Heterogeneous networks in multifunctional spaces

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Published in:
Design Research Epistemologies I

Publication date:
2010

Document Version
Early version, also known as pre-print

DESIGN RESEARCAH EPISTEMOLOGIES I

- Research in Architectural Design

AALBORG UNIVERSITY

DESIGN RESEARCH EPISTEMOLOGIES I

Department of Architecture, Design and Media Technology

Aalborg University

Edited: Ole B. Jensen

Printed in Denmark 2010

ISSN nr. 1603-6204

AALBORG UNIVERSITET

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The aim behind this publication is twofold. First of all this is an attempt to reflect upon the nature of the knowledge that currently is being produced in the different PhD projects hosted at the Department of Architecture, Design and Media Technology, Aalborg University. During some years now the PhD research has been organized within the Architecture and Design PhD Lab (ADPL). Now the time has come to put the pen to paper and actually reflect across a wide range of very diverse types of architecture and design research projects. Secondly, the aim is to show this research and in particular its epistemological basis to the external world. By this is partly meant the rest of the research environment at the Department of Architecture, Design and Media Technology. But obviously also to the many research networks and professional contacts that collaborate with the Department. Amongst such 'external' target groups are also students of Architecture, Design and Media Technology here at Aalborg University and elsewhere.

The individual contributions has been written by the PhD students and then discussed in the ADPL forum. There is a common structure to all of the contributions. Thus they take a stance on the following issues: project title and author, the research question, the methods applied, the theories consulted (or the state-of-the-art theory horizon), and the epistemology of the PhD research itself. Seen this way one could argue that each PhD student was asked two fundamental questions. Firstly, what sort of methods and theories are in the field external to your project? Secondly, what sort of knowledge contribution is your project an example of? Needless to say such questions are very complex and need much more attention to be fully dealt with. However, starting up this reflection it is my firm conviction that the PhD candidates slowly but gradually increase their awareness of issues and questions that take even experienced researchers a long time fully to contemplate (if ever).

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July 2010

1. Design research and knowledge - introduction to Design Research Epistemologies

BY OLE B. JENSEN

The contemporary world of design knowledge and practice is wedded to increasing academic ambitions. This the case regardless of whether one see the issue from the administrative and bureaucratic vantage point of attempting to increase the number of PhD stipends and externally funded research projects, or if one looks from within the design practice itself. As part of a general trend in society professions increasingly become dependent on the production of new knowledge. Needless to say (and this is perhaps a less obvious point), the design professions might also have a great deal to offer in terms of actually contributing to the production of knowledge. Thus the debate about 'research by design' and 'design by research' seems open and receptive to new insights.

A word of caution is in place here. First of all, this small contribution to the reflection on what sort of knowledge design research create is by no means all inclusive or comprehensive. It is a momentary glance at the present production within PhD research hosted at the Department of Architecture, Design and Media Technology[1]. Moreover, the editor and author of this introduction chapter is not a designer. Rather I am a sociologist with a strong interest in architecture and design. However being an active researcher and teacher within the field of urban design I might qualify to at least draft the rough contours of the map guiding this explorative trip. One could even argue that design research is too important to be left to designers alone (but that is another story).

1 It should be noted that by January 2010 the Department of Architecture and Design was merged with the Department of Media Technology. The main part of projects described in this publication therefore lies within the research areas of the Department of Architecture and Design. Needless to say, the future holds promises of even more exiting collections of projects when the merged research units start feeding into the same PhD network.

Even though this publication is encouraging much more positive interpretations of the situation we will take point of departure in the challenge meeting design research:

> 'Architectural academics do little research; neither they nor the profession find it relevant. Indeed, there is often a positive hostility to the very idea of this most intellectual and academic of activities, for, of course, designing buildings – not publishing papers – increases the architectural academic's symbolic capital' (Stevens 1998:172)

This evaluation coming out of a Bourdieu-inspired analysis anchored in the social sciences may not have so much credit in the design community, but also the design theorist and architect Christian Gänshirt point to this challenge:

> 'Astonishingly enough, even today architects, and particularly those who see themselves as designers, make little of the original university idea of combining teaching and research' (Gänshirt 2007:10)

This perhaps pushes it too far. In fact many contemporary architectural and design companies have research divisions and an increasing number of successful practitioners engage with the academic world either via conferences of teaching associations. Furthermore, some of the new 'wild' contemporary companies seem to work with a playful attitude that deliberately collapses the design and the research fields into one experimental and very reflective perspective. The best illustration in Denmark at this moment is to be found in the work of 'BIG' (BIG 2009). However, the quote from Stevens does contain a grain of truth and thus illustrates some of the resistance from architects and designers to become academic researchers. However, the case of BIG suggests that designers may apply theories (or at least analytical concepts) derived from the latest research in order

to become innovative and competitive without losing sight of being creative.

What seems to be a real issue though is that *'design is so centrally significant in today's society that research into it can no longer be neglected'* (Gänshirt 2007:11). This should not mean that the trenches between design practitioners and design researcher should deepen, but rather that both parties (a crude simplification of course to see only two parties) agree upon the fascinating opportunities for creating new research projects across these old and unfortunate divisions. One way into such a dialogue is to acknowledge that designs made by academic staffs at university programs might be seen as equivalent to academic research (Gänshirt 2007:12). Obviously there might be requirements to the reporting (i.e. peer review journal etc.) but it should be possible to think of design proposals as 'experiments' that may be reflected upon in such a manner that it meets the academic reporting requirements. The issue we are facing is thus:

> 'How do research and design relate to each other? What can research do for designers? Both activities produce knowledge, but of different kinds ... So, on the one hand, design is not a science in its own right, but draws on technical and scientific insights as well as artistic skill and ability. On the other hand design, although not a science, can be the object of systematic research' (Gänshirt 2997:17)

Perhaps the contributions to this volume are less of what one may think of as 'design' oriented in the sense that these are fairly standard academic research projects where the end goal is not some artefact or design but rather new knowledge about such themes. However, this is partly due to the profile of actual research done at the Department. But importantly this is an indication that design research and the hereto related epistemologies should be understood more broadly to also include knowledge going into the foundation of the design process (as for example when GPS research becomes a precondition for urban design practices). Davies posed the question; *'Why Do we need doctoral study in design?* (Davies 2008). The answer is affirmative and that we most certainly should have doctoral studies in design. The reasons have much to do with the rising complexities of design and its societal context, issues that will be in focus in the following.

From Germany the Danish university system inherited the Humboltian ideal of 'research based teaching' (Gänshirt 2007). This way of organizing universities meant a new relationship between researchers and university teachers that had not prior been institutionally wedded (Stevens 1998:182). Furthermore, this means that research and knowledge production is at the heart of the matter even when we are talking teaching curricula (and actually now also a formal requirement to become accredited by the national accreditation board). The programme in Architecture and Design is a programme in civil engineering with the option of graduating as either with an engineering degree or a scientific degree. What is important here is the fact that the creation of this programme was seen as rather controversial by the Danish architectural and design establishment in the mid 1990's. However, this is an insular and backwards perception as many countries in the world do have design and architecture within the engineering programmes (from the UK to Germany and Norway to mention but a few). The hallmark of the programme in Architecture and Design is a combination of architectural, aesthetic and design oriented skills with the technical disciplines of engineering. The label for this particular mix is *'Integrated Design'* and is closely related to the didactic model of *'problem based learning'* (Knudstrup 2005).

Coming out of this institutional context I have attempted during the last 5 year to present students and fellow researchers to the idea that theory and practice by no means are separate realms (or at least they should not be). Apart

from the proverb that there is *'nothing a practical as a good theory'* (Jensen 2004a) the deeper point is to acknowledge how embedded into concepts and language (and ultimately theory) our multiple contemporary professional practices actually are. We are, to speak with the later Wittgenstein and the 'speech act theory' of Austin, inherently living in a language-practice nexus of much higher complexity than imagining concepts and theories to be 'images of reality' (Austin 1962, Wittgenstein 1953).

What is design?[2]

The societal transformations during the last three to four decades make it inevitable that design and research activities are closely related. Not at least since the programs of design educations often are university programs and thus intimately linked to research environments. We may start by noting like Lawson that 'design' is both a noun and a verb, and refers to both processes and products (Lawson 2006:3). What seems common to design activities is furthermore that they in one way or the other aims at making an intervention, an act or at least an imprint on the world. Design is an interventionist field at some point (or at least it may become so if the projects are being realized).

Obviously the definition of design and thus ultimately of design research will not be sufficiently dealt with within the confinements of this chapter. There are close to as many thoughts and standpoints on this as there are institutions and environments hosting design research and educational programs.

2 I deliberately avoid the discussion about the relationship between architecture and design as two distinct fields of operation regardless of that this is by no means an innocent distinction (Lawson 2006). The merging of the Danish Design School and the Royal Academy of Arts makes this difference more than conspicuous indeed.

Moreover, the definitions vary not only within fields of for example architecture, industrial design, or urban design but are of course also dependent on which of these particular fields one focus on. There are generic definitions to be found and there are common grounds between some of these fields of design. Here we shall only scratch the surface and invite a few definitions into the argument for the single reason of fuelling our reflection upon the research related to these types of design.

According to Webster's dictionary *'design'* reaches back to the Latin word *'designare'* which means to *'mark out or designate'*. Likewise the Oxford dictionary points towards *'design'* as a verb implying *'to set something apart for someone, to intend, to make an imaginary sketch ...'* (Shane 2005:104). As mentioned; this is not the place to unfold a comprehensive design discussion. Rather I shall present a few definitions as point of departure (realizing of course that the selection of these will say more about my limited horizon than about the field of design itself):

> 'Design: The deliberate shaping of the environment in ways that satisfy individual and societal needs' (Norman 2007:171)
>
> 'The conscious process to develop physical objects with functional, ergonomic, economic and aesthetic concern' (Rune Monö, in Molotch 2005: 263, note 1)
>
> 'Designing means devising a form for an object without having that actual object in front of you' (Gänshirt 2007:57)
>
> 'Design is the playful creation and strict evaluation of the possible forms of something, including how it is to be made. That something need not be a physical object, nor is design expressed only in drawings. Although attempts

> have been made to reduce design to completely explicit systems of search and synthesis, it remains an art, a peculiar mix of rationality and irrationality. Design deals with qualities, with complex connections, and also with ambiguities' (Lynch 1980:290)

From those four different statements there may be inferred some common agenda after all. Indeed the *'peculiar mix of rationality and irrationality'* means that we are into a cross-disciplinary territory and furthermore that we are facing a creative field of solutions to a number of practical problems in the world. Some of these even with a strong ethical dimension to them as the discussion about the political and normative dimension to design reaches from socially concerned projects like *'Design like you give a damn'* (see http://architectureforhumanity.org/) to explorations of the meaning of design to the public good in general (Erlhoff, Heidkamp & Utikal 2008). At least we may say that:

> 'The question 'What is design?' turns out to be a fundamental one, to which there is no conclusive answer, something Flusser would call a 'riddle to be deciphered' – in contrast to a soluble problem ' Gänshirt 2007:52)

Design relates to a practice indeed, but there must be some sort of intellectual and reflective dimension to this as well. Obviously this is the case in the 'birth' of the idea or at least in its intellectual processing. As Karl Marx famously said:

