså. [M: "Hmm"] [C: "Hvoror det var nemt?"] Hvorfor kom de her resultater, hvorfor kom vi frem til</p>	<p>a. [43:56,0] "Men baseret på det som vi lige oplevede, [M: "Mmh"] og de grønne ting du skrev ned her. [M: "Jaer"] Så skal du give en lille tale som forsøger at, ja, gøre det godt igen. eller hvad man siger. [M: "Gøre det godt igen?"] Eller ikke gøre det godt igen, men altså, bruge de erfaringer, du lige har fået, måske tage udgangspunkt i de grønne punkter du har.."</p> <p>b. [47:15,9] "jeres opgave er så at eh, i forhold til jeres bachelorprojekt eller jeres tidligere arbejde, eller, ja. Hvis i så skulle tage det her Morten har fortalt om, hans projekt, og på en eller anden måde, indkorporere det med jeres eget tidligere arbejde. Hvordan ville I så bruge det Morten lige har fortalt om?"</p> <p>c. [54:19,7] "din opgave er jo lidt i stil med før, at udpege lidt hvor du måske tænker at de er ude på et sidespor eller at det måske ikke er helt realistisk at bruge dit projekt til det de nu snakker om. "</p> <p>d. [58:31,1] "ud fra hvordan de reagerede på den nye tale de lige gav her og det i havde snakket om før. [M: "Mmh"] Altså ud fra de ideer de kom op med og de ting de skrev ned, eh, hvis du så skulle sige noget igen eller have ændret noget af det du havde sagt, eh, altså i forhold til de ideer de kommer op med nu, hvad der noget, ville du have sat flere</p>

		det her resultat så, at der måske ikke var så store.. [C: "Ja"]"	detaljer på eller hvad, hvad ville du have gjort.? Var der nogen specifikke ting du gerne ville have fortalt om?"
3	<p>a. [33:17,4] "Godt, du [J] får lige den der at kigge på [mindmappet fra lige før] og din opgave nu det er, ud fra sådan nogle ressourcer, tid, teknisk mulighed, hvorfor kunne de ting som hun foreslog før, hvorfor kan de måske ikke lade sig gøre. Altså hvad var problemerne, altså meget praktiske ting. Du må gerne blive konkret. Altså i forhold til ressourcer, tid og tekniske muligheder."</p> <p>b. [38:31,0] "Nu har du fået lidt ny information, men hvordan vil du, ligesom. Ja du må gerne meget konkret og måske endda relatere til, nu tager vi udgangspunkt i dit sidste projekt, og så relatere direkte til det. De ting han nu har sagt."</p> <p>c. [42:22,5] "nu er opgaven så at. At i skal blive enige om sådan en meget simplistisk forskningsprotokol, eller projekt. I får den her lige at gå ud fra, så de tre ting i lige skal skrive lidt ned om det er, Projektet, hvad er målet med det, Hvordan vil i gøre det, og så lige en meget grov tidsplan. Og det skal i se om i kan prøve at blive enige om. Og det må meget gerne være ud fra det i lige har snakket om her."</p> <p>d. [1:00:45,6] "Godt. Jamen så vil jeg gerne lige zoome lidt</p>	<p>a. [1:28:00,0] "du skal gerne basere din præsentation på det der skete her og især måske også på resultatet her. [M: "Ja. Som i at jeg skal tage udgangspunkt i vores baggrund og snakke om hvordan.."] jamen, ehh, altså hvad var det I kom frem til her?" (Her får jeg ikke inkluderet ord som "ressourcer, tid og teknisk mulighed")</p> <p>b. [1:30:10,0] "i forhold det i fandt frem til før. Det det i lige skrev ned herpå [Mindmappet fra sidste runde]. Og i forhold til det Mary igen lige har sagt, var der så noget af det her i gerne vil ændre lidt på eller komme med nogle småændringer på? I kan lige få lov at kigge lidt på det."</p> <p>c. [1:32:29,5] "nu får I den opgave at I, baseret på det her, skal blive enige om en ehh, en ehh, forskningsprotokol. ... Så I skal blive enige om hvad skal målet være, med jeres nye projekt, forskningsprojekt her, ehh, hvad er jeres, hvordan vil I gøre det, og hvordan skal tidsplanen se ud? ... Jeg glemte bare lige at sige noget. At der på en eller anden måde skal indgå lidt af hver persons ehh [M: "Faglighed?"] faglighed ja. "</p> <p>d. [1:46:34,7] "Men ehh, så må i gerne prøve at snakke lidt om, og bare lige reflektere lidt over denne her process i lige har været igennem om at blive enige? [M: "Okay, om at blive enige"] [D: "Altså er det sådan.."] Og ville I gøre noget anderledes måske hvis i fik den igen, den her opgave, ja denne her lille</p>	<p>a. [1:01:46,3] "...baseret på, de her to sidste runder vi lige har haft [M: "Jaer"], ehm, prøve at forklarer pigerne lidt om hvad du sådan helt, ehh, altså prøv at forklare noget om hvordan helt realistisk i forhold til hvad man kan gøre med det her, og hvor lang tid det tager at arbejde med. Så vi snakker ressourcer og tid og hvad der egentligt er teknisk muligt."