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SHOW ME YOUR BRAIN!
STORIES OF INTERDISCIPLINARY
KNOWLEDGE CREATION IN
PRACTICE. EXPERIENCES AND
OBSERVATIONS FROM AALTO
DESIGN FACTORY, FINLAND.

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Abstract

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Show me your brain! Stories of interdisciplinary knowledge creation in practice. Experiences and observations from Aalto Design Factory, Finland.

Lappeenranta 2015

295 pages

Acta Universitatis Lappeenrantaensis 649

Diss. Lappeenranta University of Technology

ISBN 978-952-265-819-7, ISBN 978-952-265-820-3 (PDF), ISSN-L 1456-4491, ISSN 1456-4491

This dissertation centres on the themes of **knowledge creation**, **interdisciplinarity** and **knowledge work**. My research approaches interdisciplinary knowledge creation (IKC) as *practical situated activity*. I argue that by approaching IKC from the **practice-based perspective** makes it possible to "deconstruct" how knowledge creation actually happens, and demystify its strong intellectual, mentalistic and expertise-based connotations. I have rendered the work of the observed knowledge workers into something ordinary, accessible and routinized. Consequently this has made it possible to grasp the pragmatic challenges as well the concrete drivers of such activity. Thus the effective way of organizing such activities becomes a question of organizing and leading *effective everyday practices*. To achieve that end, I have conducted ethnographic research of one explicitly interdisciplinary space within higher education, Aalto Design Factory in Helsinki, Finland, where I observed how students from different disciplines collaborated in new product development projects. I argue that IKC is a multi-dimensional construct that intertwines a particular way of doing; a way of experiencing; a way of embodied being; and a way of reflecting on the very doing itself. This places emphasis not only the practices themselves, but also on the way the individual experiences the practices, as this directly affects how the individual practices.

My findings suggest that in order to effectively organize and execute knowledge creation activities organizations need to better accept and manage the emergent diversity and complexity inherent in such activities. In order to accomplish this, I highlight the importance

of understanding and using a variety of (material) objects, the centrality of mundane everyday practices, the acceptance of contradictions and negotiations well as the role of management that is involved and engaged. To succeed in interdisciplinary knowledge creation is to lead not only by example, but also by being very much present in the very everyday practices that make it happen.

Acknowledgements

The support of my employers over the years made it possible to combine work and studying. A special thanks to Ilkka Brander of S-Verkkopalvelut Oy, who thought this endeavour was admirable and not just a nuisance to our daily operations.

However, despite the support received over the years, the actual writing of this manuscript has been a lone task. I have not been part of any academic community as such, and thus my family and friends have carried the burden of my daily support. And a burden it sometimes must have been, with me disappearing to the library during beautiful summer days or despairing about some obscure paradigm wars. My husband, Petri, has over the years courageously attempted to "get" what I was up to, and made it absolutely clear that quitting was not an option. One can't ask for better support than that. My parents, Helena and Antti, provided not only their utter confidence in my abilities, but also the invaluable and concrete help of child caring. My closest circle of friends, Essi Eerola, Jonna Laurmaa, Päivi Mattila and Anna Salovaara, were always there when needed – thank you NSQ. And, as I argue, we are indeed embodied beings, I also thank my running shoes and yoga mat for keeping me grounded.

Writing this, I am struck by how often the word "trust", "belief" and "support" appear. I have met with such unwavering trust that I will get this job done, that there has in fact never been truly any doubt that it would *not* get done. It is of this belief in the capabilities of us human beings that this acknowledgment is all about. I once again humbly say "thank you".

Ulla-Maija Uusitalo
July 2015
Helsinki, Finland

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Prologue

To add insult to injury, simultaneously with my "home stretch" of writing this dissertation, we renovated our home. This meant dealing with all kinds of issues that arose during the process, and running to-and-fro between the library and our construction site. On one such time our foreman called me, and told me about a problem that had arisen. We tried to talk it over on the phone, but soon realized we couldn't put the situation in exact words. So I ran over. We looked at the problem – a literal hole in the wall – and he showed me the potential solutions, and used props to simulate how the construction would go. I understood, and was able to make a decision on how to proceed. After this he asked what I was working on at the library, and I mentioned my dissertation. He, being a polite person, asked what it was about. I told him that it's about how people of different kinds of know-how work together in order to create something new. "Oh, like with us here, we have the electrician, the plumbing guys, the carpenter and so on?" Well… yes. Exactly. I asked how he thinks they get things best done, even though all look at the subject from a different viewpoint. "Well if we have worked together for a long time, its easier, we sort of know how the other person thinks." We continued talking, and agreed that as we just had experienced, being present in person if a problem needs to be solved, so everyone can see, show, touch and feel the possible solutions is much better than trying to explain them only in words. And if a client is able to quickly pop over to talk face-to-face like I was able, it makes things much smoother and faster. After agreeing, we double-checked the place of electrical outlets I had agreed upon over the phone. Good thing too we did, as I had thought of the wrong wall.

Walking back to the library, a same question again came to mind that had nagged me before: why has the use of one's body and senses, as well as appreciating the face-to-face doing of things together seen to be "ok" for "manual labour" but not for "brain work"[1]? Why, from my own professional experience, when one is engaged in what is labelled "knowledge work",

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[1] In finnish "brainwork" is "aivotyö", and commonly used to describe work that is the opposite of doing something with your hands, as in manual labour, or "käsityö" (arts and crafts –type of work).

[2] In finnish the term is "aivoriihi", literally "traditional Scandinavian and Russian grain drying and threshing

organizations very much strive to operate in a structured and rational manner that is "easy" and "un-messy", and indeed manageable in a de-contextualized, de-humanized and overall detached manner. Somehow we still want to think that knowledge work is "cleaner", to use a loaded term. Experts are brains, and participate in "brain storming"[2] as if just the brains could up and go. There is no room for the complexity that inevitably arise when dealing with us human beings: the simultaneous subjective capability to feel, imagine, desire, reflect and bodily experience a situation. Yet it is the allowing of this very complexity and indeed messiness that research in a variety of fields has proven to be critical in knowledge creation.

I came across a very concrete example of this "messiness" inherent in intellectual work in a fascinating passage by Susan Leigh Star, the mother of "boundary objects". She is describing one anomaly "that tickled her nose" that - with other such instances – led her to the concept of boundary objects. She was researching for a historical book on nineteenth-century British researchers attempting to locate the functional areas of the brain, and was reading a notebook of one of the physiologists at the plush archives of the Royal College of Physicians in London:

> "After carefully divesting myself of anything toxic, such as a pen or food that might damage the materials, I was seated at a mahogany table, and Ferrier's lab notebooks were brought out to me—literally—on a silver platter. Gingerly lifting them up (hoping I was not sweating or anything else a primate might do) I gingerly opened the old book. I turned to one experiment where Ferrier records his attempt at trying to measure the effect of a lesion he produced earlier in the day, on the brain of an ape. The ape is less than cooperative—Ferrier's handwriting occasionally flies off the page, wobbles, and trails off in what clearly is a chase around the room after the hapless animal. The pages, in sharp contrast to my chapel-like surrounds, are stained with blood, tissue preservative, and other undocumented fluids. By contrast—and this is a finding repeated in sociology of science through the 1980s—the report of the experiment is clean, deleting mention of the vicissitudes of this experimental setting. This anomaly drew my attention to two things: the magnitude of invisible work that subtends any scientific experiment or representation and the materiality that acts to mediate the conduct of science."
>
> Susan Leigh Star 2010, 606

Therein lies a contradiction I too wished to explore: how can we acknowledge and indeed value the inherent complexity of social practices including the bodily and emotive presence of the participants, while guiding them towards set (and hopefully wise and good) goals? Personally I have always found wonder in how different people work together, how new

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[2] In finnish the term is"aivoriihi", literally "traditional Scandinavian and Russian grain drying and threshing cabin (for brains)", thus mixing up in one metaphor a setting of very physical traditional labour and brains. Come to think of it, not such a bad depiction after all.

solutions emerge seemingly out of nowhere, and how a certain type of energy seems to flow when things start "rolling". I wanted to understand more, and try to make sense of these practices. I also place great value to the appreciation of each individual, and wanted to find a way to research the subject in a way that places us humans and our social interactions in the limelight they in my mind deserve. Through ethnography and practice-based studies I found a way to make it possible. Hopefully this appreciation shines through to the reader.

> "In treating all persons humanistically, according all equal respect and value, ultimately the organizations 'bottom line' is better served."
>
> Dvora Yanow 2004, S23

1 Introduction

1.1 Themes of research: knowledge creation, interdisciplinarity and knowledge work

> "I feel that people are more like searching for something more creative and freedom to use more freely one's imagination, to try and experiment. I have friends, who, one reason may be, that they have started their companies, is that this way you take responsibility yourself and you are allowed to do yourself and learn that way too."
> Business student (SB1)

> "Knowledge creation is an integral part of what organizations do and why they exist and is a fundamental reason why people choose to join and contribute to them."
> Von Krogh & Geilinger 2014, 156

In the uncertain and hypercompetitive environment of today's global economy (Frieden 2006), the focus on organizational capabilities and resources as the principal source of sustainable competitive advantage is prevalent (see e.g. Grant 1996a, 2002; Prahalad & Hamel 1990). More specifically, *knowledge* has been recognized as one of the most important of these resources, as it is the main resource that is idiosyncratic (and therefore scarce), and not easily transferable or replicable (Grant 1996a, b). Knowledge-based views of the firm have emerged that view organizations as complex knowledge systems (e.g. Spender & Grant 1996; Choo & Bontis 2002; Tsoukas 2005), as well as theories concerning knowledge as a (dynamic) competitive advantage, i.e. resource and knowledge based views of the firm (Grant 1996b, Grant 2002). A sub-set of firms has been defined as "knowledge-intensive" and as a consequence, its workers "knowledge-workers" (Newell et al. 2009; Alvesson 2004; Hislop 2009).

In particular, knowledge management (KM) that emerged as a popular management discourse in the 1990's has endured as a lively research area (for overviews on KM, see e.g. Tuomi 2002; Hong & Ståhle 2005; Acedo et al. 2006; Baskerville & Dulipovici 2006; Jasimuddin

2006; Hislop 2009).[3] KM can be defined in many ways, and these definitions have naturally evolved over time (see e.g. Jasimuddin 2006 for a discussion). In Chapter 2.2 I will explore in depth the way KM has evolved, in this conjunction I offer the reader the following definition: knowledge management refers to the set of management activities conducted in a firm with the aim of improving the effectiveness and efficiency of organizational knowledge resources (Kianto & Andreeva 2012). In the late 1990's and early 21st century the notions of knowledge shifted from the "management" of knowledge to the creation of new knowledge. "Maintaining superior performance ultimately requires the continual renewal of competitive advantages through innovation and the development of new capabilities" (Grant 1996a, 382). This placed increasing interest on not only knowledge as a resource, but also on knowledge creation (Nonaka 1994; Nonaka et al. 2006; Carlile 2002, 2004) and innovation (Fagerberg & Verspagen 2009). This has meant a shift from *knowledge exploitation* (improving the use of existing knowledge) gradually towards questions of *exploration* (processes of knowledge creation) became central research issues (Newell et al. 2009, Nonaka et al. 2006, Hong & Ståhle 2005). When this is taken into account, we can offer another definition of KM as the effective and efficient exploration and utilization of organizational knowledge so as to enhance an organization's sustainable competitive advantage (Jasimuddin 2006).

What then enables knowledge creation, where and how does new organizational knowledge emerge? The subject has been researched to a great extent, for example Suorsa (2012) has identified eight varying focus areas relating to knowledge creation within knowledge management research. Tsoukas (2009) notes a particular focus of research on intraorganizational processes, which highlight the importance of both social practices within which new knowledge is created and social interaction through which new knowledge emerges. Of these academics, Nonaka with other authors is arguably the most influential,

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[3] All of the above themes relate to the rhetoric of the knowledge-intensiveness of society at large, and its effects on humans, social relations etc. This has prompted numerous ways of explaining what is happening. The discussion centres on the debate if we indeed have entered a whole new era in human history, and if so, what is the new era like and how should we as humans respond and act. This era has been labelled for example knowledge society (after Peter Drucker's famous term from 1969), post-industrial society (coined by Daniel Bell in 1973), risk society (from Ulrich Beck, 1999) and network society (made popular by Manuel Castells, 1996). Common to these views is the distinction between the "old" and the "new" ways of ordering of the society. Another common and central theme of this debate is the role of information (technology), knowledge and symbols in every aspect of human life: economic, social and cultural. For overviews on the evolution and debates on the concepts, see Webster (2002) and Stehr (2005).

having created his SECI-model (socialization externalization combination internalization) of knowledge creation (Nonaka & Takeuchi 1995) that forms the foundation of much knowledge creation theory within organizational theorizing (Nonaka et al. 2006; Nonaka et al. 2014).

Looking from a slightly different angle, researchers on team innovation and team performance have underlined that knowledge creation requires a sufficient diversity of knowledge bases as well as participants. If for example the goal is to create a new product or a service to customers, knowledge of the markets, regulations, technology required, design, usability, manufacturing and so on is required. This knowledge does not reside in any one individual, but is typically dispersed in the organization. "Thus, knowledge creation is typically not something that is done by a single person" (Newell et al. 2009, 79.) This is a theme that has emerged in research from a variety of disciplines. In organization studies, applied psychology as well as research on new product development and innovation, cross-functionality and the resulting knowledge and skill diversity in groups is seen as fostering effective knowledge creation and innovation (Alberts 2007; West 2002; Bruns 2013; Oborn & Dawson 2010b; Park et al. 2009). In order to understand cross-functionality, the concept of *interdisciplinarity* has traversed from the sociology of science and the contexts of scientific research to organizational contexts more broadly (Olsen 2009; Monteiro & Keating 2009; Weingart & Stehr 2000; Huutoniemi et al. 2010; Siedlok & Hibbert 2014, Klein 2008b, 2010; Aram 2004).

That knowledge creation requires a variety of skills and participants means it is an activity accomplished through collaborative processes: "… knowledge creation is typically the outcome of bringing different types of knowledge together by involving a number of individuals from different professional and disciplinary backgrounds and often from different organizations in collaborative efforts of some kind (Newell et al. 2009, 79)." This manifests for example in the popularity of cross-functional project teams as a way of organizing knowledge-creation activities (Huang & Newell 2003; Sydow et al. 2004; Lindkvist 2005) as well the overall saliency of different types of work groups in order to overcome the inherent functional specialization of knowledge in organizations (Carlile 2002; Ribeiro et al. 2010). Fundamentally research on knowledge creation within work groups rests on the concept of

communities-of-practice as the social locus of knowledge and learning (Lave & Wenger 1991; Wenger 1998; Ribeiro et al. 2010).

What goes on in these knowledge-creating work groups is "knowledge work" – the actual doing of knowledge-based activities. Knowledge work is a debatable concept (Alvesson 2004, Newell et al. 2009, Hislop 2009), but even though all work – and indeed all social life[4] - requires knowledge and all workers increasingly use knowledge to in order to accomplish their tasks (Bechky 2006), there is specifically knowledge-intensive work where knowledge is not only something workers have and use, but is also the main input and output of the work – and as a "by-product", this type of work engages in knowledge creation as its primary function (Newell et al. 2009). "Knowledge workers" are thus the individuals who partake in the collaborative practices of knowledge creation. Inherent in the notion of knowledge work is the concept of expertise, which in itself is transforming and the role of which in today's society is more and more ambiguous (Collins & Evans 2007; Collins 2013; Bereiter & Scardamalia 1993; Nowotny 2000).

To conclude, research on knowledge in organizations is thus giving more and more weight to the processes of knowledge creation; and in order to achieve that end, specifically noting the importance of having a sufficient diversity of knowledge bases (interdisciplinarity), as well as forms of collaboration between individuals (knowledge workers). It is of this broad theme of **knowledge creation**, and more particularly, the concepts of **interdisciplinarity** and **knowledge work** that my research is about.

I have recognized three levels of analysis as being relevant to my research dealing with the themes mentioned above: the organizational context of knowledge creation, the work group level of collaboration, and the level of the individual knowledge worker. Each has corresponding key theoretical concepts that will be covered in later chapters of this dissertation. The levels of analysis and their corresponding key concepts are summarized in Table 1 below.

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[4] For example Stehr (2005) reminds us that knowledge has always had a major function in social life. "That human action is knowledge-based might even be regarded as an anthropological constant. Social groups, social situations, social interaction and social roles all depend on, and are mediated by knowledge." (Ibid. 301.)

Level of analysis	Key theoretical concepts
Organization	Knowledge creation (KC) and knowledge management (KM) within organizations Organizational epistemology
Work group	Interdisciplinarity Cross-functional and interdisciplinary collaboration
Individual	Knowledge work Expertise

Table 1: Research framework. Levels of analysis and key concepts

The level of the individual is worth some elaboration. As I pondered in my Prologue, I want to explore how the embodied individual with his and her differing experiences figures in knowledge creation and knowledge work, and how these differences potentially affect the collaboration between experts. Thus my research aims to give voice to a variety of individuals, not just the one that is my own.

1.2 Positioning of research within practice-based tradition

When dealing with a concept such as "knowledge creation", the challenge is in the multitude of directions one can approach the issue. "Although it may be intuitively understood that knowledge matters a great deal to the everyday life of organizations, how organizations create this knowledge is a multifaceted question that requires analysis at many levels, from the individual to the overall organizational entity (von Krogh & Geilinger 2014, 156)." The way "knowledge" is to be framed in the analysis directly affects the research framework. In this chapter I will introduce two broad possible framings, and make explicit the positioning of my research.

The shift in focus towards knowledge creation as told in the previous chapter was partly enabled and fuelled by a shift in the epistemological base of how knowledge was theorized in organizational settings (organizational epistemology)[5]. The general consensus is that two

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[5] For an overview on epistemology from a braoder philosophical outlook as in the "theory of knowledge", see Williams 2001; and for research on personal epistemology (the psychology of beliefs about knowledge and

main views on knowledge stand out (for overviews see Hislop 2009; Newell et al. 2009): the notion of knowledge as something people have, it being a body of cumulative stock, an asset that can be acquired and transferred, i.e. the epistemology of possession; and the notion that knowledge is something people do, i.e. the epistemology of practice (Cook & Brown 1999). Hislop himself (2009) distinguishes between the objectivist perspective and the practice-based perspective, and has compiled the following "competing" notions of knowledge that have their manifestations in KM initiatives and practices within organizations:

Objectivist perspective	Practice-based perspective
Epistemology of duality	Epistemology of dualism
Knowledge as theory	Knowledge as practice
Knowledge as an asset	Knowing as a process
Epistemology of possession	Epistemology of practice
Knowledge as truth	Knowledge a socially constructed
'Content' theory of knowledge	'Relational' view of knowledge

Table 2: The objectivist and practice-based perspectives on knowledge (Hislop 2009)

The objectivist perspective has widely been contested (see e.g. Orlikowski 2002; Dall'Alba & Barnacle 2007; Gherardi 2001, 2006; Brown & Duguid 2001). This critique highlights the inadequacies of the way knowledge has been represented as a rational-cognitive "stock"; the way which bodies of knowledge and skills are decontextualized from the practices to which they belong (Dall'Alba & Barnacle 2007) and how the recognized challenges of knowledge management (such as sharing and transferring of knowledge) are treated as being related to certain properties of the knowledge itself, rather than to potentially questions of individual learning and its sociocultural dimensions (Brown & Duguid 2001). Especially studies on organizational learning and knowing brought the focus to that of *practice*, and enabled the conceptual shift from knowledge to knowing (Gherardi 2001). The main premise being that knowledge and knowing cannot be separated from an individual's engagement in the "practicing" of their practice (Cook and Brown 1999).

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knowing) see Hofer & Pintrich, 2002, and on the individual conceptions of knowledge and knowing, see Hofer, 2008.

Hislop (2013) states that the objectivist perspective has been dominant in KM research, although the practice-based perspective is gaining ground. However, one can safely say that the practice-based perspective is still a rather marginal approach within KM related research. What then are its main treatises?

Depending on researcher's epistemological orientation, two fundamental issues arise: what constitutes "knowledge" and where does it reside in organizations. For example, Ikujiro Nonaka, whose theorizing is generally cited as being synonymous with organizational knowledge creation theory (based on his highly influential article from 1994, "A Dynamic Theory of Organizational Knowledge Creation" and subsequent work, see e.g. Nonaka & Takeuchi 1995; Nonaka et al. 2006) has been criticized for treating knowledge as existing only at the individual level (Gourlay 2006; Gueldenberg & Helting 2007; Tsoukas 2005) - even though the theory places great emphasis on the context, process and "knowledge assets" being intertwined (von Krogh & Geilinger 2014).[6]

In contrast, the proponents of the "epistemology of practice" treat knowledge as inseparable from human *activity* (Orlikowski 2002), and as such, it is rather *knowing* we should be talking of, in a holistic bodily sense (Gherardi 2000; 2013), resulting in a "fragmented systems of knowledge" (Bruni et al. 2007) and dispersed practices of (knowledge) work that are ambiguous and uncertain (Alvesson 2004; Tsoukas 1996). The implications of having this perspective when approaching knowledge creation are quite far-reaching, and as a consequence they bring different research issues into focus. *First*, it brings to focus the actual *work practices* that "accomplish" the work itself (Brown & Duguid 1991). Knowledge creation is thus the result of "the practical ordering of heterogeneous human, material, and symbolic elements (Nicolini 2009, 121)" as opposed to the "cult of the individual" (Collins 1998), where knowledge creation is seen as a result of the mentalistic intellectual action of singled out individuals. "…practices are loci – spatial and temporal – in which working, organizing , innovating or reproducing occurs (Gherardi 2012, 2). This means that for

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[6] In a recent article, Nonaka et al. (2014, 139) state: "We believe that the most important aspect of economics and business studies from now on will be the focus on knowledge and the subjectivity of humans, who create and utilize the knowledge."

example new product development (i.e. knowledge creation) can be approached as work activity such as any other, and not privileging it as some form of "higher order intellectual activity". To give an example, when taking the objectivist stance one might focus on how to manage the identifiable stocks of knowledge needed as inputs for product development processes, which then are used by individual actors and at the end of the process, result in a new "package", i.e. a new product. In contrast, when one takes the practice-based perspective, the focus shifts to the actual way people accomplish new product development as *work activity,* approaching knowledge creation as the work of professionals that is *ordinary, accessible and routinized* (Smith 2007).

Second, practice-based perspective recognizes the way knowledge creation is "nested" within broader field of practices (Schatzki et al. 2001), and as such cannot be understood as an isolated activity and, consequently, it cannot be studied in isolation either. Concretely this manifests in taking the context of knowledge creation into account, and not attempting to reach "one size fits all" solutions.

Third, it recognizes the sociomaterial dimensions present in practices - that is their embeddedness in the "matter" that surrounds us, including our bodies (Gherardi et al. 2013; Gärtner 2013); objects and technology (Nicolini et al. 2012; Orlikowski 2007); and spatiality (van Merrewijk & Yanow 2010) – themes which are gaining increasing interest in practice-based organizational studies research (see e.g. Lee & Amjadi 2014). This enables the analysis of the interaction between humans and artefacts (non-human elements), as well as the recognition of the existence of differing personal experiences of practice itself.

To conclude, taking the practice-based perspective enables a researcher to overcome the decontextualized and depersonalized manner of treating knowledge related activities that are the tendency in the objectivist perspective to knowledge. It opens up the "black boxes" of both the individual human (and his/her glorified intellect) as well as the isolated processes of "knowledge creation".

My research is thus based on epistemology of practice, and uses **a practice-based perspective** as defined by Corradi et al. (2010): practice is a "way of seeing" a context.

Practice is used as a lens that enables one to highlight the role of "knowledge grounded in site-specific work practice" (Sole & Edmondson 2002, 18). The practice-based perspective brings out the specificities of behaviour and meaning in situated contexts, affording understanding of the everyday interactions between the individuals. Approaching practice in this manner focuses in gaining a "sense of doing" and enables one to observe also the role individuals play in practices – dimension which has been argued to have been somewhat disregarded in practice-based studies (Erden et al. 2014). In addition, using practice as an epistemological approach enables one to study the "kind of hidden knowledge" (Gherardi 2012, 202) supporting work practices. This in turn offers the potential to explore how knowledge transforms itself as it is used – i.e. the logic of transformation, as Gherardi (2012, 202) calls it.[7] As the main theme of my research is knowledge creation, this notion of *knowledge transformation* (as opposed to "knowledge production) is key.

However, the practices under study are also the empirical focus of analysis. Practice "may be assumed as an empirical unit of analysis in order to study how, within a practice, people reach a practical agreement starting from heterogeneous understandings and modes of cooperation with the material world" (Gherardi 2012, 202). This is not to deny the existence of the individual or forgetting the broader context either: "…work practices do not take place in a vacuum and that people's organizational lives are shaped both through individual agency and historical conditions (Nicolini. 2008, 120)." Rather it is recognizing for example that "…what we call macro-socio-economical structures and processes are work and practice 'all the way down' (Nicolini 2008, 131)." Thus, in addition to seeing practice as an epistemology, the practices themselves are treated as empirical phenomena. Thus the research framework needs refinement based on the positioning of the research as a practice based study. Practice-based research does not lend well to being represented in tables or graphs, as the interconnectedness and intertwining of various levels and the immersion of one practice within those interconnected webs makes rather a branching-out –type of a construct[8]. However, at the cost

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[7] This contributes to the other issues of epistemology: the logic of verification (validity conditions of knowledge) and the logic of discovery (conditions for the production of knowledge) (Gherardi 2012, 202).

[8] For example Nicolini (2008) has suggested the shape of a rhizome to capture this nature of practice-based research Co-incidentally, during my research, I chanced upon another instance of using a rhizome: the rhizomatic model of scientific knowledge production, According to this model, scientific knowledge production is "characterized by constant, uncontrollable flows of information and perspectives in knowledge formation that transgress disciplinary boundaries all of the time. Disciplines may be viewed as temporary bulbs in the rhizome

of oversimplifying, I will use the previous Table I constructed. Below in Table 3 I have added "the area of action" between the work group and individual. Importantly it is treated as being mutually constituted by both the collaborative action within the work group and the individuals participating in the said collaboration. Thus the levels of analysis are bracketed: in my research the individual, the work group and the organization are constituted by the practices themselves, and manifest in the same practices. Taking the practice-based perspective also calls for the elaboration of the concepts such as objects, embodiment and spatiality (sociomateriality) as well as boundaries inherent in collaborative practices, and these are added in to the research framework.

Level of analysis	Key theoretical concepts
(Organization)	Knowledge creation (KC) and knowledge management (KM) within organizations Organizational epistemology
(Work group)	Interdisciplinarity Cross-functional and interdisciplinary collaboration Sociomateriality (objects, embodiment, spatiality) Boundaries
	In the middle of action: ***Interdisciplinary knowledge creation practices***
(Individual)	Knowledge work, expertise

Table 3: Research framework in practice-based perspective

To conclude: the main empirical unit of analysis of this research is *interdisciplinary knowledge creation practices*. The analysis starts "in the middle of the action" (Nicolini 2008, 122) rather than privileging any level of analysis *a priori*.

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of scientific knowledge, and they are heterogeneous, fragmented, fractal and linked to neighboring fields. As a result, interdisciplinarity is in the disciplines a much as it is between them." (Bruun et al. 2005, 20.)

1.3 The empirical focus and overview of research process

1.3.1 Interdisciplinary knowledge creation in practice at Aalto Design Factory

So far I have identified the themes of the research and their corresponding levels of analysis. I have positioned my research within the practice-based research tradition, thus positioning the practices, rather than any pre-given level of analysis as the starting point of research. What is still missing is the description of the situated context within which the practices are to be observed, i.e. the empirical phenomena that is the focus of my research.

The broader empirical context within which I look at the research themes is that of higher education institutions (HEI's), specifically at the undergraduate level. I argue that higher education offers an interesting and timely context for the study of interdisciplinary knowledge creation practices and indeed knowledge work, as HEI's are more and more intertwined with the more (explicitly) commercially oriented organizations in the "knowledge society", as well as being the "producers" of skilful workforce to the society at large. Higher education institutions are also "knowledge-intensive organizations" par excellence, as well as offering a context where interdisciplinarity is present in ever growing degree (Knight et al. 2013; Holley 2009). In addition HEI's are under pressure to shift their knowledge creation processes away from academic, investigator-initiated and discipline-based knowledge production (often depicted as "Mode 1" of knowledge production) towards context-driven, problem-focused and interdisciplinary modes ("Mode 2"); (Gibbons et al. 2004; Nowotny et al. 2001, 2003; Swan et al. 2010; Bruun et al. 2005).

The HEI in focus is Aalto University in Finland, itself a manifestation of how HEI's change and are transformed (for an analysis on the making of Aalto, see Aarrevaara et al. 2009; Välimaa 2007). It is thus a representative of a knowledge producing organization within which certain forms of knowledge creation practices take place. Within Aalto, the specific site of empirical research is Aalto Design Factory (ADF). ADF is an "interdisciplinary platform; a physical and mental space, designed for supporting interdisciplinary learning and co-operation; a platform for experiments in industry-university co-creation; and a temple for experimental problem-based learning for better learning outcomes", as self-described in its

yearbook of 2011-2012. ADF is thus a self-proclaimed and explicitly interdisciplinary context for knowledge related practices.

ADF is itself embedded within the practices of Aalto University, and situated within this specific place and time. Of course, ADF in its own right is multifaceted research subject, but my focus is on the group-based activities organized by and in ADF: courses, everyday get-togethers and other events. However, most importantly, the courses or group-events or indeed ADF are not of interest in themselves (as in "practices of organizing interdisciplinary courses", "practices of building an interdisciplinary curriculum" or "practices of running an interdisciplinary community" and the like), rather they are seen as the sites of observing knowledge creation in practice. They are the reason that these individuals are collaborating in this particular time and place. The action, so to speak, takes place within the practices of a course that take place within ADF and the practices related to its operations. ADF is the broader field of interconnected practices within which the practices of knowledge creation unfold – and itself being nested in the practices of Aalto University.

In my empirical setting the students are the knowledge workers who partake in and enact the practices. As stated earlier, my research places a particular focus on the role the individual plays in interdisciplinary knowledge creation practices. I do acknowledge that being a student is different from being an employed worker in a company, but as I will show in later chapters, partaking in the courses at ADF in fact does involve the students in knowledge-work. ADF is explicitly committed to bringing these the two worlds of academia and business closer together in the form of project-based courses that involve corporate sponsors, budgets and deadlines, encouraging having an entrepreneurial mind-set and housing start-ups on its premises. In this sense the experiences of student's are meant to echo the realities of working life, and do offer insight into the practices of knowledge work.

Below in Table 4 I have added the empirical focus to my research framework. In addition, the role of higher education in contemporary society and its knowledge creation processes are to be explored as the empirical context of research is within this setting.

Level of analysis	Key theoretical concepts	Corresponding empirical focus
(Organization)	Knowledge creation (KC) and knowledge management (KM) within organizations Organizational epistemology Role of higher education in society's knowledge processes	Higher education institution of Aalto University, Finland
(Work group)	Interdisciplinarity Cross-functional and interdisciplinary collaboration Sociomateriality (objects, embodiment, spatiality) Boundaries	Aalto Design Factory (ADF)
In the middle of action: ***Interdisciplinary knowledge creation practices***		Knowledge creation practices
(Individual)	Knowledge work, expertise	Students participating in ADF activities

Table 4: Research framework: key concepts and empirical focus

1.3.2 Research process, materials and analysis

In the previous Chapter I positioned my research as practice-based. The focus on knowledge creation in practice requires being able to study these practices in situ – and this means studying them ethnographically. "Only through immersing oneself and being there is one capable of appreciating, understanding, and translating the situated, creative, interpretive and moral nature of the actual practices of organizing (Nicolini 2008, 120)." At the same time, being on-site enables one to grasp both how practices are embedded in their context and how individuals shape those practices, what are the emerging meanings and specificities of behaviour within this context – as well as making interpretations based on these observations possible. In Part II I will provide a more detailed account of organizational ethnography methodology as well as my research design. In this Chapter I will give a brief overview of my research process as to how the research was conducted and what types of material was generated during the process.

I am a management practitioner, and as such, the research process has been an on-off journey of over six years. The original idea was to study discourses of knowledge that were manifesting in Finnish higher education undergoing dramatic changes at the time (2008-

2009), based on methodologies and frameworks I had applied in my master's thesis on Knowledge Management discourse[9]. The merger of Aalto University was the focus of my research at that time. Interdisciplinarity became a central concept soon during that process. However, progressing with this line of inquiry I became more and more interested in interdisciplinarity as action, as something people do, rather than how it manifests in discourses. I also noted a lack of research on interdisciplinarity from the student's viewpoint. These developments pointed me towards ADF. I gained access and spent the spring of 2011 (January-April) doing on-site fieldwork at ADF. During this time, I better acquainted myself with practice-based theorizing. My own working life then offered an interesting opportunity to collect material from a cross-functional new service development project. The aim was to thus do a multi-site ethnographic research. I collected material from this project during September 2011-August 2012, when the new service went live. However, as the analysis of my materials progressed, it became clear that for the purposes of the dissertation, to focus on ADF was the better choice. The material from the second site was thus used in the capacity of triangulating the findings from ADF as to their relevance within another context. The autumn of 2014 was spent writing the manuscript finally full-time. I also returned to ADF for some time to double-check some issues, as well as to observe how its operations had evolved. Overall, I spent in total approximately 225 hours on 45 separate days at ADF during my research process.

Materials used in the analysis are partly from secondary sources, but the main bulk was generated during my ethnographic research on-site at ADF. They comprise of my field diary, other personal observational notes and materials such as pictures. I also interviewed 31 students more in-depth (see Appendix 1 for details). In addition 55 students from an interdisciplinary course answered an open-ended survey about their preconceptions of "interdisciplinarity". Below in Table 5 I have summarized the empirical material used in my research set within the research framework.

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[9] School of Business at Lappeenranta University of Technology (LUT): "Representations of work and worker in the three generations of Knowledge Management. Critical Discourse Analysis of selected texts", 2008.

Key theoretical concepts	Corresponding empirical focus	Materials collected / generated during research process
Knowledge creation (KC) and knowledge management (KM) within organizations Organizational epistemology Role of higher education in society's knowledge processes	Higher education institution of Aalto University, Finland	• OECD Country Note on Finnish Tertiary Education • National Government Inquiry Committee Report on the merger • Rector Tuula Teeri's editorials, blog texts, presentations • Aalto University official material
Interdisciplinarity Cross-functional and interdisciplinary collaboration Sociomateriality (objects, embodiment, spatiality) Boundaries	Aalto Design Factory (ADF)	• ADF own material (annual reports, other presentation material) • Ethnographic material collected 01-04/2011 • Open questionnaire (55 students from Interdisciplinary Product Development (IPD) course • Supporting interviews with staff • Other supporting observational material, pictures etc.
In the middle of action: ***Interdisciplinary knowledge creation practices***	Knowledge creation practices	• Ethnographic material collected 01-04/2011 • 31 interviews of students participating in interdisciplinary courses • Other supporting observational material, pictures etc. • Field diary, personal notes
Knowledge work, expertise	Students participating in ADF activities	As above.

Table 5: Empirical material within the research framework.

The analysis itself was an iterative process that bounced back and forth between the field notes, interviews and second-hand material as well the reflecting vis-à-vis the key concepts and earlier research. Despite the iterative nature of the analysis, my field diaries form the foundation of the analysis, and I used thematic colour coding in order to identify emerging themes regarding my research questions. The interviews conducted enriched the emerging issues as well as offered many new ones themselves – to which I returned again in my field diaries. The secondary source materials were used as supporting material in order to gain a holistic picture of the ADF operations and its position within Aalto University. In Chapter 7 I offer a more detailed description of my empirical materials and their analysis.

1.4   Review of earlier literature and research gaps

As described in the previous chapters, it is the purpose of my research to gain a better understanding of knowledge creation in interdisciplinary contexts by observing it as grounded

in site-specific (knowledge) work practice within the context of higher education. As research approach a practice-based perspective is taken, where the focus is on gaining a sense of the doing, and observing the specificities of participant behaviour and meaning in site-specific work-practices of knowledge creation, with a special focus on the individuals engaging in these practices. My research employs organizational ethnographic research methods in the form of on-site fieldwork, generating field diaries, observations, semi-structured interviews and additional secondary sources and materials.

Relevant earlier research derives from these origins: the purpose of my research as well as the research approach taken. The "keywords" of my research are *knowledge creation, interdisciplinarity (incl. cross-functionality), knowledge work (incl. expertise) and practice.* Relevant earlier research is to be found under these broad themes. As my part-time research process has taken several years, I have become acquainted with a broad array of earlier research, and thus some authors have been "with" me for a long time. They include for example Spender, Alvesson, Hislop, Orlikowski, Grant, Tsoukas, Carlile, Gherardi and Contu. Following their research and references, I have been able to navigate further into the keywords of my research. In addition I owe a great deal to a few recent literature review -type articles that have provided an excellent map and analysis on earlier research – as well as offering their own strong contribution to the subject: Corradi et al. (2010) and Erden et al. (2014) on practice-based research; Nicolini et al. (2012) on objects; Gherardi et al. (2013) on embodiment; Amin & Roberts (2008) on communities of practice and beyond; and Huutoniemi et al. (2010) on interdisciplinarity. Their strong knowledge of the research conducted on their research subject has aided me immensely.

Based on the themes of my research I have distinguished four themes of earlier research that I have evaluated to be relevant for my research. First, looking from the level of the organization, research on organizational knowledge processes is relevant. I use the discourses of knowledge management (KM) as a window to exploring organizational knowledge creation activities. I also explore the epistemological underpinnings of KM as well as specifically research on the knowledge production processes of higher education institutions as it is the organizational context of my empirical material. Second, as I take the practice-based perspective to organizational knowledge creation, I analyze earlier research that have

taken this particular perspective towards new product development, for example. Third, research on interdisciplinary and cross-functional collaboration is of interest, as this research looks at the work group practices of knowledge creation. Fourth, studies on knowledge work and expertise are relevant as they conceptualize how individuals may be construed in knowledge intensive practices, and how this type of work practice is potentially distinct from other types of work.

In the following sections, the earlier research on each theme is looked at in more detail, and consequent research gaps are identified.

1.4.1 Organizational knowledge processes

The overall importance of knowledge to organizations' competitiveness is well acknowledged in earlier research (Kogut & Zander 1992; Spender & Grant 1996, Grant 2002). From the viewpoint of understanding earlier research, Kianto et al. (2013) usefully distinguish the topics of research between organizational knowledge management activities and the more generic knowledge processes such as knowledge sharing and knowledge creation. Knowledge management activities refer to the more controllable and intentional management activities such as structural arrangements, information and communication technology related activities and HR-practices, whilst knowledge processes are "more generic in nature and likely to take place to some extent in any organization regardless of whether there are any systematic efforts for management control concerning them (ibid; 386)".

Overall however, knowledge management (KM) as a *management discourse* or "fashion" (Zorn & Taylor 2003) provides a useful contextual and historical anchor within which knowledge-intensive organizations (Alvesson 2004; Newell et al. 2009; Hislop 2009) and their practices can be grounded. Through KM we can also better understand the possible epistemological underpinnings of knowledge processes within organizations. Understanding this context is vital in practice-based studies: "Central to the practice perspective is acknowledgement of the social, historical and structural contexts in which action takes place (Sole & Edmondson 2002, 18)". KM literature has been reviewed to a great extent elsewhere (Tuomi 2002; Hong & Ståhle 2005; Acedo et al. 2006; Baskerville & Dulipovici 2006;

Jasimuddin 2006), and it is not in the scope of this research to contribute to this type of review. Rather, for the purposes of understanding KM as a "window" to the context, in this research I mainly turn to two comprehensive textbooks on KM, namely those of Newell et al. (2009) and Hislop (2009, 2013)[10], both which offer a multifaceted and multi-level treatment of KM related issues, including knowledge-intensive organizations as the contexts for knowledge-work (see also Alvesson 2004).

Higher education is the empirical context within which the observed practices on-site are situated in. In order to understand the role of higher education institutions (HEI's) and subsequently of science more broadly in contemporary societies, I turn to research that conceptualizes knowledge production within HEI's as well as theorizes the relation between science and society (the sociology of science). Key references are Gibbons et al. (1994), Nowotny et al. (2001) and Swan et al. (2010). Especially Nowotny et al.'s (2001) concept of the *Agora* as the space in which scientific processes (as socially and contextually bound) meet and interacts with many diverse agents is of interest.

1.4.2 Research on organizational knowledge creation in practice-based studies

As innovation and the need to constantly create new services and products has become a central challenge to organizations, so too the processes of knowledge creation (KC) have become the focus of increased interest within knowledge management as well as within organizational learning, innovation studies and knowledge-based theories of the firm (Grant 2002; Nonaka et al. 2006; Carlile 2002, 2004; Tsoukas 2009; Easterby-Smith & Lyles 2011). As the phenomena of knowledge creation is multifaceted, so too are the approaches that researchers have taken; they include for example taking behavioural approach (Schultze & Hoegl 2008), using social systems theory (Morner & von Krogh 2009) and using an interactional and dialogical approach (Tsoukas 2009).

Researchers who view knowledge as socially constructed and residing in processes and/ or practices have generally emphasized the importance of social practices within which new

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[10] Due to availability reasons, I mainly use Hislop's 2009 edition. I have cross-checked with the 2013 edition, and if the treatment of an issue differs notably between the two editions, I cite the 2013 edition.

knowledge is created and social interaction through which new knowledge emerges (Newell et al. 2009; Tsoukas 2009). Nonaka & Takeuchi's (1994) SECI-model (socialization externalization combination internalization) of knowledge creation is at the basis of much research on KC, which states that knowledge is created through the interaction between tacit and explicit knowledge, and Nonaka et al. (2006, 1179) describe organizational knowledge creation as "the process of making available and amplifying knowledge created by individuals as well as crystallizing and connecting it to organization's knowledge system."

The SECI-model has been criticized over the years (Gourlay 2006; Gueldenberg & Helting 2007; Newell et al. 2009; Orlikowski 2002). In addition its lack of explaining empirically *how* the interaction and dialogue between tacit and explicit knowledge in fact happens has been noted in research building on its premises. For example Gourlay notes that there is little actual evidence that something such as the SECI-model actually exists in the "life-world" of organizations: "Nonaka's proposition that knowledge is created through the interaction of tacit and explicit knowledge via four knowledge conversion processes has been found wanting on empirical and conceptual grounds" (2006, 1430); "…the evidence adduced in support of the modes of knowledge conversion is either non-existent, anecdotal, or open to alternative explanations" (2006, 1416)[11]. Tsoukas (2009, 942) also notes that Nonaka et al. "stop short of explicating this process". Tsoukas also more generally notes that "Yet, despite the proliferation of empirical studies and the important insights gained, more theoretical work is needed to further expand on the processes through which new organizational knowledge emerges (Tsoukas 2009, 941)".

I will take as a reference point the research on KC that has evolved from both practice-based epistemology, as well as taking an ethnographic research approach in attempting to understand how knowledge creation actually happens – in particular within "knowledge work" and knowledge intensive organizations. These both have a strong empirical focus, and as such offer contributions to KC that have been noted lacking in e.g. Nonaka et al.'s treatment of the subject. The study of work related practices in practice-based research has a

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[11] Nonaka et al. (2006, 1179-1180) naturally argue the contrary, stating that knowledge creation theory (i.e. the one including the SECI-model), "is increasingly having an impact on today's general management practice. Several organizations [...] report that they have built initiatives, projects and functions on concepts outlined in organizational knowledge creation theory."

long tradition, as often in organizational settings practice is equated with the ways in which work overall gets accomplished, following the seminal work of Brown & Duguid (1991). The study of *knowledge-related* work activities is a particularly strong perspective within practice-based scholars, as much of practice-based research originates from its particular epistemological stance (Erden et al. 2014).

Knowledge creation as distinct knowledge process has been researched for example in the contexts of new product development and product innovation. Research in this vein tends to centre around the social dynamics through which people create and share knowledge especially across various boundaries, and explore how this type of work practice should be coordinated (Erden et al. 2014). This includes for example Carlile's conceptualizations on boundary objects and boundary spanning in product development (2002, 2004); Dougherty's ethnographic research on innovation in service firms (2004); Orlikowski's (2002) and Sole & Edmondson's (2002) empirical studies on knowing-in-practice and situated knowing within dispersed product development; Kellogg et al.'s (2006) research on boundary-spanning coordination in volatile and dynamic organizational contexts; project-based learning practices studied by Scarbrough et al. (2004); and Yanow's theorizing on "local" knowledge that exists in the peripheries of organization (2004). Ethnographic research on occupational communities and their work-practices (including the use of knowledge to accomplish the work) include Bechky's work (2003, 2006) and Orr 's famous and much used thick description on the work practices of copier technicians in "Talking about Machines" (1996). In addition, Gherardi (2012) offers a comprehensive overview of practice-based research of "knowledge as practical activity" that is a central reference.

Within KC research in general, and practice-based studies in particular, there are two research gaps to which my research can potentially make its contribution. **First,** I will place a particular focus on the individuals (students in my empirical context) participating in knowledge creation practices. The abovementioned research does not in fact say much about how the individuals partaking in the practices under study experience the very practices, and explore the differences in their experiences. They do, of course, give *voice* to the individual worker (especially in the ethnographically oriented research), but overall there is little analysis on how the participants as individuals *experience and feel* the practices themselves.

For example in Orlikowski research on knowing-in-practice (2002), even though the individual as an active agent is prominent, the representation does not acknowledge (or rather look for) individual differences in relation to practice. In addition "it has been pointed out that, while processes of 'meaning-making are illuminated, the 'subjective experience of agency'—how human agents feel about themselves and their circumstances—tends to be devalued (Stein et al. 2014, 157, quoting Thompson, 2012). Consequently, the collective context where work happens is pronounced, and the "knowing" of the individual is part of a collective capability. Erden et al. (2014, 719) recognize this as well: "… studies adopting the knowledge perspective have a tendency to disregard the roles that individuals play in social practice. Future research might examine how individual differences are linked to knowledge in a social practice."

The **second** research gap and thus a potential contribution stems from the practice-based orientation of taking "matter" seriously, that is the physical aspects of work practices. In addition using an ethnographic method ties empirical research into a very specific physical setting, that it is the site of the fieldwork. Within knowledge creation theory, von Krogh & Geilinger (2014) see that there is limited understanding of how a physical space (as opposed to virtual spaces such as online communities, that have been the topic of more research), enables or constrains knowledge creation: "… it is our belief that works on the dimensions of the physical places from which knowledge creation emerges has drifted to the background… we consider a focus on the physical space, or the localization of organizational knowledge creation, to be vitally important… (Ibid. 2014, 156)."

Thus when *the individual and the physical place* where the individual is engaged in practices are put in explicit focus, one can establish a link to *sociomaterial theories and research on spatiality:* the analysis of the important role physical matter and bodies play in practices (Fenwick & Nerland 2014). This (in some cases renewed) increasing interest in the relations between the body, senses and non-human elements such as office space in organization studies has manifested in a variety of research on these issues, whether labeling them embodiment, materiality or socio-materiality[12].

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[12] See for example the special issues of Scandinavian Journal of Management (Dec. 2013): Body, Senses and Knowing in Organization; Leadership (August 2013): "The Materiality of Leadership"; Journal of Education and

I distinguish three specific areas of earlier research within this domain: first, embodied knowing (knowing through the body, aesthetic and sensible knowledge; second, materiality (objects, artefacts, technologies); and third, spatiality (physical settings). Of course, and this cannot be stressed enough, the three are dynamically enmeshed in practices, but for the purposes of providing a literature overview I look at them as separate themes in this conjunction.

Embodied knowing. The practice-based view on knowledge postulates "it is people who create, invent, and enact organization through their corporeality, which enables them to acquire sensible knowledge as well as to engage in intellectual ratiocination – and always in relation to the non-human elements that make up the organizational space" (Strati 2007,66). As stated in the previous Chapter, Erden et al. (2014) recognized a potential research gap in the analysis of individual difference in practice. Most importantly however, within practice-based research, these differences do not stem from the individual "minds", but from the holistic corporeality of the participants (Strati 2007). The differences individuals bring to knowing and knowledge activities thus originate from our unique way of experiencing our sensory data that establishes us in a particular (materially) situated activity (Varela et al. 1991). Strati (2007, 67) provides an overview of field research that establishes how the practices of knowing and learning in organizations are "processes which are not only mental and logical-analytical but also corporeal and multi-sensorial". Gärnter (2013) has reviewed the literature on embodiment in organization studies. He identifies six perspectives on embodiment that differ on how they treat the dichotomy of mind vs. body; the distinction between having a body vs. being a lived body; and on the conceptualizations of the relation of the embodied subject and its sociomaterial environment. Gherardi et al. (2013) have similarly analysed how the body has been treated in organizational studies, recognizing three categories: the body that works through the senses, the body that experiences through the senses, and the body that knows through the senses.

Gärnter's discussion on how the different views on embodiment can be integrated into a more comprehensive understanding of knowledge work and knowledge creation is of special interest. He for example suggests taking the notions of sociomateriality (Orlikowski 2007) as a base concept for this type of integration, but acknowledging that the individuals not only have a body in the practice that interacts with its sociomaterial surroundings – they are lived embodied beings, and as such knowledge work is based on *their sensuous understanding and experience during the work practice* (Cunliffe & Coupland 2012; Hindmarsh & Pilnick 2007). Also Yanow (2004) theorizes on the "experiental-contextual" and "lived experience-based local knowledge" that differs from the more abstracted and de-contextualized "expert knowledge". This in turn can be *reflected* upon in relation to the individuals' *former experiences* in other sociomaterial environments – and as such not focusing only on the here-and-now, which according to Gärtner is one tendency of earlier research in this vein [which includes the by now familiar Bechky (2003), Carlile (2002) and Orlikowski (2007)].

As knowledge is one central perspective in practice-based research, so too is **materiality.** Nicolini et al. (2010, 612) note that "A mounting number of social theorists have argued, moreover, that a characteristic feature of modern society is that it is increasingly mediated by objects and material artefacts". Research of this materiality is concerned with objects, artefacts and technologies and their properties, identities and relations with other entities (e.g. humans) in practices (Erden et al. 2014; Lee & Amjadi 2014). As with the concept of knowledge, practice-based research attempts to overcome the ontological distinction and separation of material and social, instead approaching them using the notion of constitutive entanglement, which "presumes that there are no independently existing entities with inherent characteristics. Humans are constituted through relations of materiality — bodies, clothes, food, devices and tools, which, in turn, are produced through human practices. The distinction of humans and artifacts, on this view, is analytical only; these entities relationally entail or enact each other in practice" (Orlikowski 2007, 1438.) Thus she promotes the term "sociomateriality" rather that of "materiality", used for example in research on how technology shapes and is shaped by work practices (Gherardi 2012). As with practice-based research more generally, within sociomaterial theorizing, the role of emotions and the "felt quality of sociomateriality" - that is the consideration of the emotional side of individuals - is seen as a neglected research area (Stein et al. 2014, 157).

Within the theme of knowledge creation, Carlile's (2002) research on "boundary objects" has been a much-used and prominent way of approaching materiality - how knowledge processes unfold around material artifacts – however, mostly treating objects as quite static tools, as in "materiality", as well as possibly seeing boundary objects where there in fact may be none (as proposed in the original form). Relevant to my research topic, Nicolini et al. (2012) have studied the role of objects in cross-disciplinary collaboration, and construct a pluralistic framework to study the role of objects not only as boundary objects, but also as epistemic things, objects of activities and infrastructures. In addition Ewenstein & Whyte (2007, 2009) have concentrated on visual representations and aesthetic knowledge present in design – oriented work practices – both particularly relevant to the empirical setting of Aalto Design Factory. In addition, Star - the author who introduced the concept of boundary objects in the first place – has interestingly reflected on her concept, and to its possible mishandling in research (2010).

A special case of physical matter present in practices is the actual **physical space** in which practices happen. As noted earlier, von Krogh & Geilinger (2014) call for more research on the relationships between physical space and knowledge creation. Van Merrewijk & Yanow (2010) also recognize that spatial elements are easily deemed either irrelevant or are a blind spot in organizational theorizing, stemming to some extent from the research methods that its study requires. According to them, the study of spaces is interpretive to the extreme because "studying space rests on the researcher's heightened awareness of that body moving through space as a medium through which to articulate provisional understandings of that space's effects on others' bodies (ibid. 7)." As a consequence, these provisional understandings require triangulating, i.e. on other persons, other sources, or other spaces, as well as increased reflexivity. Thus my use of ethnography as research methods enables me to take spatiality into account.

Relevant to my themes is the earlier research by Dale & Burrell (2008; 2010), as they center on the "ideal of community", the concept increasingly popular within space design: treating organizational work spaces as homes with kitchens and other recreational areas, thus making the "workplace" disappear from the work place. "These themes incorporate an

aestheticization of the workspaces, consciously designing them to produce pleasurable and sometimes sensuous effects (ibid. 20)." Also Felstead et al.'s (2005) research on knowledge work settings and spaces as tools to enhance creativity, team work and knowledge sharing, or broader organizational transformations altogether – that is, the use of spatial design to bring about desired behavior among the users of such space – provides additional input.

1.4.3 Research on interdisciplinarity and cross-functional collaboration

As stated earlier, "… knowledge creation is typically not something that is done by a single person" (Newell et al. 2009, 79), and knowledge and skill diversity in groups (i.e. interdisciplinairty and cross-functionality) is seen as fostering knowledge creation and innovation (Alberts 2007; West 2002; Bruns 2013). This means that work is increasingly accomplished through collaboration among interdependent groups of disciplinary specialists (Nicolini et al. 2010). As my empirical setting is a self-described "interdisciplinary community", research on work groups and knowledge creation practices within them is thus an important stream of earlier research. The keywords here are "interdisciplinarity", "community" and "collaboration".

Research on **interdisciplinarity** is extensive, and it has been researched from a variety of viewpoints (Klein 2008a, 2008b; Bruun et al. 2005; Huutoniemi et al. 2010; Siedlok & Hibbert 2014), and I will use Klein's writings in later chapters when defining the concept of interdisciplinarity in detail. Huutoniemi et al. (2014, 18) categorize interdisciplinary research into three groups according to their focus of interest: research into the degrees of interdisciplinary integration; research on interdisciplinary practices; and into the rationales, motives and demands driving interdisciplinarity. Stemming from my research purpose, two areas of earlier research are of special interest: a) interdisciplinarity in the particular context of higher education programs at undergraduate level (as opposed to scientific research); and b) knowledge creation practices in interdisciplinary groups.

Interdisciplinarity within the context of (undergraduate) higher education. The extensive and recent literature overviews provided by Huutoniemi et al. (2014), Klein (2008a) and Siedlok & Hibbert (2014) as well as my own research into the subject seems to indicate that

research that deals explicitly with interdisciplinarity in higher education at the undergraduate level is rather scarce, and even more so in the case empirical research from the student's viewpoint. Knight et al. (2013) have studied the features of undergraduate interdisciplinary programs in the US in order to lay groundwork for better researching on how different programs affect student's learning outcomes, and they also note the lack of empirical research on the subject: "Though the number of interdisciplinary undergraduate programs has increased rapidly over the past several decades, little empirical research has characterized such programs (Ibid. 143)". Holley (2009) has analyzed (also in the US context) how universities as organizations have undertaken this change towards interdisciplinarity. In addition there are case studies done on specific interdisciplinary courses and programs (for an example on health care management see McFadden et al. 2010). Thus we can identify a research gap of empirically oriented research into interdisciplinary undergraduate level programs and even more pronounced is the lack of research on how the students partaking in them experience such programs.

The notion of **community** is inescapable when researching into knowledge creation within groups. Fundamentally research in this arena rests on the by-now classic concept of communities-of-practice (CoP's) as the social locus of knowledge and learning (Lave & Wenger 1991; Wenger 1998). These studies have also been recognized as the antecedent for practice-based studies (Corradi et al. 2010). The concept of the CoP has provoked numerous studies and a widespread use of the term, but also critique (see e.g. Lindkvist 2005; Ribeiro et al. 2010; Amin & Roberts 2008; Handley et al. 2006). For the purposes of my research, I will approach the extensive literature on CoP's from the particular viewpoint of cross-functionality and interdisciplinarity, as there is an interesting potential research issue regarding interdisciplinarity. Lattuca (2002) notes: "I noted earlier that a considerable body of literature addresses the activities of disciplinary communities of practice, *but few have investigated whether interdisciplinarity engenders similar practice communities* (ibid 734, my emphasis)". Are cross-functional and interdisciplinary communities distinct from CoP's (in their most common conceptualization), and if so, how? If, following Knorr Cetina (1999), disciplinary divisions are deeply entrenched on many levels, then the disciplinary CoP's are by definition also separated from each other by the very same boundaries. Thus CoP's in *interdisciplinary* contexts seem a contradiction in terms. Lindkvist (2005) offers the concept

of Collectivity-in-Practice (CiP) as an alternative to these cross-functional project-based groups; Gherardi (2009) has proposed an overall profound shift from the notion of CoP's to that of Practices-of-Community (PoC), where the situated and repeated actions create a context where certain practices are sustained, rather than the context being the CoP; and Amin & Roberts (2008) offer a typology of the different kinds of collaboration "beyond CoP's". I will explore these and analyze the findings in light of these different conceptualizations.

As stated earlier, interdisciplinarity is characterized by the co-existence of *boundaries, divisions and specializations*. Boundaries mark a difference as they "refer to discontinuities, to lines of distinctions between inside/outside, membership and non-membership, inclusion and exclusion" (Wenger, 1998: 120)." It is argued that it is at these very boundaries where knowledge creation is often found and where innovation occurs or is thwarted (Carlile, 2002, 2004). Both Carlile (2004) and Contu (2014) cite Leonard-Barton (1995) who argue that most innovation happens at the boundaries between disciplines or specializations, and uses the concept of "creative abrasions": sparks igniting a conflict among individuals who work together but have different signature-skills, ideas and ways of seeing a particular task/problem. "As such, creative abrasions may appear to be a universal functional process proper to knowledge-creation work (Contu 2014, 289)".

Empirical research into these boundaries, abrasions as well as ways to overcome the boundaries ill effects on knowledge creation in interdisciplinary contexts includes once again the before-mentioned Carlile's (2002, 2004) research on boundary objects and managing boundaries; Nicolini et al.'s (2012) research on the plural role of objects; Contu's (2014) ethnographic research on the power relations in creative work; Lattuca's (2002) study of the learning experiences of faculty in interdisciplinary projects; Olsen's (2009) research on interdisciplinary practices within nanosciences; Monteiro & Keating's (2009) ethnography on the role of language in interdisciplinary scientific collaboration; and Jeffrey's (2003) account on processes of cross-disciplinary research collaboration. Other related research includes Bruns' (2013) ethnographic fieldwork at two top U.S. universities in the field of systems biology cancer research using the notion of "multiple expert domains", as well as Oborn & Dawson's (2010b) studies of medical teams dealing in diagnostics. Knorr Cetina's study (1999) on scientific communities is an additional insightful research that aids in approaching

knowing-in-action in an environment characterized by deep disciplinary divisions. Another field of study where the presence of multiple knowledge bases and functions has been recognized as being fruitful to knowledge creation is the research on cross-functional new product development and innovation [see e.g. McDonough (2000)] – however, this stream of research is heavily based on quantitative analysis of the factors influencing successful and effective product innovation, and as such does not directly contribute to my research focus of the actual practices of such activity.

In fact, it is important to remember that much research done on work-practices in the practice-based orientation include analysis on how diversely specialized groups of people work together (e.g. Bechky 2003; Kellogg et al. 2006), indicating that diversity, interdisciplinary, cross-functional collaboration and boundaries are concepts that are strongly present in contemporary knowledge work practices in general.

My research attempts to contribute to the above literature in exploring how the individuals experience such boundaries, what types of practices emerge when attempting to overcome them, and how objects figure in these practices. In addition focusing on the actual "doing", it may in its small part help uncover what Bruun et al. (2005, 25) refer to as the "concealed" reality of interdisciplinarity: "Measuring the full impact of interdisciplinary research requires accounting for both the "overt" and the "concealed" reality that emerges within the course of daily work."