> 'A bee puts to shame many an architect in the construction of her cells but what distinguishes the worst of architects form the best of bees is this, that the architect raises the structure in imagination before he erects it in reality' (Marx 1887/1972:233)

Another route into the discussion might follow from exploring what is a *'design problem'* instead of trying to define design on its own. One such route was taken by Alexander who defined a *'design problem'* like the following:

> 'It is based on the idea that every design problem begins with an effort to achieve fitness between two entities: the form in question and its context. The form is the solution to the problem; the context defines the problem. In other words, when we speak of design, the real object of discussion is not the form alone, but the ensemble comprising the form and its context' (Alexander 1964:15-16)

One obvious fault (or at least limitation) to these definitions is their exclusive emphasis of the physical. Needless to say processes, institutions, virtual worlds and much else are 'designed'. This would then have to be to first qualifier; that in order for these scattered definitions to create some common denominators one should broaden them to also include the realm of the immaterial. Both architects and urban designers may also embark on immaterial designs in their practices, as do the field of *'interaction design'* which moves beyond a clear distinction between the physical and the virtual (McCullough 2004). What does fall in common though is the very general condition of *'giving form'* to not yet materialised objects (in its widest sense of the word):

> 'We believe that the designer should be able to design anything, "from spoon to the city" because the basic discipline of design is one, the only things that change are the specifics' (Lella and Massimo Vignelli, in Gibson 2009:17)

So regardless if one is engaged in the design of service systems, virtual worlds, artefacts, furniture, buildings or urban spaces there seems to be a common set of issues related to the practical tools as well as the theoretical concepts used (Gänshirt 2007). Moreover, we may start to reflect upon the nature of the research theories and methods needed for engaging with such a plethora of practice fields. Here less is written, and therefore the publication at hand may also serve the purpose of inviting to a discussion about the content and meaning of 'design research'.

What is design knowledge and design research?

Lawson poses the question *'is there such a thing as 'design knowledge'?'* (Lawson 2004:1) and argues for the complexity and multifaceted dimension of the issue. The designer's knowledge is naturally wedded to the representational techniques and the practical tools at hand (Gänshirt 2007, Lawson 2004). Here we shall not be able to take this interesting discussion much further than to acknowledge that the tools, theories, and methods of any professions in a profound way creates the *'horizon of possibilities'* of that discipline in no simple way. Here we shall have to pay more attention to the knowledge frames and the relationship between theories/concepts/abstractions and the architectural/design practice.

The notion of 'epistemology' used in the title of this publication point less at a strong 'theory of knowledge' than to the definition hereof as the field of reflective enquiry into the conditions for knowledge creation wedded to the particular fields:

> 'Scientists made explicit not just their results but also their procedures. Their work could be replicated and criticized and their methods were above suspicion. How nice it would be if designers followed such a clear, open public process!' (Lawson 2006:28)

At times the field of epistemology goes under the name of *'Theory of science'* or *'Philosophy of science'*. There is much complexity and difference to discuss under such diverse headings. However, in this context we shall apply the notion of epistemology as; *the self-reflective gaze that increases our understanding of what we actually do whilst embarking on the production of knowledge*. Since the writings of Vitruvius (2009) the multiple skills and types of knowledge needed for a professional designer has been clearly articulated. However, the technological complexity of contemporary society and the diffusion of scientific and research-based knowledge into all walks of life have increased the relevance to the reflections upon the status of the knowledge used and produced in relation to design.

The knowledge relied upon and produced by the designers in general may be categorised in many different ways; according to the level of abstraction, the influence of methods and technologies in the knowledge production, the application and intervention modes when actually using the knowledge etc. Knowledge may be embodied into a practical capacity to do things in the world (like creating a model or a drawing) or it may be dependent on technical knowledge of scientific nature (as when the designer deals with adequate dimensioning or choice of material). Certain types of knowledge are handed down generations of practitioners by worth-of-mouth whereas other types of *'codified knowledge'* is found in technical manuals of encyclopaedic dimensions like the seminal Neuftert's collection of architects data (Neuftert & Neuftert 2000). The research done by Donald Schön arguing for an understanding of professionals as *'reflective practitioners'* is another relevant framing that acknowledge the subjective assessments and the situational dependencies of various

knowledge frames by the practitioners (Schön 1983/2001). The Dreyfus leaning model illustrating that the novice clings to manuals, codified knowledge, and objectified rules whereas the expert relies much more on intuition and (well informed) guessing is yet another illustration of the complexity of knowledge frames that varies in their levels of abstractions and codification (Dreyfus & Dreyfus 1986).

What design research is the carried out at the Department of Architecture, Design and Media technology?

From these general discussions about design and design research let us make a quick overview of the contributions to this publication and how they relate to this discussion. By means of fuelling the process all contributors were asked to fill in the scheme below (figure 1). In this way all chapters relate to these issues: research question and title, methods, theory (state of the art/external perspective), and epistemology (internal reflection upon one's own contribution to knowledge production).

Project/chapter	Theory input	Methodology	Epistemology
2. Line Marie Bruun Jespersen: New Aesthetic Experience in public space: Performativity and Interaction in Urban Design	Aesthetics, urban theory	Interviews, Observations, Installation analysis	Phenomenology, Critical Theory, Hermeneutics
3. Mads Dines Petersen: Implementation of technical knowledge into the early design phases	Design theory, Architectural theory, engineering energy theory	Experiment, Research by design, Interviews, Action	Empirical-analytical, Pragmatism
4. Camilla Brunsgaard: Understanding of Danish Passive Houses based on Pilot Project the Comfort Houses	Sociology (everyday life), Engineering science, passive house theory, architectural theory	Interviews, measuring/calculations, (and observations, photo documentary, survey)	Empirical-analytical, Phenomenology
5. Anne-Marie Skriver Hansen: The Study of Social Play through Sound and Musical Games	Ecological perception theory, psychology	Observation, Signal processing, Experiment	Phenomenology, Hermeneutics, Empirical-analytical
6. Valinka Suenson: Heterogeneous networks in multifunctional spaces	Actor-Network-Theory, Foam Theory	RFID tracking, GIS, questionnaire, qualitative interviews	Post structuralism, Social constructivism
7. Nis Ovesen: Changeability and Decision-making in the product development process	Project management theory, Theory on decision making, Theory on creativity and iterative processes, Team dynamics	Interviews, Action research, Video documentation, Interaction analysis	Empirical-analytical, social constructivism

Project/chapter	Theory input	Methodology	Epistemology
8. Tenna Doktor Olsen: Hospital Foodscape Design – considering if dining environment influence patient healing?	Social Science (everyday life), Food Sociology (meal behaviour), Consumer Science (meal experience), Architectural Theory: Healing Architecture, Space Perception, Experience Design, Dining Interior, Scenography, Social Design (creating social space), Interaction Design (human/space)	Strategy: Deductive, Approach: CASE STUDY (embedded multiple case), Methods: Qualitative: Interviews, observations, participant observation, photo documentary, drawing, Quantitative: measuring patient output	Viewpoint: Holistic Approach: Empirical-analytical, Hermeneutic-Interpretive, Philosophy: Phenomenology, Semiotics
9. Louise Møller Nielsen: Enabling communication and supporting the creation of shared frames in interdisciplinary teams working in the early phases of innovation	Creative – and Engineering Design Theory, Innovation Management Theory, Framing and Communication Theory	LEGO Serious Play Workshops, Video-documentation, Action Research, Interaction Analysis	Social Constructivism
10. Marie Frier: INTERIORITY – Architecture in the Future Prefabricated Home	*Architectural theory*, herein specifically aesthetics and interiority in relation to domestic architecture. *Engineering science*, herein specifically construction technology and management in relation to prefabrication.	*Deductive theory* development, herein literature studies and spatial analyses. *Inductive prefab case study*, herein field studies and 1:1 experiments within prefab practice at Boel Living A/S.	The project takes its point of departure in *phenomenology*, herein aiming to actively confront and develop *subjective-aesthetic* and *objective-technical* epistemologies mutually.

Figure 1: Theory, methodology and epistemology of the projects

From the initial discussions the filling out of the first three columns were clearly the most simple. All projects had an explicit title, and all contributors had a clear sense of which theories and methods to use. More complicated was the identification of the epistemological basis for each project. One might think of such self-labelling as unnecessary academic rituals. However, what I find from years of research-based teaching at BA, MA and PhD levels is that stepping aside to reflect upon the knowledge that one either engages with in an external sense (i.e. brings 'into' the project) and the knowledge that one is actually contributing with in an internal sense (i.e. what knowledge the project 'produces') is a very fruitful exercise. The reflection upon what type of knowledge one is engaging with offers the self-awareness of *'blind spots'* and limits to the project. All theories and methods have such *'blind spots'* and the sensible thing is not to ignore this or fall into despair, but rather to try in the best possible way to be open minded and reflective about this.

The reader must embark on each chapter to get a deeper explanation of the way that the components of theory, method, and epistemology come together in the individual research design. Here we shall point at the main issue that very few of the projects 'belong' into only one epistemological framing. Most crosses the faculty lines of humanity, social science and technology/engineering and thus reaches into epistemological fields such as phenomenology, hermeneutics and critical theory, as well as pragmatics, social constructivism, empirical-analytical science (and even positivism). Actually this only confirms the self-description of the nature of the research efforts at the Department. However, I would argue that only rarely are these practices taken out in a completely open and transparent field of reflection. This is done by these contributors in what I consider to be a bold and courageous way. Why bold and courageous? Because it is far easier to subscribe to the 'school of thought' and the conformity of less reflected research practices where one follow the research leader or majority than it is to stick ones neck out risking to exposes oneself to criticism. The publication at hand has therefore also only been possible to make due to an environment of trust and mutual respect. I shall not deny that good research comes out of very competitive environs, but here the creation of a trustful environment where one can explore the epistemological underpinnings of one's project has been prioritised. And if I may say so, with great success indeed!

The epistemological and methodological hybrids suggest a certain pragmatism which I believe is inevitable whilst attempting to use technical, aesthetic and social approaches to a holistic or integrated design problem. The nature of the cross-disciplinary problems at hand mirrors in the multiple theories and methods applied into the research design of these PhD projects and is in accordance with the complexity of real-life research problems:

> 'Only rarely can one find an instance in the real world outside the psychologist's laboratory when one kind of thought is employed in isolation' (Lawson 2006:138)

According to Gänshirt design research can be approached either based upon examples (*what* one can design), upon principles (*how* one can design), or based on theories (how design can be *accounted* for) (Gänshirt 2007:25). If we look at theory-based design research which has the central theme of 'accountability' as it pivotal focus, we find that this again opens up to approaches, methods and theories derived from natural sciences, cultural sciences, and the social sciences. This is also the case for the PhD projects conducted at the Department of Architecture, Design and Media Technology.