</p> <p>b. [1:06:32,0] "hvis i skulle tage det som Morten lige har sagt, have hensyn til det og komme op med, ja, måske de samme ideer, måske nogle nye. Men i forhold til det han lige har sagt og så sådan et semesterprojekts tid, er det så muligt at [L: "bygge videre på"] Ja, så det er rammerne."</p> <p>c. [1:11:27,6] "Det I får til opgave nu. Eller I må gerne, selvfølgelig gerne bruge denne her [Det nyeste mindmap]. [L: "Mmh"] Men, ehh, I får otte minutter til at, at hvad hedder det, at blive enige om denne her [De får "forskningsprotokol" med 3 punkter: Mål, Metode, Tidsplan], allesammen, sammen"</p> <p>d. [1:22:50,4] "Det ser jo fint ud. Okay. Men så den allersidste opgave det er bare lige at i gerne lige må tænke lidt over, snakke lidt om hvordan denne her process gik, med at forhandle på plads hvad i gerne ville. [L: "Altså den sidste del her?"] Ja bare lige snak lidt om hvordan i fandt frem til</p>

<p>ud og lige have jer til at snakke lidt om hvad, hvordan i sytnes den her proces den gik. Med at få forhandlet det her på plads, hvordan i skulle gøre, hvordan fordele jer i det.”</p>	<p>forhandlingsprocess.”</p>	<p>det her?”</p>
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13 Appendix 2 – Colour coding

The colours correspond with the following properties:

- Yellow:** Use of technical terms / academic terms
- Green:** Explanation of technical / academic terms
- Pink:** Contextual information (Method, context of project)
- Blue:** Informal language (Figure of speech, slang, cursing, rhetoric question, imitation/acting)
- Red:** Negative language (“Only”, “But”, “Not”) in relation to possibilities and limitations.

	Activity 1a	Activity 2a	Activity 3a
WS1	<p>Jamen seneste projekt det handlede om, at det egentlig var en viderebygelse på vores forrige projekt. Hvor vi lavede et teststudie omkring en ny måde at udfører usability testing på. Og det er så i sammenhæng med at teste user interfaces af softwares. Så den del som mennesker interagerer med når de interagerer med et system. Det vil sige en skærm og det, ja, det interface der er der. Og den nye måde det var noget der hedder remote og asynkron usability testing og det betyder at dem der tester systemet er fjert væk fra dem der skal evaluere det. Og da det er asynkront er det heller ikke samtidigt. Så de kan godt teste på et andet tidspunkt end evaluatorene skal evaluere på. På forstudiet lavede så en test i et fiktivt miljø med nogle studerende. Og på det her semester gjorde vi det så i praksis i samarbejde med en virksomhed og deres kunder, for at se om det faktisk er noget der virker i virkelighedens verden og i praksis. Og det gjorde det. Vi fik testet på to kunder som begge to kunne se potentiale i det. Men det vigtigste var at virksomheden kunne se potentiale i det</p>	<p>Man kan sige ved det studie vi lavede, der lærte vi at det ikke bare var en dans på roser, det kørte ikke bare derudaf, det var ikke bare mega succesfuldt det hele. Vi sådan virkelig to essentielle ting ved det her. Det ene det er: der er en kæmpe stor forskel på at lave en eller anden form for teststudie i et kontrolleret miljø og et ikke kontrolleret miljø, som det var på det seneste semester med rigtige brugere. For det første så tager, i et kontrolleret miljø, så tager de personer man har med, de tager det meget mere seriøst og er meget mere opmærksomme