This "daily work" of knowledge creation can be labelled as "knowledge work" – the actual doing of knowledge-based activities. **Knowledge work** as a distinct type of work - although in practice-based research the argument is that all work involves using of knowledge (Bechky 2006) - has been researched notably by Blacker (1995). Alvesson's (2001, 2004) research on knowledge work runs along similar lines, and his research is a key reference. Also Hislop (2008), Newell et al. (2009) and Newell (2014) have researched knowledge work in case studies. The concepts of expertise and professionalism are at the core of most views on knowledge work, and thus the possible conceptualizations of expertise are important to my research as well, for example Yanow (2004) theorizes on the distinction between "expert knowledge" and "local knowledge". In addition Nowotny et al. (2001); Nowotny (2000);

Collins & Evans (2007); Collins (2014) and Bereiter & Scardamalia (1993) all – from quite different viewpoints - attempt to theorize on the current challenges to expertise in an environment where "…loss of confidence in experts and expertise seems poised to usher in an age of technological populism (Collins & Evans 2007, 1-2)". Regarding interdisciplinarity, earlier literature offers the concepts of "A-shaped skills" (Leonard-Barton 1995) and "T-shaped skills" (Iansiti 1993) to describe individuals that have knowledge of more than one specific discipline; more recently in product innovation literature these types of individuals are labelled "multi-knowledge individuals" (Park et al. 2009).

Scientists and the scientific process is a special case of expertise[13] that has been researched quite extensively (See e.g. Knorr Cetina 1999; Stehr 2005; Nowotny 2000). I integrate these notions on the changing nature of expertise with conceptualizations of knowledge work in order to better understand the practices emerging in my empirical setting of interdisciplinary higher education.

1.4.4 Summary of relevant earlier research and research gaps

By now, the key authors and earlier research relevant to my thesis have emerged, and thus the arena of academic discussion within which my research aims to make its contribution. The key distinguishing factor is using practice-based perspective as research approach. This places my research quite firmly within a specific research tradition, and at the same time creates distinctions from others. Below in Table 6 I have summarized the preceding chapters. I have listed the references I will be using to a varying degree in grounding my empirical research in earlier discussions, as well as summarized the research gaps that have risen from my literature review. This list is not exhaustive, and further sources may be introduced if they make an additional contribution - however, these references form the foundation.

Relevant themes of earlier research	Perspective	Key references	Research gap, contribution

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13 Scientists are often treated as being wholly distinctive from "experts", see e.g. Stehr & Meja 2005. For the purposes of this dissertation I will treat scientists as a special illustrative case of expertise, through which the current ambiguities can be illustrated.

Social, historical and structural **contexts** within which knowledge creation practices take place	Knowledge management discourse in organizations, its epistemological underpinnings	Newell et al. 2009 Hislop 2009, 2013 Gherardi 2012	Contributing to practice-based studies on knowledge creation.
	The role of science and higher education institutions (HEI's) in knowledge production	Gibbons et al. 1994 Nowotny et al. 2001 Swan et al. 2010	Providing an empirical case of an undergraduate interdisciplinary program.
Knowledge creation practices	Practice-based studies on knowledge creation practices (esp. in contexts of product development and innovation)	Carlile 2002, 2004 Dougherty 2004 Orlikowski 2002 Sole & Edmondson 2002 Kellogg et al. 2006 Scarbrough et al. 2004 Yanow 2004 Gherardi 2012	Role of individuals and their differences participating in practices. Role of physical space on knowledge creation.
	General thick descriptions of work practices	Bechky 2003, 2006 Orr 1996	Providing an additional empirical context for insights into contemporary work practices.
Embodiment, sociomateriality and spatiality of knowledge creation practices	Embodiment of knowledge creation practices	Strati 2007 Gärtner 2013 Gherardi et al. 2013 Yanow 2004	Providing an integrated approach that includes embodiment, sociomateriality and spatiality.
	Sociomateriality and knowledge creation practices	Carlile 2002, 2004 Orlikowski 2007 Orlikowski & Scott 2008 Nicolini et al. 2012 Ewenstein & Whyte 2007, 2009 Stein et al. 2014	Inclusion of the individual experience of the practices.
	Role of spatiality	Van Merrewijk & Yanow 2010 Dale & Burrell 2008, 2010	

		Feldstead et al. 2005	
Interdisciplinarity and cross-functional collaboration	Conceptualizing interdisciplinarity	Klein 2008a, 2008b Bruun et al. 2005	Empirical research on student experiences of interdisciplinarity.
	Knowledge-creation practices in interdis. Groups; esp. boundaries, role and nature of community	Star 2010 Star & Ruhleder 1996 Amin & Roberts 2008 Carlile 2004 Contu 2014 Lattuca 2002 Olsen 2009 Monteiro & Keating 2009 Jeffrey 2003 Bruns 2013 Oborn & Dawson 2010a, 2010b Knorr Cetina 1999 Lindkvist 2005 Gherardi 2009 Wenger 1998	Exploring the nature of interdisiciplinary knowledge creation practices. Contributing to practice-based studies using practice both as an epistemological approach as well as an empirical unit of analysis.
Knowledge work and expertise	Conceptualizations of knowledge work and expertise	Blackler 1995 Nowotny 2000 Alvesson 2001, 2004 Hislop 2008 Newell et al. 2009 Collins & Evans 2007 Collins 2014 Yanow 2004 Leonard-Barton 1995	Contributing to empirical research on knowledge work practices in explicitly interdisciplinary contexts. Integrating concepts from knowledge work and expertise research.

Table 6: Relevant earlier research, key references and identified research gaps

1.5 Research questions and contributions of research

It is the purpose of my research to gain a better understanding of *interdisciplinary knowledge creation* by observing it as a collective, situated activity within the context of higher education, namely the Aalto Design Factory of Aalto University. As research approach a practice-based perspective is taken, where the focus is on gaining a sense of the doing, and observing the specificities of participant behaviour and meaning in site-specific work-practices of knowledge creation. I place a special focus on the role of individuals engaging in these practices, that is their potentially differing aesthetic judgements, sensible knowledge and experiences of these practices. In addition I take into account the sociomateriality and spatiality of the practices. My research employs organizational ethnographic research methods in the form of on-site fieldwork, generating field diaries, observations, semi-structured interviews and additional secondary sources and materials.

As follows from the above, my research questions focus on the practices observed as well to the individuals participating in the practices. They also contribute to the understanding of the group-level collaborative practices present in interdisciplinary contexts specifically as relating to the community and sociomaterial aspects of such collaboration. In addition, as the practice-based perspective is used both as an epistemological approach (exploring the logic of knowledge transformation through its use), I will also explore the epistemological dimension of observed practices. Finally, I will attempt to increase our understanding of how students experience the type of interdisciplinary education as observed at ADF.

I have formulated four main research questions that may have supporting sub-research questions, and tied them with the acknowledged research gaps to which I aim to make a contribution (Table 5).

> **RQ.1:** What types of knowledge frameworks (epistemologies) emerge from the observed knowledge-in-use?

> **Contribution to research gaps:** using practice both as an epistemological approach as well as an empirical unit of analysis, how does the interdisciplinary "plurality of

knowledges" manifest in practices; what is the nature of interdisciplinary knowledge practices.

RQ.2: How do the students define and experience interdisciplinarity (as an educational practice)?

Contribution to research gaps: empirical research on (undergraduate level) student experiences of interdisciplinarity in higher education.

RQ.3: How can interdisciplinary knowledge creation be construed as a situated, practical activity?

> SRQ.3.1: What enables or constrains interdisciplinary knowledge creation (objects and boundaries, communication)?
> SRQ.3.2: How do embodiment, spatiality and sociomateriality figure in the practices?
> SRQ.3.3: Do the practices engender a certain kind of practice community, and if so, what are its features?

Contribution to research gaps: contributing to practice-based studies on knowledge creation; exploring the role of spatiality; integrating the concepts of embodiment, sociomateriality and spatiality in practices; exploring the nature of emerging practice community.

RQ.4: How do individuals experience interdisciplinary knowledge creation and knowledge work (and expertise) therein?

Contribution to research gaps: empirical research on knowledge work in interdisciplinarity contexts; integrating the concepts of knowledge work and expertise; exploring the individual experiences and differences therein.

Due to the nature of my research approach, research questions serve a multiple purpose. They are used as a compass that helps me in manoeuvring the complex and multifaceted sea of

material generated during my ethnographic research. Also - to continue with the seafaring metaphors - they act as both as the anchor that enables the zooming-in (Nicolini 2009) on materials that seem relevant – staying still and going deeper when necessary – as well as the beacon in order to reversely "zoom-out" to the bigger picture without getting lost in the depths of detail.

1.6 Structure of the dissertation

The dissertation is structured in five parts. Introduction forms the first part, and in this section's Chapter 1 the themes of research, the research framework, empirical setting, earlier relevant research as well as research questions are introduced. Part I formulates the theoretical framework and key concepts: knowledge creation in organization (Chapter 2), interdisciplinary knowledge creation and its practices (Chapter 3) and knowledge work and expertise (Chapter 4). The role of science and higher education in knowledge society are discussed in Chapter 5. Part II focuses on the methdodology and methods of the dissertation. The methods of practice-based research and organization ethnography are discussed in Chapter 6. The research process, research design, materials as well as the analysis conducted are introduced in Chapter 7.

Part III (Chapter 8) offers the ethnogeraphic story of Aalto Design Factory (ADF). The narrative is told in a form of a tour of the phsycial premises of ADF, and covers for example the lobby, its various shops for prototyping, event venue Stage, groupwork spaces as well as the "heart" of ADF, Kafis office-kitchenette.

Part IV consists of the key findings from ADF (Chapter 9) vis-à-vis the research questions set forth in the Introduction. The abstraction level is raised in the concluding Chapter (Chapter 10), where the key findings are placed within a more generalized organizational context. The potential future directions for interdisciplinarity at ADF are discussed. Limitations of research as well as the avenues for future research are also discussed in this Chapter. Overall, the dissertation opens with a prologue, and closes with an epilogue.

PART I: Theoretical framework

In this Part I of the dissertation I will formulate the theoretical framework and introduce the key concepts as set forth in the Introduction (see Table 2). In Chapter 2 I look at earlier research on knowledge creation in organizations. I use knowledge management (KM) as the overarching concept within which I explore the way organizational knowledge and its creation can be conceptualized (Chapter 2.1); how KM has evolved (Chapter 2.2); what are the epistemological underpinnings of KM (Chapter 2.3); and how the practice-based perspective brings fore the plural, fragmented and practical nature of knowledge.

Chapter 3 sets organizational knowledge creation within one specific context - that is interdisciplinary collaboration. I first defined interdisciplinarity and look at its various conceptualizations (Chapter 3.1). I then start "deconstructing" the actual practice of interdisciplinary collaboration, and explore the features that earlier (practice-based) research has found relevant. These are the role of boundaries and objects that traverse these boundaries (Chapter 3.2.1); the importance of communication (Chapter 3.2.2); the nature of the collaboration in interdisciplinary contexts, whether they are seen as a community of sorts of something else (Chapter 3.2.3); and finally the recognized importance of embodiment, sociomaterialtiy and spatiality in these types of practices (Chapter 3.2.4). I integrate and summarize the key concepts in to the dimensions of *Process, Practice* and *Enablements* in Chapter 3.3.

Chapter 4 focuses on the individual level participating in the above conceptualized knowledge creation practices – the knowledge workers. I start with the definition of knowledge work (Chapter 4.1). I then move on to the concept of expertise that is central to the way knowledge work is to be understood – specifically I look at the the challenges "expertise" is seen to face (Chapter 4.2.1); how the whole notion is potentially changing (Chapter 4.2.2); what earlier research sees as "expertise" and the introduction of "multiknowledge individuals" (Chapter 4.2.4); and how expertise can be seen as practical and local, as opposed to the abstract and "general" (Chapter 4.2.4). I summarize the presented discussion in Chapter 4.3.

The concluding Chapter 5 dives deeper into the specific context of science and higher education and its evolving knowledge processes (Chapter 5.1). I also see what is the role of higher education in the "producing" of knowledge workers (Chapter 5.2). Overall, Chapter 5 acts as a bridge between the theoretical and conceptual treatment of the research themes and their actual manifestations in my empirical setting of Aalto Design Factory.

2 Knowledge creation in organizations

2.1 Knowledge management and organizational knowledge

As established in the introduction, the overall theme of this research is knowledge creation in organizations. To talk about knowledge creation, of course, begs the question "what is knowledge". The study of knowledge, i.e. epistemology is a broad subject of philosophical research in its own right (Williams 2001), and as such not in the scope of my research. What is of practical interest, however, is how knowledge is conceived in organizations - that is, organizational knowledge. I define organizational knowledge very broadly as "a learned set of norms, shared understandings and practices that integrates actors and artefacts to produce valued outcomes within a specific social and organizational context" (after Scarbrough in Newell et al. 2009, 6).

Questions dealing with knowledge, i.e. epistemology, are fundamental ones that guide human action: they affect qualities that are inherently and exclusively human – thinking, reflecting and acting guided by our own thoughts – be they "rational" or not, individual or collective. Knowledge in today's society has a strong normative status as well as always including value-judgements. "Knowledge is an "honorific title" we confer on our paradigm cognitive achievements" (Williams 2001, 11), and as such equates with other "success-terms" like "win", or "Pass" (a test). If we give someone credit for having knowledge, we make a strong positive value assumption about the status of the person. Philosopher Ian Hacking makes a similar point. He calls knowledge (alongside concepts like facts, truth, reality) an elevator word: "Elevator words are not 'objects' in the world… The words are used to say something about the world, or about what we say or think about the world. They are at a higher level."

(Hacking 1999, 22-23). He also points out that these words have undergone substantial "mutations of sense and value" (ibid., 23) over time. Thus for organizations, groups and individuals to claim having "knowledge" is to elevate one's status with the positive value connotations attached to "knowledge" and to attribute oneself with this honorific title. Indeed, it is argued that it is this claim in itself and the act of persuading others of it that is at the heart of being "knowledge-intensive" – or rather "knowledge-claim-intensive" (Alvesson 2004); and making this claim is always contestable (Blackler 1995).

The underlying assumptions about what organizational knowledge is and more importantly, where it is assumed to reside and how is it created, have direct practical consequences on the everyday practices of the people involved. As stated in the Introduction, research that focuses on the strategies, tools and practices applied by management seeking to make knowledge the resource giving a firm its competitive advantage (as theorized by e.g. Grant 1996a&b, 2002) can be said to broadly belong to knowledge management (KM) and knowledge creation theory (Nonaka et al. 2006). The discourses of knowledge within KM provide a useful window on how knowledge is conceived   and how it has evolved - in organizational settings in general.

KM emerged as a popular management discourse from the 1990's onwards, and can be placed within the wider discourse of knowledge economy. The concept of knowledge economy suggests that there has been a qualitative and a distinct change in economics and societies, in that they are now knowledge driven: change happens through the generation, circulation and operationalization of knowledge - for an overview of various theoretical perspectives on "knowledge economy", see e.g. Castells (1996); and Webster (2002). KM is thus not only one representative of an influential management tools, but also a manifestation of broader phenomena that is the "knowledge economy" and its conceptions within organizational settings (Hislop 2009). In addition, KM has been a popular management fashion and as such, influential in management practices[14], and the assumptions it holds regarding knowledge influence the way knowledge related practices are treated, developed and managed. [15]

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[14] Management "fashions" and "isms" were a popular research subject a few years back (see e.g. Furusten 1995; Gibson & Tesone 2001; Jackson 2001, Abrahamson & Fairchild 1999). This was a result of the marked increase in the number of these management ideas since 1980s, the influence they seem to have on managers, and the shortening of their life-cycles. These ideas can also be labelled management tools, as often they manifest in

Zorn & Taylor (2003, 100-101) identify the following trends as reasons behind KM's emergence as a popular "management buzzword":

- KM is part of the general increase in what is referred to as "knowledge work" and the requirements this places on the organization;
- KM efforts are prompted by the recognition of intellectual capital as a source of organizational success;
- KM is a response to the failure of previous management trends such as downsizing and the subsequent loss of expertise;
- KM is a response to the explosion of information available, the information overload;
- KM offers solutions for managing global, distributed and networked expert organizations;
- KM is partly fuelled as well as greatly facilitated by the development of ICT.

There are a number of ways to approach this varied field of research. Much of the recent debate within KM has to do with the concept of knowledge itself and the subsequent grouping of KM research according the knowledge typologies used (Alvesson 2004; Hislop 2009; Newell et al. 20009). Other possibility is to look at the principle research questions KM research, the "anxieties of KM", as Spender & Scherer (2007) put it. Yet another possible avenue is to analyze the different theoretical schools KM research belongs to, and group the research accordingly (Acedo et al. 2006), or based on the disciplinary roots of KM (Jasimuddin 2006). However, for the purposes of this research, a rather practical view that groups the KM literature in three generations was chosen in order to illustrate the evolving nature of understanding organizational knowledge. This analytical tool of dividing the evolution of KM into three generations, ages or waves using a historical viewpoint has been

concrete "how-to" frameworks to be used by management practitioners. These ideas and tools are unarguably an integral part of what management practice in the 21st century is all about: Bain & Company multi-year survey (Rigby & Bilodeau 2011) on management tools and trends reports that in 2011 an average number of tools used by companies worldwide was 10, down from 15 of the peak year of 2006. Management tools are thus very persistent, and it would seem that as ways of "doing management", these tools have become neutralized and thoroughly legitimized. According to the study, in 2010 KM was used by approximately 40% organizations, notably down from a 69% in 2006, and most interestingly, KM was regarded as a tool with a low satisfaction rate.
[15] For an analysis on how popular manangement discourses such as KM influence organizations and management, and thus workers, see e.g. Jackson 2001.

used by Tuomi (2002), Hong & Ståhle (2005) and Snowden (2002). For a broader discussion and debate on the origins, evolution and content of KM, as well on theories concerning knowledge as a competitive advantage (e.g. the resource and knowledge based views of the firm) please see accounts by Blackler 1993; Grant 2002; Tuomi 2002; Acedo et al. 2006; Baskerville & Dulipovici 2006; and Jasimuddin 2006; for critical assessment see Spender 2006; Spender & Scherer 2007; Tsoukas 2005.

2.2 Evolution of knowledge management

The first generation or age is defined as collection of KM related issues that emerged prior to 1995. Tuomi (2002) sees that KM as a management "movement" did not emerge until 1995 with the publication of Nonaka & Takeuchi's famous book "The Knowledge Company". Tuomi also places KM in a continuum with TQM and BPR, whereas Hong & Ståhle (2005) do at least implicitly claim that some form of KM did exist on its own prior to 1995, and in part led to the technologically led revolution of process management and BPR as discourse: they describe the first generation of KM as "…focused on the appropriate structuring and flow of information to decision-makers, as well as on the computerisation of major business applications, which lead to a technology-enabled revolution dominated by the perceived efficiencies of Business Process Reengineering (BPR)" (Hång & Ståhle 2005, 131). Snowden (2002) takes the middle ground, stating that prior to 1995 the KM –type activities' main goal was to provide the informational support for BPR initiatives, and as a distinct entity emerged in 1995. There are also views that KM actually emerged because of BPR: the efficiency gains were achieved often by downsizing, which in turn meant the loss of expertise in organizations (Zorn & Taylor 2003). Hislop (2009) and Schultze & Stabell (2004) call KM of this era as the neo-functionalist discourse; Newell et al. (2009) use the label "structural perspective).

However the first generation is defined, it has some distinct features: it has a technological perspective, its main concern is to identify knowledge and take care of its subsequent storage and distribution (information processing), using mainly ICT as the key tool. Individuals are seen as the prime knowledge carriers. Knowledge is an asset, rational, explicit and context free – unproblematic, so to speak (Snowden 2002). The temporal focus is on skills and knowledge needed at present.

Unlike the first, **the second generation** is much easier to define: the year 1995 is seen as a historical year for KM. The second generation "…started circa 1995, focusing on the movement of socialisation, externalisation, combination, and internationalisation known as the SECI model, proposed by Nonaka and Takeuchi" (Hång & Ståhle 2005, 131). The perspective is one of sociology and organizational development, with the main concern of knowledge sharing and transfer and its exploitation. Key tool is social interaction and communication, which defines the nature of knowledge to be communicative and tacit – and thus more problematic. Prime knowledge carrier is a collective, group or a community. The temporal focus is more in the near future. In addition the advances in distributive computing and groupware as well as the emergence of what became the internet around mid 1990s helped spark the interest in the more socially oriented and knowledge sharing views (Tuomi 2002). However, knowledge is still seen as something organizations can transfer/convert from one type (e.g. tacit to explicit) or location (individual, organizational) to another (Newell et al. 2009). Nonaka's SECI-model and knowledge creation theory associated with it (Nonaka 1994; Nonaka & Takeuchi 1995; Nonaka et al. 2006) has reached a paradigmatic position within KM, but it has also been more critically evaluated, for example Gourlay (2006) offers a summary of existing critique as well as presenting his own, and Gueldenberg & Helting (2007) criticize the epistemological and philosophical grounding of Nonaka's theory.[16] Notably, Hislop (2009) and Newell et al. (2009) firmly place KM research in this vein and era still in the neo-functional and structural "box".

The third generation (and beyond) has brought more multifaceted views into KM discourse. There is no one view that would represent the recent developments around the concept of KM. Tentatively, three broad themes or developments can be singled out. First, there is research on the philosophical foundations of knowledge itself, where knowledge itself is treated more as a representation than something "actual", and this discussion on the very nature of knowledge has been the subject of much KM research (see e.g. Spender & Scherer 2007). Second, an emerging theme is the even more pronounced shift in focus towards exploration and knowledge creation: how to create new knowledge for the needs of a future

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[16] Overall, for an interesting analysis on how organizational research has used and (misused) the foundational concepts from Simon (bounded rationality) and Polanyi (tacit knowledge), see Miller (2008).

still unknown (Hong & Ståhle 2005); this has resulted in the further development of knowledge creation theory (Nonaka et al. 2006). For example, Nonaka et al. (2014) have very recently brought fore the concept of "dynamic fractal organizations" where knowledge exists in "triad relationships" of tacit, explicit and practical knowing, the overall aim being the promotion of "knowledge-based transformation" and culture which "…fosters the culture of synthesizing parts and the whole […] through dialogue and practice from which new knowledge constantly emerges" (Ibid. 145). In addition, the role of context, physical and virtual places where knowledge creation becomes localized as well as the broader ecosystem to which organizations belong to has gained increasing research interest (van Korgh & Geilinger 2014).

Third, the evolution of KM can also be linked with the broader "practice turn" in organization studies (Schatzki et al. 2001), where organizational work and "knowing" is seen as embedded situated practice (Orlikowski 2002). Research under the labels of e.g. "knowing-in-practice" and "practice-based approaches/perspectives" has increased notably (Corrodi et al. 2010; Erden et al. 2014), and e.g. Hislop (2013) sees this increased focus on practice as one of the most significant recent changes in KM. "Arguably, the neo-functionalist perspective may no longer be as dominant as it used to be (Ibid. 251)."

It is however evident that the representations of all of the generations of KM are simultaneously present: the later generation builds on the earlier ones, mixing features of this discourse with new rhetoric. As Tuomi (2002) aptly describes, in the increasingly informationalized society, the first generation KM will stay alive and well, as investments into information technology have a long lifecycle and their replacement is slow and expensive. Spender & Scherer (2007, 8) note: "What concerns and anxieties appear in the KM literature? For most the IT issues dominate…"

KM has been argued to be on its decline as a management discourse - for example Newell et al. (2009, 21) state that "Knowledge Management has largely lost its ground as 'flavour of the

month'"[17]. However, one can also argue the opposite. For example, Hislop's textbook "Knowledge management in organizations" is now on its third edition (2013), and Serenko & Bontis (2013) identified currently 25 academic journals purely dealing with issues of KM (and intellectual capital). However, the central themes of Knowledge Management are also increasingly researched under the keywords of for example organizational learning, knowledge creation, epistemology, practice and more generally, organization theory – and not as "Knowledge Management". Thus – as it of course should be - KM is ever evolving, perhaps to the direction of dissolving into the "other" practices of the organization.

2.3 The epistemological underpinnings of organizational knowledge

As the discourses of knowledge in organizations have evolved, so has the way knowledge itself is framed and treated. In the bulk of pragmatically oriented KM literature, it is safe to say that epistemology has not been a central issue. Stehr & Meja (2005, 11) see this neglect as a broader issue: "Daniel Bell and other authors who discovered knowledge as the new axial principle of modern society spent little time reflecting about the nature of knowledge, how knowledge was produced or why there appeared to be a growing demand for knowledge in the first place. Theoretical knowledge was in a way treated a black box."

What the epistemological pondering behind KM typically has resulted in is a typology of knowledge of some sort, e.g. Data-Information-Knowledge-Wisdom (Ackoff 1989); Tacit-Explicit (Nonaka 1994); and Data-Meaning-Skilled Practice (Spender 2006), to name some of the most known ones[18]. Knowledge Management research itself has been the subject of some epistemological research (e.g. Schultze & Stabell 2004), where various typologies have been created in order to better understand the epistemological foundations of various KM research.

As mentioned in Chapter 1.2, organizational epistemology can be grouped into two main perspectives. First, there is the epistemology of possession (Cook & Brown 1999) - also called the "objectivist perspective" (Hislop 2009) or an "epistemology of dualism" (Schultze

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[17] This claim is supprted by the aforementioned Bain & Company study on Management Tools and Trends: in its most recent 2013 study KM did not "make the cut" as one of the 25 most used tools anymore. (Rigby & Bilodeau 2013).
[18] For an analysis on the probably most used data-information-knowledge –typlogy, see Boisot & Canals 2004

& Stabell 2004), which sees knowledge as a thing to be captured and transferred, separate from the people using it. The second one in contrast recognizes the role of enabling contexts and processes as well as "knowing" as a social activity – an "epistemology of duality", where knowledge is embedded and inseparable from people's workplace, practices and contexts (Schultze & Stabell 2004). The latter has generally been given the umbrella term "epistemology of practice" (Cook & Brown 1999; Newell et al. 2009) and "practice-based perspective" (Hislop 2009), which forms the foundations of a broader "practice turn" in organizational theorizing (Schatzki et al. 2001) and a social-practice theory in general (for extensive reviews on literature as well as the development of these concepts, see Erden et al. 2014; Corradi et al. 2010; Gherardi 2012). [19] (See Table 2 for an overview of the contrasting perspectives.)

Corradi et al. (2010) provide a useful chronological account on the evolution of practice-based studies (PBS). Importantly they state "Nevertheless a unified theory of practice does not exist (Ibid. 267)", which is to say that one needs to be more specific in describing what one means by practice, and how research is designed to uncover this "hidden practical knowledge" associated with working practices. Somewhat ironically, given KM's traditional epistemological position, the authors see that KM has in fact been instrumental in bringing practices (back) into focus: "The advent of knowledge society and knowledge management has generated renewed interest in practical knowledge and its transmission (deliberate or otherwise); and the study of working practices, workplace interactions and activities has become central in 'bringing work back in' (Ibid. 2010, 267.)"

Thus in practice-based research, the question of epistemology is a fundamental one. The practice-based epistemology sees that knowing and doing are inseparable (tacit and explicit knowledge are mutually constituted), it is embodied in people and that knowledge is socially constructed. In this perspective, knowledge sharing requires rich social interaction and "immersion in practice" as well as the development of mutual tacit assumptions. If the

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[19] There a variety of approaches that have been connected to this perspective, having more in common than not, but differing for example in their position within the agency / structure -debate. For example Newell et al. (2009, 18) have divided the practice-based approaches into two sub-categories: process and practice perspectives; and Hislop (2009, 17) recognizes six different epistemological perspectives within the practice one. For a lively debate on the agency / structure –issue, see e.g. Reed 2005a&b; Contu & Willmott 2005; Mutch 2005, and for an overview of more recent developments within sociology, see King 2010.

objectivist epistemology results in a codify-capture-collect-structure-transfer –mode of knowledge processes in organization, then the practice-based epistemology focuses on methods to facilitate interpersonal interaction, communication and the building of trust in order to enable knowledge creation and sharing. (Hislop 2009; Newell et al. 2009.) The shift towards seeing epistemology as practice-base brings the focus on social interactions and developing mutual tacit assumptions. Miller (2008) calls this the creation of a *shared epistemological base*. Individuals with shared epistemologies can be grouped together, but broader knowledge integration and boundary crossing requires capacity to span these local epistemologies. Thus treating knowledge as embedded and multidimensional creates an unavoidable *epistemological diversity* that can be either functional – preserving the heterogeneous knowledge - or dysfunctional, slowing the adoption of potentially beneficial knowledge. The starting point for understanding this diversity is *epistemological pluralism*.

To conclude, in recent research on organizational knowledge and in knowledge management, knowledge is increasingly seen not as something foundational and absolute, but rather as being situated and local "knowings". These knowings cannot be transferred and acquired, rather they become known during being-in-the-world. Knowing is interdependent on being. What this means, epistemologically, is that there is not one "Knowledge". There is a diversity of local epistemologies, i.e. the existence of a variety of epistemological bases between a group of people that may or may not co-exist harmoniously. This is a pluralistic view on epistemologies (Miller 2008), and recognizes the epistemic differences that exist in organizations (Brown & Duguid 2001). As Barnett (2000, 415) puts it, "there are a multiplicity of knowledge frameworks to inhabit".

2.4 Fragmented systems of knowledge and practical knowledge

As the result of this acknowledged multiplicity of knowledges that are present in every activity, accomplishing work requires interacting with what Bruni et al. (2007) have called a *fragmented system of knowledge*. This can be seen in contrast to the notion of using or applying some acquired and "complete" asset-base of knowledge that is deemed valuable a priori to the activity in question. Bruni et al. (2007, 83) define this fragmented system as a "setting in which people, symbols and technologies work jointly to construct and reconstruct

understanding of social and organizational action". Consequently all who participate in the activity in question bring to the practice their own "pieces of knowledge which, as in a jigsaw puzzle, must be fitted together to acquire intelligibility (Gherardi 2012, 24)". Thus work is action that uses various knowledges as a resource for that action – and working produces further knowledges. In this way, knowledge transforms itself through its use (Gherardi 2012). This interaction with plural knowledges is argued to be purposive and object-oriented, making it pragmatic (Blackler 1995) – and "knowledge" is subsequently a practical accomplishment. Gherardi (2012, 25) elaborates on this, and gives the following characteristics of practical knowledge[20]:

- A pragmatic stance: practical knowledge is directed to doing, taking decisions and to solving problems;
- A specific temporality: practical knowledge emerges from the situation and from situated action;
- An anchoring in materiality: practical knowledge uses fragments of knowledge embedded in objects and technology, and in the material world that interacts with humans;
- An anchoring in discursive practices: practical knowledge uses discourses as cues for action as well as positioning them within a narrative scheme that gives sense to what occurs;
- A historical-cultural anchoring: practical knowledge is mediated by what has happened in the past and has been learned from experience (and in experience).

Thus new knowledge creation such as innovating new products and services can be approached as a situated, cooperative and practical work activity rather than something slightly mystical that involves a specified set of intellectually capable individuals (knowledge workers, experts) that use an organizational knowledge-base in order to "innovate". By stripping away the "elevator word" or "honorific title" Knowledge, it is possible to approach

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[20] Of interest is that Nonaka et al. (2014) have proposed a "knowledge triad" that synthetizes tacit and explicit knowledge by phronesis, i.e. practical knowing. They draw on Aristotle and define this as " Phronesis is a way of practical understanding that accompanies goals, values and actions. It is the practical knowledge that enables optimum ''here and now'' judgment in particular contexts, while maintaining the standards of common good. Phronesis is characterized by contemplation in action – thinking things through while engaged in activity – and quick judgment within a context with timely balance" (Ibid. 139). It would offer an interesting avenue of further research to compare these recent developments of knowledge creation theory and practice-based theorizing.

knowledge creation as something people do, speak, see and feel: "Knowing how to see (and therefore develop a professional vision), knowing how to speak (to use technical vocabulary with competence) and knowing how to do: these, therefore, are the 'observable and reportable' competences that the sociologist of work considers when describing and interpreting working practices (Gherardi 2012, 27)." This further enables the "demystifying" of professional work, "to give what seem to be chaotic, challenging, uncertain work setting a sense of order, of familiarity and repetition" and show how "complex jobs are routine" as well (Smith 2007, 223).

Knorr Cetina (2001,177) additionally argues that the transition to knowledge societies involves not only the presence of more experts, more specialists or more technological tools, "it involves the presence of knowledge processes themselves […] it involves the presence of epistemic practice", making it crucial to direct attention to the actual knowledge creating practices. I thus argue that taking the practice-based perspective allows research to focus on the actual *doing* of knowledge creation and epistemic practice, and consequently shed light on what Spender & Scherer (2007, 11) call the "problematics" of knowledge itself – and this being fundamentally the whole raison d'être of KM: "One of its paradoxes is that KM is only separable from existing disciplines such as microeconomics and organization theory when it treats knowledge itself as problematic. It gets its traction from admitting we do not know what knowledge is, so demanding we think about the ways managers and organizations respond to these doubts. Our normal theorizing, especially in the positivistic tradition, regards knowledge as problematic only in its absence. The perplexing magic of KM is that it allows us to throw in other problematics." The inherent diversity in the way individuals participate in and experience practice is potentially the ultimate "problematic" into which practice-based approach may shed some light.

3 Interdisciplinary knowledge creation

Knowledge creation as distinct knowledge-related practice has been researched especially in the contexts of product development and product innovation, making it relevant to my research as these activities typically involve specialized experts, i.e. knowledge workers. The reviewed research to a great extent centres around the social dynamics through which people create and share knowledge especially across various boundaries – occupational and functional - and conceptualizes from empirical studies the practices that enable the common understandings and new knowledge(s) to emerge. In this Chapter I attempt to synthetize the findings from earlier empirical research as to which practices are seen to foster knowledge creation in contexts of interdisciplinary collaboration, and how knowledge creation in fact happens as a practical (recurrent) activity.

I start by looking at the concept of interdisciplinarity in more detail, as it is the distinguishing feature of my empirical research subject. I then move on to analysing how interdisciplinarity is seen to affect collaboration, what types of issues emerge and how they might be overcome. Especially the salience of boundaries is of interest and how empirical research has found that knowledge creation is enabled or constrained in practices dealing with these boundaries. The role of objects – boundary and others – is given special prominence. I also consider the concept of community, as to its relevance on interdisciplinarity.

3.1 Defining interdisciplinarity

> "Over the course of the 20th century, a major shift in the figurative language of knowledge description occurred, away from static images of a foundation and a structure to the dynamic properties of a network, a web, a system, and a field. The rhetoric of teaching and learning shifted in kind from metaphors of accumulation and discrete inputs of information and facts to acts of constructing knowledge and problem posing. Following suit, metaphors of production, prescription, control, performance, mastery, and expertise were supplanted by dialogue, process, inquiry, transformation, interaction, construction, and negotiation. Older tropes of unity, universality, and certainty were replaced in turn by tropes of plurality, heterogeneity, and complexity. And the image of the curriculum shifted from vertically stacked silos to horizontal pathways, clusters, connections, matrixes, and communities. Interdisciplinarity was implicated in all these shifts, fostering a parallel redescription of the work of research and teaching. (Klein 2008b, 269-270)

The above quote from Klein illustrates the rhetorics of interdisciplinarity, as well as tying it with the underlying epistemological shift I described in the previous Chapter. One major manifestation of these developments is the increasingly interdisciplinary nature of current research teams (Monteiro & Keating 2009; Weingart & Stehr 2000; Huutoniemi et al. 2010; Siedlok & Hibbert 2014). There is also direct critique voiced towards the discipline-specificity of modern science: "This ever increasing specialization has prompted many to consider how disparate scientific contributions can be rebuilt or integrated to provide solutions to (or at least help us understand) the complex challenges which face our communities" (Jeffrey 2003, 539). The issue is made even more relevant as the problems and issues taken on by science cannot be defined by one discipline alone. As Jeffrey (2003, 539) puts it, "Real-world problems do not come in disciplinary-shaped boxes". Challenges such as climate change, aging of populations, urban crime and dealing with ethnic diversity have given impetus for new interdisciplinary research entities such as environmental studies, gerontology, ethnic and urban studies (Klein 2008b).

The terms multidisciplinary, transdisciplinary and interdisciplinary are used in literature somewhat interchangeably. A widely used typology was presented at the first international conference on interdisciplinary research and teaching in 1970, cosponsored by the Organisation for Economic Cooperation and Development (OECD, 1972). According to Klein (2008b), the distinction between multidisciplinary and interdisciplinary is widely recognized, whereas the precise meanings of interdisciplinary and transdisciplinary, however, are still disputed. Klein cites the following definitions of the OECD:

> **Multidisciplinary approaches** juxtapose disciplinary/professional perspectives, adding breadth and available knowledge, information, and methods. They speak as separate voices, in encyclopedic alignment.

> **Interdisciplinary approaches** integrate separate disciplinary data, methods, tools, concepts, and theories to create a holistic view or common understanding of a complex issue, question, or problem.

Transdisciplinarity refers to a set of common axioms that transcends the narrow scope of disciplinary worldviews through an overarching synthesis, and is a descriptor of broad fields and synoptic disciplines, such as a team-based holistic approach to health care, a general ethos, and a comprehensive integrative curriculum design.

Jeffrey (2003) has further defined that multidisciplinarity comprises of independent studies that are externally coordinated e.g. editorially. Transdisciplinarity aims for a "supradisciplinary paradigm" that encompasses the other disciplines. Interdisciplinarity falls between the two, it has substantial internal integration but without the paradigmatic reach. Jeffrey himself uses the additional term "cross-disciplinary" to include all these forms of collaboration between researchers with different backgrounds as an umbrella term, and indeed this term is also used in the management and organizational research on collaboration across disciplinary and functional boundaries (e.g. Nicolini et al. 2012).

Importantly, however, Klein reminds us that interdisciplinarity can contain both "instrumental" and "critical" practices. "Instrumental forms motivated by 'strategic,' 'pragmatic,' or 'opportunistic' goals are prominent in economic, technological, and scientific problem solving, without regard for questions of epistemology or institutional structure. Critical forms interrogate disciplines and institutional structures with the aim of transforming them." (Klein 2008b, 276.)

I use the term interdisciplinarity, as my empirical setting of Aalto Design Factory is dedicated to "bringing together all the disciplines of Aalto University" in order to enable problem-based learning, and thus its articulated aim fits with interdisciplinarity as depicted above. However, "interdisciplinarity" is used somewhat loosely, and in fact its Finnish translation "poikkitieteellinen" corresponds better with "cross-disciplinary". It can thus be argued that interdisciplinarity and cross-disciplinarity could be used interchangeable in my empirical instance[21].

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[21] Adding to the mix, Alberts (2007, 173) cites earlier research and states that "terms 'multidiscipline' and 'cross-functional' seem to be interchangeable, but what distinguishes an interdisciplinary team from a multidisciplinary team is the number of disciplines involved. Interdisciplinary refers to a team of people from two disciplines. Multidisciplinary refers to a team of people from at least three disciplines." I have not however seen this type of a definition that rests on the number of disciplines in other research I have come across.

There are many different types of contexts where interdisciplinary collaboration may occur. Oborn & Dawson (2010a) have categorized three such contexts:

- Collocated teams engaging in on-going interdependent activity (e.g. surgical teams), where the presence of hierarchical relations between participants structure the interactions (see e.g. Edmondson 2003)
- Project-based teams that have a specified task and measurable outcome (e.g. new product or service) and a given timeline (see e.g. Carlile 2002, Scarbrough et al. 2004).
- A team with less clearly defined outputs and rules of engagement, with the need of establishing an on-going interdisciplinary interaction without tasks, timelines and authority structures being clearly specified (e.g. a formally constituted team of independent specialists required to meet on a regular basis, but with no specific goal, salient especially in health-care) (see e.g. Oborn & Dawson 2010a).

The project-based collaboration is of particular relevance for my empirical analysis, as Aalto Design Factory's activities to great extent centre around the product development –oriented courses that are organized as projects, and I will be using this category of interdisciplinary collaboration as my main focus.

3.2 Practising interdisciplinarity

The process through which interdisciplinarity "happens" is depicted by Klein (2008b) in the following fashion: first, interdisciplinary fields detach a category as subject and object from existing disciplinary frameworks, loosening boundaries and stimulating trading zones. Then, they fill gaps in knowledge from lack of attention to a category, creating new interim pidgin tongues and creole language cultures. After this, if the communities attain critical mass, they constitute new social and cognitive structures that reconfigure the space of the academy[22].

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[22] The knowledge produced in interdisciplinary research then enters the curriculum in three ways: as the intellectual foundation for interdisciplinary programs, as new topics in core curricula and general education, and as new foci in traditional subjects and disciplines (Klein 2008b).

Klein calls this the threefold process as the "architectonics of forming new knowledge communities" (ibid. 272). This description contains key elements and concepts of this type of collaboration, and I will thus deconstruct the above description, and use it to address the issues that empirical research has found to be relevant for knowledge creation in these types of context.

3.2.1 Boundaries and objects: the materiality of interdisciplinarity

Let us start with the first phase: "Interdisciplinary fields detach a category as subject and object from existing disciplinary frameworks, loosening boundaries and stimulating trading zones."

As in all types of collaborative team efforts (see e.g. West 2002), also in collaborative research, members start off with the team engaging in joint definition of the goals of a project, attempt to define the core problem and questions, and design a framework for coordinated inputs with ongoing communication and interaction (Klein 2008b). In interdisciplinary collaboration, the definition of the goal and problem itself is often problematic. As Klein states, the problem needs to be first "detached" from the various existing frameworks, which originate from the disciplinary domains of the participants.

First and foremost, this involves the "loosening of boundaries" that Klein refers to. Boundaries are a crucial and critical element in all cross-functional and interdisciplinary collaboration. Within the practice-based studies, Erden et al. (2014) note that a considerable body of research concentrates on what they call the theme of "practice boundaries and coordination of work". More specifically, research has focused on the differences and boundaries between social practices that result from adopting the practice-based view of knowledge in itself – viewing knowledge as localized, plural and situated. Carlile's work (2002, 2004) has been crucial in increasing our understanding of how knowledge itself is a barrier to knowledge sharing and creation. He has developed a framework that depicts three kinds of knowledge boundary – syntactic, semantic and pragmatic – and suggests the ways in

which to overcome these boundaries. A particular prominence in his research has been given to the concept of boundary objects; that is studying the knowledge processes – more particularly that of knowledge sharing - that unfold around material artefacts, and facilitate the sharing of knowledge across the knowledge domains.

The term "object" – is used in literature in a variety of ways, some of which I will explore in this chapter. In its simplest definition within this particular context of collaboration[23], objects are "the collection of artifacts that individuals work with—the numbers, blueprints, faxes, parts, tools, and machines that individuals create, measure, or manipulate (Carlile 2002, 446)". To broaden the definition, Star (2010, 603) states: "an object is something people act toward and with. Its materiality derives from action, not from a sense of prefabricated stuff or ''thing''-ness. So, a theory may be a powerful object." The above implies that what is an object is not bound to its physical substance – rather, it is the action it potentially invokes that makes it "an object". "Boundary object" as a consequence is an object that acts in the capacity of being the "stuff of action" (ibid.) in creating a shared space across boundaries.

Empirically, for example Bechky (2003) in her ethnographic study on the work practices of engineers, technicians and assemblers on the production floor, found that in cases where the participants come from strongly contextualized and situated occupational communities, very concrete and tangible means were needed in order to achieve knowledge sharing between these participants. The required tangibility, however, may pose additional challenges, as "people are not always able to create tangible definitions of their problems… In attempts to share knowledge across occupational boundaries, written and verbal explanations frequently failed to make meanings clear. Because their languages emerged from different contexts, members of different groups had a difficult time finding common ground on which to base their conversation. This common ground was more frequently found in a tangible object, which provided a concrete referent that individuals could manipulate to embed the understandings of others into their own understanding of their work context." (Ibid. 2003, 327.)

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[23] Of the more general use of the term, Star writes (2010, 603): "In common parlance an object is a thing, a material entity composed of more or less well-structured stuff."

Bechky was describing the importance of boundary objects, which indeed has become a "house-hold concept" ever since Carlile introduced it in 2002, becoming an almost "catch-all" notion of explanation to all things object-like (Nicolini et al. 2010, 614).[24] However, to be more precise, Carlile *re-introduced* a concept originally developed by Star in 1988. Star developed the model of boundary objects (to full extent with Griesemer in 1989) that theorizes on objects that are shared and shareable across different problem solving contexts, and in fact her concept was intended to explain the possibility of cooperation of groups working without consensus – not to be applicable in all situation of collaboration. In addition, boundary objects involve three dimensions: interpretive flexibility, that is their dependence on the use and interpretation of the object; the material / organizational structure of the objects; and their scale / granularity.[25]

Most importantly to my research, Star (2010) points out that boundary objects are "a sort of arrangement that allow different groups to work together without consensus" (ibid. 602). The context from which her initial framing of the concept arose was in fact interdisciplinary scientific research, which she characterizes as co-operative work without consensus, yet still succeeding. "From my own fieldwork among scientists and other cooperating across disciplinary borders, and two historical analyses of heterogeneous groups who did cooperate and did not agree at the local level, it seemed to me that the consensus model was untrue. Consensus was rarely reached, and fragile when it was, but cooperation continued, often unproblematically. How might this be explained? (Ibid. 604)." For Star, boundary objects arise from the information and work requirements as perceived locally and by groups wishing to cooperate, and what is important is how practices structure, and language emerge, for the doing of things together. Thus in interdisciplinary contexts, *boundary objects emerge from the needs of the people in order to do things together without consensus*. They "sit in the middle" (ibid. 608) in order to create the shared context. In fact, Star explains that for her, the term boundary is used to mean a *shared space*, where the common objects form the

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[24] The concepts widespread use has prompted Star to name her article "This is Not a Boundary Object: Reflections on the Origin of the Concept" (2010).
[25] Star (2010) argues that in fact almost all work on boundary objects concentrates on the interpretive flexibility dimension, neglecting the other two.

boundaries between groups through their flexibility and shared structure, being the "stuff of action" (ibid. 603). In this sense, boundary objects themselves create boundaries as the shared space makes the joint action possible.

The basic premise in most research on boundary objects is that the practices of interacting with artefacts, technology and tools are constitutive of knowing and learning within and between organizations. For example the research of Bechky (2003), Orlikowski (2007) and Carlile (2002) show how learning and knowing indeed does not happen just in the mind, but in interaction with the material environment (represented through the objects). However, Gärnter (2013) points out that there is a tendency to downplay the role of the human body in these interactions (for example assuming that the interactions physically can happen in the first place), as well as emphasizing the here-and-now quality of interactions. They do not take into account how material interactions are also themselves learned over time as embodied skills. Erden et al. (2014) have further noted that boundary objects are not static tools, as much research takes them to be, but dynamic. Star (2010) herself points this out: boundary objects are dynamic organic infrastructures that arise from the needs of the people cooperating, and that they grow, evolve and indeed – die. She sees that the dynamics involved is core to the whole notion of boundary objects, and which often has been ignored in the concept's use.

The dynamic involved has to do with the ill-structured nature of the boundary objects. There is an anomaly, a problem that seems to defy existing categorizations. It something that does not "fit": "Our experience and our language frequently delineate 'in-between' phenomena… Characterizing what lies 'in-between' things, or that which is unusual, new, or which simply just 'doesn't fit'" (Aram 2004). Star calls these "residual categories" (Star 2010, 615); and as in the quote from Klein in the beginning of this Chapter, they are detached from the existing disciplines and such. These anomalies draw people together – often from the "outside" of the actual categories, and as cooperative work starts to emerge, boundary objects are generated. The group, however, does not have a consensus – or a fragile one at best -– on fundamental issues such as evaluation, measurement, validity and the like. The problem – and the later emerging processes of solving it - is given a very ill structured and sketchy form that serves as the basis for creating a shared space and basis for communication between the different

domains within the group, being however recognizable enough to serve the different information requirements and allowing for the translation to take place. When needed, this object is "reversely detached" from the interdisciplinary practice and space, and worked on in the disciplinary domains, making it more structured and specific (but not in the interdisciplinary sense). The group is able to tack back-and-forth between these types of objects, the structured and the ill structured, in order to satisfyingly resolve the problem at hand. Over time, if the boundary object reaches a critical mass, or becomes of broader (political, economical, societal) interest, and if the ill/well-structured forms of it collapse into one, the object becomes standardized and part of some domains infrastructure. Until the next residual category or anomaly comes up, "the others" take it up – and a new boundary object is born.

One more concept that emerged from both Klein's (2008b) description opening this Chapter as well as practice based research on cross-boundary coordination is that of *trading zone*. Kellogg, Orlikwoski & Yates (2006) studied a fast-paced digital marketing organization (a post bureaucratic organization in their terms) in order to examine how members of different communities coordinate their work across boundaries. They draw from a perspective developed in a study by Galison (1997) on how distinct communities within physics were able to align their activities without homogenizing the inherent diversity of their communities. This research found that despite the fundamental differences members were able to work out coordination practices in "exquisite local detail, without global agreement" (Galison 1997, quoted in Kellogg et al. 2006, 39). This is strongly aligned with Star's notion of *cooperation without consensus*. The research proposed that this type of cross-disciplinary interaction could be described as a "trading zone", where the local coordination of ideas and actions may take place despite differences in the disciplinary purposes, norms, meanings and evaluative criteria. They further propose that this trading zone is a coordination structure that is enacted by organizational members, allowing the continuous practices to make one's own perspective visible happen. Kellogg et al. conclude that in a high-paced, volatile and uncertain environments such as digital media, boundary objects may not be effective, as thoughts and ideas change too rapidly for them to be "inscribed within objects" (ibid. 41).

This opens up few questions regarding boundaries and specially boundary objects. If, as Kellogg et al. demonstrated, in some types of collaboration there is evidence of something like objects that facilitate the working of together, but they are not "boundary objects", what other types of objects might emerge in interdisciplinary collaboration? And what about the actual reason for the cooperation in the first place, as in "why these participants in this particular time and space have gathered together"? Star (2010) and Klein (2008b) both refer to this in that they both see that some "anomaly" or "detaching a category as subject and object from existing disciplinary frameworks" as the starting point of interdisciplinary collaboration. But what *is* the anomaly or the detached object, and what is its role in practices?

I found important additional insights from the plural approach to objects developed by Nicolini et al. (2012). They have taken up on the tendency to ascribe the status of "boundary object" to all objects, and instead have looked at the multitude of roles objects in fact play in supporting interdisciplinary[26] collaboration, following Star (2010) in understanding objects as something people *act toward and with.*[27] They develop a pluralistic theoretical approach to studying objects in this type of setting, drawing - in addition to the concept of boundary objects - from both the notion of "epistemic things" introduced by Knorr Cetina (1999), as well as the role of the object(ive) that motivates collaborative work from activity theory. They also include Orlikowski's (2007) notion of the "scaffolding" or infrastructure that objects provide in daily work practices.[28] This is also to what Star (2010) refers to in objects becoming "standardized" and becoming part of the categories and structures of a particular domain.

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[26] Nicolini et al. use the term cross-disciplinary, without defining it further. For the sake of being consistent, I dare to use interdisciplinary also in the conjunction of their work (excluding naturally citations).

[27] Also Ewenstein & Whyte (2009) have taken a more holistic and multidimensional approach to looking at objects (architectural drawings in their empirical case) in order to see the roles they play in knowledge-intensive work. They employ the concepts of boundary objects, epistemic objects and technical objects, taking a cultural approach to analyse their situated meaning.

[28] Nicolini et al. (2012, 614) argue that although all four perspectives are distinctive, they share a number of common assumptions that make it possible for them to be used together: seeing collaboration as practical accomplishment; the mediation of social action by artefacts; groups and communities are results of organizing work, not a given; social structures are both mediums and outcomes of human activities; that action and environment all mutually constituted; and that human actors not only are driven by rational considerations but also by emotions, desires and passion.

Nicolini et al.'s plural approach includes important elements that I have found to be relevant and holding explanatory power to the empirical material of my ethnography. First, they apply the idea of the *epistemic object* in order to shed light on "why people make the effort to search for alignment to begin with" (ibid. 618). Thus the object of investigation – i.e. the anomaly or other – that is in the process of being materially defined is an epistemic thing or object that embodies *what one does not yet know*. They are open-ended and are the source of interest and motivation for the participants. Knorr Cetina (1999) has explored where the power of these epistemic objects arises from, and Nicolini et al (2012, 618) elaborate on her findings. First, epistemic objects arouse "wanting" and a lack of fulfillment that generates energy and emotional investment in the participants as well is the group that is forming around the epistemic object. It is thus the "push" or "drive" that sets the wheel on motion. Based on their ethnography, Nicolini et al. aptly describe how "the epistemic object triggered a form of desire and attachment that had a libidinal, rather than calculative origin (ibid. 619).[29] Epistemic objects also provide the engine of solidarity for the group, and from their material Nicolini et al. "find" a lead scientist that "was, in a real sense organizing by desire – jelling the group by stimulating attachment and a desire to know (ibid. 619)".

The nature of the epistemic object also influences the ways of working, as it proposes some structure on the "lack of knowing" related to it. It thus guides the participants towards some forms of "collective obligations" which then turns the loose group into a "proto-community" (Ibid. 619)[30]. The group may thus engage in practices that are indeed interdisciplinary, and community-like, but most importantly, they are not stemming from the socialization processes of the community (as in the communities-of-practice literature, see next Chapter). Rather they are *induced by the epistemic object* and the community-like practices stem from the promises it holds for each participant.

However, the above paints a rather harmonious picture of interdisciplinary collaboration. The object of collaboration is in most cases at least partly given (the "official" reason for the

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[29] I am willing to argue that most organizations are not prepared for the "libidinal desire" that their product or service innocation work might generate, let alone attempting to nurture it. Of course, more sadly, most innovation work might not generate any such desires in the first place. Therein may lie a bigger challenge altogether.

[30] The notion of "proto-community" is an interesting one, even though Nicolini et al. elaborate it no further.

group to be formed, as in a development project of a new product or service). Nicolini et al. draw further from the cultural historical activity theorists in order to explore how the partly given nature of the object dictates what types of skills and functions should be involved, what the division of work might be like, and what is the position of each member within the group. In some cases participation may even be forced. Thus the object is also potentially conflictual and heterogenous and "the mutuality performed by the object is far from a smooth fusion of intents and goals (ibid. 622)". They name these *activity objects*.

As the collaboration progresses, the objects that facilitate the work across boundaries become pronounced. It is in this function that Nicolini et al. place *boundary objects*. They follow Star & Griesemeyer (1989, 393) in seeing them as "flexible artifacts that inhabit several intersecting social worlds". They provide a shared medium allowing the representation of particular knowledge to be such that the "other side" of a particular boundary can understand it as well. They also provide concrete means to uncover the differences that the different perspectives might have. Boundary objects also act as anchors around which the emergent shared meanings can happen. Boundary objects are complimented by boundary-spanning activities, that is the face-to-face interactions that supporting the role of the objects. (Nicolini et al. 2012, 616.)

Finally, Nicolini et al. turn to the bulk of objects that surround us in our work practices. They are the ones that are in the "shadow of other practices (ibid. 622)", and form the mundane support of everyday life (Orlikowski 2007), or "material infrastructure" as defined by Star and Ruhleder (1996). Nicolini et al. further distinguish (after Hanseth & Lundberg 2001) between work-oriented infrastructure and service infrastructure that support interdisciplinary collaboration. Work-oriented infrastructure refers to the various objects that help initiate and support the collaborative work practices, and have a relational property that emerges from the practices – i.e. the objects are infrastructure only if they become used and enacted in practices. Typically these include the various ICT-systems people use (e-mail, chats, social media platforms, collaboration software, databases etc.) and documents (e.g. project documents). Service infrastructure on the other hand is more "sunk-in" and invisible in the sense that they are more removed from the day-to-day practices, even though work could not happen without them. These include the physical space where collaboration takes place and

the (material) services of the space such as electricity, photocopiers, coffee machines etc. These objects are rarely considered in themselves, they are taken for granted – until for example the photocopier or coffee machine breaks down!

Nicolini et al. (2012, 625) have conceptualized the role of objects as described above in a three-level hierarchy: primary, secondary and tertiary objects of collaboration, in relation to their "closeness" to the actual practices. They also cite examples from their empirical research. Their conceptualization is provided in the Table 7 below.

	Main function	Theoretical approach	Examples
Tertiary objects of collaboration	Provide the basic infrastructure support	Infrastructure theory	E-mail system, phones, project management documents, built environment
Secondary objects of collaboration	Facilitate work across different types of boundaries	Boundary objects	Visual slides, bioreactor to be built, shared analytical methods
Primary objects of collaboration	Triggers/sustain/motivate the cross-disciplinary collaboration	Epistemic objects Activity objects	Bioreactor to be built (goal of the project)

Table 7: The role of objects in cross-disciplinary collaboration (Nicolini et al. 2012, 625)

Based on their empirical analysis, Nicolini et al. further suggest that the different types of objects were more useful at different stages of the collaboration, as well as noting that the same object may change its role over time – i.e. the object have a "career" (ibid. 627). In addition participants of the collaboration may attribute different roles for the same object, thus potentially creating misunderstandings and conflicts.

3.2.2 Creating partial understandings: knowing how to speak

Let us continue with the process of the architectonics of interdisciplinarity as depicted by Klein. In the previous Chapter, I deconstructed the first phase: "Interdisciplinary fields detach a category as subject and object from existing disciplinary frameworks, loosening boundaries and stimulating trading zones." What would happen next is that "they fill gaps in knowledge

from lack of attention to a category, creating new interim pidgin tongues and creole language cultures" (Klein 2008b, 272).

Language is an important mediator in working practices, and practical knowledge presupposes the ability to use language which is appropriate to the specific context (Gherardi 2012, 129). This emphasis on communication, shared meanings and the creation of own "pidgin" tongues is strongly supported by empirical research into interdisciplinarity. As Star noted, there are often insurmountable differences between disciplines. Stein et al. (2008, 402) emphasize how "Interdisciplinary syntheses are among the most epistemologically complex endeavours that humans can attempt". This complexity arises from e.g. following factors:

- Deep differences of perspectives that need to be bridged
- Different methods frame research questions differently, thus generating different kinds of knowledge
- Interdisciplinary integration needs to generate something higher-order knowledge that is more than the sum of its parts
- New forms of "quality control" are needed.

Monteiro & Keating (2009) add to the list the differences in communication styles between members. Empirical research has given indications on how to overcome these "in-between" challenges, and what enables successful interdisciplinary practices. Jeffrey (2003) studied cross-disciplinary research teams, and found that the story-lines, metaphors, common choice of vocabulary, nature of dialogue and the role of mediating agents were crucial in creating the base for collaboration. He concludes that they all require time and contact, and need to create also *experiental value* in the participants – value which rests on the continuity of experience of the participants. This indicates taking the lived-in experience of the participants seriously – a point I will follow on in the Chapter dealing with embodiment. Likewise, Monteiro & Keating (2009) in their ethnographic study of an interdisciplinary group, place emphasis on the communication strategies: they find that creating *partial understandings* is crucial when collaborating across disciplines, as the goal is not to bring everyone to the same level of expertise on all topics, but to arrive at a working set of understanding that allow the team to work together and the project goals to be reached. They also note the important role of

visualizations in highly abstract work that is supported by the research of Ewenstein & Whyte (2007, 2009).