The road from here – a few perspectives and thoughts

From the discussion so far we shall now draw some general lines of conclusion to the discussion about the relationship between design and research at the department of Architecture, Design and Media technology. The discussion about how rational and scientific a design program should be is far from settled and will of course neither be so in this context. But there are influential writers and theorists who argue for a more scientific approach to design:

> 'Design, today is taught and practiced as an art form or craft, not as a science with known principles that have been verified through experimentation and that can be used to derive new design approaches. Most design schools today teach through mentoring and apprenticeship. Students and beginning professionals practice their craft in workshop and studios under the watchful eye of instructors and mentors. This is an excellent way to learn a craft, but not a science' (Norman 2007:172)

Needless to say the relevance and sensibility of this comments has much to do with the context and the intellectual climate of one's enquiry. For instance the particular ways that design programs are hosted within universities do seem to soften up this claim. Here we shall not find time and space to engage with all dimensions of such statement, but acknowledge that there might be a need for a science of design. However, more importantly there seem to be less reason to opt for a strict 'science' of design if by this is meant a model emulated over the natural sciences only. Rather I should advocate for a *'research culture of design'*. By this is meant, a usage and inclusiveness of the many different types of knowledge and academic disciplines amongst which we also find less strict scientific practices but nonetheless committed to *'reflective research design'*. Returning to the overall picture given by the research projects reflected in this small publication I think that is what should be advocated is; a creative *cross-disciplinary research environment constantly challenging and exploring the state-of-the-art theories, methods and design approaches.*

Coming from a critique of separating language and practice, theory and practice (Jensen 2004b) we should aim for understanding that thinking is a precursor for designing, and recursively that designing is a key influence for thinking (that being either by means of reference projects, modelling or design drawings). Within the field of design this dual-traffic modus must be developed and encouraged so that theoretically informed design and design enlightened theory becomes a common knowledge base for design teaching, research, and practice. In an earlier comment to John Forrester's paper *'Reflections on Trying to Teach Planning Theory'* (Forrester 2004) I argued that:

> '… there can be no such thing as 'pure practice'. Thus we neither choose to start with clean theory and pure abstraction, nor start with concept-less practical examples. We need to understand more about the complex nature of utterances and concepts in relation to practices and actions as for example Austin (1962/75) highlights. Likewise the later work of Wittgenstein demonstrates language use is a 'form of life' (1953) and hence separation between knowledge and action, of theory and practice, is impossible. As the observation of Kurt Lewin goes, 'there is nothing so practical as a good theory!' (Jensen 2004a:255)

The cross-disciplinary research design mirrors the nature of the research questions and thereby the problems facing the field regardless of its name. Much will be gained from realizing that the research based approaches and methods

are detrimental to a good result in a culture of science and knowledge. But that should not push one into a dogmatic trench war of advocating either hard scientific theories only, or conversely hermeneutic and phenomenological approaches only. I would advocate what Moudon has termed a *'Catholic approach'* to what designers should know (Moudon 1992). Given the aspiration expressed in the foreword of this publication the aim is now to collect inputs for a next volume of *'Design Research Epistemologies'* amongst the more experienced researchers at the Department of Architecture, Design and Media Technology so that we may aim for a wider debate about this:

> 'Growing research and research programs in design, therefore, is a necessary but complicated task. It is obvious that the proprietary behaviour of design practitioners will not make new knowledge widely available and that universities must take on the roles of knowledge generation and dissemination. At the same time, it is also clear that development in this area will be slow without broader recognition that research matters to the future of the design professions and that the outcomes of design decisions have consequences in society' (Davies 2008:79

A final introductory remark is that the research references in this publication are more than just the individual chapter's references. This obviously they are, but they also constitute a 'map of knowledge' for the field as it looked at the moment of writing. Needless to say much more literature could be accounted for as well as this is a dynamic endeavour. However by going over this list with the more general interest of exploring the key references and literatures consulted one get a first birds-eye view of the territory of 'design research epistemologies'.

Thus it is with no little pride that I present this first version of a fruitful collaborative writing and reflection phase, and hopefully there will be more volumes of *'Design Research Epistemologies'* and perhaps even ones moving beyond PhD projects to include the general research efforts at the Department of Architecture, Design and Media Technology.

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2. New Aesthetic Experiences in Public Space: Performativity and Interaction in Urban Design

BY LINE MARIE BRUUN JESPERSEN

Timeline: 01.08.2008 - 01.08.2011

Keywords: Art in public space, Urban Design, Performativity, Play, Experience City.

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Collaborators: This PhD-project is a part of the research project Experience City – performative urban space and hybrid cultural projects, funded by Realdania and AAU, and carried out by: Gitte Marling, Hans Kiib and Ole B. Jensen, Department of Architecture, Design and Media Technology, Aalborg University

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Project/chapter	Theory input	Methodology	Epistemology
New Aesthetic Experience in public space: Performativity and Interaction in Urban Design	Aesthetics, urban theory	Interviews, Observations, Installation analysis	Phenomenology, Critical Theory, Hermeneutics

Introduction to the project and my research questions

The PhD-project "New Aesthetic Experiences in Public Space: Performativity and Interaction in Urban Design" is dealing with urban design projects that want to activate the public in the city, and engage people in an often playful interaction between users and the physical environment. Projects that fit under this description are many and diverse, but as a common feature they all seek to expand the use and functionality of the city, in terms of introducing aesthetic experiences based on user involvement.
Performative and interactive qualities are increasingly occurring in urban design and architecture projects, and the same can be said for contemporary art in public space. My hypothesis is that this shared interest in "the city" and "public space" can be used to develop new aesthetic experiences that have potential of becoming public domains, which can expand the scope of urban design by introducing new types of activities, attract a diversity of user groups, and be innovative in terms of aesthetics and form. I am advocating thoughts on New Public Domain formulated by Hajer and Rejndorp (2003), which essentially are a pragmatic development of ideas of the public sphere as a place of appearance, interaction and dialogue between citizens of the city (state), also formulated by, among others, Hannah Arendt (1958) and Jane Jacobs (1961). While a lot of art theory is dealing with performative aspects of new public art (Rendell (2006), Deutsche (1998), Kwon (2004), Bishop (2006), Lacy (1995), Kester (2004), there seems to be a lack of interest in the potential of the performative experiences in public space in literature and theory rooted in Urban theory and Urban design, because the users perception and possible positive potential of these designs are only partly addressed.

The purpose of my project is first to establish appropriate theoretical and methodological approaches for analyzing performative urban projects, and then discuss the projects socially inclusive potential - creating new public domains.

Background

There is an increasing tendency towards making urban design project that favours aesthetic experiences. In recent years many cities have invested a lot of money and effort in creating inviting and attractive city spaces, which can function as a frame for a lively city and street life. A lively city seems to be the ideal for the contemporary city. Many different strategies are used in reaching this ideal: increase in number of out door cafes, new facilities for basket ball in the city centre and other sports, e.g. swimming in the harbour, or the possibility to host a variety of cultural events in the cities are some well known types of projects initiated to reach the goal. Public space has become a stage for a number of different recreative activities and cultural events. This tendency have been promoted by architects like Gehl (2003 and 2006), economists like Gulmann (2005), Pine and Gilmore (1999), and Florida (2002) and the tendency have been described from a more critical point of view by cultural theorists such as Metz (2002), Sorkin (1992), and to some extend Skot-Hansen (2007).

My project, however, is focusing on the aesthetic and cultural experiences the new projects offer. In my project I investigate the aesthetic experiences the projects add to the city. In the following text I use the term aesthetic experience about a sensory experience (greek Aisthetike, aisthesis: To sense, to get knowledge/experience through the senses) and I deal with the aesthetic experiences as a carrier of cultural content. The aesthetic experience is not, in this paper, describing the encounter with the sublime, and the beautiful form, but is referring to an encounter with the beautiful as the ethically good, which also Gadamer refers to in his The Relevance of the Beautiful. Due to the degree of user involvement in the projects, the aesthetic experiences often involve more senses.

The projects often work with bodily interaction in different forms, and I apply an understanding of aesthetics that is not primarily focused on for instance sight but I consider the sensing subject as a whole body (Merleau-Ponty 1994 (1945) and Gibson1986).

In this paper I will present some of the theoretical positions I include, to establish an understanding of the interaction between user and installations, and to establish an understanding of the special conditions that exist when introducing this type of installations into public space.

Methods

To get a deeper understanding of the performative aesthetics vocabulary, I have chosen three cases, which I use as examples. My cases represent three different approaches to urban space: one case is temporary art installed in urban space, one case is a architecture firm using temporality and performative art strategies in their planning and development processes, and one case is a temporary experience "city" planned each year, inclusive city plan, infrastructure and public art. All three cases can be described as installations that raises questions about urban life, and the layout of the city. The three cases are:

Jeppe Heins art installations for public space: the water pavillon Appearing Rooms in Cordoba, Spain, and ten Modified Social Benches put up in Aarhus, DK, both in July 2009. Jeppe Heins installations are art for public space. They have been exhibited for shorter periods in different cities, in different countries, and are not site specific. On the contrary the benches are interventions in a well-known cityscape, and the intervention is meant to have a thought provoking effect on the users of the space, and they point to our relation to space. Jeppe Heins art thematizes life in public space, and want to question our imagery, habits and prejudices.

Jeppe Hein: Appearing Rooms. Cordoba, Spain. 2009

Jeppe Hein: Modified Social Benches. Aarhus 2009

The art installations in Fuse Town, Roskilde Festival, from recent years. Roskilde Festival put up an art installation in this important space in the festival, close to Orange Scene and the main traffic routes between the main stages. According to the planners at Roskilde Festival, the installations should activate the users, and they should work both day and night. I look at Roskilde Festival as a temporary event city, which is planned with an engaging cultural experience in mind. Due to the festivals´ special status: a large cultural event with 100.000 participants in a short period is Roskilde Festival interesting, as a form of experimenting city lab, within a experience oriented field. Of course it is important to notice that all the participants in Roskilde Festival have paid for a quite expensive ticket to take part in the event, so the guests all have the right playful attitude, so the interaction is not restricted by the sensibility and discipline that dominate every day life.

Half Machine: Eksplosionslandsbyen. Roskilde Festival 2008.

Karoline H Larsen: Creative Actions. Roskilde Festival 2006

The last case is the German studio Raumlabor, who works with "a new approach to urbanism", through art, interventions, situative narratives, democratic user involvement in city development and shrinking cities. Raumlabors rather unconventional approach to architecture, and their use of different strategies, media and formats known also from activist contemporary art, give me an opportunity to look into the performative tendencies as they are applied by architects. I analyze cases where Raumlabor apply performative strategies to make citizens in a specific area take part in democratic, innovative processes, to prepare for change. Raumlabor facilitate these processes by offering temporary pavilions for meetings and dinners (Spacebuster), and interventions that change the character of the area and call for attention (Das Berg).