på at gøre det rigtigt end personer i et ikke kontrolleret miljø. Der var både det med at det var mindre kontrolleret fordi de dels ikke havde fået opgaver om hvordan de skulle bruge systemet, det havde de på det forrige semester, så de skulle bare bruge det i deres almindelige måde at bruge systemet på. Så vi havde egentlig bare prøvet at gentage præcis vi gjorde på forrige semester, men det havde så den konsekvens at deltagerne de brugte ikke de remedier de skulle bruge under testen. De skulle skrive en dagbog, og de skulle optage skærmen samtidig med at de</p>	<p>Mmh. Ja det ville nok være udfordringen at de problemer i møder det ikke altid er systembaseret. Og det er det jeg kan. [J griner] Jeg kan teste hvordan folk de bruger et eller andet system, eller i hvert fald et eller andet interface. Hvor du måske, at du kan også kigge på de menneskelige værdier, og ja, politiske og altmuligt, ISO standarder. Hvad er det mennesker siger og hvad er det de gør, det kan jeg kun sige ud fra en eller anden behavior altså hvordan man bruger et system. Og det er jo sådan meget konkret. Der kan jeg jo ikke en eller anden generalisering. Det kan godt være at de siger at de er mega bæredygtige. Men jeg kan kun teste på hvordan de er det i det i forhold til et system, i brugen af et system. Så kan jeg ikke sige: okay de gør faktisk noget helt andet end hvad de siger. For det kan godt være at de gør en hel masse andet end at bruge et system, for at gå hen imod bæredygtighed, øhm. Så hvis jeg skulle hjælpe hende med at løse et problem, så kan jeg kun give, det var også lidt det som vi snakkede om, ja sådan mit det er lidt mere konkret og specifikt så jeg kan kun hjælpe med at give et indblik i det</p>

	<p>og de resultater vi havde fået ud af selve testen. Og de var så interesserede i at de faktisk gerne ville have to omgange præsentationer for virksomheden. Så det.. Jeg vil godt holde nu.</p>	<p>brugte det. Og de lavede basically ikke en dagbog. Og det havde de misforstået. Og den misforståelse den stammede af at de ikke havde læst instruktionerne. Og først så tænkte vi, hvorfor gjorde de ikke det? Vi havde ikke gjort noget anderledes på sidste semester, det var præcis de samme instruktioner. Men det var også bare nogle mega omfattende instruktioner som vi sendte ud. Om det er fordi det er studerende, det ved jeg ikke, men der læste de egentlig alle sammen instruktionerne og fulgte dem til perfektion. Men det gjorde de ikke denne her gang. De sagde begge to at det var for langt, og man skulle måske tilpasse instruktionerne til hver enkelt deltager. Så det var en ting vi lærte. At der var virkelig stor forskel der.</p>	<p>inden for min verden, højst sandsynlig, måske. Øhm. Men det ville også være en god ting tænker jeg, jeg tænker bare at det er en positiv ting, at hun kan bruge flere fagligheder inden for sit område.</p>
<p>WS 2</p>	<p>Ja. Jamen altså i mit senste projekt som så er mit speciale, har jeg arbejdet med bæredygtigt byggeri med udgangspunkt i den certificeringsordning man bruger i Danmark, som hedder DGNB. Og har så arbejdet med hvordan man kan øge den sociale dimension af bæredygtighed når man taler bæredygtig byggeri, fordi det er den dimension der er sværest at håndtere, og sværest at arbejde med, så det er også den der let bliver glemt når man arbejder med bæredygtigt byggeri. [D, C og N skriver noter] Og det har jeg så gjort ved at involvere aktører fra alle led i en byggekæde, eller hvad man skal kalde det, både entreprenure, bygherre, arkitekter, konstruktører, og selvfølgelig også slutbrugerne. Og så prøve at samle det til hvordan man så forbedre den sociale dimension. Og det er i høj grad noget med at tænke værdi som noget mere end penge, og så den værdi, den menneskelige værdi der opnåes ved at have nogen gode bygninger. Og så arbejde med netop noget co-creation og få inddraget alle aktører i løbet af processen når man bygger. Øhh. ja. Det tror jeg at det var det.