Nicolini et al. (2012) similarly emphasize that – as opposed to the commonly held notion that collaboration requires some form of deep sharing – in interdisciplinary contexts the sharing and understanding can be partial and provisional. Their plural framework introduced in the previous Chapter shows that objects can perform this bridging work, and in this Chapter the importance of "pidgin tongues" as in common communication can be added to being one such enabler. Oborn & Dawson (2010a, 843) conclude that interdisciplinary[31] collaboration is "not so much to learn *from* each other's talk, but to learn *to* talk in this new arena" (emphasis in the original). They recognize three practices to be especially important in enabling this type of collaboration: organizing discussions: aligning skills and actions; acknowledging other perspectives: interrelating meaning; and challenging assumptions: negotiating and broadening meaning (ibid. 848). In practice-based perspective we can call this the *communicative competence* of "knowing how to speak" (Gherardi 2012, 27), which is observable in the competence of knowing how to use the required (technical) vocabulary – this communicative competence being increasingly crucial in the symbol-rich knowledge society.[32] Thus people work with words and language as much as they do with their whole bodies, and "talk not only enables work but is also work in itself (Gherardi 2012, 104)". A distinction is also to be made between talking *in* practice and talking *about* practice – the former is more unreflective, whereas the talk *about* practice involves reflection, argumentation and contestation (Geiger 2009).[33]

Finally, Olsen (2009) studied the making of nanoreactors and introduced the notion of "intertwined practice". In this particular study, the work practices between disciplines were found to be dissolved to the extent that for example biologists "were doing things we would expect physicists to do, physicists are suggesting changes in the biological experiment, which

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[31] Once again, a note on terminology; Oborn & Dawson use the term "multidisciplinary work".

[32] Chiapello & Fairclough (2002, 207) argue that language is becoming more central and more visible in the era of "new capitalism": "the whole concepts of knowledge economy and knowledge-based economy imply that the economy is in fact discourse led. Knowledge, in all its forms and manifestations, relies on language, semiosis and discourses to be produced, circulated and consumed."

[33] Geiger (2009) takes a Habermasian approach to discursive practices, which brings fore the notion of communicative action, distinguising between different modes of communication when engaged in life-world practices and reflecting on them.

we would only expect biologists to do and responsibility for a successful experiment is joint" (Ibid. 407.) This way of working (or rather, allowing for the contribution of experts to enter each others' domain), Olsen suggests, may aid in creating the partial understandings as they also develop the respect of each other's expertise.

3.2.3   Interdisciplinary collaboration: a community of practice or something else?

The question of community and the reference to community of practice (CoP) is often referred to in interdisciplinary research, and particularly salient it is in practice-based approach as CoP is one fundamental concept in practice-based notions of knowing. In 1991, Lave & Wenger used the concept of community of practice (CoP) for describing the locale for learning and socialization in organizations, marking a transition from a cognitive and individual notion of learning to a social and situated one: learning is a participative social process rather than happening in the brain of individuals (Wegner 1998). Fundamentally, CoP's refer to 'tightly knit' (Brown and Duguid, 1998) groups that have been practising together long enough to develop into a cohesive community with relationships of mutuality and shared understandings (Lave and Wenger 1991; Wenger 1998). The main features of a CoP are presented in the Table 8 below.

Key characteristics of a community of practice (CoP)
Sustained mutual relationships—harmonious or conflictual
Shared ways of engaging in doing things together
The rapid flow of information and propagation of innovation
Very quick setup of a problem to be discussed
Substantial overlap in participants' descriptions of who belongs
Knowing what others know, what they can do, and how they can contribute
Mutually defining identities
The ability to assess the appropriateness of actions and products
Specific tools, representations, and other artefacts
Local lore, shared stories, inside jokes, knowing laughter
A shared language, jargon and style that creates a shared discourse

Table 8: The characteristics of a CoP (Wenger 1998, 125-126)

CoP is seen as the source and medium of the socialization through which learning happens and the knowledge at the basis of a profession is transmitted. It is a form of self-organization that is based on sociality among practitioners and on the sharing of practical activities. (Wegner 1998.)

Approaching CoP as an independent entity and studying its internal dynamics is a well-developed concept, but using the concept of CoP in a variety of settings of cross-boundary co-operation of participants that belong to *different* CoP's and thus engage in co-operation *between* CoP's has met critique and is seen as problematic, and has fostered further expansions of the original notion (Bechky 2006; Lindkvist 2005; Amin & Roberts 2008; Handley et al. 2006; Brown & Duguid 2001). For example Gherardi (2009) has proposed that as research has shown the existence of many different types of CoP's, we should consider switching from CoP to the concept of "practices of the community" (PoC): how *situated and repeated actions* create a context in which social relations among people, and between people and the material and cultural world, become stabilized and sustained.

Wenger (1998, 2000) himself has written few words about cross-disciplinary projects[34]. In his theory of social learning systems he stresses the complementary value of communities and their boundaries: "Deep expertise depends on a convergence between experience and competence, but innovative learning requires their divergence. In either case, you need strong competences to anchor the process. But these competences also need to interact." (Wenger 2000, 234.) In fact, for him, cross-disciplinary projects provide a way to "sustain a creative tension between experience and competence when our participation in a project leverages and nourishes our participation in a community of practice (ibid. 2000, 238.)" Importantly he also notes that the participation in CoP's and project teams is simultaneous. Thus for Wegner, *interdisciplinarity is in fact one form of interaction* among people from different CoP's that act as a bridge – or boundary process - across the inherent boundaries; the other bridges being brokering and boundary objects. It is treated, quite clearly, not a kind of CoP in itself, but *a*

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[34] I am beginning to note a trend. More pragmatically oriented research within management and organization studies tends to talk of "cross-disciplinarity", whereas sociology of science –oriented studies refer to "interdisciplinarity", the intended use being a general concept to include various types of collaboration between specialists from different functions and disciplines.

boundary process between CoP's. As such, consequently, participation in such a process makes the participant a "broker" or a boundary spanner, and places the participant at the risk of becoming marginalized in respective CoPs. (Ibid.)

Oborn & Dawson (2010a) have elaborated on Wenger's notions, and based on their empirical research, they however argue that the role of such boundary processes, especially those of brokering and boundary objects, are in fact central and valuable to the "emergence of a new multidisciplinary space (ibid. 857)". Participating in boundary processes and acting as a broker was in their empirical setting seen rather as being ambassadors of their CoP's and thus quite esteemed. They also note the following: "It is conceivable, though not yet empirically shown, that in time the MDT [multidisciplinary teams] could be on train to becoming a CoP. As yet the ties to the separate CoPs are still undeniably dominant and indeed the very placing of them in the same context is shown on occasion to reinforce their separateness rather than to lessen it. (Ibid. 844.)"

If then interdisciplinary groups are not to be treated as CoPs, how then do they operate and enable knowing and knowledge creation? As Nicolini et al. noted in the case of boundary objects, so too Amin & Roberts (2008) question the value of turning the distinctive insights of the concept of CoP into generic formulations and "formulaic distillations of the workings of CoPs (ibid. 353)". They argue that there are different socialities of knowing-in-action, and the original emphasis of context, process, social interaction, material practices, ambiguity and disagreement should not be lost: "… in short, the frequently idiosyncratic and always performative nature of learning (ibid. 353)". Based on their analysis on earlier research on CoPs, they recognize four different types of knowledge dynamics and collaborative working[35]. I found this to be a very useful addition to the analysis of collaborative groups that are particularly focused on the creation of new knowledge such as product innovation, and thus will elaborate it in the following section.

Amin & Roberts distinguish four different types of knowing in action: craft / task knowing in action, professional knowing, epistemic / creative knowing and virtual knowing. *The craft /*

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[35] As is usual in the case of creating typologies, Amin & Roberts remind that the typology is heuristic, not a comprehensive and clearly defined classification.

task knowing in action refers to some of the "classic" examples of communities that are used in when talking of CoP's. These include Wenger's own studies of insurance claims prcessors (Wenger 1998), Strati's (2007) studies of construction workers as well as the famous photocopier repairmen in Orr's ethnography (1996). *Professional knowing in action* is characterized by research done on healthcare professionals and their practices in order to gain efficiency and quality through practice-based innovation. *Epistemic / creative knowing in action* refers to research done on the dynamics of collaboration among experts brought together explicitly to (radically) innovate, for example in science, product development and design. Finally, the *virtual knowing in action* is the focus of research of for example online communities and their practices. Amin & Roberts look for the distinctive nature of social ties, temporal aspects, degree of innovation, nature of communication and the type of knowledge typical to each of these knowing in action activities. (Amin & Roberts 2007.)

In their typology, the presence of multiple disciplines and domains of expertise as well as the purpose of creation of new knowledge – understood as radical innovation – is most linked to the epistemic and creative ways of knowing[36]. They see this as the activity identifiable in the multidisciplinary projects through which organizations aim to innovate in for example product development. This way of knowing-in-action is characterized by ambiguity, variety, high energy and structured chaos and a high-level of independence of the participants. Thus the crucial issue is how to align the practices so that this "creative energy" becomes productive as well, resulting in the innovation that was sought after. According to Amin & Roberts, four factors appear to be significant in achieving this alignment:

- The worth of the individual experts is pronounced, stemming from their skills, reputation and experience. Their collaboration is aided by the motivation of the goal and the not-yet-known possibilities inherent in the task itself, which has the possibility of furthering their reputation and "worth" (reminiscent of epistemic objects as depicted by Nicolini et al.);
- The ties that bind trace to the shared problem, not so much on existing strong social ties;

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[36] They were also regarded as salient in virtual collaboration, but as the dimension of virtuality is not in the scope of my research, I concentrate on the epistemic and creative knowing.

- Productive ambiguity includes "organised slack": scope for free thinking, imaginative play, visualization of problems and serendipity. This includes the consciously cultivated informality that may stem from the use of a particularly designed physical space (this ties with Dale & Burrell's research on spatial design (2010), which I will cover in Chapter 3.2.4);
- Project-based work with tight deadlines relies on a variety of objects such as scribbles, drawings, reports, briefings etc. that enables the collaboration to move towards the common direction and make abstract issues tangible, enabling also the partial understandings mentioned before (strongly also supporting the plural approach to objects by Nicolini et al.).

The above type of knowing-in-action portrays many of the features of interdisciplinary knowledge creation as shown earlier. If, in addition, as stated earlier, one context of interdisciplinary collaboration is a project-based group with a set goal and timeline, this conceptualization offers a good basis for empirical analysis. I will, however, still elaborate on it from the research by Lindkvist (2005), who too argues that often these temporary cross-functional teams in organizations are equated with CoP's when, in fact, they are, on many fronts, quite different.

Lindkvist lists some of the inherent differences between CoP's and project-based groups: "Typically, such temporary organizations or project organizations or project groups within firms consist of people, most of whom have not met before, who have to engage in swift socialization and carry out a pre-specified tasks within limits as to time and costs. Moreover, they comprise a mix of individuals with highly specialized competences, making it difficult to establish shared understandings or a common knowledge base." (Ibid. 1190.) Also Bechky (2006, 1763) recognizes these types of work groups, where a "practice binds people together with shared understanding, but the people themselves may not know one another", and adds that if the group is project-based, it does not have familiar organizational boundaries. Importantly, she calls for more richly detailed empirical studies on these types of work groups in order to be able to see how a community or such might "stretch beyond occupational lines to encompass more diverse sets of related practices focused in a single product or service (ibid. 1764)."

To further our understanding of these types of groups, Lindkvist offers the concept of "*knowledge collectivity*" or "collectivity-of-practice" (CIP) to be better suited to groups of this kind. These are projects that are formed with a specific (customer oriented) outcome such as a good or a service in mind, but the process of creating these outcomes is a complex, collaborative effort. These projects are highly autonomous within goals set, they comprise of participants representing different specialties as well as representing a variety of functions. There is a limited overlap of knowledge bases, little time to build communal knowledge and also due to a deadline-orientation, little time to extensively socialize. Thus, Lindkvist argues that "the connotations of intimacy, endurance and learning together that are often associated with the 'community' notion, would thus seem to be less fitting in the context of such project practices." (Lindkvist 2005, 1200.)

A knowledge collectivity operates on distributed knowledge that is highly dispersed and individualized among members. This gives rise to the importance of knowing "someone who knows" and where to start a search process when particular problems arise – a network memory of sorts, rather than the communal knowledge base inherent in CoP's. This places the knowledgeable individuals in a more pronounced position, as they engage with each other in the goal-oriented trial-and-error type of process. They need to "know what they know" and thus be able to at least to some extent articulate this knowledge – Lindkvist defines this as placing greater reliance on individual agency rather than the knowledge community. If a CoP encultures its members, then the CIP with a specified goal encourages "entrepreneurship" and a "marketplace" where "ideas compete for attention and where individuals continuously look for new ideas and criticism that might help them solve their problems (ibid. 1203)."

I have compiled the following Table 8 in order to summarize the depictions of Amin & Roberts (2008) and Lindkvist (2005), with input from Nicolini et al. (2012).

Epistemic / creative knowing in project-based interdisciplinary knowledge creation	
Knowledge base	Distributed, to be extended in project, accessed through participants' "knowing-who-knows"
Type of knowledge	Specialized expert knowledge, with strong embodied interaction with material objects
Type of knowledge creation	Radical innovation, creative energy, goal-directed, market-like exchange through trial-and-error, improvisation, problem solving
Temporality	Short-lived, deadline-oriented but with "organized slack" and productive idleness
Type of knowledge worker	Autonomous, strong individuals, no strong (previous) ties between participants from socialization, expectations of others' expertise
Overall "ethos"	"Desire to know"; "we tell more than we can know"; "anything is possible"
Characteristics	Ambiguity, variety, uncertainty
Management	Project-based management, use of objects (epistemic, boundary, infrastructure, activity)
Spatiality	Physical proximity, ad-hoc meetings and active use of spatial possibilities

Table 9: Features of project-based epistemic / creative knowledge-in-practice (Amin & Roberts 2008, Lindkvist 2005 and Nicolini et al. 2012).

From the above it can be concluded that the notion of community, and even more so, community of practice, needs to be handled with more precision than potentially has been the tendency to do. Writers seem to use many euphemisms to tackle the challenge: "community without unity" and "proto-community" (Nicolini et al. 2012) and "cooperation without consensus" (Star 2010) for example. One of the research questions I set forth in the Introduction was to explore the practices engender a certain kind of practice community, and if so, what are its features (SRQ3.3)? In the attempt to answer the question, I will in fact not look at the practices of knowledge creation assuming they might be a community (of practice) – instead I will approach my empirical material using the practices of epistemic and creative knowing summarized in the above table. In my conclusions I will then come back to the question from the viewpoint of a potential community in light of my empirical findings.

3.2.4 Embodiment of knowledge creation practice: being there in person

The empirical practice-based research on knowledge creation places a growing importance on physical interactions, not only between people, but also between people and non-human elements of practice (e.g. Gherardi 2012). In fact, when reviewing the literature, the most recent contributions on practice-based research seemed to concentrate on sociomateriality of the practices. The importance for knowledge creation of being *physically* present has been acknowledged in various empirical studies. In addition to highlighting the role of very tangible objects through which knowledge sharing and creation is enabled (Chapter 3.2.1), Behcky (2003) stresses the importance of the cross-occupational team meeting physically during the process of product development. Likewise, Sole & Edmondson (2002) in their study on dispersed teams emphasize spending time together physically and using "social approaches" (ibid. 531) such as inter-site visits, re-locations and co-locations as instrumental in creating a foundation for the effective knowledge creation practices in settings that include boundaries of geographies as well as occupations. Also within research on organizational knowledge creation, the physical space as the localization of knowledge creation practices is seen as important (von Krogh & Geilinger, 2014)[37]. The above findings indicate that being there "in person" – body and all – strongly enables interdisciplinary knowledge creation[38].

When approached in the knowledge as possession –epistemology, knowledge creation implies using one's mind – that is the cognitive dimension of our "humanness", or "mentalism" (Gherardi 2012, 199). Thus knowledge work is categorized as intellectual activity, as opposed to the, say, more manual type of labour. In addition, the view of intellectual activity as the activity of sole individuals, acting alone and isolated, has a long tradition especially in sociology of science. However, if we approach knowledge work from the practice-based epistemology, the body and its situatedness in a particular social context enters the picture. As the sociologist Randall Collins argues in his tome of a book "The Sociology of Philosophies: A Global Theory of Intellectual Change" (1998), even the most abstract type of intellectual

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[37] Within organizational knowledge creation theory, this context of localizing knowledge creation, including the material space, has most often been captured in Nonaka's concept of "ba", the Japanese word which means "place", see e.g. Nonaka et al. 2006.
[38] Amin & Roberts (2008) question this premise in their research, noting that there might be a very different kind of sociality, building on a commitment at a distance, present in virtual knowing-in-action – but a sociality nevertheless, that enables similar practices as physical presence.

activity - that of creation of philosophical ideas that truly matter historically - are located in social contexts: "…. it is possible to demonstrate that individuals who bring forward such ideas are located in typical social patterns: intellectual groups, networks, and rivalries (ibid, 3). [39] The view of knowledge as socially constructed demands the presence of social relations by definition: "As a socially constructed phenomenon knowledge does not exist on its own, but is dependent on social recognition. Without being perceived and recognized by others knowledge does not, for all practical purposes, appear as much, at least not in market and organizational contexts." (Alvesson 2004, 98.)

Another by-product of the tendency to isolate intellectual activity to an action of the mind is to neglect the body and its senses; in organization studies this has resulted in a cognitive bias towards privileging the mind and its processes. In contrast the practice-based notions of knowledge stress the embodied nature of knowledge and knowing and the relevance of sensible knowledge. This is not by any means a novel conception in organization studies: for example Gärtner (2013) provides a thorough review of the different views on embodied knowing in organization studies that traces back over twenty years. Gherardi et al. (2013) classify the problem-space further into three categories: exploring the body that works *through* the senses; researching the body that *experiences* through the senses; and investigating the body that *knows* through the senses.

Body that works through the senses. This research focuses on how organizations attempt to manage how the employees look, behave and even feel, as well as looking at work as a "bodily performance", or "body work". Gherardi et al. claim that this view however tends to privilege forces *outside* the body (the body as being discursively inscribed from the outside).

Body that experiences through the senses. This research is based on notions of sensible and aesthetic knowledge that legitimizes emotions, intuitions and bodily sensations as the basis of knowing. Research on '"aesthetic leadership" for example looks at how material places and subjectively experienced spaces construct leadership (e.g. Ropo et al. 2013). According to Gherardi et al., as opposed to the "body work" category, this research has a strong "inside-

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[39] Another book making a smiliar argument within domains of art, literature and psychology is Michael P. Farrell's "Collaborative circles: Friendship Dynamics and Creative Work" (2001)

out" orientation: we not only have a body, we *are* our lived body, and experience (live) the world from the inside through our senses.

Body that knows through the senses. This category is the one to which Gherardi et al. place practice-based theorizing, as the focus is knowing and learning that derives from sensory faculties: "Knowledge rooted in 'practice' emphasizes that it is the people who create, invent, and enact organization through their corporeality" (ibid. 334). The practice-based view is seen as integrating both the "inside" and "outside", as the body is engaged and embedded in practices that in turn are always in relation to the "organizational space". This research legitimizes our sense-based data, such as emotions, intuitions and mental representations as a basis for knowledge development (Strati 2007, 64). The corporeal and personal relation of the subject's relation with the experience of the world is at the locus of this view.

As my research places a special focus on the individual role in practices, sensible knowledge and the judgments made based on these aesthetic experiences are of interest as they provide ne *avenue for understanding the differences* in individual experiences - for example the differences of how individuals perceive objects, as Nicolini et al. (2012) stress. In Gherardi et al.'s terms, it is the body that knows through the senses, and thus creates the personal relation of one's experience that is different for each one of us – it becomes *personal knowledge* which distinguishes one individual from another (Gherardi 2012, 75). This aspect is one I feel is somewhat lacking in research on knowledge creation within the epistemic/creative –type of knowledge-in-action. For example, Amin & Roberts (2008) state that aesthetic, kinesthetic and embodied knowledge has a strong relevance to craft/task types of knowing, and indeed some much-cited studies of situated work practice have concentrated on these types of occupations (Lave & Wenger 1991; Orr 1996; Strati 2007; Yanow 2004). In addition, embodiment has been studied within more professional settings, such as healthcare (Hindmarsh & Pilnick 2007) and Amin & Roberts acknowledge this as well. However, the embodiment dimension does not figure in the epistemic/creative type of knowing – and neither Lindkvist (2005) makes any reference to its relevance. Following Gherardi et al. this may result from the viewing of the body either from the outside - i.e. looking at how the body is "worked on" by organizations – or inside – i.e. how the body "lives work" - but not the reciprocal relation of our embodiment with practices and materiality. This type of expertise-

based epistemic knowledge creation is an embodied lived-experience, but this experience also shapes how one perceives and "knows" the situated practices within which one is situated in. This embodied knowing then results in differences between individuals, manifesting in potential misunderstandings, conflicts but also "creative abrasions". Even if for example new product development requires a variety of abstract expert knowledge, and not so much, say, learning from demonstration, feeling, seeing or bodily doing as repairing copiers or doing surgery, for example, it does not mean that individuals do not use their senses to perceive, enact and indeed, create this "knowledge work". The acknowledged "object-orientation" of such work (Amin & Roberts 2008, 362) in itself makes our embodiment a necessity. If there is an object, then there must be an embodied person that "makes" the object as the result of acting towards and with it. This is the "when" of objects that results from them being "stuff of action" (Star 2010, 603).

This embodied nature of our practices is another interesting avenue for enriching the view on knowledge work: the social and embodied view on knowledge work also places this activity in a specific physically material setting. Popular discourse often heralds the "time- and space –less" nature of knowledge work, touting virtual teams and distance work as the "new" way of working[40]. This is potentially partly the result of knowledge work being defined as mediated through information technology, partly due to the traditional view of knowledge as transferrable, context-free and non-situated, and partly stemming from the above-described neglect of the body and its senses. However, if we take embodiment as a starting point, knowledge work by definition happens somewhere where the body itself is. This directs us to emerging research on the *materiality* of organizations and work (see van Marrewijk & Yanow, 2010 for an overview). This research calls for "space and other dimensions of the material world to be brought back into organizational theorizing" (van Marrewijk & Yanow 2010, 3). This implies that not only the dualism of the mind and body, but also the dualism of the social and the material (i.e. human and non-human) needs to be re-examined, and a more holistic perspective applied altogether. To some extent this view on materiality is included in the embodied notions of work and organizations as classified by Gherardi et al. (2013), on some respects it is distinct from it as the focus on non-human elements is more pronounced as

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[40] For example, the main Finnish daily newspaper Helsingin Sanomat titled an article on current office designs "Own desks disappearing from the workplace" (Omat työpöydät katoavat työpaikoilta, HS 4.11.2014), and refers to "trendy" organizations that are designed as "multi-spatial offices" (monitilatoimisto).

the research focus itself. Research on work settings and spaces as tools to enhance creativity, team work and knowledge sharing, or broader organizational transformations altogether – that is, the use of spatial design to bring about desired behavior among the users of such space - are for example the focus of this research (see e.g. Felstead et al. 2005). In addition, the spatial dimension of creative industries (Amin & Thrift 2007), physically facilitating the organized slack deemed important for epistemic knowing (Amin & Roberts 2008) and recognition of the broader material infrastructure (Star & Ruhleder 1996; Nicolini et al. 2012) all highlight that physical space should not be ignored.

When the spatial design of open-space and "turfless" office is combined with the notion of professional work[41] being mobile and space-less, Felstead et al. (2005, 3) state that "We no longer go to the office, but the office comes with us, every where and every when". This leads to the "exploding workplace", to use their apt phrase that leads to three distinct socio-spatial contexts of working: working in the collective office, working at home and working on the move (ibid. 6). Another popular tendency in spatial design is what Dale & Burrell (2008) state as making the "workplace" disappear from the work place: treating organizational work spaces as homes with kitchens and other recreational areas. Dale & Burrell reveal the contradictions inherent in these types of current ways of designing organizational spaces, as they emphasize notions of flow, liquidity and placelessness but at the same time the designs employ notions of community, surveillance and aestheticized consumption. Dale & Burrell use the term "spatial rhetoric" in order to describe the way spatial design uses terms such as "home", "play" and "family", which further erodes the distinction between worker's free time and work time – reversely, spatial design uses colors, lighting and furnishings that do not say "work" or "labour".[42]

Theoretically, Dale & Burrell (2008), following the French social philosopher Henri Lefebvre, treat space as a social phenomenon, that is emergent from the relationship between three analytically distinct, but inter-related elements: conceived space - space as the product of e.g. planners and architects; perceived space - the ways in which space is produced and

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[41] It should be mentioned that Feldsted et al. (2005) explicitly avoid using the term "knowledge worker" due to its contested nature, and opts for the use of "professional work".

[42] However, the authors note that at the same time these types of designs are easier to identify and malleable so the empolyees can work around them. They make a strong argument that spaces are embedded with power relations, following Focault.

reproduced through our movements within the space we occupy; and lived space - the meanings we give to space and the ways in which we also reorder the space, so it better reflects our given meanings. This relationship further consists of three levels of analysis, that is those of enchantment (aestheticization of space through design), emplacement (regulation of space and its use) and enactment (the ways in which the space is used by those who inhabit it). The authors argue that space is performative in character and thus subjectified by those who enact it – the space and subject are mutually constitutive – aligining the argument with that of Nicolini et al. regarding objects, where physical space in fact is part of the objectual infrastructure of practices.

To conclude, Gherardi (2012, 97) reminds us that *workplace is also a workspace:* the physical space is a resource for practice; working is a situated performance within a context that enables the certain ways of doing – the context is "equipped for the socio-temporal conduct of practice" (Ibid.); and that objects help humans to be competent. Especially when a practice becomes recurrent and routine-like, do the contextual "equipment" become visible and repetition makes them familiar to its users. This results in a form of "improvisational choreography: bodily (knowledgeable) movements within an equipped environment (Ibid. 102)".

3.3   Integrating the central concepts

To summarize, earlier research on interdisciplinary knowledge creation centers on boundaries, plurality of objects and the creation of communicative partial understandings. Especially the research by Klein (2008b), Nicolini et al. (2012) and Star (2010) offer conceptual devices for approaching the practices that I observed at Aalto Design Factory (ADF). In addition Amin & Roberts' (2008) typology of the different types of collaborative working, elaborated with Lindkvist's (2005) concept of "collectivities in practice", offer a useful way to distinguish the particular context of interdisciplinary practices I witnessed at ADF, and how knowledge creation particularly is enabled in such contexts, without resorting to labeling it *a priori* a community of some kind. The above is complimented by the views on embodiment as conceptualized by Gherardi et al. (2013), viewing space after Dale & Burrell (2008), as well as input from other authors mentioned.

I have integrated the central concepts into a theoretical framework that is pictured on Figure 1. It consists of three dimensions: process, practice and enabling factors. First, I have summarized the "architectonics of forming new knowledge communities (Klein 2008b, 272)" as a process that depicts how interdisciplinarity progresses in order to formulate new subject matters that are detached from existing categories. The aim is to facilitate continuous movement beyond boundaries, and foster potentially new fields to yet again emerge: "Gender is not confined to women's studies. Culture is not the sole property of anthropology or traditional humanities disciplines. Globalization is not isolated to programs of international studies. Sustainability is not the sole province of environmental studies. Conflict, justice, and democratic participation in decision-making are present outside policy studies. And health, wellness, and the body are not restricted to medicine." (Ibid. 272.) This process is derived from the field of scientifically oriented research, but I found it to be applicable to interdisciplinary organizational knowledge creation more generally, as it resonates strongly with empirical research of e.g. cross-boundary collaboration.

If the first dimension offers an overall view and anchor of the broader process, then the second is the framing of interdisciplinary knowledge creation practices themselves. These practices constitute the above process, and highlight its dynamic, contextual and heterogeneous nature. I have chosen to approach knowledge creation practices using the notion of "epistemic / creative knowing-in-action" as conceptualized by Amin & Roberts (2008), and more particularly focusing on project-based way of interdisciplinary collaboration as specified by Lindkvist (2005). I am thus able to frame a "space of interdisciplinarity in practice", in which the participants and a variety of objects interact and "tack back and forth" (Star 2010) between and over boundaries, between knowing and lack of knowing, between structured and ill-structured, as well as between understanding and misunderstanding.

In order to enable such a practice space to emerge, the third dimesion offers the key enabling factors earlier research has shown to be relevant for interdisciplinary knowledge creation. Here I draw on Nicolini et al.'s (2012) plural view on objects, and I also found inspiration from Stars research. To complement the object-orientation, I add the more meaning-focused research that underscores the importance of "partial understandings" that common way of talking and communicating makes possible. Finally, as an important dimension within

practice-based perspective is the acknowledgement of embodiment and sociomateriality in knowledge creation. Of course, this is already inbuilt in the treatment of objects, but it is important to further highlight the embodied nature of these practices, as they help understanding the individual differences within practices. In addition the physical space where the embodied practices take place is given special prominence.

Process

The problem / residual category / anomaly, outside single discipline's reach

Interdisciplinary collaboration

Detaching the subject and object

Loosening boundaries, trading zones

Filling the "lack" of knowledge

Interim pidgin tongues

Constituting new structures and reconfigurations

Practices

?

Partly given goal, something that may never exist.
The desire to know!

Epistemic objects

Epistemic / creative knowledge creation in practice
(

Boundary objects

Activity objects

Infrastructure

?

Boundaries
Differences
Conflicts
Misunderstandings

Enabling factors

Plural role of objects – stuff of action

Creation of partial understandings

Embodiment of practice
(sociomateriality, space, senses)

Figure 1: Summarizing the key theoretical concepts

In the preceding chapters I have taken the first two themes of my research – knowledge creation and interdisciplinarity – and looked at their theoretical and conceptual framings in light of earlier research. I recognized process, practice and enabling factors as the three dimensions making the conceptual treatment of interdisciplinary knowledge creation in practice possible. Next I turn to the third and final theme of my research: the framing of knowledge work and expertise.

4   Knowledge work and expertise

4.1   Defining knowledge work

As I have shown in the preceding chapters, the focus on knowledge and knowing is a prevalent perspective in practice-based studies, as too is the focus on work practices that accomplish what needs to be done in organizations. In this sense one can argue that all the research I have reviewed so far deals with "knowledge work", even though all are not specifically concerned with work that is particularly knowledge-intensive. Bechky, for example (2006, 1758) argues: "While we frequently talk about the implications of changes in the economy for organizations, we simultaneously overlook or even disregard what people do to accomplish their work in these organizations. For instance, the knowledge economy cuts across a broad swath of occupations". Here we find evidence of the demarcation problem: all work involves using some form of knowledge, and the amount of knowledge needed in doing any work is increasing, as the knowledge-intensiveness of our whole society increases. Hislop (2008) has labelled this the "all work is knowledge work" perspective, which also recognizes tacit and contextual knowledge as key in accomplishing one's work even in more "manual" settings. In fact Hislop argues that by taking a practice-based perspective on work (employing practice-based epistemology) implies also taking the "all work is knowledge work" stance, as it "provides a way of understanding the types of knowing utilized by a wide range of workers (ibid. 583)". However, if, as in my empirical setting, the practices of work observed deal with knowledge *creation,* that is the generating of novelty in products and services utilizing to a great extent both abstract and contextual knowledge, then some form of definition for knowledge work would be conceptually useful.

Historically, management theorist Peter Drucker has been credited for the term "knowledge work" in 1959 – and indeed the term "knowledge economy" itself, in 1969. He distinguishes in a rather straightforward fashion between manual labour and knowledge-based work, and his legacy has lived on in the treatment of knowledge work within the epistemology of possession –tradition [43]. Thus traditionally, using Hislop's terminology, the elitist "professional knowledge worker" perspective has been dominant, privileging the utilization and creation of abstract theoretical knowledge; this is also what Yanow (2004) refers to in her concept of "expert" knowledge as opposed to the localized, contextual kind.

According to Hislop (2008), this view greatly overlaps with the notion of "professionalism" as in the occupations traditionally viewed as knowledge work. It is indeed the concepts of expertise and professionalism that are at the core of most views on knowledge work, and thus the possible conceptualizations of expertise are important to my research as well. However, Nowotny et al. (2001, 215) state that "Expertise is at once contested, problematical, central and indispensable", making it an elusive research topic.

Blackler (1995) has explored the way expertise and knowledge work had been represented in organizational research, and he advocated that knowledge should be seen as knowing, which in turn is mediated, situated, provisional, pragmatic and contested (the building blocks on which practice-based research is built): "Applied to the study of knowledge work, the approach developed here suggested that, as an alternative to focusing on the kinds of knowledge that capitalism currently demands, attention should focus on the systems through which knowing and doing are achieved (ibid. 1995, 1040.)"

Following Blackler, there are attempts to define knowledge work in more detail without resorting to the elitist privileging of abstract theoretical knowledge[44]. Alvesson (2001, 2004) has extensively studied knowledge work, as has Newell et al. (2009). They offer the following characteristics that are seen as typical of knowledge work:

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[43] For the purposes of this dissertation, it is not necessary to analyse the full evolution of discourses on knowledge work, for an overview see e.g. Easterby-Smith & Lyles, 2011.

[44] Hislop (2008) recognizes also "knowledgeability in work" –perspective, but deems it conceptually "as virtually co-terminus with the 'all work is knowledge work' perspective" (ibid. 584). He introduces a framework to utilize both the concepts of knowledge and skill in order to conceptualize work.

- Involving of highly qualified and educated individuals, including "professionals" [45]
- The centrality of intellectual and symbolic skills in work (as the main input to the work, the way to achieve the work as well as the major output of the work)
- The salience of self-organization and dispersed authority
- The tendency to favour ad-hoc and flexible organizational forms
- A high level of uncertainty and problem-awareness, need for extensive communication in coordination and problem-solving
- Complex problems and solutions involve intangibility, calling for subjectivity, making work difficult to standardize
- The pronounced expert position (whether "real", believed or claimed) creates asymmetrical power relations between e.g. expert and client, and knowledge claiming organizations and its customers. [46]

However, as notions of knowledge itself have shifted towards more contextual and plural views, so too has the view on knowledge-work. Based on their research, both Alvesson (2004) and Newell et al. (2009) add to the above list features they feel are central to understanding (and managing) knowledge work. First, knowledge intensive means *ambiguity-intensive*, as knowledge itself is ambiguous. The role of "knowledge" in doing the work may in fact be more limited than commonly conceived. Second, knowledge-work is highly context-sensitive, and the "best practice" –approach to developing this type of work may in fact be counterproductive – what works in some context may be even disruptive in others. Third, the centrality of symbols and their manifestations in various artefacts as the outputs of work (e.g. concepts, prototypes, ideas etc.) raise issues of rhetoric, persuasion and image: how to convince others of the superiority of the knowledge claims embedded in these symbols. Fourth, Newell et al. (2009) come to the conclusion that knowledge work depends primarily on the behaviors, attitudes and motivations of those who undertake and manage it. And

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[45] The term "professional work" is often used as a synonym for "knowledge work". Following Newell et al. (2009), knowledge work is seen as encompassing professional work (e.g. accounting, legal work) as well as more contemporary work such as consultancy, advertising, design etc.

[46] The power relations between experts and domains of expertise in knowledge creation and collaboration has been researched e.g. by Contu (2014) and Oborn & Dawson (2010b). Contu's research sheds light into creative work practices and the "struggle of a practice that is caught between art and commerce, management and craft and passion and business and the antagonisms therein generated (ibid. 312). Oborn & Dawson's research reveals how the knowledge of some experts in a multidisciplinary group may be privileged and reconstituted as practice of the whole group. In addition, Carlile (2004) refers to "political boundaries" where the negotiation of interests occur and trade-offs are being made.

finally, the identity and its constant formation of the knowledge workers is a central part of working life, as the traditional "professional identities" and notions of expertise are blurring.

Overall, Alvesson (2004, 29) reminds us that it is "…perhaps the *claim* to knowledge-intensiveness that is highly distinctive of KIFs compared with many other (average) companies…" He places *symbolism* as a key feature in knowledge-related issues, as knowledge is symbolic in nature, the symbols themselves are value-laden (see Chapter 2.1 for Hackings' apt term "elevator word" describing knowledge), and various actions, rituals and rhetoric are used in persuasion of this symbolism. Thus knowledge work itself is work laden with rituals, rhetoric and other "non-cognitive" elements.

If this is so, what is then the role of "professional knowledge", i.e. being qualified in some area of speciality and having "the facts", so to speak? No matter how knowledge work is defined, organizations still consist of "professions", to which individuals ascribe themselves. A useful avenue is to look at the notion of expertise and how it is changing.

4.2 Changing notions of expertise

4.2.1 Traditional views on expertise and its current challenges

Intuitively one would argue that being a knowledge-worker means one has (at least) a claim of *expertise* in some specific domain, be it abstract such as having knowledge of legal matters, or producing something more tangible, such as being able to design new products using CAD-software, for example. Experts have traditionally held a reified position in contemporary societies. "Expert cultures" is used by the philosopher and social theorist Jurgen Habermas (1987) who argues that advances in science has resulted in massive growth of (technically useful) knowledge, which in turn separates three distinct value spheres from our lifeworld – i.e. the everyday world we share with others - into distinct value spheres: scientific-technical, moral-legal and aesthetic-expressive. All these spheres have their own expert cultures that in turn have distinct validity dimensions. This results in their separation as well as estrangement from broader cultural traditions. Our lifeworld relies increasingly on the specialized (cognitive and technical) rationality of these experts, as well as being

"colonialized" by market economy and legal-bureaucratic regulation. (Outhwaite 2009; Finlayson 2005.) A similar point is made by Antony Giddens (1990) in his argument that our world is increasingly mediated by expert systems.

Sociology of knowledge, which explores the social production of (in most cases scientific) knowledge, defines knowledge as a capacity for action: "The term capacity for action signals that knowledge may be left unused or may be employed for irrational ends and that the material realization and implementation of knowledge is dependant on, or embedded within, the context of specific social and intellectual conditions" (Stehr & Meja 2005, 13.) Scientists and experts are traditionally the ones who engage in this capacity. In this view, scientific and technical knowledge has a special importance not so much because it is assumed to be "objective", but because it provides the basis for applied or incremental capacity of action, that is the type of knowledge seen as "adding value". In addition, we cannot state *a priori* what knowledge is of value, as the value is dependent on knowledge's realization, a.k.a. enacting the capacity. Knowledge-based occupations are needed to mediate between this production context of scientific and technical knowledge and the "end-users" needing the "incremental" capacity for action (Ibid., 14.) "The set of limits to the social power of scientific knowledge constitutes an inevitable part of the fabrication and the utilization of scientific knowledge. But they also explain why the knowledge work performed by the stratum of experts of knowledge-based occupations, generally speaking, attains greater and greater centrality in advanced societies. The knowledge work performed by knowledge-based occupations or by experts, counsellors and advisors is crucial in that their work 'heals' some of the practical deficiencies of scientific knowledge." (Stehr 2005, 311.)

The above view does imply that if viewed as experts, knowledge workers are cognitively capable and specialized agents using capacity for action towards separate objects such as "knowledge" at their choice in order to make knowledge "practical", available, interpreted and linked to emerging local circumstances. This has traditionally provided these types of knowledge workers their strong position.[47]

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[47] This notion of "capacity to act" inscribes to a certain view of agency, that is the notion that agency is an essence that inheres in humans as opposed to agency being mutually constituted with materiality and structures. See e.g. King 2010 for an overview of the debate as epitomized in the "duel" between the British sociologists Margaret Archer and Antony Giddens; and Emirbayer & Miche (1989) for a thorough analysis on the concept.

Facts have traditionally been the exclusive property of (natural) science, giving them their "honorific" status. Scientific knowledge has been attributed as being a unique form of human knowledge: universal, rational and necessary. This is now regarded as an obsolete view, labelled often as "scientism" (see e.g. Stehr, 2005). The view of scientific facts, scientists and how they "do science" has changed drastically: scientific inquiry is "just" another context of situated knowing and an "action-cognition mesh" to paraphrase the apt phrase of Knorr Cetina (2005, 179), and facts it produces are just as much "fabrications" as "facts" produced in any other setting (Knorr Cetina 2005). [48]

"In the middle of the century Thomas Kuhn's famous book *The Structure of Scientific Revolutions* was seen by some to replace the idea of orderly progress in science with mob-psychology. Subsequently a series of carefully documented studies of the day-to-day unfolding of scientific life, especially scientific controversies, showed that the 'canonical model' of science did not coincide with the practice itself." (Collins & Evans 2007, 1.) This is how sociologists Harry Collins and Robert Evans open their book "Rethinking Expertise". They also list a number of cases where the public trust in science was seriously damaged, especially in the fields of biology[49]. All these development have, in their opinion, created a situation where "we no longer understand how to balance science and technology against general opinion… Our loss of confidence in experts and expertise seems poised to usher in an age of technological populism." (Ibid. 1-2.)

When the above developments illustrated within the field of science are combined with the pluralistic notion of knowledges – most radical at the extreme social constructivist end resulting in the relativistic notion of every view being equally "true" or "fact" (Raatikainen 2004; Rolin 2006) – we may indeed question the whole concept. Perhaps the strongest pressure to the expert identity comes from the questioning of the whole rationale behind the

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[48] For a classic example of this "de-bunking" of scientific process, see Bruno Latour & Steve Woolgar's (1979) "Laboratory Life: The Construction of Scientific Facts". This approach altogether owes to Thomas Kuhn's book (1962) "The Structure of Scientific Revolutions".
[49] An example given by Collins is the 2012 measles outbreak in UK (which in fact occured on a much smaller scale in Finland in 2013) due to a drop in vaccination levels that were partly fuelled by high-profile scientific research done on the linkages between the measles vaccine and autism. The article in question has later been proven to have been erronoeus (Collins 2014.)

asymmetry of power positions between experts and non-experts (Alvesson 2004): the digitalization of information and the use of "smart" technology makes it possible for anyone to access such vast amount of data, opinions, viewpoints etc., that the "layman" is often indeed very "knowledgeable" on a given subject (the claim of "folk wisdom" prominent in populist politics as well as increasingly in many other sectors of public debate[50]). The erosion of this power position of expertise is a permeating feature of the knowledge society, this being especially salient in the general attitudes towards scientific knowledge as described by Collins & Evans above. In addition, science is increasingly used (and explicitly created) to influence political agenda (see e.g. Stehr & Meja 2005; Fischer 2000). Thus the pluralistic notion of knowledges as being socially constructed brings with it serious questions about whom to trust as a "knower", what risks are involved in using particular knowledge, whose interests knowledge serves and so forth. [51]

4.2.2   The changing of expertise

Are the experts then just a relic, and hold no more than just a rhetorical position in contemporary "postmodern" times, based on obsolete notions of objective possessed knowledge? From the "technological populist" soapbox it would be easy to make such a claim. However, if we remember that expertise can be positioned within the broader framework of "knowledge-work", as was done in the preceding Chapter, we can also argue otherwise: expertise is very much present and salient in our societies – but "what *is* expertise" is indeed transforming.

The answer to "what is expertise" depends on one's ontological premises. If we take a purely relativist and social constructionist view, then expertise as something substantial does not exist. It exists only in relation with others - that is if others attribute expertise to the person or not. This is implied in e.g. Alvesson's (2004) view on knowledge work when he stresses that knowledge without someone acknowledging it as knowledge does not amount to much, and that expertise requires the social relations within which knowledge workers make the

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[50] "Kyllä kansa tietää", "The people know", is a popular phrase used first by a colourful Finnish politician Veikko Vennamo in the 1960's, made again popular by the populist party Perussuomalaiset.
[51]"Knowledge politics" is a concept in political economy used to deal with questions such as regulation of knowledge, governance models of knowledge etc. (Stehr & Meja, 2005).

symbolic claim to expertise. Knorr Cetina (1999, 2005) has used the constructivist lens to study "how sciences make science" especially in laboratory settings, and similarly argues that all scientific work is embedded within transscientific fields of interaction and discourse and thus the resulting knowledge should be treated as being socially relative.

In contrast, Collins & Evans (2007) take a realist position, and aim to (still) treat expertise as the real and substantive possession of groups of experts and that individuals acquire real and substantive expertise through their membership in these groups. "Acquiring expertise is, therefore, a social process – a matter of socialization into the practices of an expert group – and expertise can be lost if time is spent away from the group. Acquiring expertise is, however, more than attribution by a social group even though acquiring it is a social process; socialization takes time and effort on the part of the putative expert… Under our treatment, then, individuals may or may not possess expertise independently of whether others think they possess expertise." (Ibid. 3.) To advance the realist view on expertise, Collins & Evans have created a "periodic table of expertise" that categorizes the various types of expertise that are used when individuals make judgments on any given topics. The classification distinguishes between general dispositions of expertise, ubiquitous expertise we all have living in our particular societies, different types of specialist expertise as well as "meta-expertise" (expertise such as mine when writing this dissertation). Collins has continued this argument in a later book (2014), and its simplified point is that there are specialists, who have gained their knowledge on a subject "second-hand" from media, documentaries or reading primary sources such as journal articles; and specialists, whose knowledge comes first-hand through training with other experts, or through the social interaction and immersion with experts on a given field.[52]

Worthy a mention is the concept of "interactional expertise": according to Collins and Evans, this is expertise that is constituted by a thorough going grasp of the *language* of a specialism or subject area. Interactional experts cannot make a direct contribution to the discipline - they

[52] Collins' views have been criticized as being reminiscent of "scientism". Collins & Evans (2007) respond to these claims, and defend their position as an attempt to create a new framework in order to discuss scientific knowledge as still having some normative status. Overall, Collins has put forth an extensive attempt to theorize on the sociology of scientific knowledge in his theory of the three waves in science studies: wave one being the traditional view on the legitimacy of science; second wave "exposed" science as a relativistic and political enterprise; and wave three being "Studies of Expertise and Experience (SEE)".

cannot for example carry out "experiments" as do the *contributory experts* (contributing directly to the body of knowledge) of the subject - but they have a *genuine expertise* that enables them to act as mediators. Specialist (science) journalists are the most common examples of this type of expertise.

Overall, Collins & Evans stress the importance of socialization emphasizes the development of complex tacit knowledge in social groups that only humans are capable of. This points us to notions of embodied (tacit) knowledge as being a key element in expertise and knowledge work in general. The centrality of this tacit knowledge and socialization is a strong counterargument to the "folk wisdom" view that argues that "distance least to enchantment" (Collins & Evans 2007, 6). A similar type of socialization process has also been recognized in the communities-of-practice (CoP's) –literature, introduced in Chapter 3.2.3: the "tightly knit" groups that have been practising together long enough to develop into a cohesive community with relationships of mutuality and shared understandings (Wenger 1998). However, the views of Collins & Evans differ from the CoP –orientation in their ontological premises: knowledge development in CoP's is regarded as being strongly practice-based, and assuming a strong similarity in the epistemological bases of its participants. The expert in a CoP is enculturated into the ways of the CoP, and in this sense the knowledge of experts is decentred and dispersed within the CoP, not so much being regarded as knowledge of the expert as an individual knower. (Lindkvist, 2005.) This is in stark contrast to the realist position taken by Collins & Evans.

Attempting to rise above these ontological debates (without wanting to diminish their foundational importance), I conclude the following: to be an expert in our times means not being able to rely on some specialist "Knowledge" or status it has previously provided[53]. Research would indicate that it in fact means having skills and capabilities that are related to image-building, inter-personal skills, communicative abilities and persuasion tactics. In

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[53] Similar findings were reported by Björklund (2010, 517) in a study of product development projects' success factors and knowledge-work within: "Collaboration and cognitive-motivational factors such as trust, attitude, and intrinsic motivation-related issues formed the most common classes of discovered critical factors behind product development project success, along with the mediating categories of goal and autonomy-related factors. Furthermore, product development specific skills or knowledge accounted only for a small minority of the identified factors."

addition, in order to gain the (if only rhetorical and symbolic) claim to expertise, the individual needs to have been extensively socialized within an "own" social community.

4.2.3 Conceptualizations of multiknowledge individuals

Even if there is evidence that some explicit specific "Knowledge" plays a potentially lesser role in knowledge work and knowledge creation than typically perceived, the existence of specialized knowledge and expertise still forms the basis of organizing for knowledge creation. As I have shown, earlier research has given indications that the presence of a variety of skills increases the effectiveness of knowledge creation in for example new product development[54]. "Careful research confirms our everyday observation that products in the market are increasingly complex and draw upon diverse sources of expertise" noted Leonard-Barton in 1995 (1995, 74). However there is a distinction in earlier research made regarding the *source* of the diversity. The most common conceptualization regards team diversity to be the result of the team consisting of individuals each of whom has different functional or disciplinary knowledge (Park et al. 2009). Thus the diversity stems from the number of specialized experts constituting the team. There is however another source of diversity, one that is less recognized and researched, that stems from some of the individual team members having knowledge of several disciplines or functions. Park et al. (2009) call these "multiknowledge individuals", and Leonard-Barton "people with A-Shaped skills", as they have most often "two disciplinary 'legs' on which to stand" (1995, 77). In addition, Iansiti (1993, 139) has defined the profile of integrative experts with "T-shaped combination of skills".

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[54] Out of curiosity, quantitative empirical research into the positive relationship between cross-functionality and the outcome of new product development is somewhat inconsistent, showing both negative and positive effects, even though the most common hypothesis is that there is a positive relation. This ambiguity is argued to stem for example from contextual factors influencing product development activites. (Haon et al. 2009.) Emirbayer (1997, 289) would lament that this type of research "ignore the ontological embeddedness or locatedeness of entities within actual situational contexts".

How are these types of multiknowledge individuals perceived? The "T-type" as conceptualized by Iansiti has a specific functional or disciplinary skill – forming the stem of the "T", but also the ability to apply this knowledge across various contexts and situations (the integration skills) – forming then the horizontal top stroke of the "T". These experts thus know how their specific knowledge "interacts with others" (Iansiti 1993, 139), and "speak two or more professional 'languages'" (Leonard-Barton 1995, 75) – reminiscent of interactional expertise as conceptualized by Collins & Evans (2007). They also focus more on the problem at hand rather than "insisting that the problem appear in a particular, recognizable form" (Ibid.). The "A-type", in contrast, "embody technology fusion" and are "cross-overs" in that they have - either through experience or education - deep knowledge of more than one discipline, and can thus contribute to new knowledge creation in multiple areas of expertise. (Ibid. 77.) Leonard-Barton also uses the term "generalist" to describe the downside of placing too much focus on the "cross-bar" of the "T": "Of course, a risk is creating a class of generalists with no deep knowledge of any particular speciality but possessing only the crossbar of the T" (Ibid. 76-77). This implies that for both Leonard-Barton and Iansiti the existence of at least one strong "stem" - The "I-shaped skills" – is the hallmark of expertise, and that the integrative skills are complementary, rather than a form of expertise in its own right. Overall, Leonard-Barton (1995, 75) emphasizes the role of experience as the key to the emerging of these multi-knowledge individuals. She also recognizes the role of practical knowledge that complements theoretical knowledge that is embodied by these types of individuals. Subsequent research has challenged the basic notion of equating functional diversity with knowledge diversity that is typical to most research on the effects of cross-functionality, and for example Haon et al. (2009) introduced the concept of "competence diversity" that takes into account education, functional, experience and expertise diversity within teams.

4.2.4   Emergence and recognition of localized expertise

The above described challenges to expertise create what Nowotny (2000) calls "transgressive competence": expertise in our times is attempting to answer questions which are never only "scientific" or "technical" – the questions are inscribed in practices that "are characterized by overlaps and interlinkages. Unpredictable 'seamless web' hold them together, in which the

various areas of societal life, technology, science, the law, values and politics are intermeshed (ibid. 16)". This means that there is an audience to expertise that is never just other experts; experts always speak and reach to a wide and diverse audience - and that audience may indeed decide not to trust the experts. Contemporary knowledge production is a socially distributed system that, as Nowotny argues, further increases the context dependence of expertise and its transgressivity. There are thus "different forms of localized and particularized experience and expertise emanating from the private sphere… this process involves the de-professionalization of expertise and a reappropriation of expertise through lay participants (Ibid. 18)."

This localized form of knowledge and expertise has been theorized from a different angle   by Yanow (2004), who focuses on the knowledge of workers at the "bottom" of the organizations – indeed at the very local level. She identified *"boundary workers",* who are located at the "double periphery" of an organization: they work at the lower levels of the organizations, thus removed from the centre of decision-making; and simultaneously they intersect with people outside the organization, most notably customers of the product or service their organizations provide. An example of these types of boundary workers would be customer service representatives or salespeople. Yanow theorizes on the nature of the knowledge that exists in the practices of these boundary workers, and calls this "local knowledge": the very mundane, yet expert understanding of and practical reasoning about local conditions derived from lived experience. She juxtaposes this with "expert knowledge", traditionally referring to the professional expertise derived from academic training. (Yanow 2004.)

For Nowotny, future of expertise lies in its ability to become more *inclusive*; creating a way of working that transcends boundaries and adopting a more long-term time perspective. This means that the "lay participants and their experience should receive a recognized place (ibid. 19)" in this space of inclusive participation. This inclusiveness is also a guiding notion for Yanow as she argues that promotion of local knowledge – instead of it being disregarded by the experts of the technical-professional kind – ultimately serves the whole organization well. "The problem with this elitist way of conceptualizing (knowledge) work is not simply that it over-privileges abstract/theoretical knowledge and intellective skills, but in the process, such

a conceptualization has the potential to allow other, equally important types of knowledge and skills involved in work to become neglected and overlooked" (Hislop 2008, 593)

As a conclusion, a transgressive and local expertise can be seen as a fusion of education and expertise. Taking a practice-based perspective can potentially further our understanding of this issue, as knowledge diversity is approached from a very different viewpoint altogether. The question of "what is diversity" or "what constitutes multi-knowledge individuals" becomes almost a moot point, as the focus on practice emphasizes the practical knowledge that emerges from the situation itself in order to solve a particular problem, i.e. the knowledge-in-action is not reducible to certain "sources" of diversity that exist a priori. Its constitutive parts are distinguishable only in practice.

4.3 Knowledge work as localized practice: living both theory and experience

As my research employs a practice-based perspective, on a general level I thus ascribe to the "all work is knowledge work" perspective. However, if we place this notion within my overall theoretical framework of interdisciplinary knowledge creation (see Figure 1, Chapter 3.3), we see that in my particular empirical setting the work practices in question are those of epistemic and creative knowing-in-action, and involve students within higher education. As such, the context and its participants bear the hallmark of "knowledge work and worker" as depicted by Alvesson and Newell et al. This is not to make a distinction between knowledge work and "non-knowledge work", rather it is a recognition of a *contextual space where both the more theoretical form of knowledge*[55] *as well as the experiential-practice –based practical knowledge are present by definition*. I argue that it is not an either / or context. Work is embodied, and thus the workers not only live the particular situated experience of knowledge creation, they also carry with them the more theoretically oriented knowledge they "live and experience" as they are educated. They cannot "de-live" the theoretical knowledge, they are to some extent *"scholarly-academic" experts but simultaneously engaged in*

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[55] Most importantly, theoretical knowledge too is anchored in the material world, and does not reside in the heads of people; it too is made to "happen" as it is used in practice. It is, however, more abstract and its temporal dimension is more non-specific.

practices that constitute their "experiential-contextual specialization" - to borrow Yanow's (2004) terminology.

This might be particularly appropriate for interdisciplinary knowledge creation, as the argued importance of objects in such collaboration cannot happen without the first-hand lived-experience that makes the objects "happen" in the first place – once again the "when" of objects. In another context, the balance between theoretical and contextual will be different.

This argument is in line with for example Alvesson's research, which has revealed that due to the plural and contextual nature of knowledge itself, knowledge work is in fact more *pragmatically oriented, ambiguous and dependent on individuals "non-knowledge" capabilities* than possibly earlier perceived. Knowledge work's ambiguity arises not only from the notion of knowledge itself, but also from the ambiguity of the actual working practices and results. This ambiguity creates strong pressures on the individuals' identity, and to counter this, knowledge-workers rely on image and rhetoric to establish themselves and their position within their broader context. For example, the traditionally strong identity given to a knowledge-worker thorough their expertise and "expert status", is eroding due to the pressures of "plural knowledges" not privileging any one process of knowledge development. Empirical research has further given indications of the importance of *social interactions, embodiment and spatiality in knowledge-work – that is its socio-materiality and the bodily experiences of it.* In addition, the inherently *human qualities* such as personal dispositions, emotions and motivations are also seen as central to accomplishing knowledge-related work.

Thus to summarize: knowledge-work consists of a) at least rhetorical claims of specific expertise, making the participant a representative of a particular domain of knowledge or function, b) the embodied socio-materiality of the participants (human and non-humans) and their interactions; c) personal dispositions and motivations of the "knowledge worker"; and d) general interactional skills and capabilities required in the creation of the shifting and ambiguous role of being "an expert" in relation to others.

In my particular empirical setting, this work takes place in a contextual space where both the theoretical form of knowledge as well as the experiential-practice –based knowledge are

present, as the participants are scholarly-academic experts but simultaneously engaged in practices that constitute their experiential-contextual accomplishment of interdisciplinarity. In the rest of the dissertation I will explore one such space, and tell the ethnographic story of Aalto Design Factory, analyze it in the light of the framework constructed, and attempt to shed light into one context of interdisciplinary knowledge creation and its practices as well as analyzing how knowledge work is construed – mind, body, experience, theory and all.

However, before we take our tour of Aalto Design Factory, I will introduce the broader context in which it operates: higher education as part of our knowledge-intensive society.

5 Role of science and higher education institutions in society

The theoretical framework constructed above highlights the key concepts and their central notions found to be relevant to interdisciplinary knowledge creation practices and the knowledge work that takes place within. However, as my empirical setting is within higher education, I will briefly explore the way knowledge and knowledge creation processes are conceptualized within this specific domain as to see what potential specificities it might bring fore.

5.1 Knowledge society and science

> "Contemporary society is characterized – irreversibly - by pluralism and diversity and also, we argue, volatility and transgressivity. It can no longer be understood either in terms of the norms and practices of scientific rationality […] or in terms of hegemonic forces such as the market |…]. It is increasingly difficult to distinguish between the domains of the state and of the market, between culture and mass media, between public and private arenas. Science itself is increasingly challenged by forms of knowledge production, which are subsumed under the term 'research', epitomizing its potential for innovation and exhibiting its seductive lure to politicians and policy-makers alike."
>
> Nowotny et al. 2001, 21

In 1994, Gibbons et al. introduced the concepts of Mode 1 and Mode 2 of knowledge production. They recognized a form of context-driven, problem-focused and interdisciplinary knowledge production that they claimed had emerged since the Second World War, and

labeled this as 'Mode 2' knowledge production where multidisciplinary teams get together for short periods of time to work on specific problems. They persuasively distinguished this from 'Mode 1', that is academic, investigator-initiated and discipline-based knowledge production. Marginson (2008) calls this "the Mode1/Mode2 discourse on research", and suggests that it has been influential in processes of reforms across the world. Importantly, this discourse has contributed to the ways in which the role and purpose of universities has been reconsidered by political decision-makers. Universities are increasingly thought of as knowledge producers that are accountable for external stakeholders such as the State and private business (Marginson, 2008), not the academia itself. Table 9 summarises the key features of these two logics and features for the production of knowledge (following Swan et al. 2010).

"Mode 1 knowledge production	"Mode 2" knowledge production
Problems defined by academics, professional communities	Knowledge produced in the context of application, problem solving
Disciplinary knowledge	Transdisciplinary knowledge, non-linear, "real-time"
Homogenous sites/types of knowledge production	Diverse sites/types of knowledge production
Research as objective investigation	Research as reflexive/dialogical, problem solving,
Quality control by "invisible colleges"	New forms of quality control, with social accountability

Table 10: Summary of "Mode 1" and "Mode 2" of knowledge production (Swan et al. 2010)

"Mode 2" is a popular concept, and a discourse that fits nicely with the rhetoric of "knowledge economy" that calls for a networked, co-productive and flexible ways of creating new knowledge. Even more importantly, the characteristics of "Mode 2" are strongly espoused by governmental policy initiatives, actual funding of research and the favouring of applied research. Swan et al. (2010) cite examples from the UK, where especially in the biomedical field, there are explicit initiatives to promote the co-production of knowledge amongst academic, commercial and user groups.