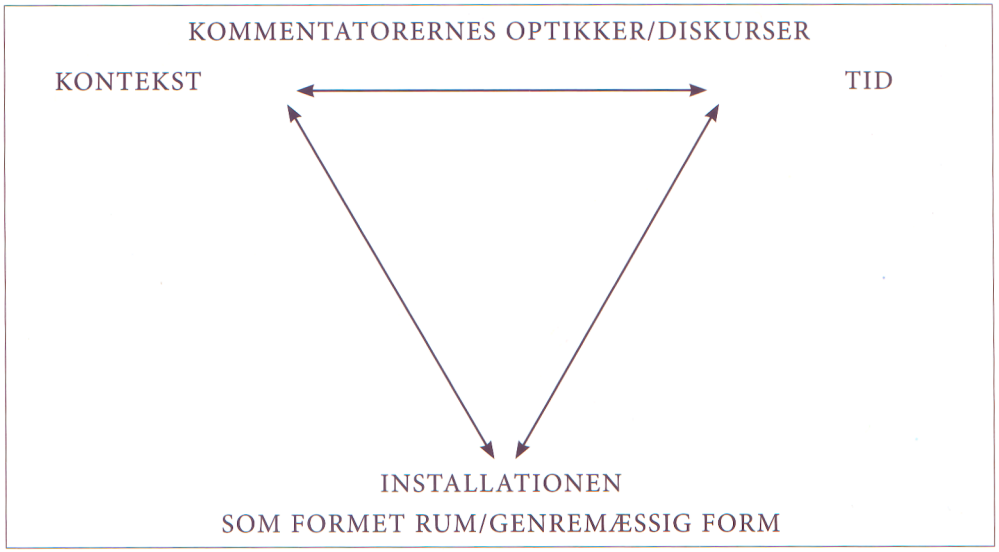
Raumlabor. Kuechenmonument. St. Pölten. Austria 2010

Raumlabor. Der Berg. Site specific installation inside Palast der Republik, Berlin. 2005

The three cases work with interaction with the users. They also illustrate how both artists and architects have interest in public space, and they are examples of the idea of installations and interventions in public space not necessarily are permanent, physical manifestations, but are thought out as temporary situations, that both works with at physical space, but also with a social or mental space, defined by the users.

The organisation of my installation-in-space analysis is described in the following. I will present the development of the model for analyzing performative installations in urban space

My analysis model, has two main inspirational sources: I have partly used the model Anne Ring Petersen has developed for analyzing installation art, and I use Edward Sojas tripartite approach to space, as a structuring principle. I will go through the two models, evaluate them in relation to my needs, and finally explain the final design of my model.

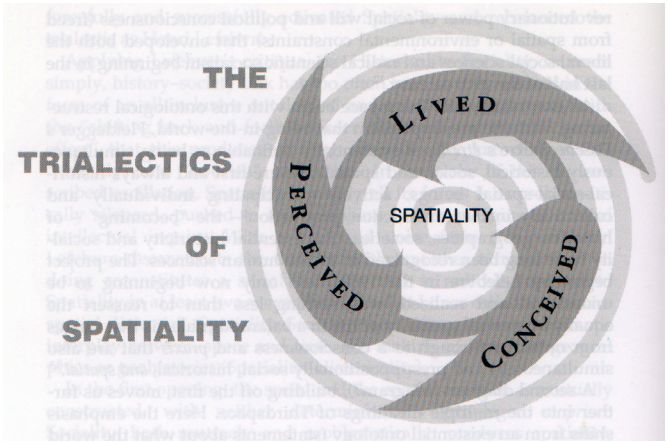


Anne Ring Petersens model

Anne Ring Petersens book "Installationskunsten – mellem billede og scene" (2010) is about defining installation art as genre, and at the same time to map out the great variety within the genre Installation art, and yet be able to define the characteristics of it. Her model is thought out as a tool to analyze installations, and to define where, within the broad field of installation art, the specific installation belongs. Petersens model consists of two layers: the triangle in the middle, concerning the installation specific characteristics: Context, Time and the Installation as Shaped Space/Form. Petersen have a broad definition of Context; it covers both the immediate physical contest, i.e. the site, the societal context and the artistic context of the installation as art form. By time Petersen means time of the artistic process (performances), the represented time (Boehm) and reception time (Boehm). Installation as shaped space/form, relates to the installation in itself; the materiality of the installation: and represents a traditional art analysis; that it is possible to analyse the material manifestation of art "in itself". Petersen states, though, that the installation is a product of the relations between the three aspects listed in the model, so she indicates some sort of mutual dependency between the categories. The second layer in Petersens model is the "frame" around the analysis model, which she calls the optics or discourses of the commentator. Since the genre is defined by discourse it is relevant to relate the analysis of the specific installation to the discourse about installation art. It is only possible for the educated commentator to make this double take on the installations, but it is an important feature for understanding the position the writer, Petersen, has. She has both been experiencing the installations as form, time and context, and she places these experiences and analysis´ results within an art discourse framework.

I do not use Petersens model in its whole, but I draw on certain aspects of it. First of all, I find her tripartite division of the analysis in the middle, slightly problematic. The concepts of Context and Time possess the same ontological status, while "Installation as shaped space/Form" belongs in a different ontological sphere. It makes perfect sense, for me, to read the installation as a product of the relations, but always with outset in the installation: It is relevant to investigate the relation between Installation as form and the context, or the way the installation works with time. But it is rather abstract to me, how the relation between time and context makes sense, without a link to the actual installation. Another point of critique, is Petersens extremely broad definition of context: It covers both physical conditions as the site, and the societal context, which I would argue could be a category on its own if seen as at socio-political context, but it might even belong in "Time", as the socio-political is bound in a historical context.

The qualities in Petersens model are the ability to visualize the double role of the commentator, as art audience and art commentator at the same time. This distinction is interesting to me as well, as it links to some of the hermeneutical issues in analyzing art, that include participation and interaction as experience modes. I will return to these issues, and explain the implications later in this paper. I also agree on adapting "Context" and "Time" as relevant categories, in analyzing in Petersens case Installation art, in my case: urban design projects. Edward Soja operates with the same two categories in his model, so I will explain them, while including Sojas thoughts on this.



Edward W. Sojas model

Jane Rendell structures her book Art and Architecture – A Place Between in three main sections: Space, Time and The Social, which se learned from the geographer Edward Soja and philosopher Henri Lefebvre(Rendell 2006, Soja 1989 and 1996) Rendell uses this structuring principle to categorize, and analyze art in public space, while Sojas model is developed for analyzing space.

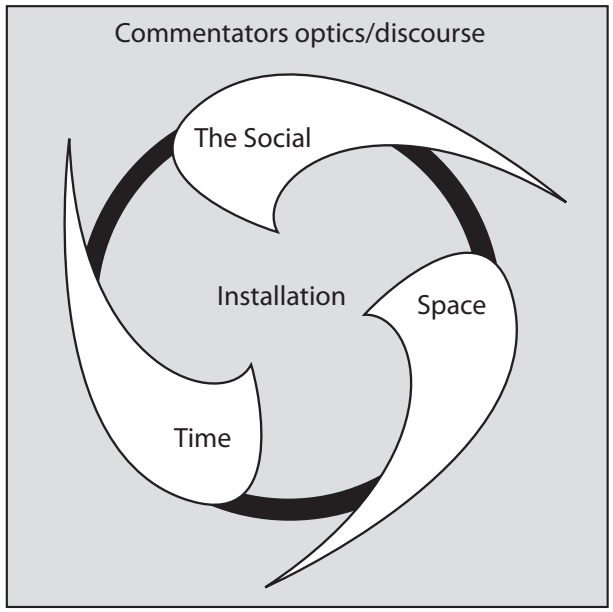
Soja is looking for a new way to work with space, seen as a thirdspace, that does not reject the existing dualistic mode of approaching space, dominated by historicality and Sociality, but develops the dualistic model into a rebalanced view on space. In his efforts to establish this; he puts up a model illustrating a tripartite existential ontology, called "The Trialectics of Being". The model is constructed of three dimensions of being: Spatiality (Social production of Space), Historicality (Time), and Sociality (Being in the world, Heideggers Da-sein) (Soja 1996) Soja whishes to give some attention to spatiality, which he feels has been ignored to some extend, and he rejects the existing firstspace epistemological approach to spatiality, which is defined objectivity, materiality and a formal science of space, and points instead towards Lefebvres Social Production of Space, as a way of understanding spatiality.

The structuring of space analysis in Space, Time and The Social, expresses a complex understanding of spaces, as constructed of more factors than physical form. Time, use and human relations, play an equally important part in understanding the constitution of a space.

Rendell remarks that all three aspects are relevant to art in public space, but maybe not equally important in each project. She uses the three concepts as "headlines", as a principle for sorting the projects in her book Soja says that the concepts are applicable at all levels, from ontology to epistemology, in theory building, empirical analysis and social praxis. The obvious advantage of using Space, Time and The Social in relation to art in public space, is the three concepts ability to place the content of the installation in the complex system, defining the space as a whole, and to adopt the three aspects for analyzing art in public space, makes good sense, especially when dealing with art in public space, where the spatial context is much more than just a site for art, but also a space for every day life and all the functions belonging to it.

The purpose of my analysis model is to be able not only to describe form or an artefact, but more precisely to define the effect the installation has on the relation between installation and site and users. In order to establish a foundation for a discussion of the inclusive potential of the designs, I need a model that has the same qualities as Sojas. My model for analyzing performative art and design in public space is mediation between the two models presented above.

My model, at this point in the process is constructed in this way:



The art/design project is placed in the middle, and is considered a motor of a dynamic process in space. The installation is an intervention in an already existing space, and the installation affects the historicity of the space; there is a before and after the installation. The spatiality is affected too: the orientation of the space might change, the users relation to the site might be altered, and finally the sociality of the site, which can be affected in terms of new social possibilities.

Around this active model, there is a commentator frame, derived from Petersens model. A part of my project is to define a catalogue of experiences, these installations can contribute with into public space, and establish a critical framework of their potential. Therefore I also need to look a bit further than the projects themselves. I need to look at the discursive frame surrounding this type of projects to determine what kind of expectations and maybe prejudices are at stake, when urban planners work.

The three cases are analyzed, considering three aspects of the installations. The first level is a formal analysis of the specific installation that focuses on the materiality of the specific installation. The second level is the installations effect on the context, so this level consists of an analysis of the site, and the relation between site and installation. The third level deals with the interaction between user and installation, so the cultural and social content of the installation is defined.

I am investigating the cases, using primarily qualitative methods. I do video and photo observation of the installations, and I make interviews with different users, about their experiences with the installations. I make a hermeneutical interpretation of the collected material, and I am looking for characteristic examples of behaviour in and around the installations, and for statements that describe the relation to the installations content and effect on the users. The interviews circles around Space, Time and the Social. I use the observations and statements in the process of creating a series of experience typologies, and for validating – or discussing – theory on the subject. In addition to this, I use my own observations and analysis of the space and the installation, to complement the layman users statements. My registrations and analysis´ are based on a combination of Sojas Firstspace and Secondspace epistemologies. I analyze the perceived spatiality (Firstspace) and "read the space like at text to be read in detail" and look at the physicical spatiality, the mesurable aspects of materiality, locations, and situations in a formal analysis of the specific space. And I analyse the conceived spatiality (secondspace) which is about the subjective imaginaries and "symbolic spaces", thought out

by the artist, and me as a commetator. It is in the secondspace epistemology that my commentator-statemens on the discoursive status of the performative urban space belongs (Soja 1996).