</p>	<p>Jo men altså man kan sige, helt grundlæggende altså, det der med også at det er en konservativ branche, så det handler i høj grad om at få, også med projektet, at få vist folk, at det kan godt betale sig at indtænke de her ting. Altså det giver mening at indtænke de her ting, altså det giver mening at tænke på den sociale dimension og det giver mening at ville bæredygtighed. Ehh. Og det kan vi blandt andet gøre ved nogle af de her, ehh, hvad kan man sige, altså ved at tage udgangspunkt i projektet, og det er så her igen hvor sådan noget som co-creation bliver relevant, men ellers også noget der hedder post-occupantsy evaluations. Hvor man netop ved; 'Okay, vi har bygget den her bygning nu, nu skal vi til at bygge en ny bygning, så tager vi udgangspunkt i de erfaringer vi har fra den her bygning, og så bygger vi ovenpå, så man kan sige at hver gang vi bygger, så bliver vi klogere og klogere og klogere og klogere. Fremfor at vi tænker, altså det siger de selv, branchen mener selv at de på nuværende tidspunkt der starter de fra Adam og Eva hver gang, Og man kan sige, hvorfor helvede gør de det? Det koster jo også en masse penge. Så også det der med at ja, ville sine erfaringer, og ikke bare tænke nyt projekt, så starter vi forfra. Øhh. Og så få, få overbevist branchen om at det kan betale sig, at det giver mening at også bruge de her erfaringer man nu har for at gøre noget, lave noget bedre byggeri. Fordi man kan sige, at i sidste ende giver det jo også mindre klager og mindre, eeh, hvad kan man sige, problemer man laver. Og så kan man jo sige så er der jo forskellige aktører der er selvfølgelig er</p>	<p>jamen altså meget af det her vi fandt frem til i projektet, det er jo alt sammen, folk kan godt se ideen med det, og, sådan, kan man sige 'det er jo meget fint' men, vi har nogle forslag til hvordan man måske kan forbedre det bæredygtige byggeri. Men det vi så også sådan, det næste step, det bliver jo så 'Hvordan pokker bliver det så helt konkret implementeret?' Hvordan får man folk til at tage den her ide til sig? Det kan godt være at vi kan påvise nogle af de her ting der, 'Men prøv nu at forstå ideerne i det her' eller, med co-creation og post-occupancy evaluation, så får du altså noget mere ud af det og sådan noget. Men, fra den, altså fra vores projekt til at der sker noget ude i byggebranchen, 'hvad er det der skal til der?' hvordan får man den ehh ting gjort? Man kan sige, det er sådan den største svaghed der er lige nu og det der egentlig er rigtig relevant at finde ud af. Så vi netop rykker noget, og ikke bare sådan, igen, sådan teoretisk sidder og finder frem til 'Nå jamen det er en god ide at gøre sådan her'. [N: "Mmh"] ... tænker jeg. Så ja, fundet frem til en masse spændende resultater og sådan noget, men altså, det er jo fint nok. Men, hvad så? ... Eller hvad kan man sige.</p>

		<p>interessere i forskellige aspekter af det her. Men. Ja. Jeg tror det var sådan en tilføjelse jeg havde nu.</p>	
WS 3	<p>Ehm. Projektet her handlede om et samarbejde mellem Dronninglund golfklub og studerende fra Aalborg Universitet. Ehm de vil introducere ny teknologi for at gøre træning og så videre nemmere og mere tilgængelig. De vil have feedback system implementeret så de kan få at vide hvor langt de er fra mål uden at de skal ud og udsætte sig selv for fare på driving range [L: "Okay"]. Projektet er rent teknologisk bygget op omkring computervision teknologi. Brugen af det til at fange udendørs, og identificere golfbolde, og lave udregninger. Så der er noget mapping, der er noget lens man skal have kigget på. Og der er noget rent fysisk setup. Hvordan man sætter det op. [L: "Altså i forhold til golftræning eller i forhold til?"] I forhold til hvordan at man fanger billedet i første omgang man skal procesere, for at kunne bolden. [L: "Okay"] Fordi en golfbold er meget lille og en golfbane er utroligt