Also OECD, whose recommendations carry weight in national level decision-making on educational policy (Lawn & Lingard, 2002), makes a strong case for the necessity of "Mode 2" type of knowledge production. Here we have a direct relation to the case of Aalto University. OECD's four analysts and experts visited Finland 12-20 December 2005 in order to produce a "Country Note" as part of OECD Thematic Review of Tertiary Education

(Davies et al. 2006)[56]. The report makes many references to the "Mode1/Mode 2" – distinction, for example:

> "Mode 1 is generally defined as academic research undertaken within the academic community according to academic norms and very often single discipline in character. Mode 2 is generally defined as multi-disciplinary research of a problem solving nature, normally commissioned by external agencies and with a strong user orientation" (Ibid. 48)

The "Mode 1" is equated with the "humboldtian[57] model" which, is deemed destined to change. Thus the report implies indirectly that the classic "scientific method" of knowledge production in "Mode 1" is not desirable. This becomes clear in the next quote:

> "Finland has enthusiastically adopted a strong commitment to a user-based problem solving perspective where real life applications of research tend to take place in the space between traditional fields. (Ibid. 48)

> "Students should be placed at the centre of the knowledge creation process, and that the knowledge creation is just as likely to take place within and with industrial partners, as within the HEI (=higher education institutions)" (Ibid. 45)

Overall throughout the report, and its recommendations, the "Mode 2" is highlighted as the preferred model for knowledge production. This is evident in e.g. recommending that Ministries should be "stimulating inter-disciplinary degrees, consistent with Mode 2." (ibid. 103) and encourage "an orientation towards Mode 2 with all its many manifestations" (ibid. 52).

However, regardless of the strong discursive and policy-oriented persuasiveness of the "Mode 2" –model, the thesis claiming this transition has been contested. Swan et al. (2010) mention the "inflated claims" made by the original authors, the lack of empirical support and the (too) sharp conceptual distinction made between the two modes. They come to the following conclusion (ibid. 1336):

> "This suggests that the continued debates about the value of shifting from one mode of knowledge production to another may be rather fruitless since, in effect, it is the co-mingling of alternate logics, and the praxis entailed, that drive progress…Therefore, rather than debating whether one mode of knowledge production is preferable to another, those governing and

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56 Available at http://www.oecd.org/dataoecd/51/29/37474463.pdf; accessed November 13th 2012
57 "Humboldtian" refers to a (myth-like) notion of universities as free from externally defined demands stressing the non-utiliarianism in research, teaching and training. For an analysis of the term see e.g. Ridell 2008, note 3.

managing academic knowledge may be better placed in recognizing that the skilful mobilizing and balancing different institutional logics is likely to be the reality faced in many projects, and directing effort towards finding creative ways to reconcile, or at least accommodate, the contradictions that will inevitably arise."

Also Barnett (2000, 414) notes, that "the thesis is, perhaps, beguiling but it is not compelling. Within its own terms the thesis is overdrawn", reminding that both types of processes might exist in parallel.

Notwithstanding the debate on how distinct the Modes 1 / 2 in actuality are, the central argument in the theorizing - the recognition of plurality, diversity and emergence of new actors in knowledge processes and the consequent interdisciplinary collaboration – is generally seen to hold (Bruuns et al. 2005; Klein 2008a). Nowotny, Scott and Gibbons (2001) elaborated on their original theory of Mode 2 knowledge production: similarly to the pluralistic notions of knowledge in the practice-based epistemologies described in the Chapter 2.3, they see a shift towards "socially robust knowledge". This knowledge is relational to its context, and knowledge itself is thus contextual, and its reliability is not only a question of scientific reliability but also its social implications. This intrusion of the "social", in their view, is not something that destroys scientific novelty (i.e. knowledge creation); instead, "it is a key source of creativity and so of innovation (ibid. 260)". This establishes a crucial link between knowledge creation in various contexts, be it "scientific" or "research", "higher education" or "commercial": they all are *social processes that take place in situated contexts*, and it is the very sociality that enables the creation of new knowledge.

The social contexts, in turn "are made, not given. Rather they emerge, are generated or constructed, either in relation to particular problems for which they are or may become relevant, or in relation to other, already existing contexts (ibid. 256). Further, this "contextualization means people" (ibid. 256), and taking the "human element" and subjective experience seriously. Nowotny et al. introduce the concept of the *Agora* as "the space in which science meets and interacts with many more agents, where institutions overlap and interact and where interests, values and actual decisions to be taken are being discussed, negotiated, fought over and somehow settled, then the self-organizing capacity of all participants need to be enhanced (ibid. 260)".

The Agora is made up of interactions and practices of people. This in turn expands the notion of expertise towards being "socially distributed and transgressive" (ibid. 215), which has direct implications to understanding knowledge work more generally.

5.2 Higher education as a producer of knowledge workers

In addition to the theorizing of social studies and sociology of science, as exemplified above, there are also other discourses explaining the recent developments in higher education. For example the Finnish university sector reform and the creation of Aalto University arguably draws from global discourses of neo-liberalism, emphasizing marketization and competition (Fairclough 1993; 2003), and the knowledge society, highlighting innovativeness and commercializable innovations (Barnett, 2000; O'Hara, 2007; Slaughter and Rhoades, 2004; Bastalich 2010). This discursive constellation, which serves particular interests and conveys a particular worldview, has arguably become hegemonic. It is reproduced across the globe, not only by means of institutional and legislative reforms, but also through its rhetorical persuasiveness and appeal. An ideology and practice of government that is labelled as New Public Management (NPM), in turn, coincides with this discursive constellation (Marginson, 2008). The colonization of public discourse by market-oriented economic values is now clearly visible in academia in peripheral countries such as Finland (Aarrevaara et al. 2009) and Australia (Bastalich 2010). This resembles developments in, for example, the United Kingdom since the early 1990s (Fairclough 1993).

Knowledge economy is of course as contested a concept within higher education as it is in other spheres of contemporary societies (see e.g. Bastalich 2010 for a critical evaluation). However, as stated above, it is so dominant, that as the discourse gains ground, it takes on the performative power to make real the "fantasies" it describes (Fairclough & Thomas 2004). And there are indeed very real manifestations of this in higher education: the pressure to improve the interface between industry and research, to increase science and technology-based research, and to produce 'knowledge workers' (Bastalich 2010).

Knowledge workers are generally defined as being highly educated (Newell et al. 2009). Put in another way, knowledge economy relies on the highly educated workforce – and indeed an ever-increasing number of young adults are expected to gain a university-level degree. OECD

(2013a[58]) estimates that on average 60% of young adults in OECD countries will enter university-level programmes (the number being 80% or higher in e.g. Australia, Poland and Portugal) and about 70% of those will graduate with at least a first degree. The proportion of students entering university-level education has increased by more than 20% between 1995-2011. This means that more than six out of ten young adults in OECD countries will participate in university-level education at some stage of their lives.

The number of people with a tertiary degree has grown even more rapidly in the non-OECD G20[59] countries: "If this trend continues, by 2020 the number of 25-34 year-olds from Argentina, Brazil, China, India, Indonesia, the Russian Federation, Saudi Arabia and South Africa with a higher education degree will be almost 40% higher than the number from all OECD countries put together. The strong demand for employees in "knowledge economy" fields suggests that the global labour market can continue to absorb the increased supply of highly-educated individuals."(OECD 2013b, 59[60]).

OECD states the significance of this trend: "It also sheds light on the accessibility and perceived value of tertiary programmes, and provides some indication of the degree to which a population is acquiring the high-level skills and knowledge valued by today's labour market…Expanding access to and improving the quality of tertiary education are vital to knowledge-based economies." (OECD 2013a, 24; 26.)

Bastalich (2010, 848) points out that this leads easily to "credential inflation and on oversupply of graduates for skilled jobs", as well as not automatically leading to e.g. improvements in societies socio-economic structure. However, whether the knowledge economy exists or not, and whether higher education always benefits the participants, its premises - and maybe more fittingly, promises - are affecting the lives of approximately 66 million young adults in OECD countries and 64 million more in the non-OECD G20

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[58] OECD "Education at a Glance, 2013. Accessed on 16.9.2014 at http://www.oecd.org/edu/eag2013%20(eng)--FINAL%2020%20June%202013.pdf.
[59] Argentina, Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, Republic of Korea, Mexico, Russia, Saudi Arabia, South Africa, Turkey, the United Kingdom, the United States and the European Union.
[60]   OECD   "Education   Today   2013:   The   OECD   Perspective.   Accessed   16.9.2014   at http://abdigm.meb.gov.tr/meb_iys_dosyalar/2013_12/20023619_educationtoday2013theoecdperspective.pdf

countries, and those numbers are seen to be increasing (OECD 2013b, 59). How higher education thus conceives knowledge and related processes is no small matter.

Barnett (2000) has summarized the various reflections on knowledge and universities, and they for the most part run along the same lines as Nowotny et al. (2001) theorized. However, specifically, in regard to higher education and its function as an educator, he focuses in on how the changing notions of knowledge might and should change what is taught. "For example, it comes to be understood that forms of action ('skill') have to find a place within the curriculum. Preferably, these skills have transportable properties, enabling individuals to move effectively from one situation to another. No longer are skills in higher education to be tied to forms of knowledge per se." (Ibid. 411.)

Barnett called for a new epistemology for the universities – an epistemology for uncertainty – that results from living in an increasingly complex world. This would enable universities to accept a shift from a privileged producer of Knowledge to embracing the multitude of knowledges, and concentrate enabling individuals "to act purposively in an environment where all bets are off, where everything is uncertain and where everything is challengeable" (ibid. 419). Similar ideas were raised by O'Hara (2007 933): "the need for reform goes beyond changes in curriculum content, technological infrastructure, business models and governance – it goes to need to create learning contexts that will result in new minds of mind altogether". Further, Clegg & Ross-Smith (2003 85) advocated a postpositivist take on education and learning in an "environment in which discursive plurality is accepted and acknowledged". And yet more recently, Fenwick & Nerland (2014) claim that the learning environment of knowledge workers[61] is still entrenched in the de-contextualized, disembodied and de-materialized notions of knowledge, learning and knower. This is in sharp contrast to the radically changing work practices they observe: "Furthermore, as more practitioners are expected to work in interprofessional collaboration, or find their work becoming distributed across organizational and geographical (and virtual) boundaries, the challenges of coordination, boundaries, and continuity come to the fore. Transnational knowledge cultures

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[61] Authors do not use the term knowledge worker, opting for "professional". They acknowledge its ambiguity, and use it to signify "members of any occupational group, usually committed to public service, that defines itself collectively sharing particular knowledge and practices, and that is publicly accountable for its service" (ibid. 2). For the purposes of this dissertation, we can place these professionals as being included within the broader term "knowledge worker".

are constantly pressing professionals into new practices and sometimes radically new knowledges." (Ibid. 2.) Thus for at least twenty years have the reflections of the academic practitioners *of* the academia itself resulted in similar conclusions on the need of reforming higher education.

In Chapter 3 I have painted the picture of the epistemological context in which knowledge creation is set. As the foundation, we find the shift from the objectivist epistemology of Knowledge with a capital K towards the contextual, plural, pragmatic and socially situated view on knowledge-as-practice. This has effects on organizations that increasingly rely on knowledge creation in search of their continuous growth and competitive advantage and thus becoming knowledge producers in their own right. This effects commercial organizations, but potentially even more profoundly the domain that traditionally has been the privileged producer of Knowledge: science and higher education. Science and modernity have walked hand-in-hand, and indeed were inseparable (Nowtony et al. 2000). What then of science and the society beyond modernity? If, to paraphrase Nowtony et al., science has spoken for centuries, but now the context and society is loudly speaking back – what is then the role of higher education and scientific knowledge?

As I have shown, higher education is attempting to tackle this changing role as (still) one significant producer of knowledge and educated knowledge workers. The interaction between "people and science" is becoming more and more pronounced – as evidenced also in the way expertise itself has been seen as changing. Participants from these domains meet and interact at the *Agora*, which is the site of this pluralistic knowledge creation in practices. The concrete manifestations of this development are the increasing numbers of interdisciplinary courses, programs, degrees and research initiatives (Klein 2008a; Knight et al. 2013; Holley 2009). It is to one such interdisciplinary "agora" to which I shed light in my dissertation.

PART II: Doing practice-based ethnographic research

"To understand the world at all, sometimes you could only focus on a tiny bit of it, look very hard at what was close to hand and make it stand for the whole."

Donna Tartt, The Goldfinch (2013, 603)

As Donna Tartt writes in the above quote, in order to understand some phenomena better, there is no substitute for "looking very hard" at its "close to hand" manifestation. Thus the theme of interdisciplinary knowledge creation as situated activity can only be understood by observing the very activity in situ - indeed "close to hand". This results in a grounded account on "how the social world works" (Watson 2012, 15). In the previous chapters (part II) I approached practice-based perspective as epistemology, which uses practice as an epistemological approach in order to produce the conceptual framework. In this part of the dissertation I will discuss how to also use practice as a methodological framework – that is, the ways one can approach practices empirically. I will also introduce the concrete methods available for conducting practice-based research, generally seen as best complimenting its premises and concepts.

Ethnography is a research method - as well as a more encompassing "social science genre" and a distinct type of doing social research (Watson 2012, 16) in its own right - that is widely used in empirical research on work practices. My research thus studies knowledge as a practical activity, giving the research its ontological and epistemological grounding, as discussed previously. To accomplish this, I engage in organizational ethnography as my research method, which I will introduce in Chapter 6.2. Chapter 7 introduces my research design and research process (my audit trail). I will also discuss my own positionality as a researcher. Chapter 7 also offers the evaluative criteria in order to assess the trustworthiness of my research. I conclude with a detailed description of materials generated and collected during the research process as well as their analysis.

6 Practice-based research and organizational ethnography

6.1 Methods of practice-based research

I read John Van Maanen's classic book on ethnography "Tales of the Field" (1979) admittedly quite late in my research process – it happened after I had immersed myself on the practice-based perspective and its research. This was the reason why the following words struck such a strong note: ''Qualitative methods are rather similar to the interpretive procedures we make use of as we go about our everyday life. The data we collect and act upon in everyday life are of the same sort a qualitative researcher explicitly attempts to gather and record'' (ibid. 521). I found in this passage a strong resonance with the notion of practical knowledge and the focus on the lifeworld of practising that is at the heart of practice-based research. Also the stated purpose of the "thick description" of ethnographic research is "to uncover and explicate the ways in which people in particular work settings come to understand, account for, take action, and otherwise manage their day-to-day situation (ibid. 540).'' Is this not exactly what practice-based researchers are also attempting to do, I found myself wondering.

Ethnography is indeed recognized as one key method – if not in some form, a prerequisite – for practice-based research[62]. The study of work pratices as situated action by definition requires that they are studied *in-situ* - and this means that they are to be studied ethnographically (Nicolini 2009). Put in another fashion, one studies "the organizing of work through the ethnographic appreciation of practice (ibid. 120)". When taking a practice-based lens into the ethnography of work, a researcher also takes on an "applicative intent" (Gherardi 2012, 46) in order to produce not only descriptions but also practical outcomes.

What ties the two approaches of practice-based research and ethnography together – both which can be conceptualized as methodological frameworks – is the focus of attention on practice as the epistemic object. Practice-based orientation focuses on certain phenomena within the organizational everyday life, and thus guides the choice for delimiting the field of analysis: it is knowledge as a practical activity that one wants to describe. Nicolini (2009)

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[62] Also ethnomethodology is mentioned as a well suited methodological approach (Nicolini 2009; Corradi et al. 2010). For a discussion on ethnomethodology and its relation to ethnography, see Pollner & Emerson (2007).

introduces a "package of theory and method" which is a recursive movement of *zooming in and zooming out* on the data and between data and theory – using ethnography as the way to approach the empirical unit of practice. The empirical focus is on the "handholds" of practice: the body, socio-material objects, languages as discursive practices, technologies, institutions and rules. A researcher then uses research methods such as ethnography in order to discover these "handholds" or resources, and analyses how they are collectively activated and aligned with competence. (Gherardi 2012.) For example, in her book "How to Conduct a Practice-based Study. Problems and methods" (2012), Silvia Gherardi mentions ethnography explicitly in the following contexts: the ethnography of non-humans (artefacts); ethnography of communication (language use in specific contexts); studying the rules that regulate situated work; and a particularly strong focus on the practice-based design of information systems[63]. *Within* the practice of doing ethnographic research, there are additional methods that enhance the ethnography in practice-based research and contribute especially to the above research focus areas. I will introduce two that I found prevalent in earlier research.

First, there is the *spiral case study*, which enables the movement within "textures of practices from any point of entry (Gherardi 2012. 173)". This means using a multiple-level research design that looks at the phenomena from multiple units of analysis: knowing within a texture of practices; knowing within an organization; knowing across communities; knowing in a community of practitioners; and becoming a practitioner. This creates a set of "scenes" where the spotlight moves between them in order to ultimately study the society as a whole "within situated interactions construed as the fragments of a hologram (ibid. 174)". This is close to doing a multi-site ethnography (Hannerz 2003), and also inherent in the "zooming in – zooming out" package proposed by Nicolini (2009).

A second method is the *interview with the double or instruction to the double,* also called projective interviewing. In this method, the interviewee is to imagine they have a double (for example the researcher) that will replace them for a day, and is asked to describe how one should behave and what to do, in order for others not to note the switch. (Gherardi 2012; Nicolini 2009) This draws out better the minutiae of everyday life than a "normal" interview.

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[63] The use of ethnographies in developing information systems is an example of "ethnography *for* an organization" (Cunliffe 2010, 232), as it is done in order to better design the information systems an organization uses. It is to study practices in order to change them (Gherardi 2012).

This type of method is strongly action research oriented and critical, in the sense that it is designed to "overcome the barriers of self-consciousness and rationality (Gherardi 2012, 162)".

In addition, techniques such as qualitative network analysis and various methods for discourse analysis (conversation analysis, Habermasian approach, narrative analysis) are used in practice-based research (see Gherardi 2012 for examples of research using these methods). Also the broader development of research methods and techniques within relational sociology, sociolinguistics and relational social psychology can contribute to practice-based research as they share the foundation of relational epistemology (Gherardi 2012; Emirbayer 1997).

6.2   Organizational ethnography

If (from methodological viewpoint) the practice-based perspective gives the research its empirical focus, how is ethnography to be approached? John Van Maanen, credited for the "resurgence" of ethnography on organizational studies, sees that "Ethnography is first and foremost a social practice concerned with the study and representation of culture (with a distinctly small c these days). It is an interpretive craft, focused more on 'how' and 'why' than on 'how much' and 'how many'.[…] Fieldwork of the immersive sort is by and large definitional of the trade." (Van Maanen 2011, 219.) Ethnography is usually described by terms such as *understanding, immersion, translation* and *telling a convincing story*. Cunliffe (2010) offers the following characteristics of ethnographic research. First, ethnographies are about culture. It is the cultures "with a small c" that are of interest, that is the in-situ meaning-making of people. Second, ethnographies are about context and temporality: immersive fieldwork is key in representing the everyday complexity and commonplace activities. Interviews or surveys alone do not make an ethnography, is the implication. Third, ethnographies are about sociality and meanings and consequently focus on interactions. Fourth, ethnographies are about thick description and imagination: this establishes the validity of the text, as in it being authentic, plausible and thought inducing to the reader.

Specifically regarding work and organizations the "writing detailed account of organizational life is a long-standing tradition" (Ybema et al. 2009, 3), and as such more a resurrected method rather than anything particularly novel. Ethnographies of the "worlds of work" - that is, the use of ethnographic approach to study work, workplaces and occupations – form a rich and varied field of research, and includes studies of "how routine jobs are complex"; "how complex jobs are routine" and "exposing and explaining power, conflict and inequality" (Smith 2007).

Despite its long history, ethnography, alongside other methods with a strong qualitative orientation, however fell out of popularity with the rise of quantitative methods from the 1950's onwards. It was the socio-cultural approach within organizational studies in the late 1970's that renewed the interest in "alternative methodologies" such as ethnography (Rouleau et al. 2014). Ethnographic methods have spread widely over the last decades, and it is a large and complex field that crosses a variety of disciplinary boundaries[64]. Rouleau et al. (2014) recognize four "favourable conditions" for the rejuvenated interest in ethnography. First, the way organizations are becoming more complex, fragmented and dispersed as well as changing rapidly, call out for a method that enables the recognition of the "subtle shifts in organizational life" (ibid. 3). Second, technological advances and use of social media have renewed the method in e.g. nethnographies of online communities as well as using smart phones to better and more rapidly document fieldwork, making it easier to conduct multi-site studies. Third, ethnography is more and more recognized as a way of theorizing workplaces and organizations, rather than just a methodological approach. Van Maanen (2011) calls it both a methodological approach to and an analytic perspective on social research, and Watson (2012, 21) a "social science genre, as opposed to a social science method". And finally, indeed the rise of discursive approaches and practice-based studies are credited as giving "ethnography a new lease in life" (Rouleau et al. 2014, 4) as gathering first-hand data is seen as the way to access the practices and their participants.

One distinction, however, is critical to make in this conjunction. Ethnographies are increasingly being distinguished between employing "qualitative" methods that are informed

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[64] I will not review the historical background of ethnography or its disciplinary "space" here, for an overview, see e.g. Atkinson et al. (2007).

by positivist ontological and epistemological presuppositions and "interpretive" methods that are based on constructivist-interpretive ones (Schwartz-Shea & Yanow 2009; Yanow 2010; van Maanen 2011)[65]. The differences are evident for example in the collection and treatment of data: qualitative methods commonly "dislodge" data from their situated contexts, and base the ethnographies for example on interview data or focus groups alone with no participant observation at all (although interpretive ethnographies may include these methods as well). Van Maanen (2011) adds that those the "interpretive camp" recognize how their positionality (social location, identity, experience and so on) influences their research, something the "positivist camp" does not.

This thesis strongly reflects the interpretive approach, and joins the tradition of classic Chicago School –style field research[66]. Emerson (2004, 9-10) identifies three recurring themes found in this style of fieldwork:

1. Heavy emphasis on discovery: the focus is neither on theory nor method. Rather the process of discovery sparks the theoretical creativity and methodological sensitivity.

2. Loyalty to the phenomenon: research needs to really "show the people". The guiding questions are: What is happening out there? How can we capture what is happening in our writings? This does not mean "disloyalty to theory", however. Research needs to balance theoretical concerns with sincere commitment to what people we study are actually doing. This description is then integrated to relevant theory to show the local action speaks to some larger phenomena. This grounds research in hermeneutic-phenomenological perspective.

3. Collection of original data: the originality from a choice of setting, selection of people studied or the angle taken in the field.

However, few words need to be said on the role of theory in doing ethnographic research. Here we find two possible avenues: an open and critical view, which advocates an a-theoretical position (grounded theory in general terms) and a "conservative" perspective,

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[65] In some topic areas, e.g. anthroplogy, qualitative and interpretive are and can used interchangeably, but in organizational studies qualitative may refer to both the realist and interpretive ethnographies. I will follow Schwartz-Shea and Yanow (2009) in calling my research interpretive rather than qualitative.
[66] For a rich overview on the Chicago School of Ethnography, see Deegan 2007.

which acknowledges the need for an initial theoretical disposition - and indeed questions if it is possible at all to "escape" the reality of theoretical conceptions in academic research (van der Waal 2009, 26). Watson (2012, 19) also argues strongly "theory is thus both a resource for guiding fieldwork and an outcome of the thinking process which is stimulated by the interplay in the researcher's mind of theory and field experience", and recommends that the researcher should be well equipped with a full and diverse knowledge of organization theory as well as a grasp of relevant sociological, anthropological and psychological research informing the organizational theories. Van Maanen (2011, 222) makes a similar point, calling this "headwork" in addition to the "fieldwork" and "textwork" that ethnography consists of. Importantly, he however states "no overarching theory required. Use only what fits such that analytic and empirical inquiries run in parallel and adjust to one another."[67]

My research falls into the "conservative" category, and as such differs from the "purist" Chicago-style research. I iterate between the inductive and deductive, making some a priori conceptualizations based on earlier research, but enriching them with the findings from my fieldwork – and this is done constantly during the research process, not in a linear fashion that may be image this final written manuscript conveys. I strongly agree with van der Waals statement (2009, 26) "In the end, ethnographic work aims not only at describing and interpreting, but also at contributing to theoretical understanding, based on new fieldwork based insight. The implication is that both social scientific theory and local frameworks of thinking need to take place in the ethnographic work of making sense of organizational process."

Is there then a distinct "sub-set" of o*rganizational ethnography*? Organizational ethnography is understood at its simplest as the "ethnographic study, and its dissemination, of organizations and their organizing processes" (Yanow et al. 2009, 4). A distinct feature is also the fact that organizational ethnography "…rather than trying to grasp the entire gestalt of the organizational 'village', organizational ethnographers are increasingly oriented toward following a person or a specific organizational practice or an object or 'fact'" (ibid, 5). Interestingly, Van Maanen (2011) however points out that organizational ethnographers do

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[67] Van Maanen (2011, 222) recognizes that this "may lead at times to a rather shameless eclectism as various theories are drawn on to explain and perhaps generalize certain matters as the specific nuts and bolts of various theorists are selectively put to use".

not in fact study organizations – they study *in* organizations. "The aim is to provide a localized understanding of the cultural processes – meaning making – as it occurs from the a vantage points within the organization (ibid. 221)". Also Watson (2012) reminds to take into account the "cultural whole", not just create a boundary between organization and "society". Too strong a conceptual boundary may result in viewing the organization under study as "too unique"; unique in the sense that one may not see the practices and features that in fact may be observed on other organizations as well. Viewed in this way, organizational ethnography should be understood as not only taking place *in* bureaucratically structured formal organization but also being part of broader forms of "social organization" which the formal organizations is part (Watson 2012, 17).

To conclude, at the core of (organizational) ethnographic research is giving voice to those we study, and the emphasis on participant observation. The interpretive ethnographic method has the following characteristics, first four that apply to ethnographic research in general (Ybema et al. 2009, 6-9):

- combined field work methods: observing, conversing (including interviews), reading of documentary source
- being at the scene: reporting the first hand, field-based observations and experiences
- revealing hidden and sometimes harsh dimensions of power and emotions
- context-sensitive and actor-centered analysis: orientation towards subjective experience and individual agency in the particular social setting (as opposed to the apolitical, acontextual and aprocessual reading of situations).
- Meaning-making: making sense of the actor's own sensemaking through the specific language, acts and objects that carry and transmit this human sensemaking.
- Multivocality: being alert to the potential multiplicity of voices, tensions and discrepancies present in the situation
- Reflexivity and positionality: the ethnographer is fully part of the construction of the phenomena under observation, and needs to inquire into their own meaning-making processes as well.

The presence of these charactaeristics form the foundation of trustworthiness and persuasion of ethnographic research. They manifest concretely in the story, as "there is simply no such thing as ethnography until it is written (Van Maanen 2011, 224)". I will next turn to my research process and design in more detail, as they convey in detail how this text came to be.

7 Research process, design, materials and analysis

7.1 Research process

As a management practitioner already established in working life and "just" a part time researcher, the research process has been anything but straightforward. Events in my working life have influenced my research and vice versa. Thus I feel it is important to open up the research process in some detail. This also hopefully contributes to the general attitude of transparency and trustworthiness of the research.

Ever since my master's thesis on knowledge management and its representations of agency[68], I have been interested in knowledge related process: how do we come to know what we know, what makes us "know together" and how do we humans accomplish such great feats as landing on the moon, curing diseases and creating the virtual world of today. And why at other times (or most times) we do not create or accomplish "anything", even though all the chips have been given. And based on my own work-life experiences, why the latter unfortunately seems to be the case for commercial organizations more often than not. Intuitively I felt it all boiled down to how we humans interact together, how these interactions were designed in the given context and what types of attitudes and behaviour was encouraged by the surrounding social setting. Thus the basis for this thesis came to being, and I was accepted as a PhD student at Lappeenranta University of Technology in June 2008.

In 2009 I was able to join a research team that was studying the merger of Aalto University.[69] I did a discourse analysis on the epistemological base of the (then) new Aalto University, and the hegemonic discourses related to the academia in the global economy that are now visible

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[68] School of Business at Lappeenranta University of Technology (LUT): "Representations of work and worker in the three generations of Knowledge Management. Critical Discourse Analysis of selected texts", 2008.
[69] "Aalto University: sources, forces and challenges of integrating three universities".

in peripheral countries such as Finland. At the time, the aim of my dissertation was to critically analyse the "knowledge-talk" present in the Aalto University merger: the multiple representations, values and functions attached to knowledge by social actors in their contextual use of language, i.e. discourse. This work resulted in e.g. a conference paper "Global-local discursive practices of higher education reform: Analyzing 'knowledge-talk' in a university merger", that was presented at EGOS Colloquium at Lisbon in 2010[70].

However, the certain aprocessual and detached nature of discourse analysis started to bother me, and I felt the research was missing the human voice of the participants related to Aalto, and a more clear focus on "interdisciplinarity" that was becoming the public mantra of Aalto. I needed to combine the students' viewpoint and the actual "doing" of interdisciplinarity". But where was this type of activity to be found…? I don't remember where and why exactly Aalto Design Factory (ADF) sprung to my mind, but I do remember calling my supervisor right away and presented the idea. It became clear that this was the perfect site to deepen my research – we were both also somewhat frustrated that the idea did not occur to us sooner, so obvious was the choice of ADF. Thus on the 5th of November 2011 I sent the director of ADF, Kalevi "Eetu" Ekman, an email explaining who I was and that I wanted to do research on and at ADF. The response came the next day: "Great idea and let's make it happen". We met on November 11th, and finally on a Friday 14th of January 2011 I started my on-site fieldwork.

I hade been working full time until this point. When the ADF came to be, I was granted a study leave of three months. This meant finally that the research was progressing full time. I spent time at ADF almost daily until April 2010 and the occasionally in May and June (for the full audit on the exact time spent, see Chapter 8.5.3.).

Up till this point, I hade focused mainly on the "meta-level" of Aalto University, and in my master's thesis I had immersed myself in the discourse of Knowledge Management. Thus my focus of key theories and concepts was mainly of the organizational level. In addition my methodological orientation had been that of Critical Discourse Analysis (CDA) (Fairclough

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[70] Paper presented to sub-theme 6, "Assembling Global and Local: Practice-Based Studies of Globalization in Organization", 26th EGOS Colloquium, Lisbon, Portugal, 28 June – 3 July 2010. Joint paper with Prof. Janne Tienari.

2003). Now I was dealing with ethnography and practice. As Nicolini (2009) points out, one's ontological assumptions and methodological choices need to work together in a coherent approach. For example Fairclough's approach to CDA is not wholly compatible with a practice-based research, as the previous is based on a critical realist assumptions about reality, and the latter on constructivist notions.[71] This meant that in addition to immersing myself in the practices of ADF, I started to do research on how knowledge –creation was perceived in practice based theorizing.

In fact, I proceeded as suggested by Nicolini (2009): I started from the middle of the action, on the practices themselves, observing them as they happened, and writing "mere" descriptions of what I observed. After some time I was able to then "zoom out" in order to start seeing the potential connections between practices, the role of materiality and artefacts as mediating between practices. My earlier research on higher education and Aalto University in particular provided me insight into the practices of "macro-level" that indeed are practices in their own right, and now I was able to start "connecting the dots". For example, ADF had a stream of "Aalto-level" visitors coming in almost every day, looking at the premises and hearing about the interdisciplinary nature of its activities. This is a practice that weaves ADF into the practices of Aalto, using ADF as a manifestation of how Aalto University as a whole is transforming into the required "seedbed of innovation" it states to be.

After my time at ADF I changed jobs during Autumn 2011. The new position was about leading a team in a very demanding new service development project with an extremely tight timetable (see next Chapter for more details). Few months in on the new job I had honestly an epiphany: I was experiencing the exact same practices, issues and challenges I had observed and felt at ADF. The innovation work of a cross-functional team in a commercial organization is another manifestation of interdisciplinary practices. It could then be researched in a similar fashion. I could do a multi-site ethnography! I have total access! Once again, my patient supervisor got an exited phone-call.

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[71] For an explicit argument of the subject, see Fairclough 2005.

In fact, the idea was feasible. I had done some analysis on my material generated at ADF, and found key practices that enabled the enthusiastic and successful knowledge creation in that particular context. I would see if the same practices would manifest in a commercial setting, and what other phenomena might emerge in this other context. Thus I started fieldwork on the site number 2: I wrote a field diary, conducted several interviews, as well as collected documents. I also researched into the literature on team innovation and cross-functional projects, gaining additional insight into the working practices of knowledge workers and experts. Our team went live with the new service in August 2012 – and it was a success. In the end I had in my hands a huge amount of material, my own daily lived-in experience of almost a year, as well as the already large amount of material from ADF.

During 2012-2013 I was part of a research sub-project of Aalto University Business School that contributed to **INWORK: "Managing and measuring innovation at work." -** project consortium by addressing the joint research questions "What are the 'innovation practices' performed in Finnish work organizations?" and "How 'innovation practices' can be shaped and sustained through managing and measuring?". Publications and results of this project include a Handbook of managerial practices and a publication for Finnish HR-professionals Henry Ry[72]. This project enabled my second study-leave in November-December 2012. I focused on the ADF material, aiming for the thick description of a good ethnography.

At this point, nature had its say, and I had my second child in May 2013. It was Spring 2014 before I seriously started thinking about the dissertation again. And I was in trouble. I started reading my field diary of the second-site - that is my own work-site. As it turned out, the work I led had been a very emotional experience, and this shone through in the diary. It was not the type I felt fitted at all with the material I had generated at ADF. In addition difficulties started to emerge, as I looked at the two ethnographies side-by-side.

In fact I was engaging in as form of *triangulation* (see Chapter 7.4). It is most important to stress that the emergence of contradictions and inconsistencies are to be expected in accounts of the complex social interactions. Ethnographic research should not strive for simplicity:

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[72] Further information on the project can be found at http://www.uef.fi/fi/inwork/etusivu

"Simplicity should be 'an empirical finding rather than a theoretical commitment'", reminds Yanow (2009, 61) citing Becker (1998). I found that fundamentally the two ethnographies did compliment and contribute to each other. I had been right in my realization that they were part of the same phenomena, and the key practices found at ADF did exist at the other site as well. However, the context of commercial organization with its explicitly commercial goals, more strict and inhibiting structures of work practices as well as the motivations of the participants differ from the context of higher education, and would have needed a thorough examination. My own role as a full participant was also too different – this ethnography was in fact what Mats Alvesson (2009) calls "at-home" ethnography" and also what Van Maanen (1988) has categrorized as a "confessional tale", and this carries with it some specific challenges. The task of feasibly writing a dissertation that had both of the sites included, was of course possible – but a herculean task.

One needs to be realistic. One also needs to keep in mind the scope and purpose of the work. I was writing a PhD dissertation. It has conventions and requirements, and ultimately a purpose: to get one's doctorate degree. I had the choice of writing both ethnographies – or concentrating on the other, which in itself had already the makings of a rich ethnographic analysis. With the support of my supervisors, I chose the latter. I left all the material from my second site behind – maybe to return with another purpose later on.[73]

Autumn of 2014 was then the final stretch: concentrated, engaged and involved reading, thinking and writing – in Van Maanen's (2011) terms, the intertwined practice of headwork and textwork and also some fieldwork as I returned to ADF for a short period as well. Thus the reader-reviewer holds in his or her hands the results of eventful on/off –work of over six years.

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[73] Multi-site ethnography is in fact gaining popularity as opposed to the "cultural island approach" of using just one (supposedly distinct and isolated) site (Van Maanen 2011).

7.2 Research design

At the heart of interpretive ethnographic research is the narrative or story, and that the readers will find the text trustworthy. "Truth, proof and validity are as much issues of styles as content" (Van Maanen 2011, 224). This is the "textwork" that Van Maanen refers to, and as such, crucial to doing ethnographic research. In this Chapter I will describe the elements of my research design, which all in the end manifest in the textwork that is this dissertation. I use Schwartz-Shea & Yanow's (2009, 64-76) classification of the eight elements that convey the ethnographic character of the text - persuading the readers to trust the research and its truth claims. Together these form the research design.

First elements establish that the research is built on the material dimensions of life – it is situated in a certain place and time, and acknowledges the only partial understanding that is ever possible. The focus is on the material (experienced) space of ethnographic research.

Access. As described earlier of how my initial access to ADF came to be, I sent the Factory Director Kalevi Ekman an email, explaining my purpose, and he accepted my proposal right away. At the initial meeting I met the person responsible for the premises, and I received the badge that allowed me to move about freely. Everything was as easy as it can be. This of course is perfectly in line with the open ethos of ADF: it is a place of and for students – and I myself was also a student. Also the overall atmosphere of ADF encourages talking and sharing of own ideas, so quite soon I had communicated the point of my being there to all that would listen. Any most did listen. Thus the process of access was in fact already revealing one key practice of ADF: "the ADF way of being", which I will elaborate in Chapter 8.9. Of course, what I did with this access and openness is another matter, and will emerge from the actual ethnographic narrative in later chapters.

The place and space. The physical place of ADF is one of its key features, as Part III of my dissertation will show. Practically all my research took place at its premises, including the recorded interviews or "talks", with one exception (which took place at Aalto Business School Campus). The premises offered all types of facilities, including quiet places where I wrote my field diary and notes. In this sense my time on-site was easy: I needed not to worry if I had spatially "covered" the place.

Time. I kept a time log of my dates and times spent at ADF during the most intensive period. I was on-site on 38 separate days between 14.1 - 20.4.2011. Hours logged were 192. During May 2011 I visited ADF on three occasions (approximately 10 hrs in total), as well as in November-January 2014 during my final stages of writing the manuscript, when I spent 18 hours at ADF, reviewing my material, taking more pictures, doing member checking etc. In addition I visited ADF on few other occasions as part of other research activities that were taking place there. Thus overall I was at ADF on **45 separate days and 223 hours in total**. In addition to the actual hours spent at the field, an important dimension is the temporal "rhythm" of the site: is the researcher present at the "right" time, so to speak. ADF operates in a flexible manner, and the rhythm emerges from the timetables of the courses, events and the student life in general. Thus there are no fixed times to be present. I tried to be on-site if there was some special event, when the project groups met etc., but also at times of seeming inactivity. Just "hanging out" is important at a place like ADF. It's good to note, however, that due to my own family commitments, I didn't spend many evenings at ADF, which the students in fact often did. This may be seen as one weakness of my research.

Exposure. Just "being there" does not mean one is exposed to the phenomena under research. Researcher needs to grasp more in-depth the *gestalt* of the site by combing the physical place, time and rhythm. Schwartz-Shea & Yanow (2009, 67) refer to "mapping" the organization in order to maximize the exposure to various organizational spaces and across time. At ADF the physical layout in fact exposes these various "territories" quite well, and this manifests in "the tour" of ADF that forms the Part III. In this sense I feel I was able to gain multi-faceted exposure to my research issue.

Researcher role. There was a challenge of not overly participating in the ADF operations, as well as cases where the students wanted to talk about careers etc. I thus experienced a variety of roles from pure participant observation (following a course held at ADF) to being observant participant (general hanging-out at ADF, adding to its "mix") to active participation (participating in prototype-testing, giving feedback on students' work, commenting when asked by staff about ADF –related issues). It has been argued that in order to write a truly nuanced ethnographic narrative, the researcher in fact needs to shift from a passive to much

more active role as a fieldworker (Moeran 2009). At the extreme is the at-home –
ethnography, where one studies the "lived realities" of one's own setting and organization
(Alvesson 2009)[74]. From my limited experience I can only state that fieldwork becomes in
itself much more motivating by participating. One also much better "gets" the place and has
sensible experiences if one gets involved. However, doing at-home –ethnography is indeed a
very different matter, as I found out with my other potential site which was also my own
working environment.

Silences. Schwartz-Shea & Yanow (2009) remind the researcher to not only focus on
presence, but also attend to *absence*, to silences of views that start becoming visible
especially once reflecting on generated material. I did encounter this issue of certain voices or
discourses being rather absent at ADF, and will elaborate on later chapters.

In addition to the above elements, all of them need to be then conveyed in the actual research
text and its stylistic choices. Data details are the key to a thick description, as to enable the
reader to follow the arguments of the researcher as well as gain a sense that the researcher
indeed "was there". The choice of presenting the ethnography in the form of "a tour" within
the premises of ADF enables me to offer pictures and details of the space and observed
practices in a way that ties the details into a coherent whole.

Van Maanen (1988) has grouped ethnographic writings into three categories: realist tales,
impressionist tales and confessional tales – which he still evaluates as to hold (2011). The
realist tales are "factual" accounts of "telling like it is", and the researcher is most often
absent for the text. This is not to be confused with positivism or using a scientific method –
rather, the text consists of "observations", "facts" and "data". (Ibid., Cunliffe 2010.) Among
these realist tales Cunliffe places for example practice-based research on sociomateriality.
Impressionist tales in contrast are interpretive, and sees sociality as emerging in interactions
and conversations between people, and labels such as social construction, meaning-making
and reflexivity have their place in these tales. Impressionist tales are multiple and include
many voices. Finally in confessional tales the ethnographer is intimately present, reflecting on

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[74] This was the nature of my initial second site, as described in Chapter 7.1.

his or her role in the research process, sometimes in an almost guiltily apologetic or therapeutic sense. (Van Maanen 1988; Cunliffe 2010.) In addition to the above, critical ethnographies can also be identified, which are informed by for example postmodern, feminist and neo-Marxist theories. The key words here are hegemony, contestation, discourses and fragmentation. (Cunliffe 2010.)

Reflecting on my stylistic choices, I am inclined to group my narrative as a sort of a hybrid "realist-impressionist" tale. The focus on sociomateriality gives it a realist touch, as well as narrating some observations quite "as they happened". However, the inclusion of a plurality of voices and meanings as well as embedding myself into the text are the features of an interpretive text. In addition I do not narrate events in any chronological order. A hint of criticality can also be identified as a certain struggle did rise from the materials as will be shown in later chapters. In hindsight, my tale seems in fact like a collection of "short stories" or smaller tales. I also realize that by using the form of a "tour" around ADF as the stylistic device for my story, I – completely unintentionally - wished to evoke a sense of movement and "never-endingness" that I feel was integral to my experiences at ADF. In this sense, I much prefer to use "story" rather than "narrative".[75]

Also presentational techniques help to make the text more readable. I have used the following techniques:

- Excerpts form my field diary or my own recollections are in a call-out with my picture. This makes it clear that the voice in question is mine:
- Longer quotations from for example my interviews are in separate quotes, and include a reference to the specific interview in question (Appendix 1), shorter quotes from the field are in cursive within the text;
- Longer extracts form my field diaries or "stories" from the students are in text boxes;

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[75] In the final stretch, I realized my choice echoe Derrida and Bakhtin, who oppose monologic story with little stories (petit récits). There is also a concept called "living story" which resonated with some of the features in my ethnography, it being about a diversity of voices and logics: "all about movement, the tour, a founding of story spaces, a networking in the unfolding present, where each story is dialogically relational to another one, and must be told to tell of another social relationship, another context. Living stories are often without beginning, and are never-ending (unlike narrative)." (Boje 2011, 3).

- Citations from secondary documentary material are in traditional citation format within the text.

To conclude, I have chosen to tell the stories of interdisciplinary knowledge creation as it happened in Aalto Design Factory, embedded into a tour of its physical space, rather than a monolithic narrative with a beginning and an end. I have also attempted to embed myself continuously within the stories, as well as being the "tour-guide". I thus tell an impressionist tale of ADF.[76]

7.3   Positionality of "I"

> **Field diary, 17.1.2011**
> - outsider, don't feel at home
> - very difficult to not think like a consultant/ student, and separate oneself from the actual content of the courses (I don't need to actually complete the course!!)
> - surprisingly tiring

As noted earlier, Van Maanen (2011) notes that interpretive ethnographers acknowledge how their own social location, identity, training and so on all influence their research. This is the "positionality" referred to also by Schwartz-Shea & Yanow (2009). In this section I will engage in researcher reflexivity, and document the role of "self" in the research process. Spending quite a lot of time at new surroundings and social setting, but not having an explicit "function" within it, creates a small identity crisis. I am used to being "useful", and thus at first the mere observation was very difficult. I wanted to be a participant; I wanted to make an impact. This is of course due to me "being me", and it is important for the reader to be able to evaluate which aspects of my background etc. may have influenced my research and how. As

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[76] It should be noted, that as a whole, this dissertation is somewhat a bipolar construction: Introduction and Parts I and II and IV are very much in the genre of a conventional academic text. It is the Part III in which the ethnography is present, and the impressionist style more dominant. This is a choice, as this text is also a PhD dissertation, and as such there are certain conventions to be followed.

I am the means through which this research is produced, my "positionality" needs to be reflected upon. As a researcher, I am composed of many practices, and I will briefly elaborate on four: my general life course (demographic identity), personality, work history and education.

Life course. All research is dependent on the life course of the researcher, and so I very briefly describe the key points here. I am an educated woman in my 40's. I have already been part of many different social settings (school, university, family-oriented settings, working life etc.), which gives me experience of a variety of different social situations. This has made ethnography rather an easy method for me: I like talking to people, I am not shy of new situations, and my age gives me certain ability to "read" new situations – compared to, say, me in my 20's.

Personality. Personality plays a bigger role in ethnographic research, as the disposition of the researcher directly affects what happens on-site. I am an open, cheerful and social personality. This combined with my life course further accentuates the ease of becoming part of new social settings. I am also "fast on my feet", making details sometimes cumbersome. This was the first main challenge for me when doing this research: the careful documentation of my activities and what I observed. I had to take extra care on this matter, since it is not in my nature.

Education / being a researcher. I have two master's degrees, and as such the context of higher education is familiar to me. I still remember being a student, which was immensely helpful at Design Factory. As a PhD student and researcher however, I have been quite alone, as I have not been actively part of any academic group – excluding the two research projects I was part of (see Chapter 7.1), which met quite sporadically. Thus I have no strong researcher –identity. This of course is not necessarily a negative issue. In fact, it might have helped me in relating to my research in a down-to-earth manner at the site, making it more accessible to people. Personally I regard education very highly, and also place value on certain "sivistys".[77]

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[77] The Finnish word "sivistys" does not translate well into English. It implies a combination of formal education, culture and "education of the heart".

This potentially makes me biased towards the importance of education in general, and I have been aware of this when drawing conclusions on my research.

Work history. I have over 17 years of professional experience, of which ten in a manager position. I have led innovation work myself, and have been the supervisor for many knowledge workers. This further makes "reading" of people and being empathetic towards their situations important for me. This experience facilitated my fieldwork considerably. I am aware of the ethical considerations that come when dealing with personal experiences and feelings. I also found it easy to approach the management of ADF as well the companies residing there. However, personally, my professional history created a second challenge: I found it very hard to be a "mere observer". At the time of the fieldwork, I was working as a management consultant. This of course is a profession that emphasizes results, improvement and pragmatism - it is a profession of "involvement". The quote from my field diary at the beginning of this Chapter illustrates the observer-participant –challenge I experienced. I needed to remind me from time-to-time not to "meddle" in the business of ADF.[78]

A noteworthy challenge I encountered was that in some instances the students became interested in my professional role. I was a flesh-and-blood knowledge worker already "out there", with possibly an interesting career. There were few cases where the students quite clearly tried to talk to me and answer my questions in a way they thought I might find "smart" or "impressive" from a potential recruitment viewpoint. In addition I sometimes was asked about career choices and consultancy work in general. There is nothing wrong in this of course, they are in fact quite sensible actions from a students' view. It just meant I had to be sensitive and note these reflections down.[79]

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[78] In the spirit of ADF, I was in fact by the staff asked from time to time for my opinions on some issues relating to ADF operations.

[79] Overall based on my experience doing this dissertation, I feel that ethnography is especially well suited for more mature management practitioners who wish to deepen their understanding by doing academic research.

7.4 Evaluative criteria: assessing trustworthiness

Schwartz-Shea & Yanow (2009, 56-82) summarize the evaluative criteria for interpretative ethnographies that is emerging as "standard" for this type of research, and aid in assessing the *trustworthiness* of a manuscript (rather than validity and reliability of positivist sciences). In this type of research, there is not only a double hermeneutic – researchers interpreting actors' interpretations – but also a third "interpretive" moment: the act of reading and the prior knowledge that readers bring to their readings of text - Schwartz-Shea & Yanow call this the "triple hermeneutic". In order to enable this third interpretation as well as possible, certain elements need to be carefully tended to. I follow Schwartz-Shea & Yanow in these guidelines. Below I have summarized first the evaluative criteria, and show how my research aims to fulfil each.

Thick description. This refers to the detailed descriptions of events, activities, interactions, people etc. in order to make clear the "lived experience" of the phenomena. Of importance is the notion of sufficient detail, as relevant to the research question - one should not aim for a complete description. Yanow (2010, 1398) states it a "puzzle" how many researchers e.g. in organizational studies present the research as "ethnographic" when it is evident that the material is interviews alone, with no observational data. Participant observation and "thick" field diaries are however the key to thick description. My primary materials consist of three separate field diaries: one which is the overall diary of my time on-site, reflections and thoughts; second, which resulted from the shadowing one team, and third, which centred around my interactions and observations of the key courses of Product Development Project (PDP) and ME310 (see Chapter 8.3.1) and their participants. I complemented my field notes with 31 in-depth transcribed interviews - or rather "talks" (Yanow 2009, 77), as they were very open-ended and little structured (details of the interviews can be found in Appendix 1). In addition, I used an open-ended survey that 55 students answered, in order to grasp how they define interdisciplinarity. From secondary sources, I collected material such as flyers, posters and other printed material found at ADF as well as used its website, Facebook and Flickr –sources for material and photos.

When telling the story of ADF, I have aimed for a balance between details and overviews. The phenomena I observed were broad, and I have chosen a holistic view of the phenomena,

as in the "tour" in Part III. Thus the need to omit some details was inevitable. My tale is not one of minutiae, but more about evoking the lived-experience of my time sent on-site.

Researcher reflexivity. The aim is to show that the researcher understands him-or herself as the means through which the research is produced. The positionality of the researcher affects the nature of interactions, access, persons met and the kinds of data generated during the process. In order to support arguments, researchers need to take account of the particular characteristics researcher brings to the field and how those personal, intellectual, professional and other characteristics shape what it is that we may see (or not), whom we might speak or interact with (or not), the events we can experience (or not). (Schwartz-Shea & Yanow, 2009.)

Triangulation. This means as drawing on different kinds of sources or analytic tools in trying to understand a phenomenon. Thus the researchers own experience and meaning making is triangulated both on other persons and their experiences (observational material, interviews) as well as using other sources (organization's own documents, research and reports). Multi-site ethnography is another form of triangulation, as is multiple approaches to looking at the data. Important is to bring to light the inconsistent and even conflicting findings.

My thesis uses a variety of material (see Chapters 1.3.2 and 7.5), and thus the main method of triangulation is the multiple methods for generating data. Additional methods are also used (textual analysis, discourse analysis) in order to feasibly analyse the more textual second-source material. I also referred to materials that relate to the role and position of ADF within Aalto University, in order to better grasp the practices within this broader context. A (very) tentative multi-site triangulation occurred when a multi-site ethnography was part of the research design (later abandoned, see Chapter 7.1). Overall I have attempted to sincerely report any arising conflicting findings.

Audit trail. An audit documents changes in the research process while doing the research, and describes the steps taken to conduct the research. The researcher is expected to identify and describe any changes to original research design as a response to changing situations, and provide transparency into how the research evolved over time and why.

The research process of this thesis has been long and changes have been inevitable. In hindsight I identify three main types of changes that have happened: first were the changes in the actual scope of the ethnography itself from one-site to multi-site to one-site again; second type has to do with the clarification of the actual phenomena itself under observation; and third involves the theoretical underpinnings that evolved during the research itself, pointing me towards issues that needed new material generation.

Negative case analysis. There are many ways to challenge researcher's own meaning-making processes, e.g. peer evaluation, using extreme cases, following up surprises, checking out rival explanations. The immersion in generated data may easily create blind spots, and the researcher must constantly ask: "How do I know what I think I know?"; "Would I know if I am missing something?" in order to challenge the favoured explanations.

This has been the most challenging part of my research process. As most of it was done part-time and outside the academia, it has been indeed quite a lonely process. However, there has been an advantage to this as well: as a researcher I have been an outsider in the sense that I am not guided explicitly or implicitly by discipline-specific discourses and am not socialized into certain paradigms. In this sense I feel I have been able to be quite "earnest" in my interpretations, as I hold no strong value statements to certain explanations.

Member-checking. Going back to the people in the setting studied for an assessment if the researcher did a good job in capturing *their* understanding is essential to all fieldwork. It is the recognition of their experience at full value – even if not accepting their critique outright. It evaluates the researchers ability of having really "been there", engaged and present. It is not about "getting it right", as there is no objective reality to be captured – rather it looks for the potential differences in the interpretations between the researcher and research participants. My core time on-site at ADF was between January – April 2011. I returned to ADF in November 2014 and met many of the same people, discussing my findings. The manuscript was read and commented by Factory Director Ekman in January 2015, who kindly pointed out some factual mistakes.

7.5   Materials collected and generated

The research process and design described above resulted in a variety of materials. My thesis magnifies the space of interdisciplinary knowledge creation within Aalto University and zooms in on the Aalto Design Factory (ADF). Then, within this setting, I dive even deeper into the everyday practices of knowledge as action and interdisciplinarity as it manifests in that action. Thus there are multiple practices that I observed, and thus a multitude of empirical material collected and generated. The data generation and collection did start from the zooming-out (the "wide angle" view), as my research process started with the analysis the knowledge discourses present in the construction of Aalto University (see Chapter 7.1 for a description of the research process). I then dived into the middle of action, as my fieldwork at ADF came to be. This was the zooming-in –process, which culminates in the "extreme close-up" of my own personal ethnographic experiences. The whole analysis alternates between these viewpoints, as more material was generated and collected during the process. This allowed "exploring and exemplifying the general through the local and the particular" (Ybema et al. 2009, 7), which is one main advantage in using organizational ethnography as a method. In Table 4 (Chapter 1.3.2) I illustrated (admittedly with some gentle violence) how my materials have a correspondence with both the key theoretical concepts as well as the corresponding empirical focus. Below I provide some more details about my materials.

Field diaries. I wrote three separate field diaries during my fieldwork. First is the general diary to which I recorded most daily observations, thoughts and reflections. Second, I had a separate field diary for the PDP –course related observations, such as attending the milestone meetings of the projects, other project meetings and so on. Third, the observations from shadowing the IPD –team as well as participating in the course itself were written in a field diary of its own.

Interviews. I conducted 31 transcribed interviews, 29 of which were students and two were staff members who had been participants of ADF courses themselves. They were open-ended and very loosely structured, asking about student's experiences of their courses, learning and ADF. I also asked them to describe themselves and their project team members from the

viewpoint of how they participate, approach the given tasks and problems and collaborated[80]. I chose the people to be interviewed so that both the major courses at ADF (PDP / ME310) were to be covered, as well as representing as many of the different project teams within the courses, and all but two PDP projects are represented in the interviews. In addition I interviewed the IPD team members who I shadowed during the spring 2011. As the majority of students participating in ADF courses were engineering students, this is reflected in the interviews as well (17 interviews); seven design students were interviewed and three business students. In addition there were two students from the University of Helsinki. There are ten female students and 21 male students. The detailed information on the interviews is provided in Appendix 1. It is important to note that in addition I talked with most of the students interviewed as well as numerous others during my time on-site on many other occasions. These interviews in Appendix 1 are the ones that were transcribed. I also talked in length with Factory Director Ekman on two occasions, as well as many other members of staff, the research team as well as the people from the companies residing at ADF. I included my notes on these talks in my field diary.

Photographs. In addition to taking photographs myself, I have used photographs from ADF public printed materials, ADF website[81] and its public Flickr –picture bank[82]. I have mentioned the outside source when applicable. Otherwise I have taken the pictures during the research process.

Survey to IPD students. The Interdisciplinary Product Development course I followed during the Spring 2011 was led by ADF's Director, Professor Kalevi Ekman. Professor Ekman submitted an "Initial state survey" to participating students in order to find out student's current level of understanding of product development. I was able to add two questions to the survey handed out to the 55 students of the course (see Chapter 8.4). The questions I added were:

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[80] Heyl (2007) use the term "ethnographic interviewing" to describe the distinctly open and meaning-centred dialogue inherent in this type of interview. The duration and frequency of contact with the person interviewed creates a potentially genuine exchange of views in order to explore in-depth with the researcher the issues under observation.
[81] http://www.aaltodesignfactory.fi
[82] https://www.flickr.com/photos/aaltodesignfactory/

1: What does 'interdisciplinary' mean to you now? What are your hopes and expectations for its manifestation during the course?

2: Try to define the core competence elements of the three original major disciplines of Aalto University. Do you feel that you are part of a certain 'discipline' yourself?

The survey was distributed and collected during the first lecture, and I photocopied the returned documents for my analysis.

Other material. I collected a great amount of additional material when spending time in the field. This includes posters, project flyers, ADF yearbooks, ADF PR-material, flyers for the various events happening at ADF, advertisements for courses and academic programs and so on. These provide anecdotal material that adds to my own observations and supports my analysis.

7.6   Analysis of the material

In the previous chapters I have introduced by broad research methodology, methods used, how the research and material came to be and what material the process resulted in. In this Chapter I will describe how I analysed the material. There is no linear process which to describe, however. The analysis was an iterative process that bounced back and forth between the field notes, interviews and second-hand material as well the reflecting vis-à-vis the key concepts and earlier research.

Despite the iterative nature of the analysis, my field diaries form the foundation of the analysis. I first read and re-read them just as they were, in order to evoke recollections of my time on-site. Of course, my field diaries already hold initial thoughts and ideas of the more conceptual kind, as my fieldwork was theory-informed, as discussed earlier in Chapter 6.2. I then commenced to identify the actions and doings that seemed relevant to my research themes of knowledge creation, interdisciplinarity and knowledge work; including the key theoretical concepts found relevant: boundaries, objects, communication, embodiment, materiality and spatiality. I did a full round of analysis of my field diaries regarding these

themes – I used thematic colour coding to highlight these themes as they emerged within the diaries.

I then turned to the interviews. I did a thorough first round of analysis just by reading the transcribed texts, without attempting to analyse the texts further. I treated the interviews as stories that the students had told me. I then performed a second round, and now I used the same colour coding technique as with my field diaries to highlight the salient passages regarding my research themes, as well as to mark possible quotes that felt particularly illustrative of some research issue. I particularly noted some new emerging issues that the initial reading of my field diaries did not reveal. After the second analysis of the interviews, I returned to my field diaries, photographs and recollections. I began the process of "connecting the dots" between the students' stories and that of my own observations. I complemented this with the analysis of the second-hand material from ADF – for example I took out the flyers that the PDP-projects had done, and looked at them with "fresh eyes" as they now started to hold meanings as "objects" rather than just "collected material". I also collected additional material at this point in order to "get the facts right", regarding for example ADF operations, course contents and so on. This iterative circle was repeated several times - I cannot distinguish "how many times" it happened – until I felt I was able to start formulating the results of the analysis in the form of "findings".

However, before this, phase, I started to write the ethnographic story of ADF. Initially, I wrote a very descriptive draft, introducing the courses, the space and the daily activities of ADF. However, as the spatial dimension had arisen strongly from the material, my evolving findings started to anchor themselves into the physical space. This resulted in the stylistic choice of constructing a "tour" of ADF in order to narrate the ethnography, and thus I re-wrote my narrative. The writing of the ethnography in itself was a powerful tool for furthering the analysis, and it was a constant movement of going back and forth between all my materials and the emerging narrative itself. In fact, this part of the process and analysis produced whole new findings that had gone relatively unnoticed until then.

To illustrate how the writing of the narrative exposed these new findings I will "reveal" how my attention became drawn to the centrality of Google, laptops and smart phones – even

though they do not figure in a particularly strong way in my empirical materials. I had noted that my field diary of the IPD course contained a delicious story of a brainstorming session (now in Chapter 8.7.2) – one, that in the light of the other material, illustrated well the practices and features to which students in their interviews referred to and what I observed elsewhere at ADF as well. I decided to use it in its entirety. As I read it, placed now within the broader narrative, my attention was drawn to few lines in the text: "student shows pictures from her iPhone"; "googling for examples"; "searches for pictures from Google"; "opens up his laptop". I started to recollect that Google had in fact been mentioned in the interviews as well. I did a word search on the transcribed texts, and indeed, I found six other instances where it was referred. Notably, the references were not *about Google,* but about student's describing how they search for information, how their collaboration with others happened and so on. I also recollected how the tables were always littered with laptops and smart phones, and their charging was a constant issue. In light of the literature on objects and infrastructure, I was able to start digging deeper into this finding – particularly the finding that these tools were in such a mundane and self-evident role that initially I had not paid any attention to them, and they do not figure in a particularly dominant position within the empirical material. You can find my findings on this matter in Chapter 9.3.3.