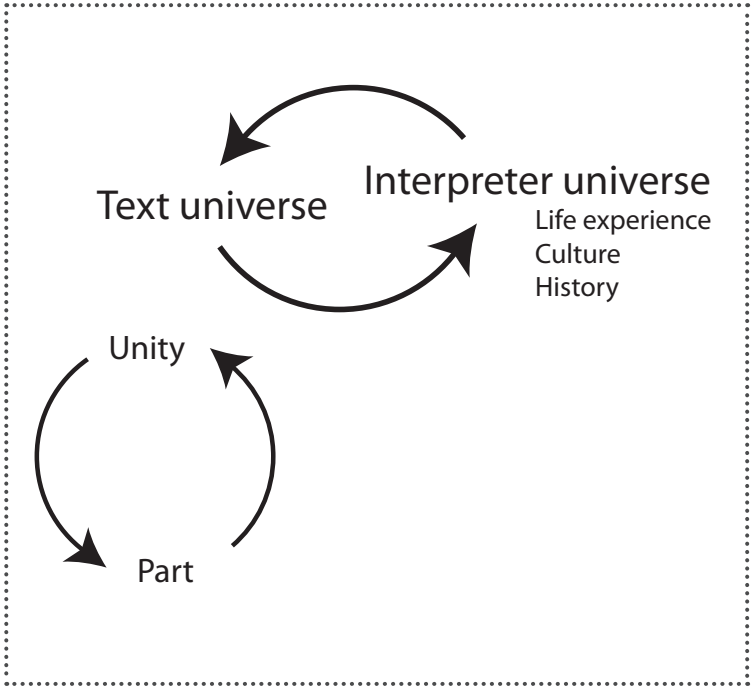
For the discussion of the socially inklusive potential of the performative urban space, I use the matetial collected in the Experience City research project, which are interviews with planners, archtitects and project leaders of a selection of groundbreaking cultural projects in danish municipalities. The interviews are, among other topics, on what kinds of usergroups the project aim at, and what the planners hope to be the effect of the projects in terms of sociality and urban life. The knowledge from the Experience City data base will be useful to me, for making perspectives to other types of performative urban projects;, that are permanent, have other types of cultural content e.t.c. The studies of the qualitative Experience City material, will also undergo hermeutical intrpretation.

Theory

As an overall frame around the investigations of the installations, I have a theoretical approach to art and architecture in the city, as described by Rosalyn Deutsche in "Evictions" and Jane Rendell in "Art and Architecture – a place between". These two books present critical, social constructivist approaches to city space and the public sphere, and as mentioned above, provides through Soja and Lefebvre with an analytical structure and set of guiding concepts in the analysis of space. In my efforts to develop an even more refined theoretical framework for analyzing the installation's performative experiences in public space in my cases, I use primarily three theoretical standpoints: Phenomenology, Hermeneutics, Performance studies. These theoretical approaches are adopted as ways of understanding the aesthetic experiences inherit in the installation: Phenomenology, because the installations engage the user in a bodily experience, Hermeneutics, to be able to interpret my material and my observations, and Performance Studies, because the performative element is a new strategy in an urban design context, so it needs to be examined in this particular context.

Both in "Truth and Method" (1960) and in the essay collection "Relevance of the Beautiful" (Gadamer 1986), Hans-Georg Gadamer writes about the hermeneutic interpretation method. The basis of this method is a firm belief in that we are surrounded by meaningful objects, which we can get meaning and knowledge from thorough interpretation. Gadamer describes how to shift between analysis of a part of the text (I refer to the object of analysis as text, but it might as well be another type of art: a painting, a sculpture, architecture or a play), and then align the understanding of the part with the understanding of the text as a whole. This process is repeated several times, and the interpreter will gradually get closer to a comprehensive interpretation. The model, the hermeneutic circle, shows how interpretation is an iterative process, and it also describes how to shift between part and unity, and that the movement between the two is essential for the interpretation process.

Hermeneutic circle:



The diagram shows the hermeneutic circles double potential. Within any text universe there is a movement between part and unity. The part is understood in relation to the unity and the unity in relation to the part. The understanding of the part may have implications on the understanding of the unity and vice versa. The arrows in the diagram describe the movements in the interpretation process. Yet another dynamic interpretation process will be going on between the interpreter and the text. The preunderstanding of the interpreter is determined by his life experience, culture and history. The interpreter throws out a "draft" for an interpretation. The draft is read and tested in dialogue with the text and the preunderstanding is evaluated and possibly developed further. The understanding of the text can affect the interpreters´ universe, and develop the preunderstanding, which means that the interpretation process is pushed forward. There is progression, a form of linearity, within the circle, despite the name. It might be more relevant to apply a spiralling movement to the diagram, to describe the process towards a comprehensive interpretation. The name of the model: The Hermeneutic Circle, stresses the interaction between the two factors, part and unity, and that it is difficult to determine when the interpretation process is finished. The model is based on the idea of the possibility to find meaning, but since the interpreter's horizon, which is individual and influenced by time and space, is important for the interpretation, we will never reach an absolute understanding of a text. The interpretation is a contribution to the understanding of a text in time and space, and not a final result (Føllesdal, Walløe, Elster 1999).

The reason for using the hermeneutic circle in my analysis´ of my collection of material is that the relation between the interpreting subject and the object, is so central in the hermeneutic circle (Heidegger 1927). As the relation is so important for the interpretation, the interpreters are important for the result. The interpreter is a part of the hermeneutic circle, including his way of being and understanding the world. Since Gadamer is very sensitive to a lot of nuances in his description of the relation between subject and object, it gives me the possibility both to work on the relation between users and installations, and between my relation to the object of study and me as a commentator.

In the following, I will demonstrate how classical phenomenological and hermeneutical ideas by primarily Gadamer and Merleau-Ponty have relevance in this particular context. The interpretation process, as it runs within the hermeneutic circle, actually describes the interpretation process of all types of art, but Gadamers vocabulary on the movements within the hermeneutic circle, lead me to think

of some of the essential characteristics of my cases, so I will applying some of Gadamers writings on Play, on the physical interaction between installation and user/participant. In this way the interpretation is not only an intellectual, academic reading of a piece of art, but is embedded in a tacit, and bodily encounter with the installation, similar to a phenomenological understanding of the interaction.

When Steen Ejler Rasmussen in an uplifted way reports of a group of roman boys bodily experience and interaction with the facade of Santa Maria Maggiore, that he witnessed in 1957, he presents the reader to a precise description of the playful approach to experience and understanding of how this specific architectonic environment is composed (Steen Ejler Rasmussen: Om at opleve Arkitektur. 1957). The boys forget themselves in the playful interaction in the game, and they establish their own space, with its own rules and demands for participation and capability of adapting to the rules and conditions of the game. Steen Ejler Rasmussens narrative has links to both the writing on phenomenology by Merleau-Ponty, and the passages on hermenutics and Play by Gadamer.

In the projects I use as cases, the playful interaction is thought out as a means to understanding the installation. The installation is only complete or in function, when interaction with the users is taking place, and often involve the interaction the whole body. These particular features of my cases, calls for a phenomenological analysis of the installations. Phenomenology is a theoretical attempt to return to studying the phenomena and especially how they appear to us. Merleau-Ponty has the perception as his main focus, and he stresses that we experience the world through our senses; and that our senses and our body are to be seen as a unity. Merleau-Ponty sees the human body as a subjective object, and mind and body as aspects of a whole body, which eliminates the dualistic epistemology of i.e. empiricism. When the bodily relation to the world is changed to such a degree, it is relevant to ask, how to understand space, then? Merleau-Ponty considers space as produced by body and intentionality. The body creates a space around it, being the "space" where as situation takes place. This means that, what goes on in a space – the human activity – is defining space. This is an interesting approach to the cases in my project. Since the installations are designed with interaction and participation by the users in mind, it is necessary to find theoretical approaches that are able to handle interaction and participation, as a central part. Merleau-Pontys phenomenology focuses on the bodily experience of the world, and is useful in terms of describing how the installations as cultural objects, communicate with the body, and how the installation´s focus on the bodily experience, contributes with another set of bodily, sensous experiences in the city scape.

Gadamer uses the term "play", to define the movement within the hermeneutic circle. Play describes the light playing on the waters surface; the tennis balls movement back and forth over the net, and that you take turns in any game. Play is a movement without an end goal, which is characteristic for all types of play and games. The movement have a special appeal: it has the attention of the participants, but also the audience pays attention to the movement. One of the fine qualities of play as allegory is its ability to make us see the interpreter as a participant in play. It is necessary to engage in the game (play), to follow the rules of the game and take the game seriously. Nobody wants to play with a "Spielverderber", so it is necessary to submit to the rules of the game, and to take the game seriously, to be part of the game. In this way Gadamer underlines the importance of the movement, and that the interpreter have certain obligations, in the interpretation process. As Gadamer describes the interpretation as play, as well as festival and symbol, I find it relevant to find out if Gadamers terms, his vocabulary and allegories, are especially suitable for explaining art, that have game-qualities, the playful attitude and the interaction/relation in the centre of their character. I am conscious of the fact that I take Gadamers words far more literally than

they are intended, but due to the links to the performative art, described above; I will use Gadamers vocabulary as a part of my pre-understanding, from where I cast out an understanding of my object of research.

According to Gadamer there is an element of self-representation in the game. In the game you use yourself, and you develop through your participation so game and play have learning potential.

The reason for including Performance Studies in this project is based on the increasing level of the users bodily interaction in many contemporary urban art projects. Since my focus is on the relation between installation/design and the users, and the fact that this relation is based on primarily bodily actions, I am applying theory stemming form performance studies, to explain the rationale in engaging the public in exactly this type of interaction, and what epistemological truths we can expect to find in performative art. I use the term "performative" as derived from cultural studies, where culture is studied as a series of performances. In the 1950´s started the formation of the study of "Cultural Performance" but it was not until the 1960s and 1970s, that the definition of the field of study really established itself. Performance studies, emerged as anthropologists started using theory and vocabulary from the theatre to do research of rites, festivals and even everyday life. Cultural performances include certain important characteristics (as Jon McKenzie, 2001, sums up John J. MacAloons definition):

1. Social and self-reflection through dramatization or embodiment of symbolic form
2. The presentation of alternative arrangements
3. The possibility of conservation and/or transformation

This brief overview hints at the social and self-reflective aspects of bodily interaction, the what-if-scenarios the art installations addresses, in their manipulation with urban reality, and the ability to either preserve or transform aspects of the issues addressed. Most performative theory has stressed the transformative potential of performance, and another keyword is "Challenging". Performance can be used for expressing critique, and to generate development processes, because the mechanisms of performance are flexible, networked, and its sense of time is nonlinear (McKenzie 2001). The mechanisms at play reminds a lot of the medieval carnival and other festivals, that are non-linear in their dramaturgy, are polycentred and have no fixed audience-positon; everyone is a participant and a performer (Anne Ring Petersen 2010). This is exactly what is going on in the performative urban installations in my project: some of the participants engage in the bodily interaction: they try out the benches, they drum the plastic tanks in Eksplosionslandsbyen or they paticipate in a community dinner in Spacebuster, but the bypassers also get a spectacle to watch. There are more roles to be played in the situations, and everyone plays a part.