stor. [N: "Og græsset kan være meget langt"] Ja. Og hvis man har svært ved at finde bolden så kan man ikke rigtigt bruge systemet. De ønsker bare noget snildt feedback med et pointsystem. [N: "Det er det der med den sjove video"] Det er det. [M har for et års tid siden vist en videodemonstration af deres produkt]</p>	<p>Ja ehm ... Det var et godt projekt om at tracke en golfbold, og vi har brugt VR til test, ehm, hvad det er for noget feedback man skal have? så det er jo udmærket at bruge under development fasen, udviklingsfasen. Eh, og når man har et ordenligt produkt og en god algoritme der kan fungere nogenlunde independent, og måske også tage nogle variabler ind med hensyn til hvad det er for en bane og sådan noget. Selvkalibrering måske endda, Så kunne man begynde at udvide til andre steder og så videre og sørge for at få et økonomisk grundlag på den måde. Også det der med udstyrsproducenter, eller producere udstyr ikke? Og special... Have noget der er integreret, noget der kan arbejde sammen, altså specielle golfkøller og sådan noget, det er også en anden måde at tjene fat cash. Og apps, fat cash. Lots of cash. Ehm. Der er internationalt ikke? Tiger Woodshan skal også have det her. Der er masse af penge. Han er også rig, han har også cash. ... Jeg har faktisk slet ikke tænkt over den der læge og genoptræning. Men det er måske lidt mere VR tænker jeg, end noget med golf at gøre. Det ved jeg ikke, kan man træne op med golf? Ehm. Og det kunne være fedt at, hvis man nu har, kommer til det punkt at man har produkt der kan sættes op steder, og lave det til et hjemmeprodukt ikke? Altså, man kan lave det portable, ting der. Ehm.</p>	<p>Jamen altså, der er jo rigtig meget, der er rigtig mange muligheder for hvad man kan gøre ik? Det handler om hvordan man opbygger softwaren. Og der skal du finde ud af hvordan man tager et billede i 2D ik? og translærer det til noget der er i fysisk, altså 3d fysiskverden. Og det har noget at gøre med hvordan det sådan er sat op med kameraet og så videre ik? Hvad er lys? Hvad er tid? Hvad er vinklen? I forhold til ækvator, hvordan kommer solen på himmelen og sådan noget. Og man skal ud og lave noget opmålinger helt per hånd. Og det skal du bruge nogle ressourcer til. Men du skal også have nogen der sidder og udvikler selve softwaren. Og du skal også have nogen der prøver at sidde og sørge for at det egentlig.. Dem der sidder og laver softwaren og dem der går ud og kigger på setup, at de egentlig snakker sammen ordenligt, at de udveksler de informationer de skal. Og at man ikke opbygger et system som kun kan tage nogle specifikke parametre ind som der ikke bliver målt efter eller omvendt. Ressourcemæssigt, så kræver det rigtig meget testing. Ehm. Med hensyn til at få algoritmen til at virke. Ehm. Men det kan jo gøres via simulationer man kan bygge op. Tag nogle film af folk der skyder med golfbolde. Det er også noget fieldwork, altså man skal lære at tænke på setups. Ehm. Selve, ja, gamification delen, ehm, af hele konceptet [R: "20 sekunder"] ville nok være mere ligetil. Men det ville også involvere rigtig meget brugertesting frem for kodning. Fordi kodning det ville bare være sådan, hvad skal vi sætte det her system op til? Hvordan giver vi brugeren point? Hvordan kører de systemet? Og vi skal finde ud af hvad skal de vide? Ehm. Og så tage ud i teste i virkeligheden. Det vil kræve en del personer. Gerne med forskellige kompetencer, både tekniske men også rent socialt, der kan gå ud og gå i et med brugerne. Men også kunne måle og finde ud af hvad er det for nogle specs vi skal buge for at få vores program til virke. Og det skal så også kommunikeres over til dem der sidder og kigger programmet. Og hvis man skal lave det alene selv? Rigtig meget arbejde. For du skal lave programmet, du skal teste det, du skal ud og lave field setup, du skal ud og interagere med brugerne. Og det kræver et bredt team af profiler</p>