As a complimentary method when analysing the texts, especially the second-hand textual material such as the OECD reports, I used discourse analysis. My method is informed by methods of Critical Discourse Analysis (CDA) in the broad sense, though not applied in its full detail and depth in this research[83]. I shall not introduce the method here, for a thorough overview, see Fairclough (2003), Titscher et al. (2000) and Wodak (2001). Following the premises of CDA, I treat the textual material as a communicative event and language-in-use (Fairclough 2003), revealing through analysis its relationship with the social practice in

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[83] As already noted earlier, fundamentally, particulary the approach to CDA developed by Norman Fairclough, and practice-based research are not ontoligically compatible, as Fairclough is explicit in his realist orientation. The perspectives also differ on their treatment of the agency and structure-question. (Fairclough 2005.) However, methods of CDA in general share certain theoretical roots with the methods of discourse analysis used in practice-based research. The theoretical framework of CDA derives from Althusser's theory of ideology, Bakhtin's genre theory, philosophical traditions of Gramsci and the critical Frankfurt School. Foucault has been a major influence as well. Furthermore, one of CDA's main theoretical roots is Critical Linguistics (CL), originating in the 1970's from the works of Habermas and Halliday, which highlighted the role of language in structuring power relations in society (Titscher et al. 2000; Wodak 2001). For example the Habermasian discourse analysis has been used in practice-based research (Gherardi 2012; Geiger 2009). Thus when treating CDA as a collection of methods rather than an overarching methodological framework one can justify its use as a complimentary method in practice-based research.

question.[84] However, I want to stress that discourse analysis is used in a supporting, background role, and as such my research does not constitute a discourse analysis of interdisciplinary practices at ADF.

Overall, however, the analysis of the materials and writing of the ethnographic account is not something one can distinguish between. They go hand in hand. Van Maanen (1988, 120) has described the process in his unimitable style:

> "We edit, contemplate and evaluate the disparate materials we leave on hand: the action observed in the field, snippets of conversation, interpretive skills we believe we have developed, documentary evidence collected, stories we have heard, events we have participated in, bits and pieces of the 'relevant' literature we have read, counts we have done, native category systems created and textualized, and so on. We assemble these originally unrelated segments into the dim shape of representation and continue with our editing. Slowly an analysis takes shape and a paper develops. But because of some wicked editor's deadline, classes that must be taught, the demands of a new project, the family vacation, the illness of a child, the visit of out-of-state friends, or the five minutes we have left to catch a plane, the form and content of the paper freeze. We know that our analysis is not finished, only over."

****

Until this point, my dissertation has concentrated in introducing its research themes, key theoretical concepts as well as described the methods, materials and analysis through which the research has come about. It is now time to open the door to ADF, and commence the story of its practices and participants. Welcome to the Aalto Design Factory!

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[84] In CDA's terms, orders of discourse are the language aspects of social practices that are made up of a combination of genres, discourses and styles. Genres, discourses and styles are the relatively stable and durable manifestations of ways of acting, representing and identifying through texts, which in turn relate to the social activity, physical and social world and persons involved in the social event (or discursive event) that is studied. (Fairclough 2003.)

PART III Welcome to Aalto Design Factory!

8 Let's take a tour

I thought long and hard how I wanted to present Aalto Design Factory (ADF) to the reader. First I wrote a rather traditional account of its history, operations, facts and figures before moving on to the observed practices. However, I noticed how in my imagination I kept returning to the physical space of ADF constantly when analyzing my material. The lived-experience of my fieldwork seemed to be anchored quite strongly in certain spaces within ADF. Thus I chose to present the reader "the map of my lived-experience": I will describe ADF - facts, figures, practices, experiences, observations and all – whilst taking a tour of the physical space. The route that is taken is based on the physical layout of ADF[85], but more importantly, I anchor the practices and other observations and key facts into certain parts of the physical space – the spaces where I find myself returning to in my mind as I recollect, reflect and analyze my material.

8.1 The frontage: embedding ADF in context

From the outside, ADF doesn't look much. The building is quite non-descript, and maybe even somewhat unwelcoming - I remember feeling downright intimidated coming to ADF the first time as I did not even find the right entrance and ended up coming in through the back door.

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[85] The actual layout is provided in Appendix 2; please note that "the tour" does not exhaustively cover all the spaces within ADF.

Picture 1: Main entrance to ADF

The building is a former wood research lab of Helsinki University of Technology (HUT), an approximately 3200 –square meter space located at Otaniemi, Espoo, the well-known and established campus of HUT, which also is the location of "Teekkarikylä", "the village of tech students", where over 2000 students have their student housing. Thus the location of ADF in itself creates quite specific connotations in students, namely those of engineering and technology. As one business student pondered – the business school campus is located in the center of Helsinki, in equally well-established premises - that even coming to Otaniemi to be with the "tech guys" is a big step.

> "…even if you know about [ADF], there are the prejudices that don't necessarily reflect the reality. Like I was too like totally terrified that I need to be with tech students, like why I was terrified, I was thinking of the tech guys like some stereotype instead of people I get to work with…"
>
> Business student, member of staff (Staff2)

ADF was opened in October 2008. During 1958-2008 the building was used as a research laboratory for VTT Technical Research Centre of Finland, focusing on concrete and wood processing technologies. However, the catalyst for the creation of the factory was the Laboratory of Machine Design at HUT, which since 1997 had organized a multidisciplinary course "Product development project PDP". To better support the course, a research and development project called the Future Lab of Product Design (FLPD) was conducted in 2006-2008, aiming to create a physical environment facilitating interdisciplinary co-operation in

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product development processes. The then-professor of product development at HUT, Kalevi Ekman, led the project. During the spring 2008, funding was received to continue the development as a spearhead projects for the upcoming Aalto University, and ADF was officially opened on the 3rd of October 2008. Professor Ekman became the Director for ADF. ADF thus existed before Aalto University, but its "status" and position as an interdisciplinary space owes to the creation of Aalto University. Thus a few words on the making of Aalto are needed in this conjunction.

Aalto University is a result of the merger of the Helsinki University of Technology (HUT), The Helsinki School of Economics (HSE) and the University of Art and Design (TaiK). First voiced in public in September 2005, the merger idea had quickly caught on. The Finnish government decided on the merger in April 2007. After a preparation period in 2007-2009, Aalto University started to operate as a new legal entity on 1 January, 2010. The Financial Times, in an article published on 29 March 2009, commented on the merger the following way:

> Across the world, business people, creative types and technology geeks struggle to understand each other. Their education and training, even much of their work, is carried out in separate silos, with exciting collaborations the exception rather than the rule. Now Helsinki's business school, art college and technology school have come up with a radical plan: a three-way merger to create what they claim will be a unique, integrated seedbed for innovation. The new institution, Aalto University, will offer joint courses later this year and will be open fully at the beginning of 2010 as the flagship project in a national shake-up of higher education.

As the text in The Financial Times implies, Aalto University is popularly constructed as the "flagship project" in the current far-reaching "shake-up" of the Finnish university sector. Since the mid-2000s in particular, Finnish universities have been subject to further radical reform, which is consistent with world-wide trends as described in Chapter 5.2: to develop linkages between higher education systems and national economic well-being, to steer higher education by negotiating and setting broad output goals and increasing market-oriented funding mechanisms, commercializing research processes and products, and emphasizing quantitative measures of academic performance (Aarrevaara et al. 2009; Välimaa 2007). Thus we can link ADF to the wider context of higher education and indeed the change in of how education, science and research itself is approached (see Chapter 5 for fuller analysis). For example "The "Country Note on Finnish Tertiary Education", published by OECD (2006)

provides an example of an authoritative international political document that has informed the Finnish higher education reform, as well as The Finnish Governmental Inquiry Committee Report titled "Merging HUT, HSE and TaiK into a New University" (2007), which is an authoritative national document that draws from international reports such as the one by OECD, and translates their recommendations into the Finnish context.[86] Aarrevaara et al. (2009) and Välimaa (2007) have further analyzed the making of Aalto in this changing context of university reform.

As part of the creation of Aalto, the question of the location for its central campus has been an emotional issue. As said before, Otaniemi is a legendary location of HUT – but one that does not resonate with business students from the former Helsinki School of Economics or from the University of Art & Design, who are located at Arabianranta, as all of the three schools have a long history behind them[87]. In 2011 it was decided that Aalto University was to centralize its operations gradually (by 2017) to the Otaniemi campus area. "The centralized campus supports boundary-breaking research and artistic activities by enabling versatile and active forms of interaction. The campus will be built gradually in an economically and ecologically sustainable manner. The aim is to create a vibrant and interactive research and studying environment where work, studying, recreational activities and everyday life will naturally be connected to each other."[88] The largest Finnish daily newspaper Helsingin Sanomat (HS) writes of these aims: "Engineer students, artists and business students are thrown together in hope of new ideas. (Aalto) University believes that this mixing will generate new ideas and innovations, as students from different disciplines meet in everyday toiling. From these ideas start-ups will be borne, creating jobs of the digital era in Finland. (HS 29.9.2013.)" in an article covering the building of the new Aalto University campus at Otaniemi.

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[86] A fuller analysis on the discourses present in these documents was presented in a conference paper "Global-local discursive practices of higher education reform: Analyzing 'knowledge-talk' in a university merger" to sub-theme 6, "Assembling Global and Local: Practice-Based Studies of Globalization in Organization", 26th EGOS Colloquium, Lisbon, Portugal, 28 June – 3 July 2010. Joint paper with Prof. Janne Tienari.

[87] HUT became a university in 1908, and is by far the largest of the three merging universities. HSE was established in 1911, and TaiK was founded in 1871 as the School of Arts and Crafts.

88 http://www.aalto.fi/en/about/campuses, accessed 10.11.2014.

Thus the location of ADF is undergoing a rhetoric shift from being at the "land of tech students" to being at the heart of the "vibrant" Aalto campus. This is not a minor issue, as indeed I found that *physically* ADF at the time of my research in 2011 was regarded both as being in the center and yet at the periphery – depending on the student you ask. Here we find first evidence of how differently people experience a physical space before they even step a foot in the premises themselves.

> "Maybe from the TaiK [University of Art & Design] viewpoint this is far [laughter], like we are the ones who always travel. Like somehow, even though it's pretty nice to come here, I could be here more doing my stuff if I didn't need to, if that traveling was easier."
>
> Design student (SD3)

Also, as noted before, ADF as the "poster-boy" for Aalto University has its roots in activities and practices that stem years back from the specific context of mechanical engineering. The background is important to bear in mind, as it is the discourse and epistemological base on which inevitably the whole ADF has been built. The original Future Lab of Product Design – project itself was multidisciplinary, consisting of students from engineering, industrial design and cognitive sciences but still the *focus* of action was product development – often associated with the domain of engineering.

8.2 The Lobby: showcasing the interdisciplinarity

Picture 2: The Lobby's reception desk; giving directions within ADF

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Once you find the main entrance you enter into the main lobby of ADF. The physical space itself changes continuously, smaller changes are happening constantly as well as bigger overhauls done approximately once a year. For example, during the beginning of my stay in 2011 there was a kitchenette located in the lobby – making the area lively and with people hanging out – and then later the kitchen was moved and reconfigured as Kafis=cafe + office, that centered the "coffee-machine -meetings" to one place away from the lobby (I will be covering Kafis in more detail in Chapter 8.6).

After my time on-site in 2011, bigger changes have been made, for example the building of an inspirational library area, opening up office spaces and increasing visibility of activities even further. In 2014 the lobby has an information desk that serves visitors, as well an improved area for catering services. Overall, officially the spaces of ADF are divided into three "usages": reservable spaces for lectures, workshops & meetings; prototyping facilities; and open spaces for working and ad hoc meetings.
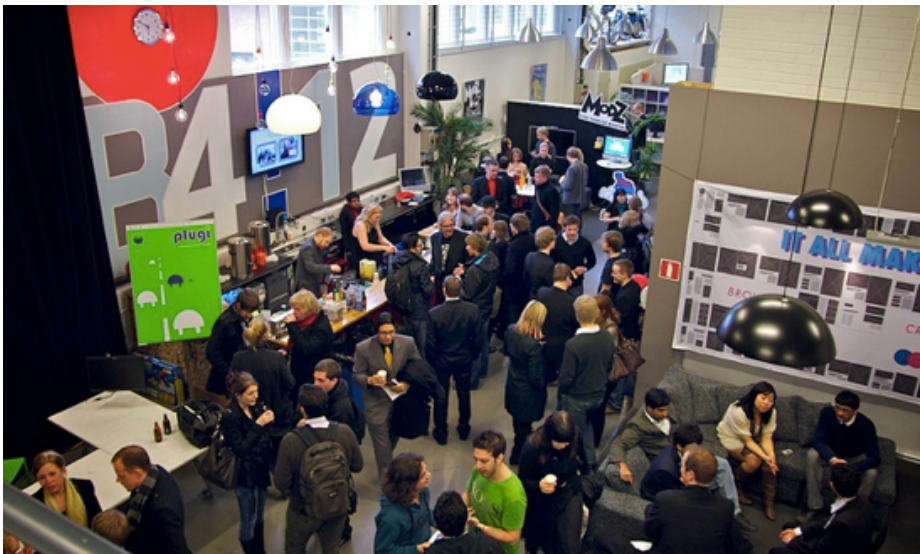
Picture 3: The Lobby in 2010 Product development Project Gala (Source: ADF Flickr)
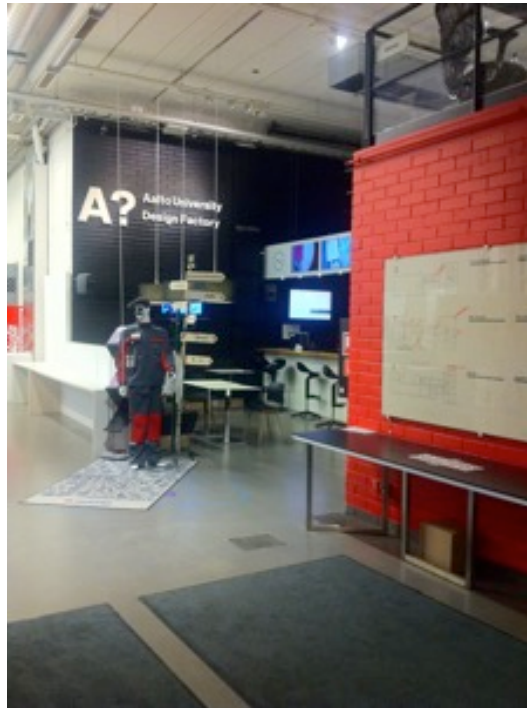
Picture 4: The 2014 version of the Lobby

Overall, when visiting ADF again in November 2014 I noted how the atmosphere was somehow "busier" than in 2011. The staff in fact that told me that the usage of the spaces had increased a great deal, as well as more people just popping over out of curiosity. *"There seems to be much more movement around"* reflected a student whom I had met in 2011, now a member of the staff at ADF. I was told that especially the foreign students at Aalto had found ADF and made it into their living room.

How does ADF define itself? I have compiled few extracts from ADF's own materials such as its yearbooks and web site that show the rhetoric of ADF:

**Aalto Design Factory in its own words –
extracts from its yearbooks and web site**

A!

**Aalto University
Design Factory**

At Design Factory, the students come first. The Factory aims to
promote real hands-on learning and doing by providing students
with easy access to all materials, equipment and tools. All Design
Factory spaces have been designed to support open idea flow, and
the actual realization of visions through rough prototyping.
Action speaks louder than words!
http://www.aaltodesignfactory.fi/inside/students/
(accessed 21.11.2012)

Our community consists of various people from different backgrounds.
Usually on everyday basis the people at ADF are Aalto University's
students, teachers, researchers and other staff members, company
representatives and partners or visitors from all over the globe. The
community consists of anyone who wants to belong to the community and
who stays shorter or longer time at ADF. Being a part of the ADF family is
more about the mentality than the official status!

I.n.t.e.r.d.i.s.c.i.p.l.i.n.a.r.y. – that's what we are all about here at Design
Factory. Different backgrounds, different fields, different experiences all
working together and enriching the outcome. It's the people, who are the
most valuable resources of ADF.
(ADF Annual Report 2013)

Design Factory is in essence a place where students, teachers,
researchers and industry partners can interact under the same roof.
The place has its architecture and certain enabling and supporting
technologies, but perhaps even more important are the soft issues –
philosophy, attitudes, our ways of working. Briefly put, as several
visitors have formulated it: "I can see a lot of energy in this place!"
Foreword by Kalevi "Eetu" Ekman, Factory Director

http://www.aaltodesignfactory.fi/about/ (Accessed 3.12.2014)

The focus on students, learning-by-doing, the support of the material infrastructure (tools,
materials, architecture, technology) and interaction with diverse people are key elements in
ADF philosophy. There is also a reference to "our way of working". These elements were all
observable in practice, as my ethnographic story will show.

The lobby demonstrates the diverse interaction ADF aims for – it is the place to meet and
greet the visitors and students.

"…this is an innovative environment where there are many start-ups and corporate visitors and such, so there is never a day when the same people are present…[…] you either meet someone directly who can help you, or you meet someone who knows someone who can help you. There are all the possible permutations what can exist, who you can find contacts and things."

Engineering student (SE9)

A concrete manifestation of this was "Andy's desk", located in 2011 in the lobby kitchenette and bar. Andy was the "coach" at ADF, which for example meant that the manned the desk in the Lobby, was there to "meet and greet" people as well as introducing people to each other. In this way, he showed by example how to "be" at ADF. One student, whom I met during my stay in 2011, reminisced later how ADF for her equals "Andy's desk", and she lost count of how many people Andy introduced her to.[89]
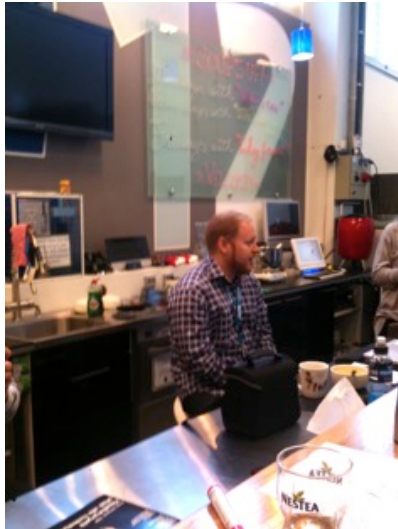
Picture 5: Andy and his desk in 2011.

Overall, during 2010-2011 ADF states to have had 12400 visitors, 225 tours given around the premises, and 76 different nationalities present, according to its yearbook. In 2012 yearbook there was also an estimate of 3500 given for the number of students of design, business and engineering "actively involved in different activities" during the then-four years of operations. During the time of my fieldwork in 2011, Aalto University was ramping up its operations and visibility, and ADF was indeed one important showcase for the interdisciplinarity that was

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[89] In 2014, there was a notably more "official looking" reception desk for visitors.

stated as one of the university's key goals. This is reflected in the high number of visitors and guided tours given during that time: during my stay there was a group visiting almost every day. The groups were of a great variety, ranging from interested parties within Aalto, to other HEI's and commercial companies. ADF was also a usual stop when explicitly showcasing the new Aalto "in action".

> "The main goal for Design Factory-project is to be a source of inspiration. We want to be a showcase for the whole Aalto University in successful courses and ideas, which creates new kind of community and support Aalto's goals."
>
> Design Factory News 2.3.2012, http://www.aaltodesignfactory.fi/aalto-design-factorys-new-life/ (accessed 21.11.2012)

The staff commented that this publicity is mainly a positive thing – indeed being a showcase is one of ADF's goals as quoted above - as well as a sign that the practices of ADF have been noted.

Visiting ADF in November 2014 I asked staff about the current amount of visitors, and I was told that ADF in fact has to somewhat limit the amount of visitors due to practical reasons. At the same time, however, there have been a number of hig profile visitors at ADF; for example the King of Sweden visited ADF in November 2014, as well as the Prime Minister of Finland hosting the Northern Future Forum at ADF. The seminar was attended by eight Prime Ministers from the Nordic Countries, the Baltic States and the United Kingdom. This seems to indicate that ADF has established itself as a regular stop when showcasing Aalto University in action, as well as a venue for high-visibility events. "This is an explonatory platform for interdisciplinary collaboration, a kind of Aalto University in miniature size. That is the reason why the prestigious visitors to the University, such as heads of state, want to come here", says Director Ekman in the Aalto University Magazine (October 2014)[90]

However, there were voices that seemed a touch tired of being the showcase: "*What are we, an Aalto tourist attraction, they come here because there is no other place to visit or anyplace else where anyone is allowed to go…?*", commented one member of the staff. This and other similar comments imply that the people of the ADF thought it was high time Aalto and its

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[90] http://issuu.com/aaltouniversity/docs/aum-11_pdf-www-hq_2. Accessed at 12.12.2014.

promises of interdisciplinarity and new ways of doing manifested in other ways as well than only ADF. I also found that people were worried that in Aalto's context ADF was seen as being "enough of interdisciplinarity" for now, and these types of practices were to be confined to just its' walls.

The showcasing of ADF shows how its practices are nested in the practices of Aalto and are affected by them – as well as how the practices of ADF affect Aalto. The practice of promoting ADF as the "proof" of Aalto University's interdisciplinarity validates its existence, and at the same time it contributed to the branding of Aalto University (on the branding of universities, see e.g. Aspara et al. 2014). The image of ADF itself has been built to my eye very purposefully and with a PR-like zeal. ADF's presentation materials, yearbooks and other flyers are of a very high standard, and great attention is paid to the visual design of various aspects within ADF. ADF is also "commoditized" as a concept, which has been implemented abroad.[91]

However, in my conversations with people, some did offer critique about the "inflated goals" of the ADF when contrasted with the reality of numbers: the number of different students attending the courses held at ADF – and thus "affected" by the practices - is still relatively small compared to the overall size of Aalto. The ADF 2011-2012 yearbook states that ADF had 500 interdisciplinary students during the academic year, whereas the overall number of Aalto students in 2013 was just under 20 000[92]. The numbers become less when one looks at the very active members of the community. Based on my own observations, the most active students were the ones participating in the long courses. This amounts to approximately 200 students. In addition, the 60 students from the master's program of International Design Business Management were also to some extent present. There were very active days at ADF, but also very quiet days. I also observed that the turnover of people seemed to be very slow,

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[91] The concept of ADF has been implemented abroad, and in 2014 there were four joint projects: Aalto-Tongji Design Factory with Tongji University in Shangai (opened in 2010); the Swinburne Design Factory with Swinburne University of Technology in Melbourne (opened on 2011) and Chile Design Factory with the local partners Duoc UC and Pontificia Catholic University in Santiago (opened in November 2012). There is also a new type of initiative in Delhi, India, where Design Factory India is part of developing Design Village, a new Design University in Chandigar, India, as well as activities being developed in New York (Pace University) and Geneva (CERN).
[92] http://www.aalto.fi/fi/about/reports_and_statistics/ accessed 10.1.2014

meaning that on a typical day, the ADF community mostly consisted of the staff and the "heavy users", and indeed I came to know many of the "regulars" during my stay at ADF.[93]

8.3   Puuhamaa: Show me your brain!

At the other end of the lobby there is a space called Puuhamaa ("Activity Land") that in 2011 was the home-base of one of the long courses held yearly at ADF, Mechanical Engineering Course "Stanford" ME310, which engaged 19 students for nine months for the academic year 2010-2011. The students were allowed to make the space their own and indeed it looked like combination of a dorm room, a garage, a café and a laboratory.

Picture 6: Puuhamaa in one of its many mutations (Source: ADF Flickr)

"…and then we planned it and did it, and it was also a kind of fun project. And then you have been part of it yourself, so it's like your own space. Even though it's a complete pit at the moment, it's still your own pit, yeah."

Engineering student (SE13)

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[93] An interesting observation was that when I visited ADF at later stages during 2012-2014, I still recognized many people other than staff – in fact few of the "hard-core" users of ADF had become members of the staff.

8.3.1 Key courses at ADF

Picture 7: Posters advertising the 2014 PDP course (left) and the 2011 PDP Gala.

The above-mentioned ME310 is one of the key courses that ADF houses every year. The other timportant course that brings the students to ADF is the Product Development Project (PDP). In addition the two-year Master's Program of International Design Business Management (IDBM) of Aalto University holds some of its courses ar ADF. The PDP and Stanford ME310 courses are held in entirety at ADF. The participants of these courses were the ones I met most frequently and also interviewed for my research. In addition there are a variety of other "lighter" courses that are held at ADF – some organized by ADF as well, others use ADF as their physical venue. One such course was the Interdisciplinary Product Development (IPD) course that is described later in Chapter 8.4. Below are brief descriptions of the PDP, ME310 and IDBM courses.

Product Development Project (PDP) -course

Put together over 140 engineering, business and design students across various nationalities. Divide them into 15 groups. Give a corporate sponsor given brief to design a concept and prototype for a new product or service. Projects have a rough timetable, a small budget, the space, support of a community and…not much else. And…action!

This is how one can describe the Product development Course (PDP) at Aalto University. It is one of the few semester-long interdisciplinary courses and is organized in Aalto Design Factory. The course is meant for students in the final stages of their master level studies. The students come from all the Aalto schools, the engineering students being however a majority. There are also participants from the international universities collaborating with Aalto.

PDP centers around corporate collaboration, and in 2010-2011 the participating companies included Ericsson, ABB, KONE, Planmeca, Metso, Panasonic, Nokia and Wärtsilä. The course has been organized in some form since 1997. The course lasts the whole academic year. The students are divided into project teams, and approximately 13-15 projects start each year with the teams having generally at least eight members. The projects during 2010-2011 included the following:

- Creating an ad hoc information network to serve relief workers at disaster sites (Sponsor: Ericsson)
- Developing lightning solutions to ensure smooth people flow around elevators (Sponsor: Kone)
- Finding solutions for easier vessel control on a ship bridge (Sponsor: Wärtsilä)
- Finding a way to keep patient's head still while taking demanding 3D-photographs (Sponsor: Planmeca)
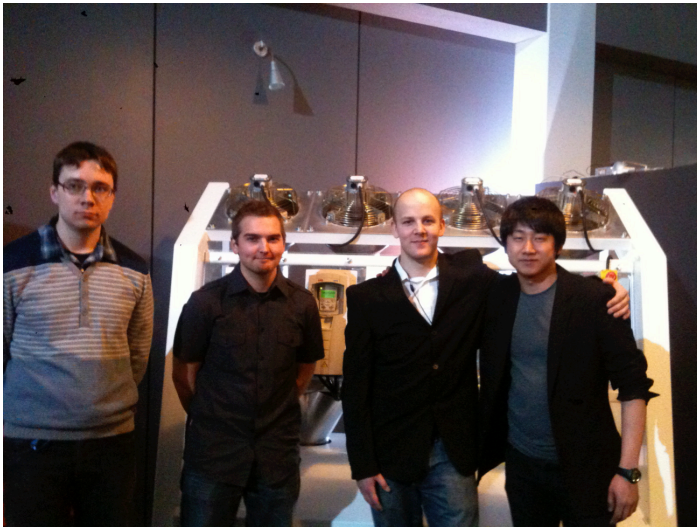
Eight months later all the teams have accomplished amazing end results, which they proudly showcase to the public at the annual Product Development Gala.

Stanford ME301 -course

Aalto University

ME310 is an interdisciplinary course for Master-level students from all Aalto schools. During one academic year, the course teaches students how to use the Stanford/IDEO design process in product development, and is concentrated in practice-based learning. The global student teams prototype, test and iterate in order to develop and implement innovative solutions to real world design challenges posed by multinational corporate sponsors. The final proof-of-concept prototypes are typically featured at the Stanford Design EXPE each June in California.

Students in Aalto-based courses usually number less than 20, and work in multidisciplinary teams of 3-4. Partnering global teams work in teams of 3-5. Each Aalto team partners with one global team, combining to 6-9 students per client project. (http://me310.aalto.fi/about-me310/)
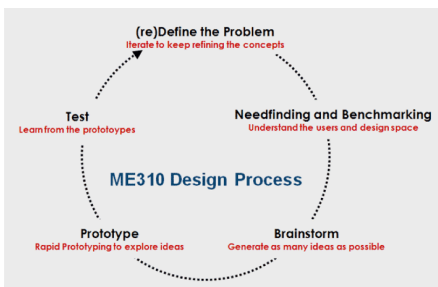
The Stanford / IDEO design process

http://web.stanford.edu/group/me310/me310_20 12/about.html

During the nine-month period students learn how to "dance with ambiguity", as the ME310 saying goes. This means tackling ill-defined problems, tight deadlines, surprise assignments and lots of prototyping. The projects of 2011 in which Aalto students were involved in included the innovative use of plywood in packaging, creating a new game-controller for first-person-shooter gaming, and designing a proton therapy unit for cancer treatment.

Included in the course is the famous "paper-bot challenge", in which the participants are to build a working robot out of paper - which, in some cases, needs to be able to travel overseas to California and re-assembled - in order to participate in a "battle of the bots". Paper-bikes have also been constructed, which have proved to be surprisingly durable.

Source: ADF Flickr

The International Design Business Management (IDBM) -Master's Program

IDBM International Design Business Management

IDBM is a Master's Program of the Aalto University School of Business, the School of Arts, Design and Architecture, and Schools of Technology. The program is intended for all students with interest in interdisciplinary work, design driven innovation, creative business models and product development. The IDBM Master program is a two-year 120 ECTS degree program that contains four core modules, elective studies, and a master's thesis.
http://www.aalto.fi/fi/studies/education/programme/international_design_business_management_tech_master/

IDBM involves a strong collaboration with industry, and attempts to utilize approaches from many disciplines to solve "real" life problems as well as participating in research. ADF is the venue for some of the courses included in the IDBM program.

Overall, during the academic years 2009-2010 and 2010-2011 there were approximately 16 courses from the Aalto curriculum, and in addition few courses held in collaboration with other universities and entities as well as courses aimed at Aalto teachers. During year 2011-2012 the number of courses was 10, and in 2012-2013 the number was 37, indicating that the space of ADF as the venue for courses is gaining in popularity. The courses are naturally the key reason students come to ADF. Consequently for some the courses at ADF they are obligatory and to some, the participation is based more on their own wants and interests. This has an effect on the motivation and levels of participation, as observed by the students themselves:

> "Yeah, then to motivation may be maybe a bit different, like I was talking at the beginning with K and H, like it sounded a bit like 'well here we are because this is obligatory for us in our curriculum' and not to learn something."
>
> Design student (SD5)

8.3.2 Central role of prototyping

On 12.4.2011 I visited ADF with my son, who was five at the time. We spent time at Kafis, and as usual, post-it notes and pens were lying around. I had explained what ADF was and what people there do.

Soon I found him drawing something.
- What's that? I asked.
- It's a new type of computer, I'm testing it, he said.

He had just built a quick-and-dirty prototype.

The result was also posted on ADF's Facebook –page, challenging "what was your last quick-and-dirty prototype?".

One day, on the door of one Puuhamaa there was a post-it note that boldly stated: "Fast Prototype – Show me your brain"[94]. I pondered on its meaning and at the same time marveled how obvious it was and how well it fitted ADF. In fact, one of the students I talked to had noticed the same note.

> "…someone had marked on the door of the Puuhamaa a post-it note that reads "fast prototype, show me your brain" and there are two guys showing each other their brains. Like I don't know, to that somehow, like maybe through that I found that wait a minute, maybe that's true, the point is that you have these cool ideas in your head, but putting them in words is often pretty difficult, so complex ideas. But prototyping, in prototyping you bring the idea fast and you get fast feedback on it."
>
> Engineering student (SE2)

Picture 8: The door to the group work space Brainstorm

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[94] In 2014 I noticed that one of the spaces meant for group work was now named "Brainstorm – Show Us Your Brain"

I noticed very soon that all the ongoing course projects had produced many physical objects during the course. Product prototypes were the obvious manifestation, which culminate in their showcasing in events. But the objects were not all prototypes in a typical sense, but also visual materials such as flyers, posters, logos, web pages and other manifestations. I asked about this from the students and they saw it as one way of making them just "do" things – instead of only thinking about it in their heads, also signaling that things were moving forward, which further motivated them.

> "…maybe it's like encouraging to do something when usually no, usually you just read theories at least in "Kauppis" [Aalto Business School], so it's really like, you don't concretely do anything. Here you are encouraged to try, experiment in a way, you don't think that even though it's not gonna be perfect thing what you do, you can at least learn so much when you do and try out different things."
>
> Business student (SB1)

> "…they are like a continuous sign that we are progressing, like we create a proto about something, like I think, like endless thinking is not good, like at some point you just need to do more, and then if things go wrong, then you do again…"
>
> Engineering student (SE4)

This made the stated purpose of ADF as encouraging "experimental problem-based learning" and learning-by-doing very concrete. Students also appreciated the fact that trying and failing was encouraged.

> "I think this has been really encouraging, I remember right in the beginning that just try, doesn't matter if you fail, this has not been said before. Or actually this is the only place someone has said things like that during my time at school."
>
> Business student (SB1)

There were also few a touch amused comments that at times the need for prototyping and creating something tangible went a bit too far. One student reminisces laughing on some instances where the prototyping veered towards the bizarre:

> "…but somethimes I like feel that a bit too much they just say that 'cross borders and be stupid' and then build a thing from legos and say that its like a new nuclear powerplant that uses bananapeels for energy…soi t goes a bit like 'let's be propeller-heads'…"
>
> Engineering student (SE1)

Students experienced the prototypes with multiple senses. Prototyping involves the not only the sight, but senses of touch, even smell and taste. I was having a cup of coffee at Kafis one day, and an engineering student came by, holding in his hands some metal construction. I asked what it was, and he said it was nothing in particular, but it had a certain strength that he wanted to "feel". He continued that when you do strength calculations it really helps to then hold some piece that in fact has that certain strength, to gain a rule of thumb, so to speak. The same issue came up again in an interview with another student.

"Yeah it's that you can do things. I mean do something, I have talked about this quite a lot with my friends who have been working for example at building sites, that they have like a physics class or something…that when they, they have a calculation or principle or else, that when you really take some example really into your hands…so you can really try it, because it does so much more, you understand it so much better…Like I have a friend studying heating and plumbing, he frets that really he doesn't understand anything…he understands in theory but then goes like to watch someplace, he doesn't know which pipe is which…like you just don't get it…So if you could more really hold the thing in your hands, it would be so much better already."

Design student (SD6)

Picture 9: Doing with your hands (Source: ADF Flickr)

The act of physical doing was also referred to as being relaxing and helping in team building.

"…in a way it [the prototype] it was quite useless in itself, but I thought it was a really big team building event...[…]… it sort of made things easier, kinda, like 'yeah, we are really doing something'. Yeah that could be it, it was kinda relaxing even, that we got to do something with our hands and stuff."

Engineering student (SE6)

"In this sense the prototype is not just that this is now the model from which we do the final product, it's more like a tool for thinking and a physical thing, of which we can talk of and directs our attention and you find stuff. Ergonomics, person's dimensions and stuff are pretty hard to think in abstract, like is this lever 20 cm or 30 cm in length. So there, you have the actual lever and you wave it about and then a bigger guy comes along to wave it, then you notice those things."

Engineering student (SE5)

> "Like every time we have built something, it's been fun and maybe uplifting to the team spirit. That sitting around in small spaces like this and talking, not moving or doing anything, it's kind of paralyzing".
>
> Design student (SD3)

The building of the prototypes together also meant that students who had never done anything similar before were suddenly learning how to use different tools and thus *participating* in practices that were potentially more familiar to others[95].

> "…it is exactly that getting out of the comfort zone. It was fun to notice that like T who totally is not the type of person to build things and stuff, but then after Christmas we were doing a proto and I told him a bit what to do, so then he happily worked the planing machine, the sawdust just flew around and so on… and it was really great to notice that people are not like 'I don't want to touch those' but all are really involved together."
>
> Engineering student (SE13)

The prototypes also acted as a *bridge* between the different project teams, as students from other projects tested the prototypes of others and gave feedback on their prototype. There was, for example, a car parked in front of ADF once, where anyone could test a new product that was installed within by the students. I think I tested at least ten different prototypes during my stay. It seemed a good way to get people engaged and interested over project boundaries.

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[95] Interestingly one machine shop staff member told me how there were quite clear cultural differences. Foreign students especially from Asia had often never held any tools in their hand, or even seen someone use them, whereas Finnish students had been exposed to doing for example wood work at school, at their summer cottages etc. In this sense, prototype building was not as "alien" to most Finnish students as potentially students from other cultures.

Here students test a headrest to be used in dentistry x-ray. The project timed the process of x-raying and studied how much the head moved, if the "patient" was comfortable etc.

Picture 10: Testing of prototypes

Acting was one way of using all the senses in prototyping, and there was one engaging story I was told of how one PDP-group acted what they were going to do in the PDP Christmas Gala. I recount it below in its entirety, as it finely illustrates many things I observed at ADF: the applying of prototyping also to service concepts, engaging the whole embodied participant in the process, the creative way the group dramatized the service context of their product – and not least, the amount of fun that was evident the group had in the process!

Acting the prototype - as told by a student

"So we came to the conclusion, that in fact the concrete part of our project is not the device, because if we did a proto if the device, like we did, it's a lump of modelling clay. Really what we do is a service, because our device is designed for a very specific purpose and specific use cases, what it really does. How we do it, and what we do with it, it's in fact more a service concept. And in fact our proto for the PD6 (Christmas gala) was a play.

We did the modelling clay phone, but we just briefly showed it, and it was a bit like a toy. But we did a play, which started from the catastrophe area workers (relief workers) are in their way and something happens. The guys drive around. There was a thing where we had like few chairs and bits. Then there is an earthquake or something lie that, and the tire of the ambulance goes flat, and people start having all kinds of problems: I have this problem, I have that problem. In the beginning some had these construction helmets on and they were the helpers – they were all confused and always in the wrong place. If you had a broken leg, the helper was "hey sorry, I'm a mechanic" and then the flat tire, "no I'm the doctor" and all that.

Then we showed the second part, where our device comes to the stage – which at this point of our great play was a coffee mug with strings attached, our fancy ad hoc network! We had the idea with the stringed cuos, that more cups, and a big circle, and all the strings all tied up in there. The network comes around them.

Then they all start to communicate, and we had question marks on post-its on the helmets. Then you took away the post-it, and beneath there were red crosses, wrenches and stuff. You identified who is who, and they found their right place. That was kind of the thing, like what we bring is a certain degree of organizing and big picture to the chaos. That you know where what resources are and what they do, and if you suddenly need something – you may be fixing the cars or a hospital an you fall off the ladder you need suddenly a doctor, then you need suddenly some completely different expertise.

I don't know if anyone liked it, well it was like so much fun. It lead to the point, where we planned it for way too long, then we had half an hour left, We practiced it like three-four times. We had thought about so long that everyone knew the basic plot, but every time we acted it, it went totally different way! We laughed so hard.

It was so much fun, like it went always, always different and everyone talked like different stuff. But you saw that it was to go perfect! At some point someone was like all the time with a broken leg, and then someone comes and starts to fix the arm! The other guy is like "hey it's my leg that hurts" but the doctor is all "no no, it's your arm, you are just delusional. I'm a doctor, I know it's your arm, really".

    Engineering student (SE9)

Another way of using objects was the role given to *visualizations and drawings.*

Picture 11: A drawing on the door of Stage

> "Yeah I think that the ability to draw is really key, you can visualize ideas quickly, and make others convinced that hey this works, my drawings have been often the sort of talking point of our meeting or meeting around it has organized the meeting"
>
> Design student (SE1)

Also coming up with names and visual identity for the project groups right at the start of the collaboration was seen – when reflected - as being very useful and acting as an invisible guiding hand of sorts[96].

> "For example the flyer, it was supposed to, in order to be able to do it, we had to first think ok, what is this thing in the end all about. We can't know what the final product is, and still we had to do the flyer and visualize the fundamental thing…the names in particular were good, maybe a sort of a good invisible hand"
>
> Engineering student (SE2)

> "Yeah it brings the team together. So it does, it is the point of the visual design is just that. Well that, and the fact that then from the outside you can see that we are doing something, that we have a project going on. So that, almost my view, is that the main function is that it brings together and connects."
>
> Design student (SD3)

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[96] The project manager in question noted also that "I don't know how minutely the course staff have calculated that it works like this, or is it more like a gut feeling that it might be a good thing…" This points to the explicit management of interdisciplinary collaboration and prototyping, to which I will return to once we visit the Staff Wing.

Picture 12: Flyers from the 2011 PDP projects

However, there were observed limitations to this centrality of prototyping. Some groups I observed had such abstract problems at hand that prototyping a concrete object was experienced quite difficult.

> "…like the nature is that we revolve around quite abstract issues, like doing of concrete models or experiments or the like is already due to practical reasons pretty impossible."
>
> Engineering student (SE3)

In these groups a sense of frustration was palpable, as the product gala neared and the pressure to "show" something was increasing. All groups in the end however had a stand up and running in the Gala, and something tangible to show. In some cases it was concrete product such as a campus bike or a new type of headrest for dentistry (shown below) – and in few cases a very visual collection of design drawings.
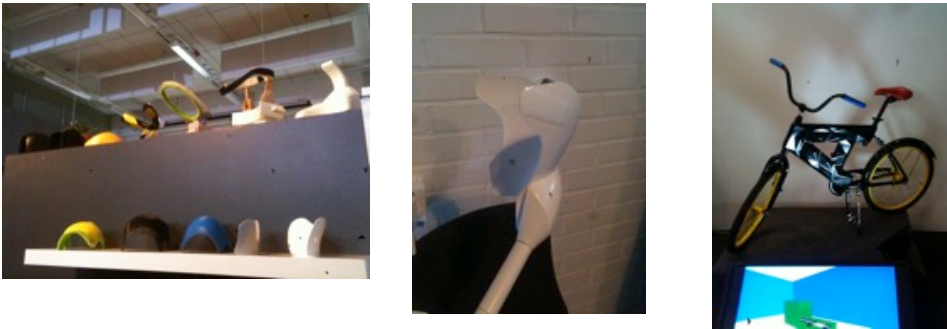
Picture 13: Final prototypes (and their evolution) on show at the 2011 PDP Gala

All of the above ways of engaging in prototyping and visualizations made it possible to "break the illusion of unity", that is the assumption that everyone understands for example the goal of the project the same way, as well as making explicit the open issues that still needed to be resolved.

> "…So what happens is was that we had thrown about ideas about what all we coud have here, and then it sort of created an illusion that ok, we have kinda a clear picture of what is this idea of ours and the product. And then once we started, Ok it was prototyping what we did, two things came out. First we all had had different ideas of what it was supposed to be. We had that illusion that the picture everyone had themselves was the same as the common one. And then on the other hand, the desicions we had not made, the fact that they were not made, were kind of made explicit and forces us to make the decisions of those things."
>
> Design student (SD5)

In the end, it seemed that already the *possibility* of building something – quick, easy and no questions asked – that was a motivator already in itself. *"Like if we have an idea, and think 'it would be nice to do a proto on this', we can just say 'ok, let's go downstairs and do it!"*

8.4 The Stage: but what IS interdisciplinarity?

Picture 14: The entrance to Stage from the Lobby (Source: ADF Flickr)

At the other end of the lobby is Stage: a big space that is reconfigured for every event held. This means literally stacking / un-stacking chairs and tables, arranging them as needed, taking "the stage" when giving presentations and so on. The space is used for lectures, workshops, evening events and so on, and is quite malleable for the different purposes. Below are few examples of how the space is configured.

Picture 15: Stage in "lecture mode" (Source: ADF web site)

Picture 16: Workshopping at Stage (Source: ADF Flickr

Picture 17: Stage for group work
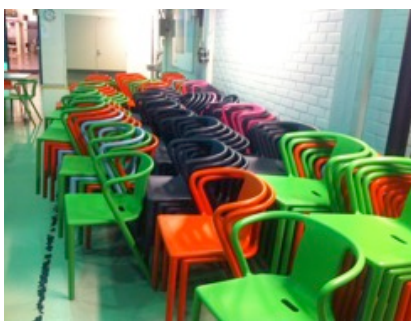
Picture 18: Stage and its chairs, all 200 of them

For me, the Stage was the venue for one bigger course I observed during January-April 2011: "**Interdisciplinary Product Development".** The course has previously been called "Industrial Design", and the 2011 course was the first held under the new name and renewed content. "Interdisciplinarity" as a concept is of course very explicitly present at ADF. It is a term used by ADF repeatedly in its annual reports, course descriptions and other materials Below is the course description from the course web site:

> "The aim of the course is to give the participants an advanced understanding of tools, methods, and theories of product development. The course initially develops an understanding about the product development process and its main phases. Special focus is on methods and tools that will help interdisciplinary teams in productive co-creation of products, related services and in common, competitive innovation concepts. Aimed at students with their background in engineering, design or business, the course is designed for participants interested in product development of capital or consumer goods."[97]

The course was an advanced specialization course, and compulsory in IDBM masters and optional minor studies program course. The course I followed had 55 students, of which 16 were of the IDBM –program (mainly from the business or design backgrounds), 35 engineering students (e.g. mechanical engineering, wood technology) and four from the Aalto Business School. All students were as required master's level students, with 18 students who had five or more years of studies behind them.

The course was led by ADF's Director, Professor Kalevi Ekman and it featured a number of guest lecturers. Professor Ekman had in previous courses submitted an "Initial state survey" to participating students in order to find out student's current level of understanding of product development. I had the chance to add two questions to the survey:

> 1: What does 'interdisciplinary' mean to you now? What are your hopes and expectations for its manifestation during the course?
> 2: Try to define the core competence elements of the three original major disciplines of Aalto University. Do you feel that you are part of a certain 'discipline' yourself?

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[97] https://noppa.aalto.fi/noppa/kurssi/kon-41.4003/esite (accessed 15.11.2012)

Students answered the survey during the first lecture, 55 answers overall were collected, I made copies of their answers and analysed them.

How then did the students' responses represent interdisciplinarity? The main representation that emerged is that of **"difference"**: different people, backgrounds, skills, specialities, fields, points of view, circumstances etc. In addition students used words like "variety" and "diversity" that imply the existence of separate entities. There were only a few opposite representations to the discourse emphasizing difference: "holistic approach: let's forget separate disciplines" said one answer. However, even this answer did assume the existence of these special fields of expertise.

The differences mentioned culminate in mentioning the three disciplines of Aalto: engineering, art & design and business. Of course, the whole discourse of Aalto University is based on the fact that it does combine these three distinct disciplines, and it is a representation that has been strongly present in all communication and branding work. Below is a quote from the Aalto University Rector Tuula Teeri, from her "inaugural" breakfast session with students (1.4.2009)[98]:

> "I've found an awful lot of inspiration in your feedback, and here's a sentence that really got me: 'where science and art meets technology and business' [quoted in English]. This crystallizes the fact that there is no intention to dissolve special characteristics, rather, this is about creating spaces for meeting between these fields so that collisions would be born in these spaces, as well as inspiration from all that can be created through connecting fields."

Thus the respect for the history and cultures of the separate schools merged together to form Aalto also creates a strong representation of "these are our three disciplines, and they are very different" that seems to permeate very strongly to student level as well. It is a self-evident reality for students as well, since "engineering", "design" or "business" is still a guiding structural division in curriculums etc. for some time to come[99].

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[98] Transctibed from a video that was posted in Aalto website, not available anymore (as of 1.11.2014).
[99] One manifestation of the "new Aalto" is the Aaltonaut programme. It is a Bachelor's Degree Minor Studies Programme in Interdisciplinary Product Development. The first students from the fields of design, business and engineering began their three-year Aaltonaut studies in 2013. Aaltonaut aims to educate its students on different aspects of product development, "reinforcing an entrepreneurial attitude, and improving working life skills" (http://aaltonaut.fi).

However, the picture is not so one-sided. The students' answers also emphasized that interdisciplinarity is about people and personalities collaborating – not so much just the putting together of abstract skills and knowledge. It is collaboration of the whole human beings having the skills. Emerging from the answers is thus a discourse that sees that at the core of interdisciplinarity is a process of "bringing and coming together of individuals". This process is expressed as collaboration, co-operation, joining forces, teamwork, communication, "coping with each other" and interaction. The emphasis on people was clear also in the answers about hopes and expectations for the course: students wanted to learn team-work and co-operation skills, new ways of thinking, to broaden their own horizons, learn from others, and even learn to cope with potential "friction" arising from the differences – not so much new "knowledge" about the content of the different fields of study.

Interdisciplinarity was also regarded as being a certain kind of attitude: being open, tolerant and flexible, and "not being afraid to address issues or try out things that seem risky or stupid at first", as one student put it. It also requires the creation of a common ground and shared language.

Finally, in order to have a need for interdisciplinarity, people need to have a common goal or purpose: "a common project"; "to create something great", "to try to invent something new", "put noise in the process to make evolution easier"; "to create feasible viable and desirable products and services". One student wrote about creating the "greater idea: in this case 1+1 might be more than 2".

Students were also allowed to express themselves by drawing, and below are apt visual representations for interdisciplinarity within the Aalto context, with the three disciplines distinctly present.
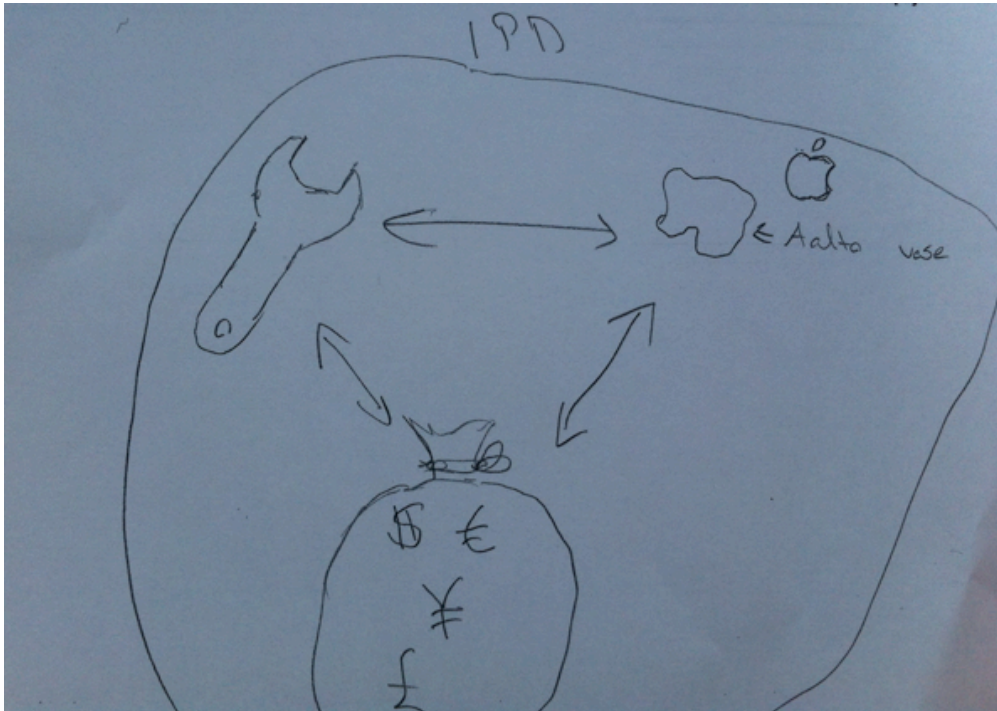
Picture 19: Bringing together the three disciplines of Aalto: student's depictions

Of course, interdisciplinarity meant absolutely nothing to some students – or if it did, the connotations were mostly negative:

> "Like I thought this was a course on industrial design, but as a huge surprise this course had changed and now IDP. My first reaction was probably like 'what's this now, hope it's not horrible crap'…the whole long English word that starts with an I, I had no clue what it meant."
>
> Engineering student (SE11)

When I asked the above student after the IPD course had ran for a while what he thought of interdisciplinarity now, he said that "*well yeah, it's been made pretty clear that the its the co-operation between three schools or like three disciplines what it is meant to mean*".

Thus the foundational concept of Aalto as enabling the coming together of the three original disciplines that make up Aalto is very strongly present in the context of ADF and the IPD course as well. How then do the students represent these disciplines?

"Then I came, I came to the PDP –course like, when there was the first lecture where the course is just introduced. Then I was really in a panic because I was like 'oh how many 'teekkari' [engineer], all men!'…And I did recognize a few design students, 'cause you recognize them first from how they dress…"

Staff member, business student (SE2)

Once again, a picture is worth a thousand words. Below in Picture 20 is a sketch by one student, making it clear that the tongue-in-cheek stereotypes of the three disciplines are alive and well: designer is artsy with a bohemian scarf, business major ("kylteri") is at home in corporate setting with a briefcase, and the engineer ("teekkari") is the nerdy book-worm calculating equations. The captions read: "This is like designer because he has a pencil and a scarf – this guy is an kylteri [business student], 'cause he has an briefcase and nice clothes - and the last on is teekkari [tech student], and he has an eyeglasses – but they still can work as a team."
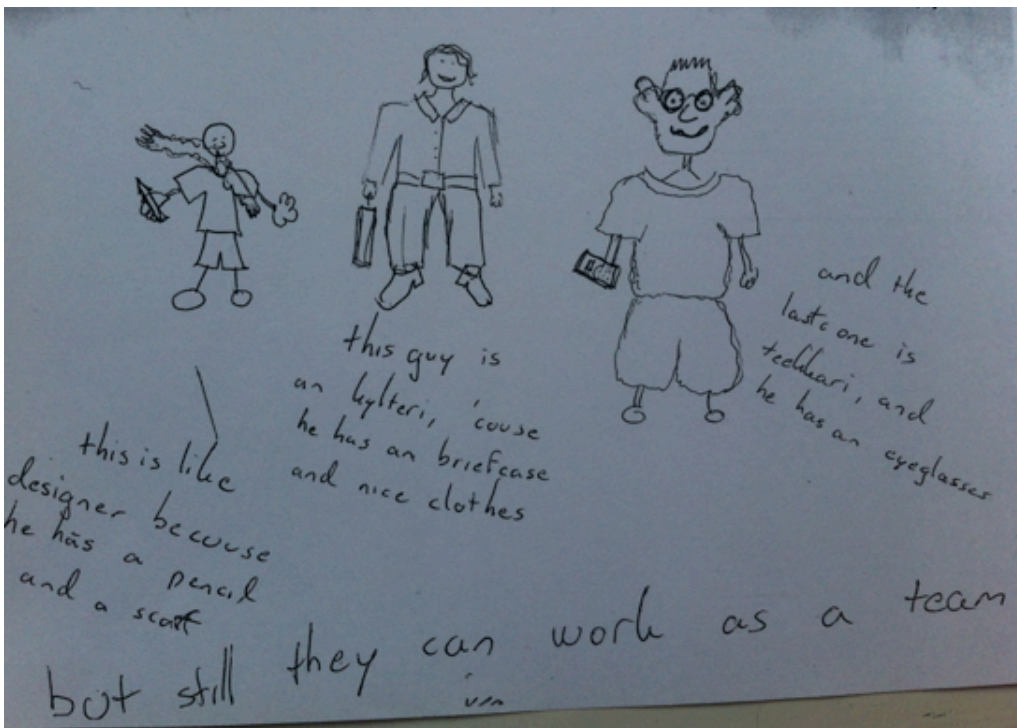
Picture 20: Student's sketch of the "caricatures" at play at ADF

A similar description was given by another student when talking about the merger of Aalto, the challenges it faces as the three schools have their own strong traditions as well as prejudices of the other schools.

> "The business students have really strong traditions, and they feel just like tech guys, that now we go and break these traditions – that now the damn 'teekkarit' [tech students], they just hang around in their student overalls, have their 'dinings in' ["sitsit" in Finnish] and drink and sing. And then the 'kylteri' [business students], they have their damn piqued shirts on and hair all done up, in design sunglasses. And then somewhere are the designers in their damn velour jackets – kind of that's the stereotype, that makes it [the merger] difficult."
>
> Engineering student (SE17)

The results imply a strong style and identity related to the different disciplines and people representing them. In addition being a representative of a discipline includes its bodily manifestations. These were re-enforced in my conversations and interviews at ADF: *"well I'm a really typical engineer"* was a common quip. I overheard also how people good-heartedly chided each other *"well you just think like that 'cause you are an engineer'"*.

> "…like I noticed that I was thinking the whole time, engineer that I am, I don't want to think that I think like that because I am, but I did notice myself that the technical implementation, I think always that how can I build something. I don't usually draw in the process, I just start doing. But then in our group we had a designer who then always thinks like 'no, we have to think who sits in it, how he sits and at what height and how the balance goes and stuff, so there you saw how your own way of thinking is pretty one-sided still, and then when you combine them, so…like you see that 'oh I was again being the engineer'."
>
> Engineering student (SE13)

What these representations however meant was that some students felt they were "trapped" as the representative for the whole discipline, even though the individual in question felt to be "not so typical" or that the whole discipline was misunderstood.

> "Well maybe I fell that marketing, well marketing always has the problem, that one thinks it equals sales. Still, it's just weird that still it feels like that, the word hasn't gotten out that it's not just sales but it consists of a lot of other things, it is a broad entity…like in our group especially in the beginning, it showed a bit like 'well this is this, let's do the marketing plan and them let's move on to the other stuff'. And I tried to really underline that hey it doesn't go like that that this is a bit in the beginning but instead that these things should go all the time in parallel. That you can't do them separately."
>
> Business student (SB1)

Considering we are at a space that is called Stage, it is tempting to continue with the theatrical metaphors: the "production" of interdisciplinarity at ADF is thus filled with a stock of "characters", that each seems to play partly a pre-set role in this interdisciplinary production. This might imply a certain friction or a struggle with the aim of the ADF to "encourage all students to challenge themselves in an interdisciplinary environment, have the guts to try new things and let ideas fly" (ADF Annual Report 2010-2011, 19). This "challenging" was treated a touch cynically as well; one business student for example commented ironically that she was now more creative as she had started to wear a scarf around her neck – i.e. she was boldly representing "creativity".

If interdisciplinarity thus quite strongly relates to the three main disciplines of Aalto, does then everyone know where he or she stands? During the first lecture at IPD, students were asked to position themselves on a whiteboard using a post-it. The whiteboard had ENGINEERING – ART&DESIGN - BUSINESS as sections at the top. This was an interesting exercise to observe. It seemed to be not straightforward for all as there was some pondering, placing post-its "in-between", changing the position, talking and laughing in front of the white-board, joking about one's own position etc. Some students first placed their post-it to one position, and then, as they saw how others were situating theirs, ran back to the whiteboard and changed their post-it to better match those of for example their friends. It also seems that people tend to create a "continuum", and place themselves along this, not to the extremes, and as such want to be somewhere "in the middle". In the end, the identity of a student as a representative of a "discipline" is understandably dependant on many factors, but a majority did equate their position to their major subject.

Picture 21: Positioning of students

There is one interesting exception to the aforementioned specialized division of styles and identities: the IDBM program (for its brief introduction, see Chapter 8.3.1). Conversing with these students I was struck by the struggle they were having attempting to "place" themselves somewhere within the Aalto structures. In fact, many found it important to stress that they in fact did not belong to any of the disciplines.

> "If I had to say how I describe myself, then it would be maybe like…I often say that I am a designer, but not an industrial designer…And then I usually just say that I study now in the IDBM –program. And then, I try to mention also that I have studied other things as well, I have studied leadership and then design management, that I have tried to make this my thing kind of broad."
>
>> Design student, part of IDBM (SD4)

> "And for example I have found out in the IDBM-program that there especially people have specifically wanted to come to that type of an environment, like they want interdisciplinarity and want to be with people from different cultures. And on the other hand I have noticed that there are a lot of people who really couldn't care less about those things."
>
>> Business student, part of IDBM (SB2)

These students also had a very broad notion of interdisciplinarity, and gave it value already in itself. I found their kinsmen and women outside IDBM as well at ADF.