When design of city spaces builds on the users willingness to interact with the design, as an essential manoeuvre in order to understand the installation, it points to a shift in the definition of architecture. Architecture is not only form, but also an event or a situation, taking place in space and real time. The users become participants and their participation is absolutely necessary for realizisation the intention of the installation (Hanne-Louise Johannesen 2007) In relation to the installations I include in my investigations, real time plays an important part. Architecture and space is experienced in time and if I were to categorize the installations after the relations´ duration in time, some differences would appear. In Karoline H. Larsens Jungle Strings and Illutron/ Halfmachines Eksplosionslandsbyen, which both have been shown at Roskilde Festival, are the users participation the

fuel for the experience. Jungle Strings exist only due to the users: they are weaving strings from one pole to another, so the installation gradually materializes. Eksplosionslandsbyen is a sound installation, in which the users not only should interact with the installation as individuals, but make coordinated efforts for drumming the same rhythm, to release the common "reward": a tall gas flame at the top of a tower in the centre of the installation. Other of my cases work more like a "surprise" and "a stone in your shoe", as they seek to intervene in everyday life. Jeppe Heins Modified Social Benches can be read visually, they do not demand the same active interaction to create an experience, but the users who choose to play along, to engage in the game of "is this a bench?" will also be exposed to the by passers, and add new aspects to the spectacle. The introduction of Modified Social Benches in a cityscape will provoke thoughts on the character of the site. A renewed interpretation or reading of the site is initiated in the user. Modified Social Benches point to aspects of the site, our understanding of a specific site, and this feeds our imagination. Modified Social Benches are a "shorter" experience than the installations at Roskilde Festival, but it uses humour and play, too, to make the user reconsider his/her ways of looking upon and acting in the city.

Epistemology.

In my project I develop a cross disciplinary approach to the experience based city spaces. This means that I not only use urban, architecture or art theory, but I combine them into my analysis model and the genre related approaches is used in different sections of the project. The knowledge production of this project is separated into different types of output.

The analysis model I develop is a methodological contribution to be used when confronted with interactive, immersive, performative art in public space. To be able to analyze and understand this new type of urban design and to make critical and informed judgements of their content, it is necessary if we whish for better planning in public space, and in the design process it is also useful to have an overview of possible ways to create interaction. The models four parts are each dominated by different scientific traditions. The installation as form is analyzed by using hermeneutic analysis method and perception psychology, as known from the humanities. Analysis of Space is more complex, since it covers both the physical space surrounding the installation: the site, but Space also includes aspects of context in a broader sense: program and use of the space, people's relations to the space etc. The analysis of Space is informed by phenomenology and structuralism. Time is analyzed in terms of Boehmes "represented time" and "reception time", and links to aesthetic theory and phenomenology. The social is a cultural studies and performance studies based category. The social is the effect in and around the design/installation in terms of social activity.

The critical evaluation of the performative urban spaces, the second part of my project, will discuss and evaluate evaluate the projects in terms of their socially inclusive potential. In this discussion I am using discourse analysis, to determine what kinds of experiences that are favoured these years, and discuss why these particular experiences have the discursive power. The analysis model is a tool for making arguments in this discussion, and the conclusion of the project will be within the "urban-spatial" or "spatial-cultural" discourse defined by Deutsche and Rendell.

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3. Implementation of technical knowledge into the early design phases

BY MADS DINES PETERSEN

Timeline: 01.10.2008 – 21.09.2011

Keywords: Architecture, Design Process, Sustainability, Simulations, Building Information Modeling

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Collaboration: Architectural offices in Denmark

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Participation on design team NoRA at the Venice Biennale 2006

Project/chapter	Theory input	Methodology	Epistemology
Implementation of technical knowledge into the early design phases	Design theory Architectural theory Engineering energy theory	Interviews Action Research Experiments	Emperical – Analytical Pragmatism

Introduction:

Discussions about sustainability in architecture have been present since the seventies (Williamson, Radford & Bennetts 2003) and today architects are becoming increasingly aware of sustainability in their work and also in communicating these issues, as it is for example seen through exhibitions (Juul Holm, Kjeldsen 2009). In Denmark the discussion about sustainability is mostly focused on the energy consumption during operation, which is also reflected in the building regulations (Erhvervs- og byggestyrelsen) and with the increasing interest in developing passive houses in Denmark where different pilot projects are currently seen. It is within this context that my approach to sustainable architecture is located. This increased focus on energy consumption requires the architect or design team to be able to utilize knowledge about relations between the architectural form and sustainable issues – basically meaning recognizing and using the fact that the technical issues have an impact on the architectural form and using that knowledge to help develop the ideas as seen in the Integrated Design Process (Knudstrup 2004). Research shows that it is important to address such issues early in the design process as this is where the impact of decisions are biggest (Chaszar, Kienzl & Stoller 2006, Neuckermans 1992), but it is also seen that the use of the different assessments, especially digital tools are mostly limited to the later stages of the design process and that the tools developed to make these simulations are difficult to use in earlier stages, making it more difficult for architects to utilize them in what could be described, as the crucial early stages of the design process where the initial and intuitive ideas based on previous experiences needs to be tested against the constraints of the brief and legislation. This problem is the point of departure for this PhD that draws on the developments in performance based simulations and Building Information Modeling (BIM) as well as knowledge about the design process. It focuses on how knowledge about the design process and the parameters that affects them in relation with new digital tools can help the design team to address issues about especially energy consumption during the early stages of the design process as research show is important (Chaszar, Kienzl & Stoller 2006, Neuckermans 1992).

Research question:

How can knowledge about the design process used in praxis and the Integrated Design Process (IDP) be used to help architects address issues about energy consumption during operation of buildings as a part of the early conceptual parts of the design process through the utilization of digital tools?

This question can then be split into three sub questions that address different perspectives of the main question as it is suggested by Andrews (Andrews 2003).

1. How are tools, currently used to address these issues in relation to the design process?

2. How do architectural offices considered as being among the leaders within sustainable architecture structure their design process with specific focus on how they address issues related to energy consumption during operation?

3. What are the possibilities for implementing knowledge about parameters affecting the energy consumption in the design process?

The research points towards gaining knowledge about how experiences from the IDP at Aalborg University can be used in relation with praxis based design process to develop the

design at an early stage of the design process in terms of the energy consumption during operation. It is especially focused on how to implement it in a practical context. Furthermore it explores how digital tools, with a focus on BIM, can help to support the implementation of knowledge at such an early point in the design process in order to help inform the design team.

Methods:

As seen in the research question the main focus is on how architects address issues about sustainability in the design process today. The PhD attempts to address these questions from the architects' point of view and understand their design process in order to relate it to the IDP set in an educational context. In order to work with these questions and gain insight to the practitioners view upon these issues it has been chosen to work with some examples where these issues are seen from the practitioners' point of view through interviews (Kvale 1994) with different architects, as well as literary review of the subject. These interviews have the form of conversations with the architects in order to gain knowledge about how they work with these issues and what their experiences are. They are designed as semi structured interviews (Kvale 1994) where the aim, as mentioned above, is to gain an understanding of how architects experience these issues in their work. This is then related to the experiences from the educational context at Architecture, Design & Media Technology that forms the starting point for my understanding of how a design process can be structured. The interviews revolve around three main questions that have a primary relation to the first and second research sub question.

1. How do they approach the design process in a competition?

2. How is the work with sustainable issues affecting this and what are their experiences?

3. What barriers do they encounter with them during the design process and how do they work their way around them?

As one can see the questions aim at giving an understanding of how sustainability is affecting the design process as well as what problems they may encounter during their design process in relation to their work with sustainable issues. The setup for the interviews is a conversational setting where the architect through the conversation is encouraged to reflect upon their work through questions – a setup where the knowledge can be drawn from the conversation (Kvale 1994) where the literary review of previous research into the different theoretical fields creates the framework for the analysis. The interviews are seen as examples that are focused on discussing how architects approach issues about sustainability in the early conceptual parts of the design process and through that discuss the possibility of implementing knowledge from the experiences at Architecture, Design & Media Technology, Aalborg University, in order to give the architects tools to deal with sustainable issues at such early conceptual stages.

Through the interviews outlined above an initial understanding of how architects work in this early conceptual development of the design process is gained and forms the basis of the part of the research that is conducted as action research (Reason, Bradbury 2001) where the data is collected through observations during the design process and the use of writing "diaries" the design process and the models and notes made as part of the project. In order to work with this

it is important to have knowledge about how they approach the design process and how they work. Using action research as a method here is chosen because knowledge about the work they do in the office is needed as well as knowledge about what can be done to change some of their procedures is needed. The work here is made in relation to an architectural competition where the knowledge gained from the IDP (Knudstrup 2004) is used in order to see how it can help to inform the design process.

Besides case studies, interviews and action research small experiments (Groat, Wang 2002) will be made in order to study how different programs can be used and possible how knowledge about sustainable issues can be implemented directly into modelling programs. This part is related to the third sub-question and is seen as a parallel to the main subject and serves as a way to gain knowledge about how different programs might be used in a design process.

As one can see the main body of the research is based on a qualitative approach with interviews and action research in order to understand the different issues from the architect's point of view, though, with small experiments to support it. Choosing this inherently qualitative approach is due to the focus on implementing knowledge to existing design process. In order to do that I have chosen to address these issues in a practical context and relate that practical context to the theoretical context due to the aim of gaining a better understanding of how knowledge from the two contexts can be used to move them closer together and help inform each other – each of them giving a different perspective of the question.

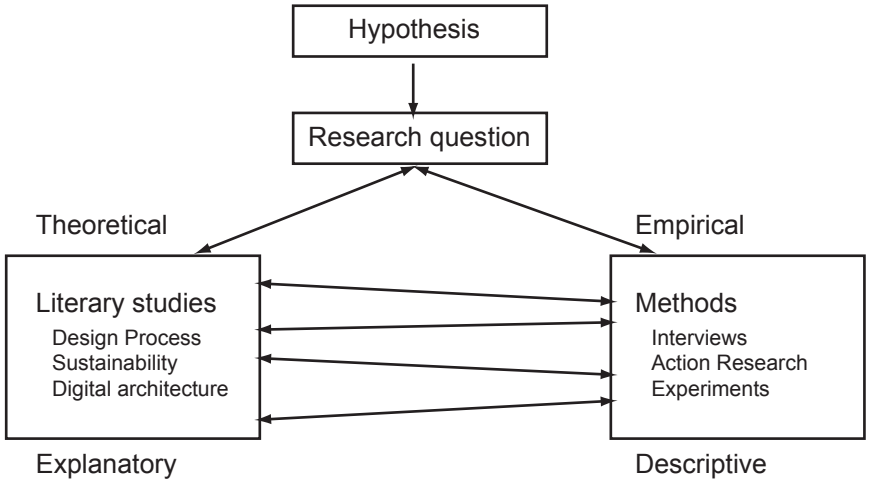

Figure 1. Diagram outlining the methodologies and the design of present research

Theoretical frame

As indicated above, present PhD is located in a diverse field of theories however with a focus on the design process and through that how architects work in the design process with sustainable issues in digital tools to support this work. Even though this is the primary theoretical focus it is touching upon engineering theory related to energy consumption and its relations to architecture as well as systems theory which is also related to the design process and the understanding of relations between different parameters that affect the design process and design theory related to the application of digital tools with specific focus on BIM.

With the theoretical framework being focused on the design process this will be the starting point here, where the IDP (Knudstrup 2004) used at Architecture, Design & Media Technology is the point of departure and is framed within a larger discussion about the design process as seen in figure 2 and described more thoroughly below.

At Architecture & Design, Aalborg University, the design process is focused on the Integrated Design Process (IDP) where technical knowledge is implemented in the architectural design process in order to let it inform the design process and through that create a hybrid design process located within an educational context (Knudstrup 2004), though it is based on the approach used in architectural offices. This means that it attempts to describe a design process where technical issues related to sustainable concerns are integrated and related to traditional architectural virtues in order to let them inform each other on a more conscious level than might traditionally be seen. This is especially evident in relation to the students' work with environmentally sustainable architecture where different calculation and simulation tools are used during the design process. A diagrammatic representation of it is seen in figure 3.

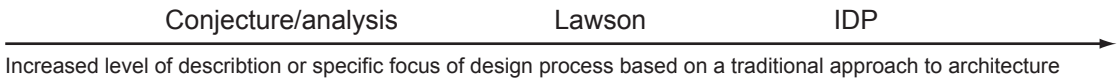

Figure 2. Placing different descriptions of the design process in relation to their specific focus and level of description.

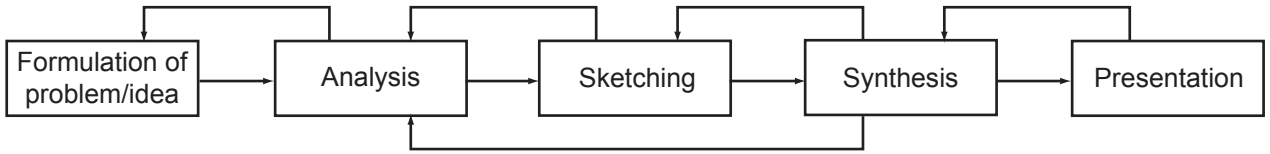

Figure 3. Integrated Design Process (Knudstrup 2004)

Research into the design process started initially during the sixties and seventies and has developed from there. This initial research points towards architects working through a conjecture/analysis model where the knowledge from previous experience is used to pre-structure the problem (Hillier, Musgrove & O'Sullivan 1972). Furthermore it showed that architects worked from a point of departure where they had a simple starting point as for example a feature in the landscape and used that as a driver of the design process (Darke 1979). This opposed some of the theoretical developments where theoreticians argued for a more scientific approach to the design process where the problem was analysed and sub-divided into sub-problems that could then be solved and re-assembled into a solution as it is for example described by Alexander (Alexander 1994). Today this line of thought still exists and is seen in different variations of integrated design processes as for example IEA's task 23 (Löhnert, Dalkowski & Sutter 2003). It describes that one needs to analyse the problem, sub-divide and solve the problems before re-assembling the parts. But it does not take into account that design problems are often wicked, ill-defined problems with a huge complexity (Cross 1982, Cross 2006). A discussion also taken by other researchers describing the design process (Lawson 1980, Lawson 2006). Lawson's description of the design process can be seen in figure 4 where it is seen that it has very little direction. It can be seen from different stages but all of them inform each other making it difficult to break into discrete parts. Similar to this Schön describes how architects work with reflection in action constantly analysing the sketches investigating the results through their knowledge, almost having conversations with their sketches (Schön 1995).

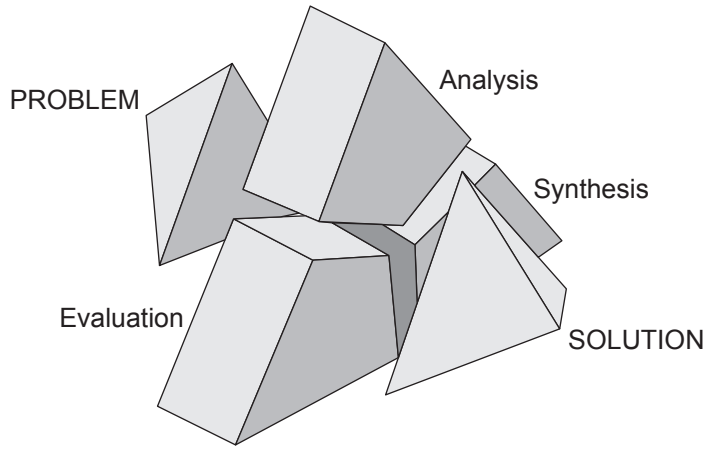

Figure 4. Design process from Lawson (Lawson 2006)

If one then focuses on working with sustainable architecture, which here is focused primarily on energy consumption during operation, as a point of departure for the studies it becomes interesting to investigate the relations between them. But it is important to note here that the discussion is much broader than that and is also based in a more philosophical sphere (Williamson, Radford & Bennetts 2003) not discussed here. However looking at what has been published about sustainable architecture within the past decades it is evident that there already is knowledge about how this should be done and practical experiences with it (Olgyay 1992, Brown, Dekay 2001, Yeang 1999). It is for example outlined in Olgyay's publication where a methodology for what he refers to as bioclimatic design is outlined as shown in figure 5. Of course all of the terms used in this figure must be related to the architectural developments and ideas.

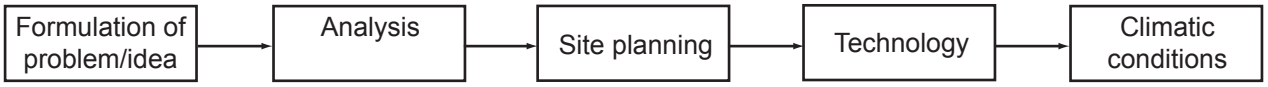

Figure 5. Diagram representing Olgyay's steps in bio climatic architecture

Within this approach there is a clear hierarchy in what needs to be done first. If this is set in a more contemporary context it is seen that considerations are made in relation to addressing these issues from an engineering point of view where the use of digital tools to support such a design process, but rarely in relation to a buildings connection with a site as seen in vernacular architecture (Thomas, Garnham 2007) or as some architecture, despite the fact it is not considered to be located within the term sustainable architecture, does (Steele 2005). Here it is the way the existing tools are used and how the results should be interpreted that are in focus (Chaszar, Kienzl & Stoller 2006). With this approach knowledge about both the programs employed is needed as well as the parameters that are relevant at a given stage is needed. Focusing solely on these issues can break the design process down to parameters analysed and solved individually and from there a solution is derived (Alexander 1994). This points in a direction where a systematic thinking is in focus and where the different parts can be treated individually. This is an important point and when working with complex problems as is seen with energy consumption in buildings. However as Alexander describes himself complex problems like that quickly becomes impossible to deal with because of amount of relations in it (Alexander 1994). This is probably better explained by Lawson in his example with a horse carriage and why its wheels are mounted as they are (Lawson 2006) – an example that shows the possible complexity of understanding how the different parameters in design affects the final design of an object.

In relation to this it is necessary to study how the design process today is supported by a variety of digital tools with a strong focus on how, especially; environmental issues are addressed during the design process pointing towards the use of different kinds of calculation and simulation programs. The tools used today also points towards the future. Today the design process is heavily influenced by the use of digital tools in the design process ranging from tools for generation, animation, performance-based design and materialization (Oxman 2006, Kolarevic 2003). The before mentioned influences are active in the design process where active in this

context means that the tools are used to generate solutions from an input from the architect without the architect takes part in the actual form generation. Another way to use digital tools is a more passive approach where the digital tools are substitutes for analogue tools as it is seen in relation to the use of CAD drawings today where the architect still has full control over the design process. This has had a great influence on the design process and the implementation of these drawing practices has caused discussions about the architects position (Schodek 2004). This only serves to show the diversity of directions within the discussions about digital tools in architecture and in the following, the more specific aim in relation to present PhD.

In a more general practical context the focus is on BIM which basically is an approach that allows for easier interoperability between different professions and the programs they use through agreements on file formats and where all information is gathered in a single model making it easier and more efficient to work as well as reducing the chance of having drawings from the different consultants that are not updated to match each other. Besides that the approach is based on 3d models that includes all this information instead of 2d representations as has traditionally been used (Eastman 2008). This is today seen as crucial for the developments in the building industry both in terms of possibilities in the design as well as the possibilities for optimizing the link to manufacturing. These are the possible benefits as well as the implementation of material properties, component definitions etc. makes it possible to link more directly to different simulations programs (Schodek 2004, Eastman 2008) which in the end means that it should be possible to get answers quicker than in a traditional process where multiple models has to be made as well as translations from 2d to 3d drawings or manual inputs to calculations programs. Current research show that there are problems with this and that the work flow currently is not as fluent as one could hope it to be (Schmitt 2004, Penttilä 2007). This can also be seen in relation to the lack of tools that allows for the architects and engineers to use them throughout the process instead of at certain steps making it a difficult field to navigate in (Krygiel, Nies 2008).

As a last note it is, however, important to note that these are not new issues to address. As mentioned previously many of the parameters that affect the energy consumption of the buildings we design are seen in vernacular architecture and are issues that are addressed anyway – though they might be addressed solely from a functional or aesthetical point of view. To some extend it can be said to underline the importance of the measurable supporting the immeasurable (Kahn 2003). Or as others have expressed that the discussions about sustainable architecture is a current trend and that it should not overshadow what architecture is about (Harries 1997). In relation to the outcome of present research this means that it is aiming for studying how knowledge already present can be integrated in the design process through the use of digital 3d object based tools, without removing the focus from the aesthetical expression of the architecture. It is not the aim to develop a general methodology. It is to understand how a better understanding of the design process can help to improve and integrate the work with sustainable architecture further into the design process.

Theories of science

The outcome of present PhD is how existing knowledge about the IDP, informed by studies of how architects think and work, can help to inform architects about the energy consumption during the early stages of the design process and how existing digital tools can help to provide and support such knowledge, thus creating a more common ground between the different professions involved in the design

process. It is the relations between the architectural form and the energy consumption there is in focus here as well as how this knowledge is implemented in the design process and how it can help to inform the design process and the final design of the building. The contribution lies in:

1. Expanding the field of knowledge about how architects approach the design process, especially now where the demands are increasing, and through that knowledge about how this can help architects to assess environmental issues from the early conceptual stages of the design process.

2. Expanding the field of knowledge about what implications the use of simulation programs can have on the design process.

With the design process in praxis described as a conjecture/analysis process where the architect from previous experiences generate one or several solutions as a starting point it is seen that it differs profoundly from the analysis/synthesis often described in teaching situations and other integrated design process (Trebilcock 2009). However my claim is that the two approaches can help to inform each other. Where the conjecture/analysis is based on using previous knowledge to start the design process through conjecturing (Hillier, Musgrove & O'Sullivan 1972, Darke 1979, Trebilcock 2009) the analysis/synthesis takes a more analytical approach identifying different parameters that are of importance for the solution to the given problem in the design process, but this is difficult because design problems are wicked and ill-defined (Cross 1982, Cross 2006) and the full scale of the problem is impossible to describe or analyze. However architects do analyze their work through the process and are using different parameters to do it. So if these parameters are a part of the first thoughts they will be an integrated part of the solution if the knowledge about how to address them and use them is also present. Then the sketching phase is used as a dialogue between analyses and sketches where they inform each other throughout the process where the architect reflects upon the work as the sketching progresses (Schön 1995) as shown in figure 6.