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"Maybe I understand it [interdisciplinarity] so, that all knowledge is good for you. So I think it so that you can study like anthropology and then look at cultural studies and then management and marketing and why not like wood technology, what-so-ever, and all this knowledge is good, you understand more all the time, understand the bigger picture in a way about things. Like myself I like that I get be with different people, who in a way think about things different from myself. It is a bit heavy sometimes [laughter], but kinda nice."

> Design student (SD4)

"For me interdisciplinary is really like a value in itself, so that I did go after it."

> Engineer student (SE5)

"It [interdisciplinarity] manifests like if the other person comes up or knows things, that makes you feel good in the sense that 'hey, I had not thought of that 'cause I either I think differently or simply don't know anything about that"

> University student (SU1)

"Yeah well maybe I see it [interdisciplinarity] as a kind of understanding of others and kind of being ready to learn, it's a bit difficult to articulate, that, yeah, general enlightment [yleissivistys] helps a damn lot….a bit like curiosity towards the world and such"

> Design student (SD7)

The last quote echoes of the traditional view on universities where the "enlightenment" and general education of people is seen a value in itself, and the good Finnish word for this is used - "yleissivistys" - that does not translate well into English. It implies a combination of formal education, culture and "education of the heart". What emerges is a representation of interdisciplinarity that is not just contained to solving a particular problem more creatively, but also encompassing a broader worldview without first thinking if a certain piece of knowledge is of practical value.

8.5 Machine shop: still engineers' playground?

At the side of the lobby, as well as downstairs in the basement there are the prototyping facilities. Machine Shop is the place to make various types of prototypes, and includes milling and drilling machines, lots of hand tools, grinding tools etc. Electro Shop guides the students with the electronics and software issues they face in prototyping. Cut & Ink is a small lab in the basement floor of ADF designed for making stickers, decals and various prints. There is also a metal shop, paint shop and wood work shop at Puuhabunkkeri (the Activity Bunker).

Picture 22: Machine Shop, Puuhabunkkeri and the power of prototyping (Source: researcher's own, ADF Flickr)

I observed the staff to be very helpful, always showing me how the shop operated when asked, safety issues are first and foremost, and the shops were much used especially as the

courses neared their end and the prototypes were to be finalized. However, the shops are potentially more familiar to engineering students than to students from other schools, and as such potentially experienced as more accessible to these students.

The intended and desired presence of all three Aalto disciplines in the practices of ADF is clear. However, as an outside observer, I found a strong emphasis on engineering practices quite obvious, with the "shops", the focus on prototyping and using the equipment as much as possible, and that the Design Factory Director Kalevi Ekman is strongly associated with (mechanical) engineering. Also the fact that ADF is located in Otaniemi, the cradle for the School of Technology, attaches to ADF certain connotations. Once I learnt more about ADF's history, this is not surprising, and in fact very natural. However, what was somewhat surprising was how this "bias" was played down in the official discourse and even to some extent in everyday practices at ADF.

The ambitious goals stated by ADF call out for representing the whole Aalto, as the picture below, taken from ADF Yearbook 2011-2012 demonstrates:
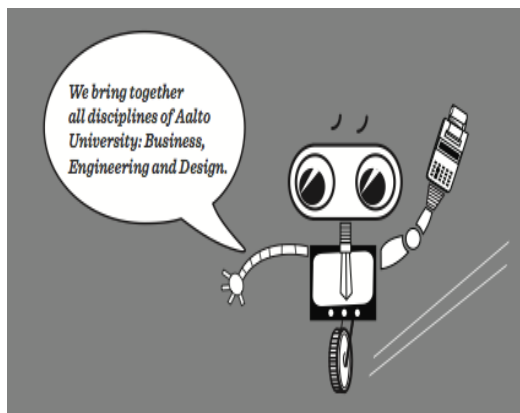
Picture 23: Bringing together the disciplines. Source: ADF yearbook 2011-2012

From my observations, however, I sensed that at least at the time of my stay, the "inspiration" served mostly (mechanical) engineers and to some extent industrial designers – but very notably less the business students. This is partly the result of the aforementioned lack of knowledge about ADF among business students. Said one business student: "…now they

have succeeded to add the design around engineering, but still marketing, customers and the broader context is given too little attention". The ADF and its courses were at the time of my on-site research still not very known among business students.

In addition there were comments that it was quite difficult to fit the ADF –courses into the then actual (as of 2011) Business school degree structures without them creating a lot of extra credits that one can not really use. This results in business students being in clear minority in the projects, and this causes some challenges in making the teams and different perspectives "equal".

> "…I feel that the marketing-side has been looked at less just because I am alone and then when I try to say my opinions [laughter] or views, there is, like there are the eight opposing forces [engineers] there anyway…"
>
> Business student (SB1)

However, also students from the Design School made similar comments, even though for example the PDP –course is obligatory for Industrial Design –majors, and thus design students are much more involved in the activities of ADF.

> "For example in PDP has the problem, that if we think from my viewpoint, so most of these people don't know what an industrial designer does in practice. And then here there are no tutors, who are designers, so like in a way if you ask people of Design Factory, then they have, can have a really different viewpoint to what a designer would say... And we are a bit in a minority, so there will be communication problems..."
>
> Design student (SD3)

This also resulted in potential prejudices.

> ."…as they usually say, that the connection between tech students and designers is pretty bad, and that they have totally different goals, that they are like kind of a certain kind, I wouldn't say that I have had like prejudices, but maybe like a bit like confrontations before this course. What I have noticed is that maybe like half are true, but that there is, really I think, a richness that you have people from different backgrounds in the team."
>
> Engineering student (SE6)

In most interviews, the engineering students had little difficulty in describing what they had done in projects, or what their input was. It was the business students (and the possible

students from outside Aalto, few of whom I met) that clearly struggled to make themselves useful, and others did note this as well.

> "But I often say, that I like don't have 'specific skills' so to speak. Like in a project, there's really often like OK, we need to do some publishing, then it's the one from Art & Design School because they know how to use In-Design. Or we have this electronic element, ok you are from electronics, you do it. But then often we have like I am from Business School, what do I do? The skills we learn are maybe not so clear-cut, so really often you need to search for your place and really think what it could be. And I found it here too in PDP that really often the business people were those, what were those in PDP, finance guys, who then in practice tape receipts onto paper."
>
> Staff member, business student (Staff2)

> "…Well like with Y [business student] it like happened, that Y never in any stage got a good role in our project…That was a bit strange that some time beginning this year we were talking of roles, so then the project manager like went to blurt out 'so Y, what was it your role was again'. And that was like not so nice, at least Y felt really bad about it.
>
> Design student (SD3)

> "…there is a kind of uncertainty, like what should I do, and you are like can I help at all in this, or am I being at all useful."
>
> University student (SU1)

Fundamentally, bubbling beneath the surface, was the bigger issue of what "constitutes" the interdisciplinarity at ADF.

> "As a designer, I really benefit from this thing, it's a dream come true… What is missing is sociology and humanities, I think this would benefit from still a fourth wild card. Well, in fact I have been a bit disappointed, to be really honest, because this interdisciplinarity has been kind of within certain limits, which I find to have been a bit boring. Like I miss even more like, or miss more like interdisciplinarity, in a way that it would be interesting to work with for example linguistis. It limits to, the so called interdisciplinarity limits to just that, the business sciences, engineering sciences and design. That you don't kind of go further than that."
>
> Design student (SD4)

The above quote indicates that some felt that the "easy road" had been taken, and more variety in lecturers would have been beneficial. One student recollected how she had learned great new insights from women's studies[100] and from a youth and popular culture researcher

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[100] Coincidentally, women's studies has often been cited as one of the forerunners in interdisciplinary research, for example Klein (2008) refers to it as an interdiciplinary field that had its impetus in the life experiences of the researchers from various disciplines.

whose lectures she had attended. Thus the "promise of interdisciplinarity" at ADF created also strong expectations from the behalf of the students, and the feeling that interdisciplinarity should encompass more than just the engineering, business and design domains.

8.6   Kafis: sinking into the space

As we move away from the lobby area, and past the Stage, we enter a corridor with big notice board on the other side, and on the other side there are smaller spaces for silent work or teamwork. The notice boards are filled with flyers that the PDP projects have created, as well as clippings of ADF from the media (the Jungle Drum).

Picture 24: The notice boards and corridor leading to Kafis

At the end of the corridor is the heart of ADF: Kafis. Opened in 2011, the space combines an office, kitchen and café, in order to "enhance knowledge and idea sharing within organizations…The tools and environment increase opportunities, harvesting tacit knowledge, connecting organizations, projects and people" (from the Kafis flyer, 2011).

Picture 25: Kafis, the heart of ADF

Kafis houses several ongoing weekly events, for example on most Tuesdays there is "Breakfast at DFanys", that is organized by the PDP projects, sometimes by the staff and at times by the collaborating companies.

"… like the breakfast that is here, I think it's just a brilliant idea…like such a simple thing as a breakfast, like it can so empowering, because you immediately get the feeling that the day is starting and we are starting it together with conversations."

Design student (SD5) of Breakfast at DFanys event
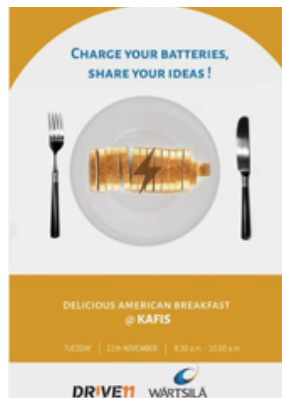
Kafis to me represents both the importance of the physical space as facilitating interaction as well as the potential manifestation of the "community" ADF aspires to be. This communal

aspect of ADF - or more fittingly, evoking a sense of family – is a strong discourse in all material generated by ADF staff. The kitchen that is available to easy use, the big table around which it is convenient to meet, and the comfortable sofa area meant for lounging all enhance the notions of family. The ADF Facewall that illustrates who work at ADF or otherwise are often present further accentuates this feeling of "family".
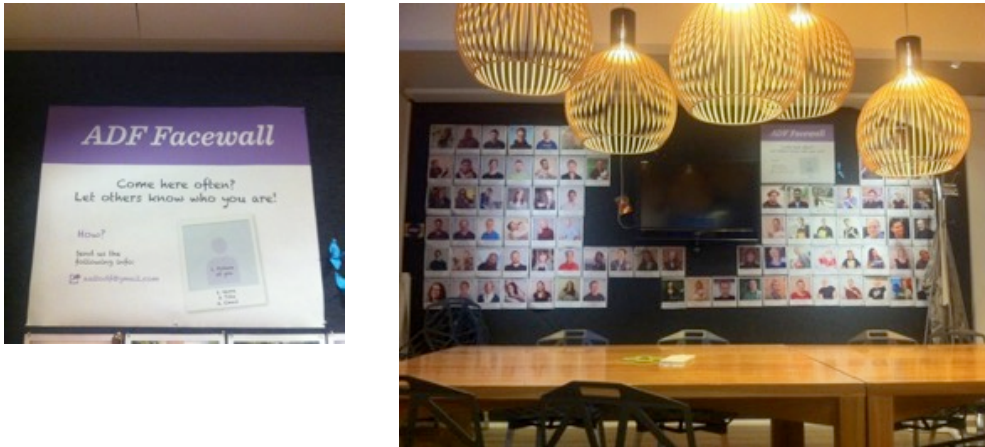
Picture 26: Kafis Facewall

Kafis also has video screens with real-time connections to the Melbourne and Shanghai Design Factories. I remember once when visiting Kafis someone started waving at me from the "window to Melbourne" – it was a member of staff who had moved to Australia to get the Melbourne Factory up and running. We were both getting coffee and exchanged a few words. This made the global network of Design Factories feel quite "close" indeed.

In addition to the community-building practices I observed, Kafis also brought to light some of the more routine-like practices of ADF. Below is a "day-in-the-life" –type of description of a typical morning I had at ADF.[101]

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[101] The following is not a direct quote from my field diary. Rather, it is a composite of many entries and recollections of my time at ADF in 2011. It is semi-fictional in the sense that the events did not happen as such on one particular day, but also factual as all of the things did happen on some instance.

As I enter I first check the noticeboard at the Lobby to see what's happening today, who are visiting and so on. I say Hi to the people sitting at the Lobby sofas, and head to the cloakroom to leave my jacket there. I then head through the door towards Kafis, checking out what's happening at the Stage through its glass door – a lecture seems to be taking place. I also see if the silent rooms are free and glimpse who are meeting in the group-work spaces.

I enter Kafis and wave a general good morning to all there. I head to the coffee machine to make myself a cappuccino, just to find out that there are no clean coffee mugs. I so walk over to the kitchen area and check if the dish washers are done. I find a clean cup and return to get my coffee, digging out the coins needed. I enter a conversation with PDP students I know and ask about their project. It turns out they have ordered some materials by accident, and wonder what to do with it as it now resides at the Lobby floor. A machine shop staff member joins in and assures the students not to worry, some use for the material will be thought of. General laughter erupts as potential uses for the materials are imagined. The project manager looks slightly worried though, as time is getting tight in getting the new material.

Director of ADF, "Eetu" Ekman walks through Kafis. He is stopped by a student asking if his project could implement some location technology into ADF and tag its visitors. Eetu comments that of course it is OK, but reminds of the need for very transparent communication about the tags.

People from one of the start-ups located at ADF come in with a visitor, get their coffee and settle in for a meeting at the sofas. I sit down at the table checking from a member of the staff how much the different shops are used. Lots of people flood the Kafis - the lecture at Stage is having a break.

I put my dirty cup in the dishwasher marked "Dirty", and head to the Lobby to catch up to the PDP students who are having a project meeting.

The above illustrates how it became a routine to check what's going on at ADF, get coffee from the Kafis, have multiple conversations whilst there, as well as treating the space a bit "homelike", putting dirty dishes away and so on. I observed these practices to be routines for others as well, as usually I met familiar faces at Kafis during the morning hours. Thus ADF was not all about practices directly involved with the projects and courses, but very much also about the mundane routines in which many participants engaged in.

The routines were encouraged by the spatial design of ADF. Through Kafis it is possible to examine the overall centrality of the physical space layout design to support the goals ADF has set for itself. One possible way of approaching the space of ADF is to ADF as an example

of the future workplace, office or creative environment; that is the spatial design principles that are seen as fostering creativity in contemporary organizational context. There was something more, however, to what I observed and experienced. First, it became evident that the space affected everyday practices, both very explicitly and at the same time at a subtler level. For example the simple everyday action of "getting coffee", that elixir of student life, was made into something more:

> "…at least I experience it so, that here there is a kitchen and it is said you can't bring a coffee machine anywhere else, because the kitchen is the place, and it's the only place to drink your coffee, so to speak, or make it. So I think it's clearly a thing and a design philosophy thing. And also that it's a bit home-grown that people like it here."
>
> Design student (SD4)

Picture 27: The much used coffee mugs of ADF (Source: ADF Flickr)

In 2011 the layout of ADF changed so that everyone "had" to get their coffee from the "Kafis". This ensured that students met, staff mingled with the students, companies located in the premises held small meetings in the space and so forth. One member of staff used the term "planned coincidences" to describe these types of interactions that took place outside courses within the every-day activated of ADF. *"It's a bit like working under the radar",* she said. It is thus important to remember that these practices are "managed", as I will explore later at the staff wing in Chapter 8.9.
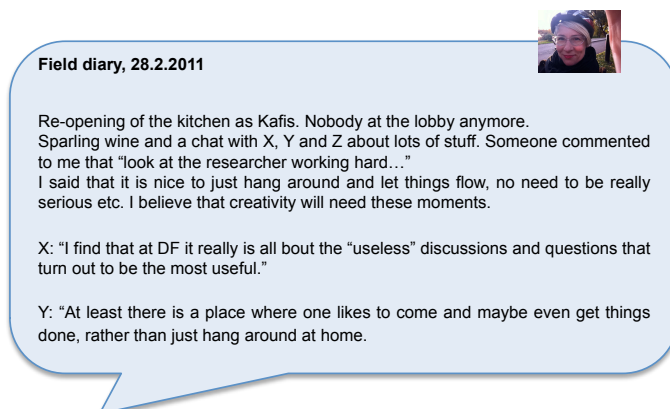
Second, the way the physical setting was referred to by the students was touching: there was a strong appreciation of the place - and its staff - as a being there truly for students.

"I think this place is fantastic. Like so that its so easily approachable over all, and like such good places to do group-work and stuff, which I have not experienced anywhere in Kauppis [Aalto Business school]. There is the problem that yeah there are group-assignments, but you fell you do them in cafes almost or someplace, there are no spaces for them… And this makes people more able, its much easier to do things together and maybe create something rather than being in a noisy auditorium-sized space where you can't even hear what others say so it's a bit of different thing. And there are really well like drawing boards on the wall where you can draw and visualize things…"

Business student (SB1)

The above quote illustrates how being in the "wrong" place makes collaboration hard already as a sensory experience: there is noise and you can't hear others, there is no space to meet, and no tools to enable for example drawing. Just having group-work assignments but no enabling space does not foster collaboration, seems to be this student's experience.

I experienced the effects personally as well. Below is an extract from my field diary.

Field diary, 28.2.2011

Re-opening of the kitchen as Kafis. Nobody at the lobby anymore.
Sparling wine and a chat with X, Y and Z about lots of stuff. Someone commented to me that "look at the researcher working hard…"
I said that it is nice to just hang around and let things flow, no need to be really serious etc. I believe that creativity will need these moments.

X: "I find that at DF it really is all bout the "useless" discussions and questions that turn out to be the most useful."

Y: "At least there is a place where one likes to come and maybe even get things done, rather than just hang around at home.

Two things stand out from the above extract. First, the opening of the central hub "Kafis" suddenly altered the whole atmosphere of the place: the lobby area became almost deserted. This implies that the physical surroundings affect very concretely how people inhabit a space. Second, the environment gave way to "useless" activity that had no direct purpose or goal. It gave value to the seemingly inefficient moments that are inevitable in every working day, and instead of trying to minimize them, in a way almost revelled in them. The resulting effect was surprisingly emotional and embodied. The notions of a "garage" and "home" were often used to describe ADF, both of which imply a somehow embodied venue of being – one that is constantly at your disposal and houses your "stuff" which you can retrieve when you need to.

"We meet here, we have a place to keep you stuff, and we can constantly talk and be with our stuff. This is kinda like, how shall I say this, like your own garage, if I had one, where you can go whenever you want."

> Engineering student (SE4)

"…kind of like this like my home like you can do things, move stuff around and touch."

> Business student (SB3)

One student used an expression of "*sinking into the environment / space*" at ADF, in describing how their group used the various spaces "within space" that ADF offered, for example deciding to explicitly change venue for brainstorming in order to "sink into" the activity.

Thus ADF as physical place is seen as supporting the tasks at hand, and at the same time generating a feeling of appreciation towards all users, regardless of status or background. The space itself communicates ownership and empowerment. The physical space signals "a work in progress", gives license to act, empowers and values all users of the space. In order to fill the space with interaction and collaboration, the space also gives value to informality and "being useless" by enabling them.

"…like many times we have wondered that we stay there at the couch, just sit like we're stuck, like we have no reason to be here…"

> Engineering student (SE13)

"There's a spirit of creating something new… This is like a space for free creating, or like working to develop something…"

> Engineering student (ST2)

"…the ownership in this environment, it's communicated so well, that it is the people here that they kind of own the place. And you can modify the rooms and give ideas and observe needs for changes and then suggest the changes, so it creates like ownership. This is then the opposite of some kind of bureaucratic machinery…"

> Design student (SD5)

However, as one could expect, there were opposing views as well. Some students felt that the place was just applying cosmetics to disguise the blemish, so to speak. One student recounted a particularly illustrating analogue he had heard:

> " yeah the spaces [ADF] are sometimes pretty ok, but [laughter] the designer in our group gave a really good example. He has this Danish design coffee mug that has like two exaggerated big ears on either side. Its made of really garish plastic, like dirty orange and supposedly you could run your car over it and it would not break, so like our designer said that this mug is a bit like Design Factory. Really stylized, somehow a bit of an odd color but then in use compared to a normal mug, completely useless."
>
> Engineer student (SE17)

The comment seems to imply that while its nice that the physical place is different and "designed", on the other hand it needs to be useful when needed – the material infrastructure needs to support what needs to be done – not just be different for the sake of being different. This was echoed in another comment that was made about the overtly "managed" way of being "relaxed and creative", highlighting the difficult balance between what emerges from the practices and what is managed (or downright felt to be manipulated):

> " …this has been, like, this plastic, artificial feeling weird bubble a bit. It's getting better I think, but like there is such a feeling of trying hard, like now we are these young hip innovative types, look at us, we have this office that is like so laid-back, we have the Fatboys [sack chairs] and all…"
>
> Design Student (SD7)

However, even though the students often realize that the space design is explicitly meant to foster certain type of behavior, it is not necessarily seen as a negative thing.

> "…we were in fact discussing lately with other guys starting here, like what is more here important, people or space. Like what is, kind of, more crucial, if there wasn't space, just people would it be the same, and it wouldn't be just the space without people.
>
> [Me: So to what conclusions did you end up with?]
>
> …That one's fuzzy, and probably something around fifty-fifty. And then I just realized that, like, people have been thinking about that on purpose. It's not like accident that it has happened here, and that's so like exciting…"
>
> Engineering student (SE14)

The space is thus experienced quite differently and at the same time reciprocally the space "exists" only through these experiences. Thus the space is not the "same" for all its users; instead it emerges from the personal embodied relation of each individual.

8.7 Brain Storm: exploring the interdisciplinary knowledge creation

As mentioned, along the corridor leading to Kafis, there are two spaces for groups to meet, Brain Storm and Birch. Here I observed few PDP –teams as they were working. In addition I observed the final "check-point meetings" of 13 projects (out of total of 15) which involves the team presenting their current status to Professor Ekman and reflecting what still needed to be done before the final prototype was to be presented in the PDP Gala later that spring. I also interviewed most of the project managers of the teams in order to get additional insight into their organizing practices.

Picture 28: The group work –space Brain Storm

Overall, the teams were quite varied in their composition, but all had participants from at least two of the main schools of Aalto University (business, technology and art & design) – the business school being however clearly the most under-represented. The process through which the teams were created was based on the wishes of the student's themselves as they applied for the course, i.e. they had to name the sponsor and project that interested them (and

also if they are interested in being a project manager for the team), and then the chosen project managers and the course coordinator from ADF together finalize the teams. In addition to Aalto University students, some groups had foreign students as well from collaborative universities, participating from distance e.g. from China or France.[102]

8.7.1 Organizing for interdisciplinary collaboration

How then did the PDP teams organize their work in practice? The teams are not given many limitations or structural guidance - they have to work their way of working out themselves.

> "So like in principle we have the final deadline, that the prototype and report is ready by then, and the milestones in between are done so that the team has to set them themselves…Like really in the beginning we do the design brief and project plans, so in the design brief we define what really is, what really is to be solved and a agree a bit on that, and then in the project plan the milestones are independently defined and we go through them. So we have not set the milestones, the team in principle sets them themselves and suggest them to us, and then hopefully they can keep the timetable they have set."
>
> Staff member (Staff1)

For example I observed one instance where a project manager complained to Factory Director Ekman that some team members were not interested anymore, and motivation was lowering. He responded "*You make your rules as a group, as decisions are made by those who show up. As a team you also decide how you as a team will do the things that need to be done.*" The strong message was that teams needed to sort their challenges out themselves.

The projects took several different routes to getting their projects going. Some relied on dividing the tasks according to the apparent skills the team members had. The team is divided into sub-teams accordingly, as is the task at hand that is also divided into corresponding sub-tasks.

> "And we have really worked so that we have divided it fully so that there is the software side, the engineers and then design and marketing, and all work in their own group as their own team."

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[102] During the project the geographically dispersed teams did meet, as there was a budget allocated for travelling. Overall, the practices of interdisciplinary knowledge creation in such teams that had both divisions of disciplines as well as of geograhical distance would have merited more analysis. However, I decided not to include this aspect in my research due to the focus on collaboration within ADF premises.

"…the division was clear right there when, like we had two electrical engineering students, and then we had – if you don't count me and J [vice-project manager], the we had tree mechanical engineers and then one industrial designer, so there we had quite clear groups then, like how we do it."

Engineering student (SE4)

"…I have to say that maybe a bit unfortunately we pretty much went along the lines of what people know or think they know…"

Engineering student (SE3)

Why then did this type of collaboration emerge? The reasons seem to have been two-fold. First, the existence of natural and strong divisions between disciplines as sub-groups as well as having potential other dividing factors such as geographical dispersion - either location of some members in another country, or doing their daily work conveniently somewhere else than ADF.

"…we had, yeah, right from the beginning…of course they weren't really independent at the start the sub-teams, but yeah we had them right from the start…they were pretty much the designers and engineers. It was already because they see each other often at TaiK and do their work there and they maybe have other courses there with each other and so on"

Engineering student (SE6)

"…well it's pretty clear of course we can create the divisions real easy to two functional teams so that the other is of course at this end, here in Finland we have five guys and then at the Shanghai end there are four guys, so there is one pretty natural division….so there is kinda another division maybe so the technical side and then this more like design and idea generation, service concept oriented stuff, that was, kinda, like been separate."

Engineering student (SE3)

As I talked to the various team members I sensed that if the team had these types of "natural" divisions, then the resulting way of collaborating "just happened" quite organically, that is, it emerged as the most pragmatic way of working, not so much from an explicit decision, and pragmatic reasons also sustained the way of working.

"Yeah it's been a good way, but on the other hand maybe we could've, at some point I tried it, that we combined work more, so the designers would not have been always one team, but instead maybe the designer and engineer would've been one team. It didn't somehow maybe feel natural, the location was probably yeah one factor. And it has worked in my view like this, how it has been, really well."

Engineering student (SE6)

Second, and almost as an opposite to the first reason observed, the strong management by the project manager towards this type of collaboration was evident as well in few projects. They chose to organize the project in a certain way, based on earlier experiences, own beliefs about best ways of working or reasons of efficacy. This is in contrast to the first observed reason, as this was wholly a managed process, an explicit choice of organizing in this manner.

> "No like really I decided the division like that because earlier when I have been part of those types of multifunctional teams so like I don't believe in the 'let's now do something nice together and accomplish a lot together'. Like it doesn't result in anything but arguments and so on, so that was the reason I divided the group into those minigroups and each group handles its own skills and others help then if need be… We have gone pretty automatically forward and pretty much accomplished something all the time without there having been any stops. So in that sense this organizing has worked out well. And indeed we have avoided that something comes up like 'should we do this' and then no-one really does it, and we just wonder about."
>
> Design student (SD2)

Interestingly, one student pondered if the above type of collaboration was indeed interdisciplinary at all:

> "I think it indeed should be that they [disciplines] should go like side-by-side and not as separate pieces because if we do together then the results is much better…and then what happens if you put it in pieces like that it goes like it has always gone: the engineers do that and marketing guys do that part and like where is the collaboration kinda in that type of doing. Like is it really that anymore…The collaboration is in my mind like the most important thing."
>
> Business student (SB1)

Another way of organizing seemed to stem more from "just" deciding to do things together, or the problem given being so vague that a clear organization would have been difficult to achieve.

> "…like when we have this interdisciplinary team so that first we'd tackle something irrelevant, like here we form the group, so maybe then we don't disperse right away to groups. Like these are designers, these are coders, now they do this and they do that but instead first we do something together as a group. Do something that is new to everyone. And only after that we start doing, I guess it could help the doing."
>
> Engineering student (SE2)

> "I was kinda surprised when there was talk that when we we were able to choose our teams, so it was like 'go ahead choose now an electrical engineer and mechanical engineer and designer, cause then you have a desginer, mechanical engineer and electrical engineer'. Well I got what I got and and I think I got a really good bunch, but we have like no such roles… It has been always like yeah, everyone has been away from one's comfort zone and then at times like totally stupid…it creates that in some case you are in your element and in some cases so totally lost…thinking of learning we thought it best. Like

if we had divided it so that everyone had done according to their own talent, then there would have been missing a lot of that [learning]."

Engineering student (SE1)

"…well we have not done anything much separately at all. It was like really hard to think for example right in the beginning that like ok, this group would do this, and this would do this".

Engineering student (SE7)

"in the beginning we did with the large group, like it was pretty slow, we could've split into smaller groups, we did that too and we always shuffled the cards. Then we didn't have like you are a representative of this school, so you go there. We on purpose mixed things up totally, when we were generating ideas and developing the plans and stuff, so then we just happily did which ever way."

Engineering student (SE5)

So it seems that despite a "push" to choose "a representative" from all disciplines, in some cases the group formed nicely without these "pre-set roles". The groups that were organized in this collaborative manner, however, did utilize the specific knowledge of the participants in the later stages of their collaborative work.

"…once we choose which concepts to develop further and then of course we need to take more into account those strengths and look at what each can do."

Engineering student (SE1)

"…soon as we start the building phase, I am sure there will be like groups who do their own thing."

Engineering student (SE8)

The students also told me about the ambiguous nature of their problem, or their design brief being very broad; thus in order to make sense of the problem, they felt it best to work together without thinking too much "who knows what" because there was a "lack of not knowing" what they in fact needed as a way of knowledge.

"…we were just given a task of 'design an interface. So first we had to figure out what was the problem and then think of the solution to that problem."

Engineering student (SE8)

Interesting to note, the groups within the ME310 course were to my understanding all organized in this manner. They did not have project management, and their problem

definition was also much more ambiguous and unstructured than the ones usually given in the PDP course[103]. The participants of ME310 in fact voiced their frustration in several occasions, and reflected on the difficulties of getting started in such a vague context.

> "Like it didn't really matter, who came from which school and like that, that you learn stuff then during the journey. Because it all stems from the user [as according to the Stanford Design process] like you don't need to be an expert in anything, which I found really interesting."
>
> > Design student (SD6)

This ambiguity of the task at hand was naturally a source of frustration as well.

> "But in the beginning it was a bit, we didn't believe the advice we were given, that one should just like decide to start doing something for first two weeks and if it doesn't work then try something else. But just start doing something like its meant. But as our project was so loose, then making choices was hard and through that the fact that we were from such different backgrounds, so no-one was playing kind of in the most natural way. Or like we were outside our comfort zone, in a really mushy uncomfort-zone, and did not utilize at all what each would do best."
>
> > University student (SU2)

The frustrations also stemmed from the "*wasted time that doesn't result in anything*", which was salient as the projects had, despite their vagueness, strict deadlines. This resulted in uncertainness that individuals coped with varying success and sometimes resulted in downright conflicts.

Interestingly, there was one group that had only male engineers in it – and as such, not what one might label a very interdisciplinary group - but to my view collaborated in a very "interdisciplinary fashion" which contributed to an interdisciplinary learning experience. Their project manager reflected on this as well.

> "Learning a lot programming, I used to think it is very easy and straightforward, now I see it is very complicated, lot of things are correlated and a trade-off, not only from the books. I always coded alone, now I see differnet ways of coding. I like the fact that you build a proto from scratch actually doing something, something that is real in your hand. We met with all these designers and these diffenet people. We had to think more the other side cause we are all engineers, that's been a new thing to do, brings new things to what we do. Made me realize what all that stuff is needed for, there is lot of other things than engineering needed in the world…."
>
> > Engineering student (SE9)

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[103] As opposed to PDP, in ME310 the way of organizing in fact explicitly originates from the design process used in the course, the Stanford Design Innovation Process, and as such it does not stem from the choices made by the students themselves. For more information, see http://web.stanford.edu/group/me310/me310_2014/about.html

I in fact thought about this some more in my field diary after meeting the group:

Field diary, 20.1.2011

When all are "same discipline", more interdisciplinarity learning might actually happen, as everyone is forced to learn and do things outside own areas (e.g visuals, service design). When "representatives" of relevant areas is present, everyone is more likely to stay in their own "box"?

This was echoed by Factory Director Ekman noted to one group, who wanted to outsource some of their tasks to "professionals": *"in other groups they try to do with their own little hands, you might want to reconsider that…"* encouraging the at least trying to do even though the team had no explicit expertise on the subject.

This resonates with my other observation told earlier that these types of teams were not so pre-occupied with the "roles" needed in the team, but took the team as it was, and built from that. It was more the people as personalities that in some cases seemed to guide to organizing rather than the roles that either were given – either by others or the ones one attributed to ones self.

> "…the more diverse bunch of people you have involved right from the start you don't in a way even need to think that 'now marketing makes its marketing plan' or implements it because it has been there right from the beginning and developed together. Maybe that's why we are missing those boundaries because we have all done the same thing from the start, you sort of without noticing think about the things you would otherwise be like 'let's ask our marketing guru' and she tells us her exhaustive answer."
>
> Engineering student (SE1)

> "But if you think another way of saying it, so like a kind of, like in our group we have three very different personalities, and one is really systematic, and then another who gets upset if things don't move along, and maybe then I can handle the uncertainty at some level, but like it doesn't bother me, but then I am not maybe the most productive always…Yeah, but like maybe as a first thing if you come to an interdisciplinary course, you can think like 'what's my role in this project', and that's in my view kind of the pretty wrong way to think."
>
> Engineering student (SE13)

However, not all the team members experienced the organizing the same. Thus what the project manager may have meant as a very inclusive way of organizing was simultaneously experienced by one participant as "*me doing alone at TaiK, and the engineers someplace and the electrical guys then somewhere in the basement and no-one goes to see what the others are doing*". Another example was when a member of one project told me that "*So that the feeling of doing together, that's been kind of missing*", even though the project manager had just told me the opposite, that they did "*everything together*". This once again underscores that participants experience things differently.

Finally, one project manager talked about the importance of motivation, and pondered that the effective organization of interdisciplinarity might be aided if everyone could do what they did best.

> "One thing that's interesting is really what I have learned during this course, is that people are most motivated when they do the thing they know how to do."
>
> Engineering student (SE2)

Regardless of the discipline to which one placed oneself, the group (or at least the project manager) had sensed the importance of giving value to all kinds of know-how that were present in the interdisciplinary group. One's own input needs to be valued, and the resulting mutual respect enables fruitful co-operation. In a way this was present in all the projects I observed: at some point most did divide into task specific activities.

8.7.2 A story of a brainstorming session

In the IDP course (see Chapter 8,4), the students formed interdisciplinary groups - in this case meaning that there were to be participants from as many different schools or majors as possible. The course assignments were then to be accomplished as group work. I was kindly enough allowed to shadow one group of five students around during the course and attend their group meetings. The group consisted of two engineers and three students from the IDBM –program, two being design students and one from business school.

Below is a longer extract from my field diary as I observed the group engaging in its first brainstorming session that was meant to also act as a team-building exercise. It was a gloomy January morning, and we were sitting at the sofas at ADF lobby with coffee cups, laptops and smart phones and the group was trying to decide which topic they were to choose from the given list. The overall brief was to engage in "designing emotions" around the chosen theme. I wrote their exchange down simultaneously as it happened, so the transcribing is not *in verbatim,* but surely the gist shines through. My own comments written down during the process are bracketed.

[The team starts by choosing the idea that is to be the topic of the brainstorming.]

- What does not interest in the least?
- What feelings do these evoke?
- Let's start with what's the easiest!
- "Designing emotions…does this have to be like emotional design or just ordinary design…?
- Hey, should we come up with a name for the team, something really weird…Anything you like…?
- If just everyone marks like a ball next to the one you like, and then let's see?

[Team writes topics on paper and everyone draws a ball next to the topic that is of interest.]

- Oh no, not that one…
- I wanted the laptop cover thing…
- What's winning…

[The team decides on "safety lock".]

- What was the brief again?
- Intuition now to play, so we get moving quickly!
- Huh? The bike lock – I didn't want that
- Hey let's try it, it will work out to something!
- Bike lock, now what kinds of emotions does this awaken in you guys [Ironic comment]
- What kinds of locks are there….
- Alcohol, safety… like if the guy has no helmet…
- Yeah if you think safety like in general.
- What does "lock" mean anyway?
- It is supposed to stop or obstruct something right?

- You can really change the nature of a space with a lock, from a spatial sense it has like many meanings…
- And what is safety….nothing bad can touch you
- Like you have this halo that protects you …

[Laughter. The group divides into two sub-groups. One ponders the meaning of LOCK / LOCKING something, the other what types of concrete locks there exists, Googling for examples.]

- Ok, everyone, let's be democratic, get to drawing ideas!
- Hey, a gravitational magnet!
- How about just like a basic lockable bike stand, c'mon…
- Something invisible would be so cool…
- Or one that moves by itself!
- Guys please note, it says "safety" not "security" in the brief -they are like two totally different things
- So let's think, what is "safety"?
- But safety to whom – to the driver, others, the bike
- Are we to find a solution to everything or…
- Let's think what the consumer would want. It is the stealing you wanna block, like if you have a thousand euro bike….
- In Japan all the negative signs and so on have been reversed into somehow empathetic and cute, colourful and like…we have talked about that a lot.

[The IDBM –course had been recently to Japan on a study trip. One student starts to search pictures from her iPhone to show what she means, and shows them around to others.]

- Or it could be like something so hostile that you don't want to steal it?
- Is this like your own bike or a communal one?
- Lock integrated to the bike or external?

[One student opens his laptop and starts to document the ideas as a mind map using an application on his laptop.]

- Could we like attach a light to it?
- Hey that's a good idea, light always increases safety!
- And some other elements, like fingerprint identification, lights…
- If the light was attached to the bike frame?
- Hey a really good idea!

[A student starts to draw how the light might be attached to the bike frame.]

- And using sounds? Like if a really horrible sound comes out it would be like pretty irritating to steal!
- And if you try to carry it away without fingerprint id, it would start to scream like totally…
- Yeah it could scream in different languages "THIEF THIEF THIEF"

- Or having like a picture of a lion and horrendous roaring of a lion!!

[This was a referring to a similar actual implementation seen in Japan.]

- And there could be an application where you could change the sounds
- Yeah like a monkey
- This is really emotional if nothing else.
- Yeah and tear gas…
- Yeah!
- And if all the sounds and else don't work then you get tear gas or electrical shocks
- Yeah there are electrodes in the handlebar, and send you shocks like at regular intervals accompanied by the lion roaring…!!

[Hysterical laughter erupts after every idea.]

- I gotta say that was a good idea, let's just use them all
- All the emotions are there, indeed…

[A picture of an elephant is shown around. Googling for more.]

- A kind of picasso-esque elephant there…
- And if all else fails, then an ejection seat.
- Or it just sort of dips you over…
- Ok ok, what types of identification are we gonna use?
- Smell?
- Like a periscope could rise…
- The shape of a nose!!
- Yaeh, now just to start commerzialization of this idea…
- Think of all the commercials!!!
- OK, what's the product, let's integrate the ideas.

[The team starts to go through the ideas in the mind map: sound, feeling, sight, hands, smell. Negotiation, thinking, quieter exhange of opinions.]

- The fingerprint ID integrated to the handlebar.
- Yeah, let's do that.

[A "definition" phase follows: the team describes the attributes chosen. Next the team starts thinking of the "alert process".]

- Would that be good if the lion takes a picture and sends it to the owner, I mean if it is a friend not a thief…
- We need use cases, what happens in each stage…
- How are we going to present this?
- How about two stories, like on powerpoint, where the other is that a friend loans the bike and then a thief…
- Let's do a manuscript

> - Good story first!
> - Just the main one, not everything…
>
> [The team engages in planning the manuscript.]
>
> - Pictures would be really good here..
> - Let's go find bikes we can photograph?
> - What's best to convey the idea, something really simple?
> - If we would act this it would be kinda fun…
> - No let's just do a good powerpoint, it's so much easier…
> - Or we could act and the ppt supports it?
> - We need to practice…
> - Or just wing it?
> - No we need to practice…
>
> [One student remembers that a PDP course is designing a campus bike and that there are some bikes downstairs that they have used. The team goes off to find bikes to photograph.]

This longer passage serves as a good demonstration of how the interdisciplinary teams worked together, which types of different views and language-use pops up. The practices that emerge from the above were present also in other collaborative situations I observed:

- The attempt to engage all participants: "hey democratically everyone just drawing ideas!"
- The broad notion of "doing something" (acting, drawing, building, deciding) is strongly present. The overall feeling is that of "action" and with the wish of "let's move on quickly", almost with a sense of urgency.
- The pace of doing is very fast, iterative, the discussion bouncing back and forth rapidly.
- The active use of tools at hand (e.g. smart phones and laptops) is prominent. In fact, this was a salient feature overall at ADF, the students were quite attached to their various devices, and they were used constantly when searching for information, references, ideas, pictures (and not always used related to the task at hand).
- Google search as the starting point of information search, especially Google picture search

- Conflicts and bargaining of meaning, for example: "what is security", "what is a lock"; "what type of a bike are we talking about"; ambiguity around the assignment itself: "it was safety not security, totally different things".
- Taking of roles and positions: the realists vs. the "crazy idea generators", concrete vs. abstract; documentation vs. "lots of talk"
- Negotiating the doing itself: use cases vs. acting vs. power point; "what was the brief again?"
- Importance of appearances: visual representations, presentation format, what does the team want to convey to other teams
- References to other cultures, drawing from own experiences
- Use of humour to engage all participants, lighting up the atmosphere.

This story of the brain storming session thus illuminates many practices that were salient to interdisciplinary knowledge creation more generally at ADF, and gives a particularly vivid picture of the lively way collaboration most often seemed to progress.

8.7.3 Filling the gaps: experiences of interdisciplinary knowing-in-practice

How then would knowledge creation and knowing happen in interdisciplinary contexts? What truly surprised me was the depth of reflection some students were able to offer when I asked them about their experience. For example there were several students who contrasted between an abstract and concrete ways of knowledge creation and how they had experienced that they both were present in their practices, as well as noting the struggles that emerge when these two types collide in interdisciplinary collaboration. They also noted how prototypes and other tools such as brainstorming potentially act in-between these two ways of approaching knowledge creation. The students seemed to be very aware of the presence of these types of different approaches.

> "Like either you build something or else…it like came to a head, like there is just one dimension and in the other end there is the concrete building and in the other end something… an abstract pulp or mess."
>
> University student (SU2)

In addition to the contrasting ways of approaching knowledge creation most projects did not seem to follow any clear "methodology" as to for example gathering information. One student also told me a potential reason why:

> "Well I would start off with like kind of open mindedness towards various approaches and maybe thinking outside the box even though that's a clichéd saying, but I think it fits here well. So not necessarily like, we can learn not to solve the problems using the fixed methodology you learn in your own school but instead you think 'what's the best way here, that does this fit with this particular case, to this case the learned ways of solving, or should we look for models somewhere else".
>
> Engineering student (SE3)

The students acknowledged that the problem should guide the group and knowledge creation, not any particular pre-set model. However, the conflict seems to be that many students commented on the ways their "own schools" "indoctrinated" them to certain ways of problem-solving and knowledge creation, which then created friction when these "modes" collide. The different modes of problem solving were described as follows by students.

> "Let's define the problem and then look for info with which we solve the problem. That pretty much in my view sums up the whole engineering stuff."
>
> Engineering student (SE3)

> "Well maybe kind of systematic way and like what's reasonable and think like just that, really a lot about the practical side that how does it apply in practice, the kind of pragmatic view. It is probably like difficult to go crazy so to speak…[…]… at least that's what I experienced at Kauppis [business school] that if you do like really different stuff that's not looked at well. There is not much room for kind of creativity, so that kind of myself I have come to learn that, so that you notice that myself I try to limit things, maybe try to limit others and oneself, by accident."
>
> Business student (SB3)

> "…it's this kind of creative thinking, design thinking, or what you could call design thinking, questioning of pre-set notions, try to recognize these prior assumptions, try to approach holistically the problems."
>
> Design student (SD5)

The above manifested in very concrete ways, for example I noted how many design students used the *picture* search of Google when researching on a subject, where as some others were more inclined to search for articles. This means that the very different - in this case, Google search - processes resulted in the combination of these both ways in order to solve a problem

or research an issue. In fact, without exaggerating, I observed that the practice of information search was in fact equal to Google search in its various forms.

These "learned ways of learning" however result in a priori judgements about the different disciplines, for example one design student said that *"beneath the surface there is the thought that others don't generate ideas, others don't brainstorm and others don't kind of think outside the box and so on"*, that these are reserved only for the design students as they represent "all things creative".

Once the "concrete" and "abstract" meet, some conflicts are inevitable. One student described the collision of these approaches in an illuminating way.

"Like the first thing that comes to mind, from which to start thinking this, is the adjective 'lost'. But [laughing] what I have noted about the designers, is that they have really a kind of 'but hey, here is this great new material and if we put it a bit like here and turn it like this, it could be really cool'. And then at times I feel there is this strong – even stronger than in marketing – this 'exploding galaxies' –aspect there. And then we talk for a while and of course we reach a some sort of reasonable solution.

We have tried to delimit our mindmapping pretty mich, we think it is a really importan part, and I think we have used like two kilos of post-its per team, but… We try to start from a certain problem, be it for example really exact. Or then like who is our user, of which we must've talked about yesterday for like two hours, and we all have a different view on it. We all completely diagreed, but…

Like who is the user of the system. Like one says that the actual customer, one says a mechanic who has to service the system. Another says its the whole instance where its installed. And actually, all of them, they all in fact go wihtin the whole instance. We tried to delimit it and reach a definition, but we again got nowhere. Until we used a bit of violence and decided it's to be the actual customer.

Like I think a bit like in a cold engineer way that this is a product for someone who uses it, using as in a part of the machine, kind of. And then our business student is like really human centric and thinks, that waht if we have this type of customer, and what they think, what kind of experience they will get. Human centric is maybe the best work here.

And then the engineers, the other one, I don't know, whe may not be so stuck into this technology sector as yours truly. Like he is really open and has really good ideas… What I have noticed now, during the past five-six months, is that engineers need to be a bit in the

between, so like when the galaxies explode and then there is the person whose galaxies are the ones exploding, one needs to fill the gap there, and there maybe it is the tech guy who should be in between.

So the other tech guy, I think he is there pretty well, very well filling in the between. I think that reluctantly - when everyone keeps reminding that do not shoot any ideas down, don't b etoo critical – byt like I at times reluctantly need to be like, 'sorry to say Mr. Designer, that this thing just can't float in the air', or like 'even though it would be really lovely to have flowers around, they might not thrive in this tenvironment that well'…. Or like no matter how cool that looks, 'have you guys thought that that will weigh something like hundred and ninety tons?'"

Engineering student (SE17)

The above highlights the saliency of constant discussing, negotiating and challenging of diverse viewpoints. There is no true consensus, rather there emerges temporary agreements from which the next steps then are built from – only to be challenged and negotiated yet again. The notion of someone – in this case, an engineer - being in-between the "galaxy exploding design" and the humans using the designed product is illustrative of the recognized need to translate and mediate between the very diverse ways of approaching the problem.

In addition to the existence of multiple ways of knowing, knowledge creation in interdisciplinary contexts seemed to be much about recognizing what was *not* known by the group – and this in turn relied on some "gut feeling" of a gap that was emerging. The process was depicted to be very ad hoc, intuitive and communication-intensive, aided by tools such as Google search.

"…this is really ad hoc, like 'now we need to know something, now we google and go see and ask some experts' so its really context dependent in my view…I think you go by your spinal cord reflexes somehow, like to some the reaction is 'ok now we need to know everything about this thing'… but it's a pragmatic framework that many times helps to get things started."

Design student (SD7)

"…it is really important to recognize the know-how that exists, the know-how we do not have, and the know-how we need. Like the recognizing and then the necessary filling of the gaps. And this filling can happen for example like ok, the person, or like if we miss some needed know-how, so then we can train this person to whose skills the gap relates to and so broaden his or her field. Or then we can have another person to do it, to fill the gap, or if you think we are physically kinda in compartments. Communication overall, like the more for example the technical side can communicate of these needs because…[…] if it goes that there is no dialogue, if I for example was not kinda being planning the

> dialogue in-between, so then it could've been fixed by like efficient communication in-between…. […] and the communication in a way supports a kind of learning process, so that the learning and filling the void kind of happens automatically…[…]… well it surely doesn't come out of nowhere…[…]… but like you kind of can recognize, for example by thinking abstractly, that ok we are missing this part, and how we kind of take care of it, so it can be filled."
>
> Design student (SD5)

I also found that in attempting to "fill in the gaps" many students seemed to draw from their experiences outside their studies. For example, one team was much helped by the fact that one of their participants was a good drawer, even though it had nothing to do with his studies as such.

Also among students, the fact that the courses held at ADF generally require very little reading of academic books or articles (or if there was required reading, its role and emphasis was minor) or indeed the requirement of any "academic conventions" was bewildering to some, and a blessing for others. "*The mental journey from here to a library is pretty long*", as aptly said one student.

> "..well it's to me a bit surprising that in the text that was meant to be in the final report one uses smileys [laughter] This is like just a one-off thing but I couldn't believe my eyes when I saw it. ..there was not much guidance on how to do it and might not need such guidance and maybe it's good to put smileys instead of references, but to me somehow it's a bit difficult to understand…it was a learning experience in itself, because I never even thought that someone would want to write anything but like basic academic text to the final report. Like I could not have thought someone would see this too so differently."
>
> Engineering student (SE3)

I also observed that the on-going projects were very time-consuming. For example in 2011 the PDP-project was officially "worth" 10 credit and the ME310 25 credits but most students agreed that they did work way more than that would imply. Why then put so much effort into the projects? To learn, it seems.

> "Yeah well like the workload is really insane compared to a normal course…[…]… but it doesn't matter, like whatever the course credits show you, like you learn the things, like your learning is not limited to those ten credits, like so you do how much you do, and you learn no more. Instead here the studying sort of goes in your own pace, and it's your own project, so you probably learn much more."
>
> Engineering student (SE4)

> "This [ME310] has been by far like the best course I have so far had on any level in this school… Because there are no problems of free time. So that despite that this is super much work and in a way

not very rewarding credits-wise…the learning happens in the group and through doing and mistakes. It is really confusing and that's probably the most difficult and strenuous thing that it is confusing, but it's the confusing that maybe teaches the most. Like not 'just do these calculations and that's it'."

Engineering student (SE13)

I also observed that the students took their projects and deadlines very seriously – there were surprisingly little comments of team members not doing their share or not doing what was promised – being free riders, so to speak[104].

"Easily in a normal course for example there is like you notice that one guy, one of the group, is not doing their calculations, and we have to his stuff too. It is really typical, and I am not blaming anyone, studying can be in the end pretty hard and you never know what might be behind it. But here I never felt that."

Engineering student (SE4)

The sense of empowerment within the courses was thus coupled surprisingly well with responsibility, and not taking advantage of the situation in a negative fashion.

8.7.4 Communication challenges

I asked a design student what interdisciplinarity means to her. She laughed and answered: *"Well at this stage, kind of it's a really good thing, but it means also a lot of communication problems"*. She continued that even though in the PDP course all the time the course personnel kept reminding that "talk to each other, communicate", it is not easy, and maybe the communicating was something that should have been explicitly *trained* as well. In a fashion, there are multiple "languages" present at ADF. First, there are the different languages of the disciplines themselves.

"So these two electrical guys of ours, they have practically their own language, like when they talk of programs and microcontrollers and those things, of which I understand nothing but they clearly understand each other. And then the two mechanics guys, things go well between them like I don't necessarily even know much of what they do…"

Design student (SD3)

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[104] In fact I was told by a student that the official (or unofficial, I never found out) politics of ADF was that a person is downright kicked off the course if this type of free-riding is observed. True or not, just the rumour probably created enough of an deterrent not to attempt such. Thus also this type of thing was probably "managed" by ADF staff to some extent.

> "…I got a recent email like 'do a lot of pictures', well I thought that if now I have to model a picture, it would be really nice to get some measurements. So I thought that the engineer should know the measurements, like isn't it sort of like his job, at least that's what I thought. Then I asked for the measurement pictures, but they didn't sort of come…"
>
> Design student (SD3)

The above quote illustrates how "picture" meant very different things to the participants. For the engineering student, it meant a drawing, a vague illustration of the various "outward" features of the product. For the designer, in contrast, "picture" was a modelling picture, which needs exact information – e.g. the measurements.

Also the honest and open communicating of ones own opinions and viewpoints was seen as surprisingly difficult and frustrating, and as such could be viewed as a particular mode of communicating that seemed to be required in interdisciplinary contexts in order to be heard and understood.

> "And just that if at Kauppis [business school] I said like a sentence something like 'well this goes like this and you know how we have to think this side' they would understand immediately what I was talking about. Well then here everyone is like 'well I don't get it'. Like then so… Or you have to know how to explain your thoughts like somehow differently because no can suddenly understand your way of thinking and that's of course sometimes frustrating like 'why can't anyone understand me [laughing]."
>
> Business student (SB1)

> "…like I had done some business development earlier so I had at least some kind of view of that, like how it works, then when the others were not at the same point and I was talking of some business world, then no-one understood anything. And then I talked of some people stuff and neither of that they didn't really get anything…I like probably didn't know how to take into account how you should communicate to different people about the things where you are strong…and I got frustrated and I then I started to think that somehow the importance of one's own opinion diminishes in the sense that it has no consequences."
>
> University student (SU2)

Differences in the way language is used affects also what one "picks out" from the communication. One student aptly described the issue in the following way.

> "And letting people explain, because many times what we have noticed is that if someone says one thing then the tech guy understands it totally different, the business one understands it different and the art school person. Like when we interview someone or have visited someplace then everyone has gotten a totally different view on it [laughter]. Like we pay attention to really different points like there, so its really funny how you can think that they said that or that. I thought they said nothing like it. Like we all

> pick such different things out so when we kinda talk about them together you get a sort of…Like you pick what you know. Of course you listen to what interests you and what you already know."
>
> Business student (SB3)

However, even though many students noted these difficulties in understanding due to what they deemed important, I did not particularly observe any "own languages" that had potentially developed. No one mentioned any such either in my many talks with the students. It was in fact more the "ADF way of talking" that was more prominent. I noted it during the very first days I spent at ADF.

Field diary, 17.1.2011

Prototyping, fast iterative way -   of talking also. => language is fast, practically oriented, pragmatic, ideas thrown about, people have views…

What the above extract implies is that instead of using particularly distinct figures of speech and so on, ADF encouraged a certain "style" of talking: assertive, often opinionated even, with a fast pace. One was to be loud to be heard, so to speak. This was also evident in the narrative of the brainstorming session I recounted in Chapter 8.7.2. This also ties in with the "house rules" of ADF, which include thinking out loud and asking questions and so on. I will cover these on more detail in Chapter 8.9.

8.8 Fatboy Lounge: exploring the differences

Picture 29: Fatboy Lounge (Source: ADF Flickr)

Let's move on. Next to the group workspaces is a smaller space called Fatboy Lounge. This space is where I conducted my "talks" or interviews (See Chapter 7.5 and Appendix 1 for details of the interviews). There are also two silent rooms meant for independent work, White and Black, and I also used these at the end of the day when I was writing my field diary or sorting through the days' material. I remember sitting in the Fatboy sack chairs, trying to make notes without a table – surprisingly difficult - and trying to drink my coffee – also somewhat challenging in the sack chair, by the way. It was in this space where I got to talk one-to-one with the students, asking how they felt about Design Factory, what interdisciplinary meant to them, and how they had experienced the projects and courses they were attending. From the interviews a broad array of issues emerged, and many of the quotes I have used through out originate from these talks.

Focusing on the individual in particular, I noted there were some specific themes that arose that dealt with the more personal experiences of the students. These had to do with the students' "life" outside ADF, the more negative feelings that had risen at some point or another, as well as the ambivalence of their own contribution and value to the interdisciplinary practices they had experienced.

The "other life" of the participants: beyond ADF and the disciplines

> "well I have always thought about that [interdisciplinary], cause I am like that myself, like I like music a lot, music is my hobby, so there it is, technology and music, how might they fit, so I have always thought if could I somehow expand this then"
>
> Engineering student (SE4)

One student told me how he restores old racing cars, how some have been athletes and competed on an international level, and how one student was involved in working with teenagers. There were also many other "hobbies" in which the students seemed quite proficient that had nothing to do with their study subjects, but which were drawn upon in the project: *"..our business student is an avid painter and drawer, so through that we got these things done"*, commented one engineering student.

The extracurricular university activities of students also regularly came up. In addition few students had lived abroad, and saw this experience as the "first piece in the interdisciplinary toolbox" as one observed. These mentions all somehow related to their experiences at ADF and of interdisciplinarity – the students clearly drew on these experiences when reflecting on their time at ADF. The students led a full life, and they were simultaneously active in many different contexts. Conversely, one engineering student reflected how he noticed how during his free time he was now thinking a bit differently, "thinking more, like if there is problem, that how I could solve it", due to being exposed to for example to the way designers were approaching problem solving.

"The other life" came up also in few somewhat negative comments regarding the "behavioural norms" of ADF.

> "well I don't know if this is also a social experiment, but this is…yeah you notice that I don't get many thanks at home, I can tell you, that we are here. And it is challenging, as you have people with kids…"
>
> Design student (SD7)

> "I have my schedules with the other school as well…As a person I am probably like, now, let's get something concrete done, now we need a decision, let's do this and this and progress like this and this. And then suddenly I am supposed to be free to just suddenly sit on the couch and drink coffee for two hours and it kinda messes up my schedule and this creates small struggles within the team… I am like thinking I have to somehow earn my student allowance"
>
> Engineer student (SE17)

The implied importance of being physically present to a great extent in e.g. the longer courses meant that "the other life" potentially suffered, even if the doing together was generally seen as aiding the work.

> "You can't escape each other's sentences. It was pretty efficient use of work time to travel 1500 kilometres in a car, it's pretty god way that you can't just jump out…they have been the most fruitful. And it's easy to make decisions when everyone is in the same place".
>
> Engineering student (SE6)

Overall the "other life" that was beyond the disciplinary roles of the students was seen both as enriching the interdisciplinary collaboration, as well as being a source of some abrasions as for some the feeling was that their "true self" was restricted by the representations attached to their discipline.

"In the dark": frustrations and prejudices

Interdisciplinary practices at ADF that I have described above should not be painted with an overtly positive brush. Quite a few students expressed their frustrations on the projects at hand. The sense was that "*everyone does everything*" even though "*we have no idea what we are supposed to do*" that results in "*just running around for running's sake*". This creates for example motivational challenges and feelings of being "*in the dark*".

> "I can say outright that for me my enthusiasm for the project is diminishing all the time. Now it's pretty much at the lowest level as I have so much other stuff to do. Like in the beginning I was really motivated and enthusiastic, but at the moment I am not."
>
> Design student (SD3)

> " …Nothing will happen if there is no drive….we all have had to work with our motivation as you feel like you make no sense of the whole project, brief is really unclear, and why the sponsor is not more interested and why they are not helping us and 'blaah'. So if you don't have the drive then it's not going to work out… "
>
> Design Student (SD7)

> " …like I see it is that I am put in a dark factory hall and my eyes are covered with a blindfold. I am given a tennis ball to my hand, and said to 'throw it into that box". It this whole project, that there is the

whole damn factory hall where one can think the box might be. Then you throw the ball around, once you hear a small sound of it hitting something and you try to throw the ball again to that direction."

Engineering student (SE17)

Also the workload of the courses - that in some cases was seen as being the result of the above "running around" – was a source of friction.

"This is, well I don't know, but among the design students, for them this [PDP] is a compulsory course, so this is pretty much, almost hated. I don't know how much you're familiar with this, but from what I have heard from many different people, that this takes a crazy amount of time ant they have still decreased the amount of credits you get from this. So they have decided stuff like 'let's count all the hours we spend on this so we can show our professor' like prove it, and that surely will not increase motivation that you count the hours you spend on this."

Engineering student (SE2)

Noting the frustrations of their fellow students, some pondered that interdisciplinarity might not be "force-fed" too much if someone just is very interested in their own are of expertise.

"Like even if they try lot of stuff, they still like their own. So maybe it should not be also pushed too hard, there is the paradox right there, that you shouldn't press people too much to try all kinds of things, but then on the other hand it would be good to push a bit, it's like, difficult stuff…"

Business student (SB2)

"…but then we have to remember that not all are interested in this type of activity. If you study your own field very strongly, and if it is a passion and stuff, and then you are not necessarily interested in like art and design, or the business school course and way of thinking, so it doesn't work in that. Like you can't force people…Because of course you need, and some people are very talented in their own area."

Design student (SD4)

As the first student said, it is an interesting paradox: in order to learn and create new knowledge one potentially needs to broaden one's own expertise beyond its usual borders, but at the same time the in-depth expertise - and indeed the talent and passion for it – may be the critical foundation for some cases of knowledge creation. The students seemed to ponder if interdisciplinarity is a skill-set that in contemporary societies is required from all in order to understand its complexity better, or is it rather something that becomes expertise in its own right? I found this to be a crucial question that was somehow present in the entire practices of ADF, and this is explored next.

"In-betweens"

As told, a particular theme that also arose from the talks was the question of being a specialist and "not". In many interviews and conversations it was underlined that a big part of motivation comes from being able to use one's own special know-how. This motivation was evident on the personal level as well as reflecting to the way a group worked together and how the project proceeded.

> "In the beginning, there was not much like, like when we planned ideas and did user studies, these types of things, so there the Indian designers were like really exicted and good at the job, but then I wondered that the coders were not so enthusiastic about the project. But then they got start the coding and suddenly they were like really enthusiastic and started to do insanely lot of work towards the thing, maybe because the things done at the start was not their comptence area…"
>
> Engineering student (SE2)

However, recognizing what everyone "can do" was not always easy, or even being able to articulate what one can do.

> "Well we had, in one meeting, like now we write all on the board what each can do. Then it was that everyone just listed the programmes they know how to use. And then I tell the names of my modelling software, that I know how to use, so like they don't mean anything to anyone else, so that does not help a bit. So people don't know what that in practice means."
>
> Design student (SD3)

Thus if collaboration seems to rest on the "coming together" of various expertise, there is the important question of "what is my expertise in practice, and how can I make others understand it as well" to answer.

> "…well everyone needs their own strong competence area, and these are then thrown together. Like I found it really great that always that I feel that I am totally lost and like 'help, hands up, I don't know anything about this', then someone comes and like yeah, well in fact we should just do this screw-bench-type-of-thingy and it's done, and you are like 'say what'?"
>
> Engineering student (SE5)

In contrast, however, there were also strong views about not being a subject-specialist, but rather someone who *understands* the different disciplines and can act "in-between". Usually these students were in the project manager –role of the PDP course, IDBM –students or students participating in otherwise interdisciplinary studies.

"I don't like really have any core comptence area, or the core is maybe just that…When I applied to the PDP, I thought okey, what could I do there, it was like the only thing that I thought of, that okey, being a project manager could be pretty good, because I understand the engineers, I understand the people from the business school, I get design, so that this core comptence maybe is just that…not bringing it yourself what is the substance know-how, but rather bring this integrative know-how."

Engineering student (SE2)

"I was working a summer job in product development…and I was a bit like a kind of plug in-between, there were these automation engineers and electronics people and custom-development and designers. I ran there between them and saw that info just didn't flow, that they had their own little groups. When I visited a group and told some results to another group, they were like 'wow oh is this really like this'. They could have just talked the things through in the coffee table, but they needed a small summer-worker then it seems...."

Engineering student (SE5)

When asked what types of competences this "generalist" speciality might mean, the ability to integrate, translate and understand many viewpoints and ideas stand out, as well as being "glue", operating at the "boundaries" and being a sort of a "hybrid". Also knowing oneself was raised as important.

"…it in my mind comes out like, that you can in a way be open-minded towards the ideas of other people. And concretely it shows in that you don't push your own idea all the time, for example when planning something, you don't just push your idea, rather you really know to think that ok we have 10 ideas and 10 different people, so we could put the ideas a bit like overlapping and combine them, and not just one person thinking that he/she is the best and his/her idea is the only existing one."

Business student (SB2)

"For me personally it is that, maybe it culminates in that you understand all possible experts, or maybe also studied stuff from different areas of expertise, you have internalized or can do a bit of everything. But maybe even more central is that you can understand everything… you can function at the boundaries of different areas of know-how. That's what I think is interdisciplinarity."

Engineering student (SE2)

"Well maybe it's exactly that, that one is like a bit like glue there in-between, that I can facilitate the collaboration somehow…kinda talk different languages…"

Engineering student (SE15)

"And maybe like, or boundary work, that you communicate between these two, I was to say disciplines, but that's not like right, but I mean between these two capabilities, so that has been like…like a valuable thing that has added value…"

Design student (SD5)

"And also a kind of strong self-knowledge is pretty important, because without it you can't kind of develop one's own communication skills or see, what are one's own strengths and weaknesses in relation to others. I think that knowing oneself is really important, and it helps in seeing what kind of role you can naturally take and what is then an area where you are not necessarily particularly strong, so you can then develop it or leave it to others…"

Business student (SB2)

What these students feel is that interdisciplinary practices need both expert/specialists and "not-specialists" – mostly dubbed by themselves as "generalists". But is the "generalist" a specialist in its' own right – or just a smart layman with enough common sense, sufficient general education and good social skills to be able to get along different people – to this the students did not have a clear view. They recognized the risk of *"sliding to being a sort of all-around guy, that does not fit anymore anywhere"* and how that *"often is really stressful, that you don't know how to do anything, but are sort of a 'vague expert'"*. For them, even when being capable of working with various disciplines and translate across the borders, *"it would be good to have something in which you are good – something to which you can base your other stuff"*.

However, one student offered a very interesting analogy to illustrate how she experienced interdisciplinarity and the question of its uniqueness as an area of expertise. She recollected how a few years back she had ran into the notion of "third culture kids[105]" as an acquaintance was researching the subject, and how these children live between two cultures and sort of create their own "third culture". She raised this issue when we were talking of boundary spanning, noting how *"…their identity is not like, it's not a straight mix of the two cultures, but they create something new out of it"*. In a sense she felt that interdisciplinarity was indeed similar, as she had experienced that practising "in an interdisciplinary way" potentially results in something that cannot be reduced to any disciplines, but something wholly distinct may emerge from the process, and in the same process the identity of the person experiencing this interdisciplinarity may also transform.

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[105] David Pollock coined the term Third Culture Kids (TCK):"[A] person who has spent a significant part of his or her developmental years outside the parents' culture. The TCK builds relationships to all of the cultures, while not having full ownership in any. Although elements from each culture are assimilated into the TCK's life experience, the sense of belonging is in relationship to others of the same background." (Pollock & van Reken 2009)

Overall, I got the sense that there were quite a few students who were struggling with this kind of "in-between" identity and had difficulty in describing what they were experiencing – especially in relation to the "experts who know what they know". *"I have gotten the feeling that it could also be that a single person could be 'interdisciplinary'"*, concluded one student.

8.9   The Barn: managing the "ADF way" of being

Picture 30: Entrance to the Barn, a.k.a. staff wing

The staff is located all around ADF, but there is a small staff wing called The Barn. This is for example where the Factory Director Kalevi Ekman - self-proclaimed as the "Janitor" of ADF - and course staff have their offices. ADF is run by a staff of 30 (the number has been stable since 2011), and the operations are organized around five teams: service team (prototyping and model-making), interaction team (collaborative activities), research team (DFRT) management team and development team (development of ADF space and services).

It is not the focus of my research to elaborate on how ADF is operated or what are its management issues. There are few issues however, that arose from the students themselves regarding the way ADF is ran. These had to do with the composition of the staff and its representations of different disciplines, the "class rules" of ADF, the examples set by the staff, as well as the explicitly managed pedagogical aspects of ADF.

I mentioned earlier in how some students felt that ADF was somehow "easier" for engineers than for students from other backgrounds.

"And there is not one course personnel that is a designer, so like if someone asks advice from someone at the design Factory staff, then they have, might have, a really different view than what a designer could say."

Design student (SD3)

This implied that for example design and business students felt that it was much their own responsibility to articulate their viewpoint and even "fight" for their ways of doing, whereas engineering students did not need similar efforts in order to be understood. However, there were differences among the engineering students as well; I remember being reminded that it is in fact *mechanical engineering* that is served best by ADF, as that was for example the background of Factory Director Ekman. Thus the composition of the staff – especially the people that course participants came to contact with – was at least in 2011 experienced as being a touch one sided[106].

Second issue that relates to the management of ADF is that ADF has a certain style permeating the way its staff acts and communicates, how ADF is presented in various material and how other participants are encouraged to act while in ADF. According to its mission, all ADF "users" should be "committed to having fun, to learning and working hard" (ADF website[107]). The 2009-2010 yearbook lists the "class rules at DF":

1. Think out loud
2. Roll up your sleeves, and learn by doing
3. Need some help? You can ask anyone
4. Remember that only the sky's your limit
5. …but safety comes first.

These rules were in fact made very clear. I remember when I first came to ADF, someone of the staff told me that the rule is to say hello to everyone and start conversations. The students I conversed with backed up this observation:

"It could be a sort of general way of thinking, that here [at ADF] one is allowed to talk to everyone, and you somehow also need to be more open here. Like when we came here for the first time, we were told that you need to say 'hi' to everyone and start talking to everyone and it's just the way things are done

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[106] The composition of staff has become more varied over the years. In 2014 almost half were from other disciplines than engineering.
[107] http://www.aaltodesignfactory.fi/about/ (accessed 3.12.2014)

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around here. So then somehow, 'that's on order' [laughter] , that's then how it needs to be. And there are somehow like, such different types of people, and you feel like you really are involved with them, it is easier to start talking to people… the atmosphere is made such, or the space maybe"

Design student (SD4)

Also the ease with which I gained my access to and within ADF is a prime example of the "ADF" way (see Chapter 7.1). During my time there, I however noted quite fast that ADF requires a certain attitude if one wants to get the most out of it, and also if one wants to become part of the community: one is expected to be talkative, out-going and pro-active. "*They have created magically the kind of atmosphere that you can meddle in other people's business and be free*", said one student.

This "preferred way of being" was also made very transparent by the examples set by the staff, by the general atmosphere as well as the enabling physical space with its "planned coincidences". This was further enhanced by the "can do" attitude of the staff.

"Like the workhopmasters ["pajamestarit", staff at the shops electroshops, machineshops etc. for prototype building] they are very interested in their job and do the thing with a right attitude, whereas at TaiK, it's really helpless to go the workshop there to try to do anything. Like it's a really awful place…[laughter]…like if you go to the workshop at Taik, the first comment you hear is 'what if we do it like this'. Whereas here its like 'yeah I'm sure we can make it work'."

Design student (SD2)

The implication of this characteristic might be that if one wants to create a certain type of attitude that fosters interaction and exchange of ideas, one needs to make it very clear and explicit that this is what the community expects from its members – and then lead by example, supported by a physical space conveying the same message.

"At least a kind of being outgoing is one thing. Most people that are here are really social and they like also like to develop and do new things, create new, something like an optimistic view to like the future and stuff…Optimists in thinking about future possibilities, what you could do."

Engineering student (SE2)

I did wonder how a more introvert personality might experience the situation, even though one student did note *"there is a total possibility to be left in peace if you want to"*. Should there be some mechanisms that give voice to the less active participants as well? There is a potential risk that this type of a community starts attracting only the types of people who
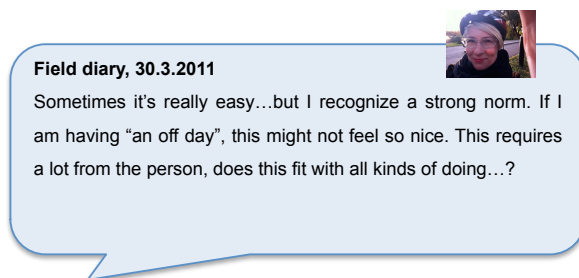
inhabit this way of being, and averts others: "*it may then happen that you just don't visit this place as much*" said one student when I asked what would happen if one just was not as outgoing. The "managed interdisciplinarity" of ADF thus may not be for all. As one student pondered:

> "You have to be really active yourself here…it is really up to the person how you experience it. I think that for some it may not suit at all, and then…you can't concentrate on what you yourself are doing, like if you are a pretty shy person, you can experience it somehow oppressive and distressive."
>
>   University student (SU1)

Another potential risk in overtly managing a certain "way of being" is that it just might become boring! One student reflected on her experiences from the IDBM –program, and she in fact thought that "*…like there also the people who apply, they have a quite a similar mindset, and think pretty much the same way about certain things, so I found it to be pretty monotonous*".

Finally, after a particularly "socially" taxing day at ADF, I have written down the following.

Field diary, 30.3.2011
Sometimes it's really easy…but I recognize a strong norm. If I am having "an off day", this might not feel so nice. This requires a lot from the person, does this fit with all kinds of doing…?

The "ADF way of being" can thus even be seen as a set of norms that as with any norms, are more beneficial to others than to others.

> "I have not been here much before, but like this thing behind is pretty good, it seems good, like exactly that you say 'hi' to everybody and so on. That you can talk freely and no-one is the boss here, so that's good, but then I don't know how it works in practice, but us Finns we are Finns, everyone is quiet."
>
>   Engineering student (SE10)

The pedagogical stance of ADF is another very explicitly managed dimension. ADF is grounded on the notions of the learner being at the center – and the learner being not just

students, but everyone in the given situation, including also the teachers.[108] Learning happens when engaging in problem solving and it happens together in social contexts, which makes it a complex and uncertain process. Students had experienced a variety of teaching during their study years, and were able to reflect on them vis-à-vis their experiences at ADF.

> "So then you come to university's lectures – or any course in fact – they say that here's this, this problem, then here's the calculation, integrate this… and if you integrate wrong, let's all laugh at it together."
>> Engineering student (SE17)

> "We have like this formula, and some dude already 500 years ago used his whole life to prove it, and then we are taught ok, how to prove this. Then we have the formula, ok, you have proven it, now you can use it…it's totally useless.. most won't become theoretical physicisits."
>> Engineering student (SE10)

> "Like I feel that a big part of education in Finland is kind of so information-oriented, if information is the right word here, but kind of like somehow that the stuff is just poured inside your head and in a way the info just bit by bit fills it up. And then there is the other side that in many places is just totally in the dark, is how to talk to people, how to work in groups, how you kind of act as the expert with other experts together, how you sort of accomplish things together."
>> Design student (SD5)

> "Well if I am honest, this [PDP] is not like any other course I have been to […] but all my courses have basically been like there are the lectures, and then there are the calculation exercises, like they are really typical over at the machine design, that you have the calculations and then lectures and then the exam, and that's it."
>> Engineering student (SE4)

One student recollected how her girlfriend, who studied at the Helsinki University, was bewildered by some of the goings-on at her boyfriend's PDP-course:

> "That we have a budget, like we went to have breakfast as a team using that money, like how can you go and have breakfast with the school's money. Well, maybe it's just when she has an exam, she reads like five books of 300-pages and then they ask what this gentleman said in this decade about this thing. Like that's at the total other end of the spectrum."
>> Engineering student (SE1)

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[108] The pedagogical dimension is not explored further in this research, e.g. researchers at ADF have published on this issue (see for example Clavert, M., Björklund, T.A. & Nevgi, A. (2014). Developing as a teacher in the fields of science and technology. *Teaching in Higher Education, 19*(6), 685-696).

There were notable differences between the courses at ADF, however. From the courses I observed, at the other extreme was the ME310, which involved the students very intensely for an academic year almost exclusively and as such had the potential of true transformative learning; at the other, the IPD –course. Over coffee after one of its lectures, I noted in my field diary comments such as *"...as a learning experience thus has been a real bad waste of time"; "we are just re-writing what we already know"*; and *"what a bad lecture, such basic stuff"*. This implies that just having the course physically at ADF does not mean it is somehow automatically transformed into something special. A bad lecture is a bad lecture even at ADF. The disappointment of students is also evidence of tensions between the expectations students hold for courses held at ADF and the actual course contents in some cases.

> "Well I would have hoped for more hands-on doing from the course (IPD). I am a little disappointed, that there is such a writing assignment, you have to write so much, like it does not teach that much, it's pretty dry."
>
> Engineering student (SE8)

In the Initial State Survey submitted to IPD students (see Chapter 8.4) students were also asked of their expectations for the course. The answers included the following:

- *"Motivated to get some hands-on experience"*
- *"I'm hoping to improve my group-working skills and hoping to learn from other fields of study. Really looking forward to the teamwork. i hope we'll really be able to get our hands dirty and build something :)"*
- *"I am expecting functional team work moments and contact with real-world companies."*
- *"My expectations are high and PD has been a big part of my studies"*

The above answers include many of the rhetorical "selling points" of ADF (Chapter 8.2), showing how students seem to "know what they should be getting". It is thus a challenge to maintain the chosen orientation so that the set expectations could be met.

Regardless of the satisfaction with the courses, the presence and helpfulness of staff and course personnel was regarded quite exceptional. The "tugging of the sleeve" described below was also demonstrated in the compiled vignette from my field diary in Chapter 8.6, where a passing student "tugs" Factory Director Ekman to ask about his project. This attitude was almost considered bewildering, as it was experienced to be so different from the "usual" manner of the teachers.

> "Yeah, like here is, like staff that you can when ever tug from the sleeve and ask, which is like really an exception. Like elsewhere you go to like Weboodi [intranet of course information] and try to find a course syllabus and the name of the professor in charge and then you try to find the room they are in…for fifteen minutes in a week…and probably not there even then".
>
> Engineering student (SE1)

> "It's not like I'm really used to it, that it's always possible to do everything you really want to do. And people are ready to help. I always really humbly approach all the people, who work here, like 'you have a minute to help?', and they always are like 'yeah yeah, I have, let me do it'. You are like 'What? You're gonna do it, really?'"
>
> Engineering student (SE8)

The word "passion" is also much used when describing the learning taking place at ADF and one of the key elements that Factory Director Ekman constantly and consistently repeats and brings forward in all instances[109]. Moreover, I observed him to be very engaged in the goings-on at ADF – not so much offering direct answers but rather sharing his own previous experiences – for example, what were the most typical challenges in development projects, in order to aid students in avoiding them. Out of curiosity, Director Ekman often refers to himself as the "Janitor" of ADF[110], both internally as well as in the media, and to enforce this image, he has appeared both in a white lab coat and "shop wear", placing himself thus right in the middle of action of the factory.

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[109] This same "message" can be found for example in a recent Aalto Magazine (October 2014), http://issuu.com/aaltouniversity/docs/aum-11_pdf-www-hq_2
[110] In Finnish he uses the Finnish term "Talonmies", which literally means "janitor". In ADF's own English translation however the term "Captain" is used.

Picture 31: Eetu "the Janitor" (Source ADF Flickr)

Factory Director Ekman also has a strong reputation among students as promoting creativity, hands-on doing and overall holistic view on product development.

> "Like if I think what I thought this course was about, I made my conclusions based on the fact that - I have to say - Kalevi Ekman is running it, than what it is called or something. Like somehow I knew to expect that we have engineers and we collaborate with them… Like it's through the mission of Eetu…"
>
>   Design student (SD5)

This enforces the "person-centric" way in which I observed ADF to be run and operated as well as laying on the already strong expectations, which were discussed earlier.

8.10 Partner Plaza: experiences and expectations of working life

At the second floor of ADF is the Partner Plaza that houses start-up companies. During my fieldwork in 2011 there were four companies, and in November 2014 three companies had their offices at ADF. In addition few companies regulary use the premises even though they have no permanent space. Some of the bigger corporate sponsors also use the various shops for their own research and development purposes (ABB and Kone). Most importantly, companies are important stakeholders in PDP and ME310 courses in their role as sponsors.

The collaboration with companies is an important part of the courses, being both learning experience as well as opening doors to potential employment. The participant companies are expected to truly be involved in the course.

> "The brief variety has expanded from traditional machine construction to mobile applications, business services and concepts. When before the briefs had everything between the earth and the sky, now we have them sea as well. This fits even better the programs at Aalto University", says the Janitor of Design Factory, Professor of Engineering Design and Production Kalevi Ekman. "Ericsson is now part [of the PDP] second time. The company organized a competition last year in order to collect suggestions for the course brief. The competition gathered 30 suggestions. The winner got to be the tutor for the course'."
>
> Metallitekniikka –magazine 5/2011[111]

The students were regularly in contact with the sponsoring companies of their projects for example in status meetings. Considering that ADF is located within higher education, I found it considerably more reminiscent of working life than the academia, and this prompted me to write the following in my field diary:

Field diary, 31.1.2011

Realization: I've used the following sentence to many people, when asked how the field work is going: "it's really similar to work, soi t feels surprisingly familiar, many people do in projects what we do at work". => PDP & IDP are using the language, methods, genres and styles of management consulting.

The above was in fact on my mind again later in March 2011, as I was interviewing a student from the IDMB program. After our actual interview, she asked me about my work as a consultant. She then told me about one of their courses that involved a corporate assignment of new product development. As part of this work, they organized an innovation workshop for the company in question as well as for some of their clients. We started conversing about this, and below is an extract from out transcribed conversation.

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[111] http://pdp.fi/2014/wordpress/wp-content/uploads/2014/02/Metallitekniikka-Gala-2011.pdf. Accessed 2.1.2015.

Me: You did a classic consultancy workshop then?

Design student (SD4): Yeah, yeah.

Me: I don't know, which is the chicken and which is the egg, but I have noted that the ways of management consulting are pretty strong here. That is there some strong discourse of how one should develop business, which was developed in the academia and then transferred to management work – and now the same consultancy way is used in education, making it stronger and stonger…"

SD4: Yeah, I get what you mean, I think, it is a sort of a rat race…

Me: Yeah, it enforces itself, but do we get blinded in the process to something…

SD4: That's what I was also trying to think, that the kind of interdisciplinarity in certain circles, does it leave out some new insight. Like it, somehow as you said, goes around in circles.

The above extract highlights my own surprise of the "consultancy way" of doing things I had noted. The student also recognized a potential risk in the way interdisciplinary practices were organized in the particular context of ADF: the explicit aim of new product or service development is driven by commercial interests, and as such draws from and utilizes the practices from the commercial context in question. This may be a limiting factor to "*bringing it to a whole new level*". One student took an even more critical view, and said outright that all the three disciplines of Aalto and the way they were applied at ADF *"they are all totally within the paradigm of conspicuous consumption still"*, and for example sustainability, the options for full blown market economy and so on were still completely ignored – even though they, if any, are questions that call for an interdisciplinary approach.

Other factors contributed to the feeling of familiarity with work life. The students I met were surprisingly entrepreneurial; many were already doing freelance work and had ideas for their own company.

> "All students are like the type that all have done like so many things, like it's really like twisted that all are like under thirty and done so much and been part of such totally interesting things… […]…that people have their companies and all that."
>
> Business student (SB3)

In fact, the students themselves joked about them being involved in so many things. The amount of work experience the students I met had already gained was considerable, and they were able to draw on these experiences. In addition, many students were quite close to graduation, and the IDBM –program in particular was for students who already had some working experience. The students also were able to compare how things were done at ADF and at the places they had worked.

> "Because a company is not really like that there are twenty tech guys around the same lunch table, but of course you have lawyers and finance guys. There are desginers, and maybe someone who integrates all the stuff and so on – and that's what's interesting…"
>
> Engineering student (SE17)

> "…like I have been part of the kind of organization, that didn't like reflect afterwards, how things had gone, they din't think beforehand either what was the best way to do things –they just do. And then how do you make sure, that people really learn, which is like pretty important…"
>
> Design student (SD5)

The students were still quite realistic in their expectations. After all the time they had spent at ADF – which mimics "real-life" as much as it in the end is even possible – they recognized that the courses at ADF are still an exception and as such, education does not prepare for work all that well.

> "…and if you never have even seen like a bolt in real life, it's gonna be difficult and so on. Then you think, like, what am I equipped with when I enter the working life, if you have not ever really done anything. So like how long will it take until you get some clue… Like you just bang your head against the wall… kind of start from the beginning."
>
> Engineering student (SE7)

Working life was thus lurking - or seductively calling - in the corners of ADF. The explicit presence of companies added their own flavour to the mix of practices, and served as a reminder that education is just one part of what we call "life".

PART IV Findings and conclusions

9 Key findings from ADF

In Part III I introduced Aalto Design Factory and its practices as I observed them during my time on-site. In this part of the dissertation I will raise the level of abstraction and reflect my key findings vis-à-vis the theoretical framework as set forth in Part I (Chapters 2-4). I also answer the research questions as constructed in Chapter 1.5.

9.1 The epistemology of knowledge creation practices at ADF

In Chapter 2.3 I noted the shift in the way knowledge is treated in organizational knowledge management literature, moving from viewing knowledge as an object or possession towards a practice-based view on epistemologies that recognizes the consequent epistemic plurality and differences that exist in organizations. To recap the apt description of Barnett (2000, 415): "there are a multiplicity of knowledge frameworks to inhabit". This plurality was evident in the practices that emerged from my materials. In fact, the students themselves were quite astute in reflecting on the potential different ways of approaching knowledge creation and indeed the whole question of how differently individuals "come to know". Few students even used the terms abductive and deductive mode of knowledge creation that echoes strongly the "traditional" division between social and natural sciences - one student did in fact talk of the "natural science approach" to thinking. From the narratives of the students I constructed a picture that attempts to capture what they told me as well as what I observed myself.
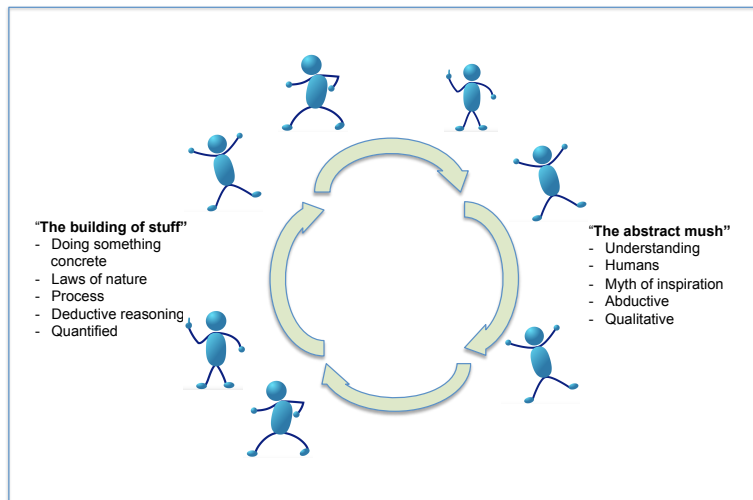
Figure 2: The different frameworks of knowledge creation in students' experiences of interdisciplinarity

The students contrasted between *concrete* and *abstract* on multiple levels. First, it represented a way of approaching a problem: either one wants to immediately "do" something (build a prototype, do research etc.) or alternatively, wait for an inspiration and "toy around" with ideas that had potentially nothing to do with the actual task. Second, the "concrete" approach wanted to acknowledge the physical materiality of the problem immediately, whereas among the more abstract "followers" there was the tendency to first look at the broad context of the issue and its potential embeddedness in other contexts, as well as think of the human actors involved in the potential service's or product's use. Third, there was the struggle between a sense of concrete "progress" and the more ambiguous "wait and see" mentality some had. The constant self-reflection as well as negotiation between team-members (see for example the longer quote from one of the students describing the way these different frameworks of knowledge interact, Chapter 8.7.3) resulted in continuous discussions of how to proceed and what was deemed useful. In this sense, the practices of knowing evolved constantly, being at the same time sustained by other, more managed and routine-like practices of ADF (see Chapters 8.6 and 8.9).

What is notable is that the students acknowledged that the framework for approaching a particular problem should emerge from the problem at hand – for example if the goal was to

"build" a concrete new product within some given limits vs. a more ambiguous design brief that could result in a great variety of end-results – but there was a struggle as the way students felt they were "indoctrinated" to certain modes of knowledge creation by their respective disciplines. For example, the engineering students described how they were taught to first define the problem as clearly as possible, and then look for information that solves the identified problem. Business students underlined a systematic and pragmatic approach that would efficiently deliver results as well as take the broader context into account. Finally design students saw it their responsibility to take a more holistic view and question the possible pre-set assumptions regarding the problem, potentially identifying the "out-of-the-box" directions from which the answers might emerge.

These findings imply that the other practices students had experienced outside ADF regarding learning and problem solving – i.e. knowledge creation – had a direct effect on how the interdisciplinary collaboration happened in practice at ADF. When reflecting on these issues, the students recognized that these types of characteristic modes were evident, but still noted that it was difficult to "break the mould" when collaborating with others - having the similar challenge of overcoming their respective learned ways of knowledge creation. I observed a self-enforcing practice where the disciplinary "characters" (see Chapter 8.4) became pronounced in the presence of *other* such characters – even if the individual had the desire and inclination to "not be a typical engineer" and so forth. Conversely, in one group where only engineers were present (Chapter 8.7.1), and as such not much "interisiciplinarity", such constraints of one's own discipline did not seem to be so pronounced, and there was potentially more freedom to engage in activities and modes of knowing outside one's own "disciplinary box".

In Chapter 1.5 I framed my first research question as follows:

> **RQ.1:** What types of knowledge frameworks (epistemologies) emerge from the observed knowledge-in-use?

Based on my observations, I identify a plurality of frameworks or systems of knowledge that alternate between the logics of "concreteness'" and "abstractness". This results in constant

negotiation and contestation between these different "ways of knowing", both as a collective activity as well the more internal struggle between the "learned way of knowing" and the requirements emerging from the situation. Thus the practical knowledge embedded in the situated action contains an inherent conflict between what has been learned in past experience and what emerges from the localized problem in-situ.

9.2 Interdisciplinarity and students

In Chapter 1.4.3 I identified an under researched issue in research on interdisciplinarity: how do students in undergraduate level experience interdisciplinary programs and education. I formulated the following a research question on this issue:

> **RQ.2:** How do the students define and experience interdisciplinarity (as an educational practice)?

In the next chapters I will elaborate on both the way students defined as well as experienced interdisciplinarity.

9.2.1 Defining interdisciplinarity

Chapter 8.4 I analysed how the students themselves described interdisciplinarity. Elaborating on the analysis of that chapter, it is possible to construct a definition of interdisciplinarity as it emerged from the students. Recalling the one specific discourse that has been identified as a key influence behing the Aalto University merger and higher education reform in general (Lawn & Lingard 2002) is that of the OECD (Chapter 5.1), I have contrasted the student's definition of interdisciplinarity with that of the OECD (introduced in Chapter 3.1):

Students' definition	OECD definition
Interdisciplinarity is the process of coming together of individuals from different backgrounds, having different skills and specialities, in order to reach a common goal of achieving "a greater idea". This is done through collaboration, teamwork and interaction, by developing new ways of thinking and by being open, tolerant and flexible.	**Interdisciplinary approaches** integrate separate disciplinary data, methods, tools, concepts, and theories to create a holistic view or common understanding of a complex issue, question, or problem.

Table 11: Defining interdisciplinarity – students and OECD

I found few notable differences between the students' definition and the more "official" definition by OECD, implicitly present in the making of Aalto. First, the students placed a great emphasis on the diversity of *individuals* who partake in the interdisciplinary practices, whereas the OECD definition is more about the diverse disciplinary nature of the "inputs" (data, methods, tools, concepts and theories) to the interdisciplinary process. Consequently, for students, interdisciplinarity involves a certain attitude or disposition that the individuals should embrace in order to collaborate, whereas these dimensions are lacking in the OECD definition. Both definitions place centrality to the end-result, be it a goal, complex issue or problem. However, the students saw the possibility of achieving something "greater" when working in interdisciplinary manner – not just creating a common holistic understanding of an issue.

I am now able to construct a first part of the answer to the following research question: the defining of interdisciplinarity. I argue that students engaging in interdisciplinary practices define the concept with a more personal, collaborative and "higher purpose" stance than what interdisciplinarity in the more "official" discourse might imply. Consequently, for students, interdisciplinarity has an emotional dimension that is an integral part of the embodied personal experience as the individual lives through the practices of interdisciplinary knowledge creation. It is not to be suppressed, downplayed or downright forgotten. For the students at ADF, interdisciplinarity is a potential pathway to meaningful new knowledge creation – "creating something great" as one student said – rather than "merely" integrating separate data in order to solve a problem as the hegemonic discourse might have it.

9.2.2 Experiencing interdisciplinarity: struggling to be equal

However, the "creating something great" was not observed to be a harmonious exercise. The struggle identified earlier between previous experiences and here-and-now demands highlights the domains of expertise that were present at ADF. My observations show that the strong presence of the different discourses of engineering, design and business with the corresponding representations make interdisciplinary practices challenging. This is made even more difficult by the finding that the disciplines are in fact *not equal*: ADF is rooted in the engineering dimension of new product development, though expanding strongly into industrial design, service concepts and the commercialization of new products. This means that certain ways of knowing, doing and being are privileged over others. The imbalance of the various domains or disciplines being present at ADF confirms the findings of e.g. Contu (2014) and Oborn & Dawson (2010b), who both stress the potential hegemonic status one area of expertise or discipline may gain in interdisciplinary collaboration.

This implies three things. First, the students *perceive* the three disciplines of Aalto very strongly, and thus they reinforce the different ways of knowing, ways of being and ways of working. This was evident in the "indoctrination" to certain modes of knowledge creation as described in the previous Chapter. Second, despite the presence and stated equality of the three disciplines, there was evidence that in students' mind, the concrete methods, ways of working and styles of the engineering discipline are perceived as dominating. This potentially diminishes the conflict-ridden nature of practical knowledge or knowledge-in-use for engineering students, but in turn amplifies them for students from other disciplines. This, as I said before, is quite natural given the history of the ADF, but an aspect that potentially needs to be more explicitly accepted and taken into account. Third, to further zoom out of to the broader practices of society at large, the depth of interdisciplinarity at ADF may be somewhat limited. Taking Habermas' distinction of the three value spheres - scientific-technical, moral-legal and aesthetic-expressive - as a reference point (see Chapter 4.2.1), my observations seem to imply that the sphere of ADF's practices is within the boundaries of the scientific-technical –discourse, with its distinct experts culture, values and validity criteria; and it is slowly embracing the more aesthetic-expressive sphere as well as the economic domain but not venturing into the moral-legal spheres of human action.

In fact, the presence of these spheres can be observed also from the way the students defined interdisciplinarity (see Chapter 8.4). To theoretically elaborate the analysis of the students' answers on the questions regarding interdisciplinarity, I have constructed the following summary (Table 11) of the students' representations and perceptions within the Habermasian (1987) notion of expert cultures and value spheres. I have elaborated these domains to include a market-network –domain as to recognize the increasing importance of horizontal networks (following Castells 1996 and King 2010).

Aalto disciplines	Domain of expertise / value sphere	Key competence areas	View of humans
Engineering	Physical world and its laws. Material realm and logic. Natural sciences. Scientific-technical value sphere.	How to technically make a product. Processes and manufacturing. Systematic thinking. Theoretical thinking, equations, mathematics, physics.	Humans as users of systems and products built. Rationality.
Art&design	Creativity and the mind, emotions, senses. Aesthetics. Aesthetic-expressive value sphere.	Idea generation, thinking 'outside-the-box'. Intuition. Using all senses: eyes, touch. Creating user interfaces and user-friendly design. Sketching and visual thinking.	Humans as holistic whole persons. Humans in their context. Sense of "mystery".
Business	Market and its laws. Companies and other actors in the marketplace. Money. Market-network.	To make money. Cost-efficiency. Accounting, finance, marketing. Social capital. Organizing and project management.	Humans as consumers. Networks of actors. Rationality.

Table 12: Student's perceptions on Aalto's major disciplines (after Habermas, 1987)

My findings indicate that at the core of ADF there is the scientific –technical value sphere, that very much centres around the physical world, and is the "home-base" for engineering students. It is slowly encompassing the more aesthetic-expressive domain of design – and as of 2011, least the market-network domain that is represented by the business students. The moral-legal domain is yet to be completely explored. I have illustrated this in the following Figure 3.
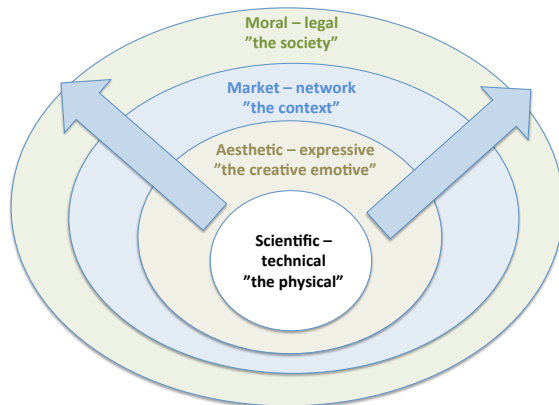
Figure 3: The expert domains of ADF and their evolving presence in practices

This finding contributes to the answer of **RQ.2:** How do the students define and experience interdisciplinarity (as an educational practice). The definition the students' gave of interdisciplinarity must be complimented with the students' experiences as I observed them. The experiences were characterized by varying degree of inequality and the experienced presence of strong disciplinary boundaries. This had an effect on how capable and enabled an individual student felt in participating in the knowledge creating practices of ADF. In addition, the feeling of some students of falling somewhere "in-between" (Chapter 8.8) implies that the touted "interdisciplinary skills" were anything but clear-cut. My research may thus serve as a reminder that changes in undergraduate level curriculums towards interdisciplinary modes may leave the students somewhat dumbfounded as to what is the ultimate aim of such endeavours.

9.3   Practising interdisciplinarity: the ADF way

The collaborative context of interdisciplinarity at ADF is that of project-based teams with a specific task, a given deadline as well as a measurable outcome (Oborn & Dawson 2010a). Based on my observations, I argue that this type of interdisciplinary collaboration may take a variety of forms by the way of organizing, and the resulting process is a very dynamic and iterative one. Here I draw on Nicolini et al. as well as Klein in exploring how interdisciplinary collaboration progresses from its inception - seen as either generated by "the desire to know" in response to an emerging anomaly or problem outside existing categories, or at least from a

partly given objective of for example product or service innovation, and thus resulting in a particular constellation of skills and functions that are seen as necessary. To recap, this forms "the architectonics of forming new knowledge communities" (Klein 2008b, 272) the process of which is depicted in Figure 1 in Chapter 3.3.

In the next chapters I present my key findings of the practices I observed at ADF and analyse them vis-à-vis the key concepts from earlier research: boundaries and objects (introduced in Chapter 3.2.1); role of communication (Chapter 3.2.2), forms of collaboration (3.2.3) and the embodiment, socio-materiality and spatiality of observed practices (3.2.4). Together these form the answers to the following research questions:

> **RQ.3:** How can interdisciplinary knowledge creation be construed as a situated, practical activity?
>> SRQ.3.1: What enables or constrains interdisciplinary knowledge creation (objects and boundaries, communication)?
>> SRQ.3.2: How do embodiment, spatiality and sociomateriality figure in the practices?
>> SRQ.3.3: Do the practices engender a certain kind of practice community, and if so, what are its features?

I will first introduce my key findings on these issues, and then in Chapter 9.4 I synthesize the findings and formulate the answers to the above research questions.

9.3.1 Boundaries and objects

As stated in Chapter 3.2.1, boundaries are crucial and a critical element in interdisciplinary collaboration, and for example research on (knowledge) work practices has much concentrated on the analysis of the different types of boundaries that exist – partly emerging from treating knowledge itself as localized, plural and situated. The participants of interdisciplinary collaboration come from their own situated disciplinary backgrounds, and as analyzed earlier, at ADF the three disciplines of engineering, art and design and business were pronounced. The students recognized them, reflected upon them – and yet found it difficult to

"be" otherwise than the way they were taught and indeed how the other disciplines expected them to "be". Thus my research at ADF confirms the salience of boundaries in interdisciplinary collaboration.

With boundaries come objects as the means to overcome the divisions. My theoretical framework draws on Nicolini et al.'s (2012) plural framework for approaching objects, and my research at ADF confirms their conclusions as to the variety of objects one observes in interdisciplinary collaboration, as well as the differences in the ways individuals may regard these objects. However, few findings stand out.

First, I argue the *overall reason for the interdisciplinary collaboration* needs to be properly understood in order to make sense of the practices. At ADF, the reason for the students was the participation in a course, and the consequently formed projects had a deadline and a goal of a varying degree of concreteness. Following Nicolini et al., the collaboration was thus often triggered and sustained by an *activity object:* the partly given nature of the object that dictates what types of skills and functions should be involved, what the division of work might be like, and what is the position of each member within the group. In some cases participation may even be forced. At ADF it can be argued that some students are indeed "forced" to participate in the activities of ADF, as the courses are in some cases obligatory in their degrees.

However, I observed practices that implied that in some cases the activity object transformed itself into an *epistemic object,* i.e. the "official design brief" as an activity object transformed into an open-ended "possibility" for the students. Especially for the students of the ME310 course, the very ambiguous but yet ambitious "brief" they were given evolved into an epistemic thing or object that embodied *what one does not yet know.* Concretely this manifested in the first attempts to define the problem-space, for example in no-limits brainstorming sessions, in order to give way to some structure around the "lack of knowing". These became then further sources of interest and motivation for the participants, as they fostered the desire of a titillating *possibility of achieving who-knows-what.* This was also fuelled by the "anything is possible" –ethos of ADF that I have described, and is a good

example of the way these types of object-related issues can be managed at least to some extent.

However, not all participants experienced the objects the same. For example there were students at the ME310 course who attached more an activity object -like connotations to the design brief, for example, than epistemic ones. They voiced their frustrations on not concentrating on getting something done and the too-high-in-the-clouds –ideas that most probably won't lead anywhere. In a similar fashion, some students of the PDP projects found their briefs very motivating and carrying possibilities of creating something novel, and regretted not having more brain-storming around the brief, for example.

Both the activity objects and epistemic objects are what Nicolini et al. call "primary objects of collaboration" as they trigger, sustain and motivate the whole endeavor of interdisciplinary collaboration. In this sense their proper understanding influences the entire "ethos" of the ensuing collaboration. My observations would further stress the probable situation where some participants see the primary objects as epistemic whereas others as activity-like objects. The question of sustaining the proper motivation in such instances is challenging, as my observations imply that the objects themselves arouse quite different emotional responses. I noted a tendency of talking about the project and the task in a more "professional, matter-of-fact" manner if the object for the collaboration was deemed to be an activity object. If the object was an epistemic one, the way the whole collaboration was described was much more emotional and personal manner. Following Nicolini et al., this would indicate that epistemic objects are indeed "sources of attraction" which beget an emotional response, whereas activity objects trigger more a negotiated and "objective" response - objective in the sense that the collaboration emerges around the expected outcomes of the activity.[112]

In both cases, the final prototype of the product or the service that was to be presented at the final PDP-gala or ME310-exposition was the *mirage* that the teams were reaching for. I use the term *mirage* as the ambiguity and uncertainty around the final prototype was very

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[112] Cultural historical activity theory also stresses the projective nature of the object, as it is constructed through the negotiation or ignoring of the different interests of the community (Nicolini et al. 2012).

noticeable, but the "want" to get it done was also evident – be the motivation a more emotional desire or a more pragmatic "want" of getting the course credits done.

As a second important finding, the importance of activity and epistemic objects imply that the task at hand, i.e. the problem to be solved (product to be innovated in this case), gets detached from its origins (in this case, the course design brief), and starts its "career" in the shared space of joint action with humans. In this sense it traverses into the "in-between" area and "sit in the middle" creating the shared context. This is in line with what Klein called the detaching of the interdisciplinary problem from its previous frameworks. I argue that this *"detaching" of the problem itself* is one key practice of interdisciplinary knowledge creation: the problem is localized and mapped in the situated context of the interdisciplinary practices, often ill-defined and sketchy. Without allowing this, the "problem" will not evolve into the activity or epistemic object that is crucial for the collaboration to be triggered, sustained and motivated.

In addition to the primary objects, I observed a variety of objects that made the collaboration possible. These are what Nicolini et al. call "secondary objects of collaboration" that facilitate work across boundaries, i.e. boundary objects. The courses at ADF are product development courses, which includes by definition prototyping. Thus the concrete doing something was in a way "a given" at ADF, and resulted in a plethora of material outcomes[113]. The prototypes were a central observed boundary objects. Importantly, I found that it was not just the concrete prototype itself; it was also the *act of building the prototype* that acted as a translation and transformation device itself. The doing of together was not only "fun" and "relaxing" - it exposed the team members to each other's "thought worlds" (Nicolini et al, 2012; Table 1) through participation. Thus the engineering students were able to show others how to use some building tools, for example; or the design students encouraged others to draw. This generated insight into the different ways of doing, making further collaboration potentially a touch easier. The quick-and-dirty prototypes that the projects were required – and constantly reminded - to make were also experienced as a sign of progress, and thus acted in a motivational capacity as well – transforming the boundary object temporarily into a primary object of collaboration.

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[113] However, as not to succumb to the fallacy of seeing boundary objects everywhere, not all materials generated by the project teams perform the translation function across boundaries, and as such not all are boundary objects. In some cases, indeed, a powerpoint is just a powerpoint.

Visualizations such as drawings became boundary objects as they gauged out the decisions that still needed to be made, forming thus a "structure of lack" (Nicolini et al. 2012, 619) and being "talking points" that anchor for example the team meetings. The drawings are experienced as being an active participant in the meeting, "directing attention". This echoes the findings by Ewenstein & Whyte (2007, 2009) on conceptual design –centric knowledge work (architectural design project).

> "Design here takes the shape of exploration or inquiry. The drawing is an active participant in a process of exploratory, projective reflection. It does not simply depict or re present the previous reflections of the designer or designers. Thus the important role visual representations play as knowledge objects is not just on account of their capacity to embed or inscribe knowledge. Inscribing, embedding and containing is only part of the story; the other is lacking, wanting and unfolding in uncharted directions."
>
> Ewenstein & Whyte 2009, 22

In some cases the prototypes resulted in a boundary object that was taken "across the boundaries" into the specific domain of one discipline to be further developed – for example the concrete "thing" that was the result of the interdisciplinary teams collective prototype building was transformed into a detailed model using modeling software by the design student. In Star's (2010) terms, the object was "reversely detached" from the interdisciplinary practice and space, worked in the disciplinary domain, becoming more specific and structured in a *non-interdisciplinary* sense. Star's notion of tacking back-and-forth between the ill-structured and structured illustrates well the practices I observed at ADF, as students experienced that sometimes the whole team "got" what was to be done, and at some other instances the "electrical guys talk of microcontrollers" of the developed prototype, of which others do not understand much. The object had thus been transformed in the disciplinary space, and potentially was not a boundary object anymore. The prototypes also acted as bridges between the projects, facilitating feedback and input across these boundaries as well: the teams tested the prototypes of other teams, giving input and development ideas.

Overall, many student's talked how the prototypes and drawings helped to break the illusion that everyone "for sure thinks the same way", and there were descriptions of moments of utter astonishment over how differently the team members could have understood something. This implies that in interdisciplinary knowledge creation boundary objects are in relation to the

epistemic or activity objects that are the primary reason for collaboration, foregrounding temporarily the contradictions and misunderstandings of the practice. Thus boundary objects can break the "illusion of unity" that epistemic objects suspend in their attachment to the common pursuit as well as magnify the contradictions that activity objects already have foregrounded.

Finally, the different objects had a strong sensible dimension attached to them. In Chapter 8.3 I described how students experienced the "feel" of knowledge creation. Prototyping can thus also be seen as a manifestation of making intellectual activity embodied and open to sensory experiences; a way to engage the participants in a holistic way and add to the senses used. Acting, gaining "rules of thumb" and physically trying out the various prototypes all contributed to this embodied experience of the objects, resulting in the personal knowledge and "feel for the game" (Gherardi 2012, 75) that is unique to each individual.

To conclude, my findings support the conclusions reached by Nicolini et al., as they stress the importance of the relation of the objects with the activity itself, and not some assumed essential features of the objects themselves. However, based on my findings, I would like to stress even more the importance of grasping *the reasons for the collaboration* in the first place, as well as the crucial detachment of the initial "reason" or problem from its original source for it t become the "property" of the collaborative team.

In addition the objects were found to be in an active relationship with each other, for example the boundary objects "disturbing" the solidarity induced by epistemic objects and temporarily foregrounding the differences. Also, boundary objects traverse boundaries from the interdisciplinary "space" to the disciplinary domains to be worked on by the discipline specialists, and in fact may lose their translation capabilities. Thus what has been an effective boundary object in one instance may not be one later on. The recognition of these careers, transformations as well as inter-relations of objects is important in order to effectively understand and consequently manage interdisciplinary knowledge creation processes.

9.3.2 Knowing how to speak: emergence of communicative competence

In earlier research on interdisciplinarity, the importance of translating across different occupational or disciplinary languages is seen as crucial (Chapter 3.2.2). The implications of this are the creation of the *partial understandings* using "pidgin tongues" and emphasizing the role of communication in interdisciplinary collaboration (in practice-based research referred to as communicative competences). Another way of overcoming these types of boundaries is the presence of "intertwined practices", where all participants participate over "expertise boundaries". This was observable at ADF in e.g. joint prototype building. In fact, this practice of making all participants to some extent join in on prototype building was "the norm" at ADF, and often cited as being a a benefitila exercise in team-building.

Based on my findings I argue that at ADF these "intertwined practices" were more salient to interdisciplinary knowledge creation practice than any particularly observed "common way of talking" within the interdisciplinary teams. This was somewhat surprising, as earlier research on interdisciplinarity places great emphasis on the development of the common vocabulary and language (e.g. Monteiro & Keating 2009; Jeffrey 2003). The communication challenges present in interdisciplinary collaboration were acknowledged and observable, but the solutions to overcome them had more to do with practices involving the prototypes than the explicit development of an "own creole tongue" for the group. I would argue that as ADF places such great emphasis on prototyping and the whole physical space, that socio-materiality and its manifestation in a variety of objects in a manner "override" the need for the development of "abstract" language: there are material objects that provide the anchor for common understandings to emerge.[114] This is in line with Lindkvists (2005) note on project based teams where there is little time for extensive socialization which might result in common languages etc., as well as Nicolini et al.'s discussion on how the objects may perform the bridging work required for the partial understandings to emerge. Thus, practice-based terms, talking *in* practice was not directly observable to be based on a particularly distinct common way of talking in the project-based epistemic groups I observed at ADF.

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[114] Additionally it is good to note that for example the research of Jeffrey and Monteiro & Keating is in the context of scientific research, in which the collaboration is between experienced and strongly encultured scientists. In that context the domain-specific language has developed much further than in my context of undergraduate higher education.

However, the communicative competence of reflecting and negotiating on the practice itself –
i.e. talking *about* practice - was evident in ADF: the students negotiated meanings, questioned
definitions and evaluated if certain course of action was desirable or not. For example the
longer story I recollected of a brainstorming session (Chapter 8.7.2) demonstrates how the
engagement in practice includes also the simultaneous negotiation *of* the practice itself.
Interdisciplinarity thus manifested in a pronounced talk *about* practice and placed an
emphasis on subsequent reflexive communicative competence. The presence of proficiency in
any specific technical language used *in* practice was not as observable.

9.3.3   Sociomateriality of practices: smart phones, laptops and Google

As shown, the interdisciplinary practices at ADF draw from a plurality of objects, the
physical space itself being an active object itself. In this Chapter I wish to highlight some
further practices where the embeddedness of knowledge creation in materiality was evident.
These practices involve the interobjectivity of various work-oriented tools used in
interdisciplinary knowledge creation.

The students were involved in new product development projects. Most of the projects I
observed were related to innovating products either using new materials, production
techniques or technology – however, given information about these materials and
technologies was scarce. This meant that searching for the newest information and ideas was
at the forefront of the practices. This practice of *information search* highlights the way
materiality (especially technological tools) was interwoven in the practices, and how
infrastructure was actively used.

Already in 2007, Orlikowski used Google search as an example to illustrate the
sociomateriality of practices. As I described in Chapter 8.7, the students at ADF very much
equated the whole practice of information search with Google: for example design students
using the picture search almost exclusively when trying to find visuals, inspiration and ideas,
and google being mentioned as the starting point for research. Thus I argue that this type of
distributed repository of information that Google represents has an important role in new

knowledge creation practices, and emphasizes ad hoc information search and "reflex-like" practices that emerge from the context. The assumed knowledge that the participants bring to the practice is in a manner downplayed as the "filling of the gaps" happens instantaneously as the gap is recognized by "googling". Following Bruni (2007) and Gherardi (2012), Google emphasizes the fragmented and puzzle-like features of the system of knowledge present in interdisciplinary knowledge creation. All participants bring their own pieces of knowledge to the table, but interaction with Google raises the amount of puzzle pieces indeterminably as all "gaps" that emerge can be instantaneously "googled". Google is a network memory, as depicted by Lindkvist (2005), to which students turn to, rather than turning to some communal knowledge base inherent in communities-of-practice, for example.

The centrality of one tool such as Google in knowledge creation is not in my view unproblematic, as the tendency is to forget that Google itself is a result of particular practices and motivations, and its search results emerge from the massive intertwined web of search practices of users world wide that feed the search algorithm. What a user gets as a search result is in itself a result of millions and millions of other searches – themselves emerging from practices. Thus the use of Google offers a potential for zooming out to the broader textures of practices (Gherardi 2012). Orlikowski writes (2007, 1439): "But as I have intimated in the earlier discussion, this way of thinking about and understanding Google's information search capability glosses over significant ways in which researchers' work practices are constitutively entangled through their everyday engagement with the materiality of the Google search engine".

Overall the interaction with technical tools, representing non-human actants and exemplified in the use of smart phones and laptops and the applications therein – is such a naturalized routine practice for the students that they were not referred to in my talks with the students in this capacity as enabling tools. I however observed them to be ever-present, and in constant use. In this sense, I argue that for the students this type of technology is in fact service infrastructure that for them is almost boring and invisible *in practice*, in the sense that for example Star meant to be used in conjunction of electrical systems and photocopiers. This is

the everyday material world that the students inhabit[115], and the use of such technical tools is recurrent practice.[116]

However, there was observable a varying degree of "uniqueness" in the material objects observed at ADF. The material objects such as prototypes, visualizations and presentations were one-of-a-kind, emerging from a very particular temporal situation and practice – they were in this sense unique. They were potentially re-used, but often they were transformed (for example as they tacked back and forth between interdisciplinary and disciplinary domains). In contrast, the use of Google, other applications and smartphones was a routine-like practice – recurrent and habitual. Knowing how to use them within the practice demonstrates the hidden practical knowledge I argue to be important in this type of knowledge creating activities. My findings would indicate that in knowledge creation practices tools, objects and technologies are at play in these two ways: the unique and the routine-like, and consequently hold different meanings to the participants. The more unique objects aid the knowledge creation towards its goal – a new product or service in the ADF case. In this way, they hold motivational power. In contrast there are sociomaterial practices that are invisible, and support the more mundane aspects of knowledge creation practices. These are the tools that the students "just knew how to use", and as such are taken for granted.

9.3.4 The importance of the physical space and spatial design

In Nicolini et al. framework the tertiary objects of collaboration are the objects that emerge from the material infrastructure, providing the "mundane" infrastructural support for the interdisciplinary practices. As explored in Chapter 3.2.1, infrastructure can be approached as work-oriented infrastructure (the tools, documents, ICT-systems and so on) and service infrastructure (the physical space of collaboration, electricity and spatial services such as copiers, coffee machines etc.) In the particular context of ADF I found that the physical space

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[115] This potentially creates additional boundaries in collaborative teams between generations as well as "technology-haves" and "have-nots".

[116] It is tempting to use improvisational choreography as highlighted by Gherardi (2012) to describe the practice of using for example Google and smartphones: their use enacts knowing-in-practice of when and how to draw on these pieces of the equipped environment. However I recognize that my observations of this particular practice are potentially too limited to feasibly expand this avenue of analysis.

and the experiences of it has such a prominent role in the interdisciplinary knowledge creation practices that it is elaborated in this chapter.

My ethnography of ADF was constructed as a tour of ADF premises. This was, as I have described, an explicit choice, in order to convey the "ethos" that the physical space evokes. The physical space of ADF is designed to support the mission of ADF to be a creative platform where diverse people can have accidental meetings, ideas can be freely exchanged and the different spaces are malleable to support the tasks at hand. As a building and the place where the interdisciplinary knowledge creation practices take place, ADF is conceptually "service infrastructure" – however, at ADF the physical space itself seems to be often experienced more like work-oriented as it is far from "invisible" to the participants – rather, the relationship between the space and practice is very active. It was even perceived as a boundary object by some participants, as the space was something to which shared meanings were attached. The space also became the object of action in some cases, as the groups arranged the spaces to better suit their particular needs and being a joint effort (e.g. the ME310 teams changing Puuhamaa to their "pit"). The physical space is thus malleable, in active relationship with its users, as well as emerging, not static.

The physical space of ADF is not "black-boxed", as it in a fashion requires the active participation of its users in order to "become used", and the different spatial possibilities are used as tools to enable the collaboration. The phrase "sinking into the space" was used to describe how the students activated the different spaces to their varying needs, be it a brain-storming session using white-boards, prototype building at the different "Shops", or "hanging out at the Puuhamaa".

What is notable is that the physical space evoked *differing, honest and emotional responses*. For some the "sinking into the space" was not a positive thing, as it potentially resulted in hanging around uselessly. The fact that that all responses were not all positive is not the issue – as questions of like and dislike will always vary – but the existence of these responses in the first place. My findings confirm what Strati noted (2007, 75): "The scholar's attention thus shifts to the specific differences among people at work. What one of them is able to feel another may not". It is not the issue to attempt to make everyone *like* for example the physical

space where they work – noting that of course the space should accommodate individual needs as not to hinder work – but rather acknowledge and respect that these differing sensible experiences exist in the first place, and not belittle them.

Thus the space at ADF enabled the sensible and embodied response and as such, gave recognition to the senses as a source of knowledge. This is potentially a virtuous cycle: a physical environment that acknowledges and *appreciates* the sensible knowledge that is present in all human activity enables the consequent responsive use of the space. As my materials confirm, this response will not always positive, as people do "feel" things differently, and the space is "exists" only through these relative experiences. Thus the space is not the "same" for all its users; instead it emerges from the personal embodied relation of each individual. This is in sharp contrast to what Strati (2007, 75) calls the practice of organizational an-aesthetization, "…by which disagreeable and problematic workplace experiences are muffled and silenced." There are multiple notions of the spatiality present in every embodied practice happening *in situ*.

This may be even more salient in knowledge work. If the epistemological representation for intellectual activity follows the "epistemology of possession", the mind is privileged and the bodily and sensory perceptions supressed. However, at ADF the knowledge creation is in a way co-created together with the material place. The activity that is usually classified as "intellectual" is made to happen "in the body" with the help of the physical environment and the sensible knowledge it generates. The whole space engages the sensible knowledge of the participants, making the intellectual activity more holistic and embodied. Or more rightly, it legitimizes the ever-present "perceptive-sensory faculties of individuals" (Strati 2007, 75). The opposite effect to this is how not moving or "doing" anything creates a feeling of paralysis, as one student noted.

The salience of the physical space consequently places a great emphasis on "being there" in person. The implications of this are two-fold: first, the practices of knowledge creation at a context such as ADF are very strongly embodied, and thus they also rely to a great extent on personal fact-to-face ways of interacting. The more routine-like practices that anchor the participants to ADF – such as the getting of coffee from Kafis, seeing who is "there" at a

given day, saying "hi" to everyone and so on – all rely on physical presence. This in turn created a certain norm of "hanging out", that potentially does not suit everyone given their simultaneous engagement in other practices elsewhere. Second, the strong embodiment of the practices make the managing of an interdisciplinary context such as the ADF "person centric" as opposed to relying on more structural tools such as project management methodologies, documented instructions and such. This makes the scaling up of operations potentially difficult. Third, the "ADF way" stresses boundary-spanning activities: the physical space and physical presence it "calls for" underline the importance of face-to-face interactions. In this way, boundary objects' effects are enhanced by the enablement of boundary spanning practices (Nicolini et al. 2012).

The above analysis is complimented by approaching ADF from the viewpoint of spatial rhetoric (Dale & Burrell 2008). The spatial rhetoric of ADF evokes terms such as "community", "creativity" and "fun". All the furnishings and décor seem to go to a great extent not to say "work". Following Dale & Burrell, the space of ADF is *conceived*, as it is managed and explicitly designed; it is also *perceived* through the production of the users moving and using the space (see for example my account of routines at ADF in Chapter 8.6); and finally ADF is *lived* as users give meanings to the space and reorder it to better suit these meanings, as in the "sinking into the space" illustrated earlier. The aesthetics experiences – both negative and positive – of the students were pronounced (enchantment in Dale & Burrells terms) but regulative aspects were altogether downplayed (emplacement), as the free and malleable use of the spaces was highlighted[117]. Consequently, the observable emphasis was on the enactment of the space – that is on the actual use – not just its admiration or critical assessment.

Theoretically ADF is an example of an explicitly performative space that is constituted by its users and vice versa. From a practice-based perspective, ADF is an equipped context designed to support certain forms of "movement" in the space that potentially enable interdisciplinary knowledge creation – such as the practice of getting coffee that is meant to enhance knowledge sharing. My observations show that the students do bodily enact these possibilities

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[117] When I visited ADF in late 2014, the increase in the number of visitors had led to taking a more regulative approach to the usage of spaces, as well as emphasis placed on the responsibility of the users in for example cleaning up. Thus the emplacement of space had become more pronounced.

– however at the same time they recognize the "managed" aspects of the context, and potentially alter the "choreography" of the practice, even resist it.

9.3.5   Interdisciplinary collaboration in project-based practice

In Chapter 8.7.1 I described the way the PDP-projects had been organized, according to the experiences of the students as narrated to me[118]. To raise the level of abstraction, I recognized two general approaches that the teams had taken towards interdisciplinary collaboration.

The **first approach** takes the team that has been formed as the starting point - I call this the *"discipline-led process of interdisciplinary collaboration"*. I observed this to be the pronounced way in seven projects. In this approach the (assumed) knowledge and skills of the team members, based on the disciplines they represent, is the basis for organizing the collaboration. This way of organizing can be argued to be closer to "multidisciplinarity" as defined in Chapter 3.1. Tying with my findings regarding objects, I tentatively argue that if the primary objects of collaboration is an activity object, there is a tendency to organize in this fashion: the partly given object that is in the interests of the corporate sponsor dictates the division of labour as well as the position and identity of each member of the team. This may potentially also partly explain why some students felt "trapped" as the representative of their discipline: the object required someone to do be "the finance guy" – and that role was given to the business student without more thought.

The **second approach** to organizing interdisciplinary collaboration on the other hand starts from the goal and task at hand, or – to put it more broadly – the problem the group is faced with. I call this approach the *"problem-led approach to interdisciplinary collaboration"*. Six projects were organized in this manner as well as the ME310 groups. This way of problem-led collaborating did not seem to have much to do with the actual composition of the group - that is, if there were many disciplines present or not. It was more a mind set of approaching the problem as an open issue, not knowing where the answers in the end might come from. In

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[118] As a limitation, it should be noted that I did not observe these teams from their inception. Thus I rely on the students' descriptions and my own interpretation of that. I shall return to this potential shortcoming in Chapter 10.3.

a way, there was also an explicit intent of "doing together". As with the first approach, I found that if the primary object of collaboration was an epistemic object, this approach to organizing was potentially more prominent: the "desire to know" encompassed the participants and the knowledges of each member were potentially valuable. However, it should be stressed that as with all the practices I observed, the organizing was potentially also at times experienced differently by the different participants of the same group (see Chapter 8.7.1 for examples).

To conclude, the project-based collaboration of interdisciplinarity in the case of the PDP-projects took two general forms: the discipline-led process and the problem-led approach to interdisciplinary collaboration. The discipline-led process potentially amplified the earlier described feelings of "being trapped" in a certain disciplinary character and the previous experiences of individuals affected collaboration. If the problem was "allowed" to lead, the practical knowledge was better enabled to emerge form the situation, and thus new pieces of the "knowledge puzzle" had the opportunity to emerge in-situ.

In Introduction I noted a prevailing research issue that explores the notion of interdisciplinary collaboration as a communities-of-practice. In Chapter 3.2.3 I looked at earlier research and found that the empirical evidence of effective co-operation without consensus (Star 2010) and collaboration resting on provisional and partial sharing that results in "community without unity" (Nicolini et al. 2012) has challenged the common notion that collaborative knowledge creation requires strong ties and extensive socialization, and could thus in all cases be treated as a community-of-practice (Lindkvist 2005; Amin & Roberts 2008).

In Chapter 3.2.1 I noted a finding from earlier research indicating that a group may engage in practices that are community-like, but most importantly, but they are not stemming from the socialization processes of the community as in the communities-of-practice literature. Arguably, the students participating in the courses were spending a lot of time at ADF, and many recognized the existence of a particular "ADF way of being and doing". In addition, many noted a sense of "family" and "community" at ADF, which was enhanced by the ownership and "home-like" quality of the physical environment. As such, there was a strong potential possibility of socialization into a certain practitioner community present in the

practices of ADF. This was particularly observable in the ME310 course that involved the students with their group, ADF and project almost exclusively for the whole academic year, potentially creating the required "strong ties".[119] In contrast, the students in the PDP courses were simultaneously involved in many other activities and the socialization was not as intense, not to mention the students of courses that were not as intensive (such as the IPD), where the level of socialization (and satisfaction) was in fact quite low (see Chapter 8.9).

Overall, I would thus argue that within the context of ADF, interdisciplinary collaboration is better characterized as a project based collectivity-in-practice than a CoP. What then brings fore the community-like features as observable at ADF? Nicolini et al. (2012, 619) note, "The emergence of an epistemic object introduces a form of a collective obligation toward it—an emotional affiliation that becomes a morally binding force among the co-researchers. Any infraction of the collaboration can now be subtly construed as an infringement of the collective obligations toward the 'structure of lack' displayed by the object. The object, in effect, turns a collection of researchers into a "proto-community." This was echoed in my findings, for example the students participating in the ME310 course talked of the certain "norm" that the course generated: the required strong physical presence, dedication to the course, the "go crazy" mentality of brainstorming and so on; if a student was unable to "hang out" at ADF all the time, it was potentially deemed indeed as an infringement.

I observed another factors to contribute to the community-like practices. The "managed practices" of ADF (emphasis on prototyping, encouraging trying and failing, having house rules and "accidental meetings") are critical as they help socially sustain and reproduce the courses of action of the students. For example the practices of prototyping are recognized by ADF to be important (as well as explicitly celebrated in galas and so on), and sustained by the support of the staff and "shops". When the spatial layout is combined with the "think out loud" ethos of ADF (see Chapter 8.9), all these resulting interactions enable diverse "accidental meetings" - or rather "planned coincidences", as one staff member put it - and communicative action, both strong requirements for idea generation and knowledge creation. Thus for example the "forced" practice of getting coffee from a certain place (Kafis) produces

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[119] This potential CoP –dimension of the ME310 course would be an interesting further research avenue - however, the materials from this research do not warrant its further analysis.

surprising outcomes, which in turn create a potential for knowledge creation between diverse participants. Gherardi (2012, 27) underlines that without these features, the activities of students may remain individual acts and not constitute practices as such. The presence of managed practices as enabling certain sustained community-like practices also point to the direction of *practices-of-Community (PoC)* (Gherardi 2009*), where the situated and repeated actions create a context where certain practices are sustained - rather than the context being the CoP.

To conclude: in Chapter 3.2.3 I introduced the conceptualization of Amin & Roberts of epistemic and creative knowing in practice as well as Lindkvist's concept of Collectivity-in-practice (CIP). My findings indicate that interdisciplinary knowledge creation at ADF holds the features of this type of project-based collaboration and knowledge practices, summarized below in Table 12 (elaborated from Table 8):

ADF as project-based epistemic / creative knowing-in-practice		
	As conceptualized by Amin & Roberts, Lindkvist	**Empirical findings from ADF**
Knowledge base	Distributed, to be extended in project, accessed through participants' "knowing-who-knows"	Network memory of Google; "asking around"; "filling the gaps" ad hoc; ADF staff
Type of knowledge	Specialized expert knowledge, with strong embodied interaction with material objects	Strong interaction with plural objects; practical knowledge; downplaying of a priori knowledge; "show me your brain"
Type of knowledge creation	Radical innovation, creative energy, goal-directed, market-like exchange through trial-and-error, improvisation, problem solving	Problem solving; goal-directed; negotiation between "abstract and concrete"; conflicts between previously learned ways of knowing and demands of here-and-now
Temporality	Short-lived, deadline-oriented but with "organized slack" and productive idleness	Project-duration; deadlines; "hanging around"; "running around for running's sake"
Type of knowledge worker	Autonomous, strong individuals, no strong (previous) ties between participants from socialization, expectations of others' expertise	Strong pre-set expectations (prejudges) of "disciplinary characters"; no strong ties but potentially intense socialization during project; individualistic
Overall "ethos"	"Desire to know"; "we tell more than we can know"; "anything is possible"	"Anything is possible", "trial-and-error", "fun"
Characteristics	Ambiguity, variety, uncertainty	Ambiguity, "in the dark", uncertainty, ambitious
Management	Project-based management, use of objects (epistemic, boundary, infrastructure, activity)	Minimal; manifesting through spatial dimension, example set by staff, "planned coincidences"; norms of being and doing
Spatiality	Physical proximity, ad-hoc meetings and active use of spatial possibilities	Emphasis on being there in person; "sinking into the space"; using space as resource

Table 13: Features of ADF as epistemic / creative knowing-in-practice

Thus the collaboration at ADF has many community-like features, but rather can be conceptualized as a collectivity-in-practice or an epistemic knowing-in-practice type of collaboration.

9.4 Summarizing findings on interdisciplinary knowledge creation practices

One main purpose of my research was to approach interdisciplinarity as a situated, practical activity rather than the outcome of black-boxed intellectual activity of expert-individuals (Chapter 2.4). Below I have drawn together the key findings from preceding chapters in order to formulate the answers to my research questions on this issue. I will start with the sub-research questions, and finally answer the main research question.

SRQ.3.1: What enables or constrains interdisciplinary knowledge creation (objects and boundaries, communication)?

I found that at ADF the three disciplines of engineering, art and design and business were quite pronounced. The students recognized them, reflected upon them – and yet found it difficult to "be" otherwise than the way they were taught and indeed how the other disciplines expected them to "be". Thus boundaries formed the very foundation of practices at ADF. Consequently, objects were in a crucial role to overcome those boundaries. I found the objects to be plural and dynamic. Key enablements found were the following.

First, the understanding the overall reason for the interdisciplinary collaboration itself is in my view crucial in order to successfully enable the best ways of motivating, encouraging and sustaining the collaboration among participants. I brought fore the notion of a "mirage" of the desired end-result as one key source of motivation. In addition, as there are strong differences in participant perceptions, there most likely needs to be a variety of motivational factors used. For example, within the same group, one student described the project as "a dream come true", whereas another one struggled with the work-load in order to get the credits. Both wanted the project to succeed, but the ways to motivate them would be very different. *Second*,

the goal of the collaboration needs to be detached from its origins (for example from the project sponsors or management initiating a particular development project), and allowed to evolve and change in the "in-between" space. This makes the problem localized and mapped in the situated context of the interdisciplinary practices, and consequently the participants gain a sense of ownership of the task at hand. To give an example, the way course personnel at ADF encouraged the students to find their own ways of doing and solve problems was at times experienced frustrating, but resulted in observable pride in the end-result as it was purely the students' own doing. *Third*, using prototypes, visualizations and other tangible objects as "talking points" enabled the participants to direct attention to potential unresolved issues, gauging out decisions to be made, and breaking the potential illusions of unity and existing common understanding. This manifested in numerous examples of gathering around prototypes or drawings where a lively discussion ensued. *Fourth*, in project-based interdisciplinary collaboration the participant's ability to talk *about* practice in order to develop is crucial. This enables the continuous evaluation and consequent changing of practice vis-a-vis the set goal. This places emphasis on the reflective capabilities of the participants, and potentially less on their socialization into some specific "practice-talk" of a practice community. This inevitably raises contradictions, negotiations as well as disagreement among the participants, but they need to be treated not as constraints but rather manifestations of learning taking place.

SRQ.3.2: How do embodiment, sociomateriality and spatiality figure in the practices?

In addition to the materiality in relation to objects, I found the following material-bound practices to be important in interdisciplinary knowledge creation. *First*, interdisciplinary knowledge creation at ADF was an embodied practice. Students talked of "getting the "feel" and "rules of thumbs" through objects, and used for example acting in order to gain more knowledge on a problem at hand. Knowledge creation was also greatly enabled by the use of ICT. Especially the practice of information search or "filling in the gaps" relied almost extensively on Google and smart phones. This made the practice of information search instantaneous and ad hoc. The knowing-in-practice of such tools is key practical knowledge in interdisciplinary knowledge creation.

Second, at ADF the active relationship between space and users was salient. To generalize, a physical environment that acknowledges and appreciates the sensible knowledge that is present in all human activity enables the consequent responsive use of the space, and thus potentially enables collaboration. This manifests in the allowed malleability of the physical space, the feel of it being continually "under construction" and "unpolished" making ownership possible. Interdisciplinary knowledge creation at ADF also relied on practices of "being there in person" accentuated by the space, which potentially may limit the scalability of such modes of operations.

SRQ.3.3: Do the practices engender a certain kind of practice community, and if so, what are its features?

This question proved to be the most difficult one to answer. My findings would indicate that ADF might be conceptualized as a temporal and physical space for epistemic and creative ways of knowing-in-action rather than a tightly knit group as a CoP. However, what makes this question somewhat ambiguous is that ADF as a social context does display community-like features and a course such as the ME310 relies also on extensive socialization. However, the emergence of these features was potentially enabled by the strong presence of objects in the practices as well the explicit management of certain practices themselves – such as having "house rules", encouraging a certain "ADF way of being" and the personnel that acted accordingly, for example. Thus there was evidence of "reaping the fruits" of a CoP-like collaboration by consciously fostering certain features.

To conclude, as an answer to the main research question: **RQ.3:** How can interdisciplinary knowledge creation be construed as a situated, practical activity? I offer the following as a way of synthesis. I argue that interdisciplinary knowledge creation (abbreviated IKC for clarity) in project-based creative contexts is a multi-dimensional construct, made out of the following intertwined elements:

1. **IKC is action, a way of doing**: interdisciplinarity is a particular mode of collaborative situated action in order to solve a particular problem. The knowledge supporting the practices involve fragmented pieces of knowledges gained from

educational experience, previous work experience as well as from the other domains of the participants' life. These pieces of knowledge emerge as the practical knowledge of knowing how to "connect the dots" and "fill the gaps", not as something that pre-exists. This collaborative action is organized in context-dependent manner and progresses non-linearly and is in constant movement between different and often conflict-ridden modes of knowledge-in-use, e.g. abstract vs. concrete; thinking vs. doing; and progress vs. "wait-and-see". The act of filling in the knowledge gaps is often intuitive, ad hoc and instantaneous using e.g. Google, making information search a critical practice within IKC.

2. **IKC is a personal experience, a way of experiencing**: interdisciplinarity is experienced differently by its participants, and becomes potentially a transforming experience for some participants, who feel themselves "becoming interdisciplinary", whereas for others it may remain more rooted in the practical action and "just" as a means for problem-solving. This results in a diversity of responses to the IKC practices, oftentimes in conflict, and the relative importance and resulting motivation for IKC varies from one participant to the next.

3. **IKC is materially anchored, a way of embodied being**: plurality of material objects are central to IKC, which results in multiple ways of interacting and "being" with the material objects. Tools such as Google and smart phones are integral to IKC knowledge creation processes. "Managed practices" such as emphasis on prototyping temporarily anchor the constant movement of knowledge-in-use enabling decisions to be made and work to continue in mutually agreed direction. Spatial infrastructure can strongly support this sociomaterial anchoring.

4. **IKC is projective, a way of reflecting**: IKC rests on the participants' ability to reflect on their practice (to talk *about* their practice) in order to rapidly change the practice if needed, vis-à-vis the given deadlines and milestones. As a result, there is constant challenging, negotiation and disagreement present in the practice (i.e. there is no strong consensus). This is not to be treated as negative phenomena but rather an integral nature of IKC practice.

This multi-dimensionality partially explains the "messiness" of knowledge creation I described in my introduction. It is a dynamic, diverse and non-linear process, rich in conflicts, differences in perceptions as well as in experiences.

9.5 Knowledge work and expertise in interdisciplinary contexts

Finally I set forth also the research questions on individuals engaging in knowledge-creation-in-practice:

> **RQ.4:** How do individuals experience interdisciplinary knowledge creation and knowledge work (and expertise) therein?

As analysed in Chapter 9.2.1, the student's notion of interdisciplinarity as it emerged was that of strong subject specialists coming together, echoing the traditional view of expertise as a subject-specific knowledge of a specific discipline, or the discourse on "core competence". The perceived value of everyone's contribution was strongly related to the amount of expert know-how one was able to bring to the project. This however left a gap for students who felt more "in-between", who had "no speciality", and who described themselves as "generalists", (reminiscent of the conceptualizations of Leonard-Barton and Iansiti as introduced in Chapter 4.2.3). In this chapter I will present my key findings that explore the issues that arose from my observations.

9.5.1 The in-betweens: boundary experts

I got the sense that there were quite a few students who were struggling with a certain "in-between" identity and were having difficulty in describing what they were experiencing – especially in relation to the "experts" who "know what they know". Thus it was not just the *problem or task at hand* that was interdisciplinary, the question encompassed the participants themselves as well. Consequently not only may we treat the end result as "interdisciplinary" – to a degree so too are the individuals who have lived the experience.

What to make of these "in-betweens" or "generalists" then? To recap earlier research, Yanow (2004) coined the term "boundary workers" that operate removed from the centre of authority and at the outside edge of the organization. I wish to argue that the "generalists" described above are in fact **boundary experts** that translate and represent the work practices between different disciplines or expertise. However, in contrast to Yanow's contextual interpretation that emphasized them as being located at a "double periphery", I wish to argue that in the context of knowledge creation and knowledge work, these boundary experts are at the *centre of interdisciplinary practices*. This is also in line with Oborn & Dawson's findings (2010a) of "brokers", who "are in fact central and valuable to the emergence of a new multidisciplinary space (ibid. 857)".

Their challenge however lies in the blurred disciplinary identity, which might not fit well within the established notions of expertise in the organization where they are located. The project-based collaboration is seen to place the knowledgeable individuals in a more pronounced position, and as such they need to "know what they know" (Lindkvist 2005) – this was a observed to be indeed a challenge to some students who felt it was hard for them to make others understand what they "knew" or who felt that at ADF engineers had a much easier time of articulating what their expertise was (see Chapter 8.5).

This difficulty of articulating what these "in-betweens" knew can be traced to their position at the boundaries, as it is exactly here that their expertise lies. Following Yanow, these boundary workers *accomplish* important tasks at the boundaries [as Carlile (2002) recognized what the boundary objects "do"]: the boundary workers engage in translation of practices, i.e. they learn to translate between their employing organization and the non-member practitioner community. They in fact practice in (and translate between) three domains simultaneously: the one of their own organization; that of their own work practice; and the context of the members outside the organization, for example the customers. Yanow's theorizing draws on empirical research that does not focus on knowledge work per se, rather more on the level of the "shop floor", or "street", so to speak, but I find her concept of boundary workers to be useful in other settings as well. Knowledge creation (innovating new products and services) in interdisciplinary contexts involves very similar boundaries and domains of practice: the one of the participants own "organization" i.e. discipline; the one emerging in the interdisciplinary

interactions themselves; and the domain of the "end-user", for whom the new service or product is to be designed to. This local knowledge of these various domains compliments the acknowledged subject-specific expertise.

9.5.2 Drawing from the participants' broader experiences and "the other life"

An observation that surprised me was that the "amount of interdisciplinarity" had sometimes quite little to do with the interdisciplinary composition of the group – i.e. if the group had for example students from all of the three schools present. As I earlier described (Chapter 8.7.1), there was one group that consisted of (male) engineers only, but in the course of their work, they had to engage in knowledge-in-use on issues that were of another discipline altogether. This meant drawing on their personal experiences and interests outside their domain of studies: one person liked to draw on his free time, and that allowed for them to do the required visualizations, for example[120]. This implies that knowledge work may overall – regardless of one's perceived strength of expertise - rest less on any actual a priori knowledge (or learned experiences) from a certain domain of expertise and more on the intertwined practices of the individuals' life in their "lifeworld" in its entirety. Or more accurately, the "thing" we categorize as "knowledge work" is constituted by both the practices and discourses of an expert culture as well the simultaneous living in the lifeworld. This might offer some explanation to the "in-between" experience as analyzed above: from interdisciplinary practices emerge knowing that does not fit into any pre-given expert culture, rather it resonates better with the participants lifeworld experiences and practical knowledge therein.

The above was concretely evident in the fact that many students were already working or had relevant working experience. As I showed through examples, many drew on these experiences as they participated in the projects at ADF. What these observations imply is that the students were able to reflect upon *former experiences* in other sociomaterial environments when engaging in the practices of question. Gherardi (2012, 11) notes "We may conclude that while

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[120] Reversely, of course, at the same time we need to be mindful of not intruding "the other life", if the person is declined to keep it to him or herself. But if the person makes his or her additional interests known to the group, then taking these interests into account may greatly enhance the process and consequently the end result.

people work, they perform activities of different kinds; they produce and reproduce society in its work relations, and they affirm an individual and collective work identity". Also Erden et al. (2014, 719) have noted this issue: "For example, members of an organization only learn a certain amount from their daily jobs. A significant proportion of what they know comes from their families, their hobbies, and books or articles they read or observe. When making choices, organizational members use not only what they have learned from a particular social practice but also what they have assimilated from prior exposure to other activities."

In treating knowledge creation as a practical accomplishment we also start to acknowledge the multitude of knowledges all individuals embody – not just based on their functional affiliation. It is practical knowledge that makes it possible to align all these experiences in order to sole a particular problem. Overall, the "life experiences" of students across various contexts and practices – i.e. in their lifeworld - seemed to contribute a great deal to the way they operated in the particular interdisciplinary context of ADF.[121]

This acknowledgment of multiple experiences as well as the simultaneous engagement in multiple practices may also aid in overcoming the possibly constricting or downright erroneous representations or roles an individual may feel as being attributed with based on what discipline one belongs to. Whereas some students stated they were "a typical engineer" in a neutral manner, some felt that these types of caricatures were indeed restricting. Notably this was the way especially business student's felt. I argue that as engineering was the core domain of ADF, from which its operations stem from, it was also the best-known discipline. Consequently the engineering students felt most at home as well as being best understood. But for the other domains or disciplines to be as well understood, it is more up to the individual to do the representing work, and engage in the struggle of making others understand better one's viewpoint. This was, as I found, however not an easy thing to do. Articulating and making one's expertise and skills known to others was difficult.

These expectations of expertise set to each other by the team members themselves was seen salient in epistemic and creative project –based ways of interdisciplinary knowledge creation

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[121] Interestingly, Klein (2008) has written about three major impetuses for new fields that produce new subject matters and methods for addressing problems and questions not accommodated in conventional taxonomies, i.e. interdisciplinarity. Life experience was one such impetus.

(see Table 8 in Chapter 3.2.3) and thus the ways of enabling this articulating of one's own expertise is an important feature in this type of collaboration. At ADF the hegemonic status of engineering made this articulating easy for the engineering students, but more difficult to the other domains and disciplines, echoing the research by Contu (2014) and Oborn & Dawson (2010a) on how the "doing of expertise" of one area of expertise may become the common norm for interdisciplinary collaboration. Thus attempting to find a balance in the management of such spaces as the ADF between the desired domains of expertise is crucial.

For some students, interdisciplinarity was not a practical question alone, but also encompassing a broader worldview without first thinking if a certain piece of knowledge is of practical value. In earlier research, interdisciplinarity is often associated with the need to solve complex "real-life problems that don't come in disciplinary shaped boxes" (Jeffrey 2003). However, my findings would indicate that for some participants there is potentially a value in interdisciplinarity *in itself* as well as its pragmatic dimension.

As an answer to **RQ.4:** How do individuals experience interdisciplinary knowledge creation and knowledge work (and expertise) therein? I argue that knowledge work in interdisciplinary contexts involves both individuals who "know what they know", as in subject specialists who rely on their previous learned experience – especially in their capability in articulating this perception of expertise to others; as well as the in-between boundary experts, who rely more on the local knowledge that emerges in the intersections of practices. Their expertise is in a sense "meshed", and thus not as easily articulated or represented as the one based on some subject specialist knowing. Overall, knowledge work in interdisciplinary contexts is a fragmented system of knowledge that emerges from the situation, complimented by knowledge gained previously in a completely different practice and context, as well as resulting in some new "pieces" of knowledge that are not yet potentially "useful", but are experienced as valuable all the same.

10 Conclusions

Knowledge creation is a messy affair. It is messy when there is just one individual drawing on his or her own experiences and resources in attempting to "create" something – and it is indeed messier still when there is a collaboration of individuals. In my prologue I voiced my frustrations on how knowledge work is often pictured with a "blurred filter" that erases the conflicts, struggles and ambiguity that I intuitively felt were intrinsic to such activity. My research done at ADF reveals that indeed, interdisciplinary knowledge creation as a collaborative effort is complex and filled with contradictions. However, in all observed cases, the collaboration succeeded as in the projects successfully reaching their goals[122]. Thus similarly to what Star (2010) observed, the collaboration of heterogeneous groups was possible without strong consensus.

My research aimed at approaching interdisciplinary knowledge creation in practice. I started "from the middle of things", that is, right in the middle of the action itself. What the observed action itself was is narrated in Part III (Chapter 8), and the key findings and answers to research questions were presented in Chapter 9. I argue that by approaching interdisciplinary knowledge creation as practical activity it is possible to "deconstruct" how it actually happens, and demystify its strong intellectual, mentalistic and expertise-based connotations. Following Smith (2007), I have rendered the work of the observed (future) professionals into *ordinary, accessible and routinized*. This in turn makes it possible to start grasping the pragmatic challenges as well the concrete drivers of such activity. Practice-based perspective gives also additional insight into the nature of interdisciplinary collaboration. Thus the effective way of organizing such activities becomes a question of organizing effective everyday practices – not attempting to manage some black-boxed, abstract and detached doings of "knowledge creators".

In this concluding chapter I wish to raise the level of abstraction further, and conceptualize my findings as I feel potentially to be applicable to contexts outside ADF and discuss their

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[122] In the case of ADF, the goal was to develop a prototype for new product or service based on the given design brief from sponsoring companies, as well as completing the course and getting the study credits. The success and usefulness of the prototype itself from the viewpoint of the sponsoring company was not possible to discern from this research.

practical implications to organizational knowledge creation. I also discuss the potential future directions of interdisciplinarity within society at large. The theoretical contributions of research are discussed in Chapter 10.3, limitations in Chapter 10.4, and avenues for further research in Chapter 10.5. I conclude on a short philosophical pondering on the epistemological and ontological fundaments of practice-based research.

10.1 Implications for organizations: opening the door to complexity

My findings form an integrated approach to interdisciplinary knowledge creation that takes into account the integration of the individual embodied experience; the contextual local knowledge emerging from the situated action; the participant reflections on the practice (often based on previous experiences); as well as the participants' here-and-now interactions with the surrounding socio-materiality. I have conceptualized how this ties together distinct expert cultures and the lifeworld of the participants. Approached in this manner, what are the potential implications for organizations outside the particular empirical context of my research?

In my Introduction I introduced the acknowledged importance of knowledge creation for organizations. Thus the ability to effectively organize and execute new knowledge creation is crucial, as only the implemented and recognized efforts count. As I have previously quoted, Alvesson states that "Without being perceived and recognized by others knowledge does not, for all practical purposes, appear as much, at least not in market and organizational contexts." (Alvesson 2004, 98.) Consequently the ability to plan and compose for example new product development teams for maximum effect is important, and requires some pre-set notions of the effective composition of the team. However, this should not be to the neglect of valuing the actual practices of cross-functional knowledge creation and the practical knowledge therein.

My findings would indicate that the participants draw from a great variety of experiences and knowledges in order to accomplish their tasks – not just their education and prior work experience, for example - and that these lived experience-based "sources" of diversity are potentially very valuable and thus legitimate. The ethos of interdisciplinary knowledge creation as enabling something where "1+1 equals more than 2" may have more to do with

this lived-experience based practical knowledge that emerges *in situ* than previously thought. Organizations are potentially unwilling to embrace this notion as this type of "emergent diversity" is much more difficult to manage and harness towards the given goals than the "a priori diversity" of for example assumed functional expertise. Based on my findings, I however conclude that there are effective practices for management to manage this type of plurality.

First, objects in their plural and dynamic sense are effective tools in anchoring the emergent diversity. I have argued that the "detaching" of the problem itself is one key practice of interdisciplinary knowledge creation. Without allowing this, the "problem" will not evolve into the activity or epistemic object that is crucial for the collaboration to be triggered, sustained and motivated. However, this means "letting go" of the problem: the problem is now the property of the participants. Having for example the expected outcome of a development project to be articulated in minute detail a priori in project plans may in fact hinder the knowledge creation as there is nothing that triggers the collaboration. The tendency of project management methods to require defining the goal beforehand erases the "residual categories" (Star 2010) and things that "do not fit" (Aram 2004) that are seen as the crucial catalysts for interdisciplinary collaboration - the problem is "made to fit" beforehand. This diminishes the "desire to know" of the participants, and greatly decreases the possibility of a novel outcome, as there is not enough left to know, so to speak, to push the wheels of knowledge creation into motion.[123] In contrast, if the problem is "allowed" to lead and to be ill-defined and sketchy, practical knowledge can emerge from the situation, and thus new pieces of the "knowledge puzzle" have the opportunity to emerge in-situ, greatly increasing the possibility of novelty in outcome.

Second, intertwined with this desire for unique novelty are the mundane practices: searching for information using the infrastructure-like tools such as Google, getting coffee and just "talking to people". Organizations may not see (or rather want to see) the importance of these aspects, but not recognizing them is in a fashion fooling oneself. It may not sound "honorific" to state out loud that a piece of information was "googled", but not acknowledging it is also

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[123] Nicolini et al. (2012) recognize that it could also be a member of the team that "leads by desire" (see Chapter 3.2.1). Thus a participant with enough emotional investment may still enable this "desire" even if the problem itself does not.

downplaying the actual practices of people. Consequently not recognizing the way for example smart phones and laptops are used in actual knowledge creating practice, then organizations may not know how to offer the best material infrastructure support for knowledge creating activities. My findings would also indicate that the role of an priori organizational "knowledge base" to which participants turn to in order to solve problems may need to be re-examined in interdisciplinary knowledge creation activities such as innovation, and the more networked-forms need to be evaluated. This includes the local knowledges emerging from the boundaries: knowledge from customers and knowledge from the "shop-floor", for example.

Third, objects are not stable, they are not essential "beings"; they are interpreted differently, and have an effect on each other. This means that the "best practice" approach taken by organizations, which takes a once-successful course of action as a reference point, is potentially not effective in interdisciplinary knowledge creation. The relational quality of objects makes them elusive, and participants continuously negotiate what is "best" practice in their situated context. If this negotiation is suppressed or viewed as problematic, no knowing takes place, and no transformation of knowledge as a consequence. "Practicing and contestation/disagreement therefore go hand in hand (Geiger 2009, 140)". To not acknowledge this is to deny the competent practicing required.

The best practice-approach may also hinder the effective composition of the teams. Based on my findings, I argue that when attempting to create interdisciplinary teams, organizations need to look for not only subject specialists but also boundary experts, i.e. individuals, who, from their lived-experience, can translate across various boundaries and thus integrate between the various domains of expertise. However, this means that in organizations there may potentially be "experts" that do not correspond with traditional functional divisions, and thus are "meshed" over various positions within the organization. This creates ambiguity and uncertainty of their identity, making them also hard to identify. However, if the importance and appreciation of such local knowledge and boundary experts is explicitly stated by the organization, it may help unearth these valuable experts.

Finally, based on my findings I am inclined to stress the importance of managing the everyday here-and-now of knowledge creation practices. This means that the organization needs to be *involved and engaged* in the knowledge creation in order to "get" the nuances and diversity that knowledge creation practices hold. There has been a tendency to "leave the innovators alone" in order for them to magically create new knowledge (as in them having the honorific title of "expert knowledge", see Chapter 2.4). Based on my findings I would in fact argue the opposite: knowledge creation is a practical activity, and for it to be effective, there needs to be a management that in fact is *very much present*. The key is the nature of this presence, as there is also a something called "micro-management" – meddling in practices that need not to me meddled with (for example the "letting go of the problem" described earlier). At ADF, Factory Director Kalevi Ekman has referred to himself as "The Janitor", and this may be a particularly astute way of describing management that enables the everyday activity but is not in the way. Especially the mundane everyday routines are not easily understood unless one is involved – and "being there" in person, as was encouraged at ADF. We can call this leading not only by example, but also by *presence*.

The "managed practices" of ADF and its emphasis on the physical space give some indication on how management can foster the emergence of effective practical knowledge as well as allow for the reflexive contestation of the practice: creating supporting "house rules" and way of being; leading by example *and* presence; and developing a spatial and material infrastructure that acts as an active and malleable resource for work practice – not a black-boxed, "pre-given" and static materiality. There was also an emotive element present in the practices I observed, whether labeled desire, passion or energy – indeed, desire being one acknowledged force driving knowledge creation. Invoking such sentiments may prove to be the final touch in managing knowledge creation.

10.2 The future of interdisciplinarity at ADF

At ADF the notion of what "interdisciplinarity" encompasses is evolving. In Chapter 9.2.2 I argued that this means taking slowly into account plural epistemologies, even more viewpoints and accepting the increasing diversity of its "characters". This would mean the evolving of interdisciplinarity from the core of the scientific-technical domain towards

encompassing also the aesthetic-expressive, market-network and moral-legal domains. This might, over time, develop into something truly innovative, a synthesis that takes the diversity and specific logics of the disciplines into account. However, in addition to the corresponding expert cultures, the existence of the plural knowledges-in-use need to be recognized and fostered - that is, the practical knowledge that emerges from the localized problem itself. This practical knowledge resides in the everyday lifeworld of practising, and might be the arena for reaching consensus and unity – "one that might be established this side of expert cultures, in a nonreified communicative everyday practice (Habermas 1987, 398)". Without this relation and anchoring to practice, expert knowledge is severely detached "from its moorings in everyday life" (Habermas, in Finlayson 2005, 65). Only through practice can we bridge the gap between what we know and how we live. Practice together with the reflexive modes of communication (as in talking *about* practice) form the interrelated "modes of practical understanding (Gherardi 2012, 123; Geiger 2009, 139)". Ultimately, this interrelation may be the key in enabling the transformation of knowledge as it is used in practice, and results in "new" knowing that surpasses any discipline and expert domain. This resulting knowing would have relevance and meaning in our lifeworld as well – *what we know* and *how we live* could be united. Thus the promise of interidsciplinarity may lie in its the intertwined relationship between reflexivity and knowing; expertise and practical knowledge; and the various expert cultures and "lifeworld".

Aalto University as a whole – not just the joining of three distinct schools – is an on going and emerging process. My research has shown that during my field work in 2011 - during still the initial stages of Aalto but however already into the third full year of ADF operations - the distinctiveness and the relative inequality of the three major disciplines was still a dominant feature in the everyday perceptions and practices of students – even in the explicitly interdisciplinary context of ADF. Higher education as the production and learning environment of knowledge workers needs to take these realities into account: does the touted "interdisciplinary" higher education (as a manifestation of the "Mode 2" knowledge production, Table 9, Chapter 5.1) wish to produce subject specialists of certain expert domain with "interdisciplinary" capabilities, or does it aim for the emergence of the "boundary experts" I conceptualized in Chapter 9.5.1 – or potentially both? For the students this is a critical issue in developing their identity as the heralded "knowledge workers".

10.3 Theoretical contributions

In Chapters 1.4 and 1.5 I reviewed earlier literature and identified emerging research gaps therein, as well as formulating the consequent research question. In this chapter I will evaluate how my research contributes to earlier research, and more importantly, the contribution to the identified research gaps. The empirical contributions and answers to the research questions were offered in Chapter 9 – this section takes a more theoretical view.

Overall, the main theoretical contribution of my research is in the attempt to expand the way knowledge creation (KC) is construed in mainstream knowledge management (KM) research. Approaching KC as a practical accomplishment using the practice-based perspective has the potential of enriching our understanding of both *using* as well as *transforming* organizational knowledge resources through the very same use. In a sense, practice is the ultimate *exploration* of what we know – yet simultaneously *exploiting* the resources made available to use in the practice and by the practitioners. Thus the focus on practice offers potential in overcoming the exploration – exploitation dualism inherent in debates about what KM is and should be about (Chapter 1.1). This contribution is supported by using ethnography as a method, offering a rich empirical case on how KC takes place.

Research question **RQ.1:** What types of knowledge frameworks (epistemologies) emerge from the observed knowledge-in-use? aimed to contribute to the (organizational) epistemological discussion on "how we (come to) know what we know", and how work such as "knowledge creation" is accomplished. My research attempted ot only to use the practice-based perspective as the "justification" for using practice as an empirical unit of analysis of work, but also using practice as an epistemological approach, as put forth by Gherardi (2012). I have attempted to explore how knowledge is *used* and how knowledge might *transform itself through this very use*. This offers insight into the processes of how new organizational knowledge comes to be: "Yet, despite the proliferation of empirical studies and the important insights gained, more theoretical work is needed to further expand on the processes through which new organizational knowledge emerges (Tsoukas 2009, 941)".

Theoretically put, the practising of interdisciplinary knowledge creation such as new product development, for example, does not rest only on what each "expert" brings to the

collaboration (or rather, is *expected* by the others to bring), but to a large extent relies on *knowing how to do* interdisciplinary knowledge creation. This knowing how to do is practical knowledge as set forth in Chapter 2.4, and thus it is the *competence* in practising interdisciplinary knowledge creation (Gherardi 2012, 205).

If the a priori expert knowledge (as the stocks of already existing pieces of knowledge) plays a lesser role in knowledge creation than research based on the objectivist perspective on knowledge creation might imply (Chapter 1.1; Chapter 2.3), what then are the elements of this practical knowledge related to interdisciplinary knowledge creation (IKC)? This was the topic of my research question **RQ.3:** How can IKC be construed as a situated, practical activity? and its sub-research questions dealing with enablements, sociomateriality and the role of community. Here my aim was to contribute to the practice-based literature on KC. The main theoretical contribution of my research is in the integrated theoretical framework as depicted in Figure 1 (Chapter 3.3). In this framework I attempt to create a holistic framework that integrates the *process*, the *practices* as well the *enabling factors* of IKC. When used as the foundation for the empirical analysis, this offers pluralistic "lenses" that take into account the multidimensional nature of IKC. This includes materiality in its broad sense including viewing the practitioners as embodied beings, exploring their interaction with objects, their use of language as well as the role of spatial materiality. Overall, this multidimensional approach contributes to KM and KC research as it does not privilege any one dimension at the outset, but rather looks at how any of them may emerge from the practices, be they objects in their plural sense, ways of talking, interacting with the physical surroundings or being bodily present in the interactions. This multi-dimensionality results in the conceptualization I offered in Chapter 9.4 of IKC as a *way of doing, experiencing, embodied being and reflecting*.

However, even though the process and practice are highlighted, there is yet another important dimension in my research: the individual. As stated earlier, Erden et al. (2014, 719) comment, "… studies adopting the knowledge perspective have a tendency to disregard the roles that individuals play in social practice. Future research might examine how individual differences are linked to knowledge in a social practice." This was the topic of my research question **RQ.4:** How do individuals experience interdisciplinary knowledge creation and knowledge work (and expertise) therein? My research gave voice to the individual participants and their

experiences, and these in turn gave rise to findings that indicate that in IKC, the way the individual *experiences* the practices directly affects *how* the individual practices. The two are not to be treated as separate "entities" - not in research or in practice.

Finally, as a more contextually specific contribution I explored how undergraduate level students experienced interdisciplinary education and courses, as this was recognized to be an under-researched subject (Chapter 1.4.3). This was the topic of research question **RQ.2:** How do the students define and experience interdisciplinarity (as an educational practice)? Regarding my findings on this matter, theoretically of interest is the finding of strong presence of certain "domains of expertise" – with subsequent inequalities - that the students experienced. This would imply that disciplinary boundaries and "characters" are present and "formed" already in the undergraduate level, and thus there exists also similar constraints to collaboration as found in research on interdisciplinarity within more advanced scientific research settings. Theoretically this also relates to the question of teaching "Knowledge" or certain actionable capabilities to deal with the increasingly complex problems facing today's societies. If KC benefits from being approached as practical action – so too does higher education. The practices observed at ADF may also be regarded as "forms of action" (Barnett 2000, 411) to be taught in higher education. In this manner, my research contributes to the attempts of formulating the future directions higher education should take. I thus join for example Barnett (2000, 411) who states: "No longer are skills in higher education to be tied to forms of knowledge per se." To recap what I wrote in Chapter 10.2: ultimately *what we know* and *how we live* should be united, and the promise of interidsciplinarity may lie in its intertwined relationship between reflexivity and knowing; expertise and practical knowledge; and the various expert cultures and "lifeworld".

10.4 Limitations of research

My dissertation has covered many themes, and its main themes of knowledge creation, interdisciplinarity and knowledge work are all very broad themes in themselves. In hindsight the theoretical framework was indeed quite broad, and as such there were some issues that would have warranted more analysis than what I have offered. Knowledge creation and interdisciplinarity have been given a rather thorough analysis, but the analysis on knowledge

work and expertise is left somewhat in their shadow and is in a fashion detached from the overall conceptual framework of interdisciplinary knowledge creation. In addition, all the themes potentially did not have enough correspondence with my empirical material. Thus the limitations of my research stem from both the neglect (or under treatment) of some research issues as well as the recognized shortcomings of my empirical material. In addition my chosen context of higher education brings fore certain limitations as well.

Regarding my empirical material and ethnography I recognize the following limitations. First, I observed only one team (from IPD course) from its inception. This means that a more in-depth analysis of how the teams more generally formed and evolved is lacking, and relies on the student's narratives of this organizing. Second, my material and analysis concentrates mostly on how students talked *about* their practice, and less so on how they talk *in* practice. Thus the discourse-dimension of practice is partly out of the realized scope of the dissertation – however, it is also recognized as a potential further research avenue. In regard to my chosen ethnographic methodologies, my research would have been greatly enriched from the use of video material. This would have enabled a more in-depth analysis of especially the embodiment of practice, for example by videotaping brainstorming and prototyping sessions. In addition, overall, arguably my ethnography has at times the dreaded snapshot feel: ADF is a distinct spatial entity, within which a multitude of different activities take place, and all can not be treated with the same level of detail. However, attempting to recognize and isolate some action as being for example "knowledge creation" is rather difficult and artificial. I feel that my broad treatment of ADF and its practices paints a more rich and representative picture of what I experienced than a more narrow focus would have done. Practices are, as emphasized on many occasions, contextual and need to be understood as emerging within the broader "flux of organizational activities (Rouleau et al. 2014, 4)". However, I do recognize that the multitude of practices one could have "trailed" and "zoomed out on" (Nicoloni 2009) might have required a more lengthy time on-site.

Finally, regarding my chosen context of higher education and ADF, there are three limitations I am aware of. First, the role of higher education in knowledge processes of our society as well as producing knowledge workers does not "tie in" with my research framework as well as I had intended. The "zooming out" of observed practices to broader practices of higher

education and the analysis of this broader "texture of practices" (Gherardi 2012, Nicolini 2009) fell to a great extent beyond the realized scope of this dissertation. Thus the relation of observed practices to their "overall cultural framework (Watson 2012, 16)" of for example the neo-liberal pressures on higher education were not analyzed as much as was the original intent. Of course, this is partly due from the choosing of certain practices to focus on (interdisciplinary collaboration, knowledge creation practice) and thus delimiting the field of analysis. Second, the issue I acknowledged in the Introduction that being a student is different from being an employed worker in a company, does affect the explanatory power of my analysis on knowledge work. In fact, it can be argued that I could have chosen to focus on "education practices" instead of knowledge work practices, as the students were engaged in both. Second, ADF is a very unique constellation, both within higher education as well as a broader spatial context of interdisciplinarity. This has limitations on the generalizing of my key findings. Third, ADF is a context for a very specific type of knowledge creation: new product development. Thus the framing of knowledge creation activity in my research more tightly as specifically *new product and service development* could have aided in clarifying my focus as well as providing a potentially better empirical base for generalizing on my findings to other organizations dealing with similar activities.

10.5 Avenues for further research

As a result of the aforementioned broadness of the research framework, this research has opened many pathways to further research. I have grouped the potential research avenues into three themes.

First, the following focus areas can enhance the analysis of interdisciplinary knowledge creation in practice:
- Conducting a more detailed longitudinal study on the careers of objects; for example the shadowing of objects would offer insights into the dynamics of their relations with other actants.
- Focusing on communicative actions, conducting a Habermasian discourse analysis of the talking *in* practice as well as talking *about* practice - the material on talking *in* practice was somewhat limited in my research

- The notion of practices-of-community (PoC) warrants closer analysis, especially the routines and practices that sustain a community.

Overall, the zooming out of the practices observed at ADF by following the trails of connections between practices would have much to offer. For example, the shadowing of Factory Director Ekman as an *intermediary of practice* (Nicolini 2009) would provide fascinating insight into the way ADF is weaved into the practices of Aalto University, the globalizing of higher education (as in visiting the ADF international network) as well as the neo-liberal and politicized discourse that necessitates the role of higher education in national economic innovation and renewal (exemplified for example in the visit of for Finnish and English prime ministers Stubb and Cameron at ADF in November 2014).

Second, the role of leadership and the management-in-practice is a crucial further research issue. In my conclusions I underlined the importance of "here-and-now –leadership". It would be interesting to analyze the potential role of the team's internal leadership as well the leadership "from the outside" [for example the "leading by desire" that Nicolini et al. (2012) observed in their research]. Leadership in interdisciplinary knowledge creation could potentially be framed as boundary expertise in its own right - i.e. being the translative capability between the knowledge creation and the rest of the organization. The materials from my initial second site (Chapter 7.1) would offer rich material to explore this question further.

Third is the question of interdisciplinarity in higher education. It would be an interesting avenue for future research to see how the students *starting* as Aalto University students will perceive their identity and ways of knowing in a few years time contrasted with the students in my study, who were experiencing the birth of Aalto during their education. In addition consequent research "zooming out" to the neoliberal discourse practices of higher education could explore issues that emerged already in this research, but were not elaborated. These include the intertwined role and impact of commercial companies in educational practices and the recognized similarity between certain practices of ADF and the genre of management consulting (Chapter 8.10).

Finally, as the concluding words, I want to zoom out into the more philosophical undercurrents of my research. I found it interesting that a similar critique has arisen regarding interdisciplinarity (e.g. Oborn & Dawson 2010a), boundary objects (e.g. Nicolini et al. 2012; Ewenstein & Whyte 2009) and communities of practice (e.g. Amin & Roberts 2008): the tendency to "over-operate" the concepts to the point of them becoming too distilled or generalized to have any real explanatory value. To counter this, in all cases the counter-argument is to take context, variety and idiosyncratic nature of practice once again seriously. A similar tendency was discernible in research on knowledge work: the critique against the elitist professional perspective implies that one cannot ascribe a clear-cut definition for "knowledge work" either. As with most of things social, there is no "one-size fits all". This is challenging for both researchers as well as practitioners, as one cannot prescribe or implement a silver bullet for effective knowledge creation. This is the direct result from the epistemic shift in viewing knowledges as plural and situated in practice, rather than Knowledge as a possession and object.

Gherardi (2012) notes that practice-based research is part of the broader intellectual movement towards a relational perspective of our social world. Mustafa Emirbayer in "Manifesto for a Relational Sociology"" (1997) outlines this alternative to treating substances (things, being, essences) as the unit of inquiry (i.e. substantialism). I shall not go into details of his argument but I shall raise some issues I found to be inspiring as pointers towards further research. In treating our social world as unfolding in dynamic relations or transactions, we can approach the various "units" involved in the transaction as "deriving their meaning, significance and identity from the (changing) functional roles they play within that transaction (ibid. 287)". This means that individual persons are inseparable from their transactional contexts within which they are embedded. Thus, for example, we can still broaden the view of knowledge work as not having some fixed (expert) identity – rather, it shifts within the transaction of interdisciplinary knowledge creation as well within the other practices not observed. All the units and "categories" present in for example the practices I observed (objects, persons, space) are in ongoing and dynamic relations between each other, and within those relations, they mutate, change, and potentially disappear altogether. Attributes of the individuals and other "units" are not pre-given – as in having "expert knowledge" a priori – rather, these attributes are constituted when they are recognized and named as such by other

human agents. This offers a more philosophically grounded premise on the argument that knowledge work indeed is a matter of perception and always relational. In this view, agency is inseparable from the unfolding dynamics of the situation, and involves different ways of experiencing the world. "Agency is a dialogic process by which actors immersed in the *durée* of lived experience engage with each others in collectively organized action contexts, temporal as well as spatial." (Ibid. 294). The tendency to categorize that is inherent in the substantialist or essentialist modes of thinking can also partly explain the feelings of "being trapped" as a representative of a certain discipline or knowledge, as these categories "totalize identities that are in fact often multidimensional and contradictory; prescribe modes of thought and action against which alternatives can only be labeled 'deviant'; naturalize rigid transformations that suppress possibilities for creative (self-) transformation…" (ibid. 309)".

Accepting this relational premise opens the door where interdisciplinary knowledge creation is the path towards creativeness and the transformation of selves as well as knowledges. When opening such door, one needs to approach the "mess" revealed with a plural – indeed interdisciplinary – outset, not with a single "best-practice" broom to clean it up.

Epilogue

The dissertation opened up with the pains of renovation, and closes with downright destruction. When I visited ADF in November 2014, I heard that the building was to be demolished in few years time to make way for the new Aalto Campus. I have to admit I felt a pang of regret upon hearing this, but at the same time it had the feel of a befitting end of an era, so to speak. Creative destruction epitomized!

If the physical materiality of ADF was to be a fleeting moment, did then the experiences of ADF and its courses leave more lasting impressions? In December 2014 I met with one of the students I had interviewed and observed, and we talked about working life and the experiences and lessons she had taken with her from ADF as well as her interdisciplinary studies from the IDBM –program.

She reflected especially on the importance of empathy in order to understand different people and their ways of doing. For her, empathy was the direct result from being exposed to different types of people in the first place, and being required to do things together – as the IDBM –program extensively did. *"You learn to read people through your own experiences"*, she reflected. This combined with "knowing oneself" and having an own "vision" of what one wants to be, makes it possible to value everyone's contribution while simultaneously being able to enrich one's own knowledges in a meaningful way. Otherwise the risk of becoming a watered-down jack-of-all-trades is all too real. This reminded me of a comment made by another student, back in 2011: *"They try to teach, I think a way of working, somehow, but it's much more learning, not the skills, but learning about yourself, I think."*

One staff member used the term "never-ending semester" to describe the learning invoked at ADF: learning is a life-long journey that never ends. The interdisciplinary practices of ADF may leave their most effective imprint by evoking an ethos of a certain appreciation: appreciation of diversity and the curiosity that creates the everlasting desire of knowing more.

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Appendix 1 List of persons interviewed

Students (code used in text)	Sex	Course / Role at ADF	Discipline in Aalto (or other)	Date of interview	Duration of interview
SE1	M	PDP / project man.	Engineering	23.2.2011	46 min
SE2	M	PDP / project man.	Engineering	9.3.2011	51 min
SE3	M	PDP / member	Engineering	25.3.2011	47 min
SE4	M	PDP / project man.	Engineering	24.2.2011	47 min
SE5	F	PDP / project man.	Engineering	1.3.2011	39 min
SE6	M	PDP / project man.	Engineering	24.2.2011	44 min
SE7	M	PDP / project man.	Engineering	9.3.2011	70 min
SE8	M	PDP / project man.	Engineering	24.2.2011	27 min
SE9	M	PDP / project man.	Engineering	23.2.2011	62 min
SE10	M	IPD	Engineering	7.3.2011	36 min
SE11	M	IPD / PDP member	Engineering	7.3.2011	23 min
SE12	M	ME310	Engineering	30.3.3011	45 min
SE13	M	ME310	Engineering	31.3.2011	63 min
SE14	M	ME310 / staff	Engineering	31.3.2011	27 min
SE15	M	ME310	Engineering	29.3.2011	29 min
SE16	F	ME310	Engineering	29.3.2011	42 min
SE17	M	ME310	Engineering	31.3.2011	61 min
SD1	M	PDP / member	Art & Design	4.3.2011	26 min
SD2	M	PDP / project mang.	Art & Design	23.2.2011	41 min
SD3	F	PDP / member	Art & Design	24.3.2011	50 min
SD4	F	IPD / IDBM	Art & Design	9.3.2011	56 min
SD5	M	IPD / IDBM	Art & Design	7.3.2011	51 min
SD6	F	ME310	Art & Design	16.3.2011	40 min

| SD7	M	ME310 (former PDP project man.)	Art & Design	30.3.2011	62 min
SB1	F	PDP / member	Business	15.3.2011	40 min
SB2	F	IPD / IDBM	Business	4.3.2011	67 min
SB3	F	ME310	Business	16.3.2011	48 min
SU1	F	PDP / project man.	Social sciences / Helsinki University	1.3.2011	44 min
SU2	M	ME310	Social sciences / Helsinki University	12.4.2011	60 min

Staff (code used in text)	Sex	Course / Role at ADF	Background discipline	Date of interview	Duration of interview
ST1	M	Staff / former PDP project manager	Engineering	18.2.2011	47 min
ST2	F	Staff / former PDP project manager, IDBM student	Business	29.3.2011	65 min

Appendix 2 Layout of Aalto Design Factory
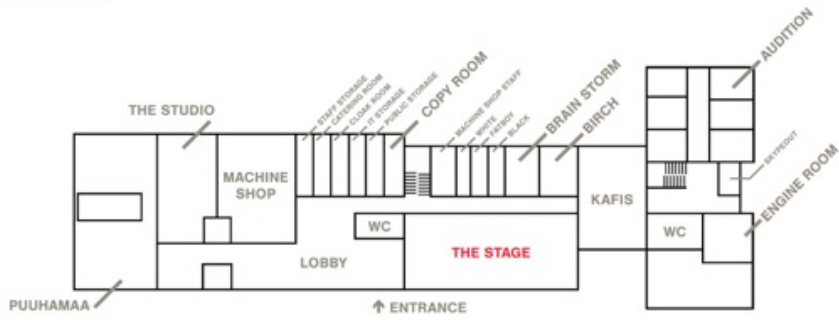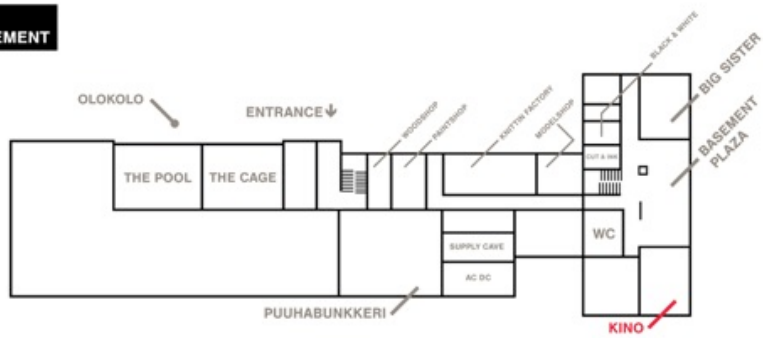
Source: Aalto Design Factory website

ACTA UNIVERSITATIS LAPPEENRANTAENSIS

611. LI, MING. Stiffness based trajectory planning and feedforward based vibration suppression control of parallel robot machines. 2014. Diss.

612. KOKKONEN, KIRSI. From entrepreneurial opportunities to successful business networks – evidence from bioenergy. 2014. Diss.

613. MAIJANEN-KYLÄHEIKO, PÄIVI. Pursuit of change versus organizational inertia: a study on strategic renewal in the Finnish broadcasting company. 2014. Diss.

614. MBALAWATA, ISAMBI SAILON. Adaptive Markov chain Monte Carlo and Bayesian filtering for state space models. 2014. Diss.

615. UUSITALO, ANTTI. Working fluid selection and design of small-scale waste heat recovery systems based on organic rankine cycles. 2014. Diss.

616. METSO, SARI. A multimethod examination of contributors to successful on-the-job learning of vocational students. 2014. Diss.

617. SIITONEN, JANI. Advanced analysis and design methods for preparative chromatographic separation processes. 2014. Diss.

618. VIHAVAINEN, JUHANI. VVER-440 thermal hydraulics as computer code validation challenge. 2014. Diss.

619. AHONEN, PASI. Between memory and strategy: media discourse analysis of an industrial shutdown. 2014. Diss.

620. MWANGA, GASPER GODSON. Mathematical modeling and optimal control of malaria. 2014. Diss.

621. PELTOLA, PETTERI. Analysis and modelling of chemical looping combustion process with and without oxygen uncoupling. 2014. Diss.

622. NISKANEN, VILLE. Radio-frequency-based measurement methods for bearing current analysis in induction motors. 2014. Diss.

623. HYVÄRINEN, MARKO. Ultraviolet light protection and weathering properties of wood-polypropylene composites. 2014. Diss.

624. RANTANEN, NOORA. The family as a collective owner – identifying performance factors in listed companies. 2014. Diss.

625. VÄNSKÄ, MIKKO. Defining the keyhole modes – the effects on the molten pool behavior and the weld geometry in high power laser welding of stainless steels. 2014. Diss.

626. KORPELA, KARI. Value of information logistics integration in digital business ecosystem. 2014. Diss.

627. GRUDINSCHI, DANIELA. Strategic management of value networks: how to create value in cross-sector collaboration and partnerships. 2014. Diss.

628. SKLYAROVA, ANASTASIA. Hyperfine interactions in the new Fe-based superconducting structures and related magnetic phases. 2015. Diss.

629.   SEMKEN, R. SCOTT. Lightweight, liquid-cooled, direct-drive generator for high–power wind turbines: motivation, concept, and performance. 2015. Diss.

630.   LUOSTARINEN, LAURI. Novel virtual environment and real-time simulation based methods for improving life-cycle efficiency of non-road mobile machinery. 2015. Diss.

631.   ERKKILÄ, ANNA-LEENA. Hygro-elasto-plastic behavior of planar orthotropic material. 2015. Diss.

632.   KOLOSENI, DAVID. Differential evolution based classification with pool of distances and aggregation operators. 2015. Diss.

633.   KARVONEN, VESA. Identification of characteristics for successful university-company partnership development. 2015. Diss.

634.   KIVYIRO, PENDO. Foreign direct investment, clean development mechanism, and environmental management: a case of Sub-Saharan Africa. 2015. Diss.

635.   SANKALA, ARTO. Modular double-cascade converter. 2015. Diss.

636.   NIKOLAEVA, MARINA. Improving the fire retardancy of extruded/coextruded wood-plastic composites. 2015. Diss.

637.   ABDEL WAHED, MAHMOUD. Geochemistry and water quality of Lake Qarun, Egypt. 2015. Diss.

638.   PETROV, ILYA. Cost reduction of permanent magnet synchronous machines. 2015. Diss.

639.   ZHANG, YUNFAN. Modification of photocatalyst with enhanced photocalytic activity for water treatment. 2015. Diss.

640.   RATAVA, JUHO. Modelling cutting states in rough turning of 34CrNiMo6 steel. 2015. Diss.

641.   MAYDANNIK, PHILIPP. Roll-to-roll atomic layer deposition process for flexible electronics applications. 2015. Diss.

642.   SETH, FRANK. Empirical studies on software quality construction: Exploring human factors and organizational influences. 2015. Diss.

643.   SMITH, AARON. New methods for controlling twin configurations and characterizing twin boundaries in 5M Ni-Mn-Ga for the development of applications. 2015. Diss.

644.   NIKKU, MARKKU. Three-dimensional modeling of biomass fuel flow in a circulating fluidized bed furnace. 2015. Diss.

645.   HENTTU, VILLE. Improving cost-efficiency and reducing environmental impacts of intermodal transportation with dry port concept – major rail transport corridor in Baltic Sea region. 2015. Diss.

646.   HAN, BING. Influence of multi-phase phenomena on semibatch crystallization processes of aqueous solutions. 2015. Diss.

647.   PTAK, PIOTR. Aircraft tracking and classification with VHF passive bistatic radar. 2015. Diss.

648.   MAKKONEN, MARI. Cross-border transmission capacity development – Experiences from the Nordic electricity markets. 2015. Diss.