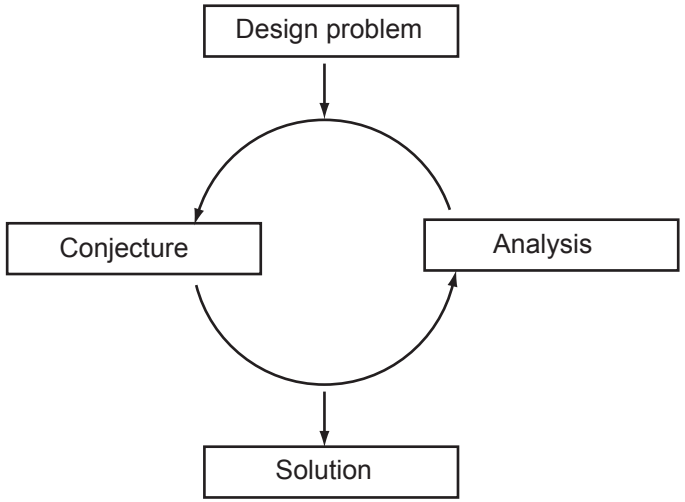

Figure 6. Representation of the design process as encountered in praxis.

Therefore the knowledge about technical issues and their possible impact on the design is becoming more important as the complexity grows. For the architect it becomes important to be able to integrate this explicitly in the design process in order to let it inform the design process and through that strengthen the link between the technical issues that is a part of the design process and the architectural form and expression.

Now one of the interesting questions in relation to this is how the increasing focus on BIM in the design process can be seen and understood in relation to knowledge about the design process and how this knowledge possibly can be used to approach some of the problems in utilizing BIM in the early stages of the design process (Schmitt 2004, Penttilä 2007). This is interesting because BIM is seen as the future in architecture and currently are used in various projects in order to streamline the design process (Schodek 2004, Eastman 2008). It is important to address the different issues at the right time during the design process. For example basic parameters like orientation, window openings and basic geometry of the building are crucial to evaluate both from and architectural and technical point of view from the beginning whereas for example ventilation systems can be addressed separately (Chaszar, Kienzl & Stoller 2006). Though one still has to be aware of that they need to be there. So even though the use of BIM can solve problems about interoperability it so far does not solve problems in the early design process. At least that is what research shows (Schmitt 2004, Penttilä 2007) and this is also confirmed by the preliminary analysis of the interviews, which have not been published yet, made with architects. In fact these interviews show that they don't use BIM tools during the very early stages of the design process. In terms of outcome for present research this means that the understanding we have of the architects design process both from research and previous experiences needs to be utilized. One cannot force a solution upon them, but have to work with how the knowledge from, in this case, the IDP can be used in their process and explores how an evidence based process can help to inform an experience based design process. So the question becomes how the evidence that one can find through using different simulation programs can be used in a design process that is traditionally experience based without relying on guessing different solutions, but by utilizing knowledge that is already present through a focus on identifying key parameters in the design process.

There exists a variety of guides within this field all focusing on how to utilize the environment in which one is building (Olgyay 1992, Brown, Dekay 2001, Yeang 1999). Furthermore a variety of schemes are today available in order to help architects and design teams to address the different issues and in the end rate the building in terms of how sustainable it is (LEED 2009, BREEAM 2009). Again the question is to use the knowledge in relation to the design process and the digital tools used to address the different issues. Here the schemes are of little use so they are not taken into further consideration. What is of importance here is to be able to locate the different parameters of interest in the problem and then describe and assess them in relation to the aims one have (Chaszar, Kienzl & Stoller 2006). This is also what is done in the IDP where both architectural and technical demands are outlined (Knudstrup 2004). Furthermore all the different issues that have an impact on the solution in relation to designing architecture are more or less impossible to list (Cross 2006). However the parameters addressed related to the energy consumption are often perfectly integrated in the design process as seen in vernacular architecture (Williamson, Radford & Bennetts 2003, Thomas, Garnham 2007, Steele 2005) however they might not be addressed from an environmental point of view even though these issues are basic within architecture (Reinmuth 2010).

Today there is a variety of research dealing with the issue of using computers to implement concerns about sustainable issue especially with a focus on energy consumption. There are of course the basic ones dealing with checklists (Synnefa, Karlessi & Santamouris 2008, Hyde et al. 2007) as it was also mentioned before to approaches focusing on generative principles to generate a range of solutions to work with in building scale and where the interaction between computer

and architect is important (Grobman, Yezioro & Capeluto 2008) and finally to the more technical approach where comfort criteria's, energy consumption and basic geometry is defined and from that a range of spaces are created that can then be assembled into a building as seen in IDBuild (Petersen 2008). However these are developed in a research environment and are rarely used in praxis. Though the IDbuild has been used with architects research shows that architects do not necessarily find it useful in the design process (Petersen 2008). What is seen in relation to the last two approaches is for using the computer as a colleague that helps one in the design process (Negroponte 1970), though, this is still an issue where architects are worried about their influence on the design process (Yu-Tung 2007, Xiyu, Mingxi & Frazer 2005).

All of the above on some level is pointing towards understanding the design process and the approach to it as something that creates a solution space that we as architects can navigate in. With the conjecture being a implicit solutions space defined primarily by previous knowledge whereas an analysis points towards a more explicitly defined space.

It is within these fields of sustainability, design process and digital tools with a focus on BIM where I see the contribution of present research. It aims at developing knowledge about how these three fields can interact to allow a focus on architectural qualities and through that suggests how architects can address the relations between sustainable issues and traditional architectural issues during the early design stages. Working with this mainly through qualitative interviews and action research allows for working in the context and with some of the people that have to work with these issues on a daily basis and through that get an understanding of how the architect see these issues getting experiences with how these issues can be addressed in the present approach to the design process with the possible problems and conflicts that can be encountered in it. Through it, it becomes possible to be engaged in the work in a way that the study environment cannot give and that small experimental projects with a specific focus on certain issues can have difficulties to address. Of course the approach also calls of an amount of uncertainty. As a researcher the control with the process will be diminished and the outcome and possibilities for adjustments in the process also diminished. However doing the research this ways allows for working and getting and improved understanding of what is required in order to make these things work in an actual design process. Furthermore the variety of methods used in the research ranging from literary studies over interviews and action research to small experiments allows a validation of the data through different perspectives.

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4. Understanding of Danish Passive Houses based on Pilot Project the Comfort Houses

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Timeline: 01.08.2007 - 31.07.2010

Keywords: Architecture, Passive houses, Low-energy, Indoor environment, Everyday life, Design processes.

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Project/chapter	Theory input	Methodology	Epistemology
Understanding of Danish Passive Houses based on Pilot Project the Comfort Houses	Sociology (everyday life), Engineering science, passive house theory, architectural theory	Interviews, measuring/calculations, (and observations, photo documentary, survey)	Empirical-analytical Phenomenology

Introduction & Research question

The building industry in Denmark and the rest of Europe is facing challenges in fulfilling the EU directive of 2002. New buildings and renovation projects need to improve the energy performance to be able to fulfil the Kyoto agreement from 1998 (Directive 2002). In Denmark it has resulted in new building codes according to energy use, which contains a classification of low energy buildings, which will be strengthened the following 5-10 years. By implementing tighter energy demands and energy labelling for existing buildings the awareness of energy performance groves and the energy performance of buildings become a competitive parameter. For the Danish building industry it means that they are facing new challenges both in developing new intelligent and holistic building concepts but also new challenges for the manufacturer of products. Today the build environment accounts for about 40 % of the energy consumption in the EU and it is continuing to expand. It is a result of an effort to give the building users an optimum indoor environment by good ventilation, comfortable temperatures and sufficient light. The level of energy consumption and the quality of the indoor environment in a specific building are very dependent on design and construction of the building envelope. Therefore to be able to fulfil the directive and to protect our environment we need to focus on new building concepts which both generate low energy consumption and a comfortable indoor climate.

In Germany they have build thousands of low energy houses they call passive houses. The concept is now very well acknowledged internationally and many countries are constructing houses that fulfil the passive house standard defined by the Passive House Institute in Darmstadt, Germany (www.passiv.de). In Denmark few certified passive houses have been built in the last 2-3 years, therefore the building industry still need to find its own approach. It is tried through the project THE COMFORT HOUSES (www.komforthusene.dk). Besides fulfilling the German passive house standard THE COMFORT HOUSES should also have a high level of indoor environmental comfort – a parameter that the initiators think appeal more to the Danish population than saving energy. The passive house solutions can not be copied directly from Germany or Austria to Denmark because the requirements from the Danish residents, the traditions in the building industry and the architectural traditions are different. Therefore it is important to find at Danish approach, to get passive houses into the Danish market and thereby minimize the energy consumption in new housing projects. Besides energy savings and new structural solutions also architecture, everyday life and the future ways of living has to be integrated if they should be future-proof and saleable in relation to the buyers and their needs. Therefore knowledge and experience about the architecture, building technique, indoor environment, user behaviour and user needs are studied to reach a more holistic approach.

Figure 1: Overview of the Comfort Houses that fulfils the German passive house standard.

The overall research question is therefore:

What is a Danish passive house seen from the experiences of the Comfort Houses? And what can these experiences enlighten about the future production and use of passive houses?

To answer that the following study fields are examined: *The design process*, *The construction process*, *Architectural expression and building technology*, *Architecture and everyday life and Indoor climate*.

All study fields will be touched upon, but the main focus will be on *The design process*, *Architecture and every day life and Indoor climate*. Therefore following sub-research questions arise:

- **How has the consortiums behind the Comfort Houses approached the design process according to teamwork, method and tools? And what barriers and possibilities lie within the approaches?**
- **How do the residents of the Comfort Houses experience the passive house architecture and the technique? And has their everyday life changed by moving into a passive house?**
- **How do the residents of the Comfort Houses experience the indoor environment and the adjustment of it? And how does is relate to the measured indoor environment? And in what degree do the Comfort Houses live up to a comfortable indoor environment?**

What is meant by architecture? The definition of architecture is generally the art and science to design buildings, rooms or physical structures. In architecture the practical and the aesthetics are inseparable e.g. functions of the house, constructions and materials, spatiality, volume, texture, light and shadow etc. Vitruvius defined before year 1500 architecture to consist of three interrelated terms: *firmitas*, *utilitas* and *venustas*, which can be translated by structural stability, appropriate spatial accommodation and attractive appearance (www.britannica.com). The purpose of this section is not do a thorough explanation or definition of what architecture is, but just to clarify what is meant by *architecture* in this particular context. The aim of this research is to understand the everyday life as it unfolds within the architecture (or the home) – what works well in the house and what does not. And the aim is not to make an extensive architectural analysis of the houses. The Comfort Houses are investigated from the occupants' point of view, since they are the ones who live in the houses everyday and their experiences generate useful knowledge about the life that unfolds in a passive house compared to a "traditional" house. The focus will therefore, in the light of Vitruvius' terms, be on *utilitas* (or translated to appropriate spatial accommodation or functionality) and less on structural stability and beauty, as it will not make sense to investigate the occupants' understanding of the latter as their understandings are on another level than the understanding from the professionals within these fileds. Generally the occupants' horizon of understanding is primarily based on functionality, usability of the house and their life within the house. The occupants are seen as representatives of the target group of this type of houses and they will represent the future occupants or owners of passive houses, therefore it is important to investigate their experience with the outcome of the Comfort House project.

Ideally all above listed study fields should be studied to get a more holistic understanding of passive houses in Denmark, but a limitation is necessary to fit the research within the timeframe (other study field could of course also be included like e.g. economy and politics etc.). Figure 2 shows how

the study fields are connected and has an influence on each other. For example first the design process defines what to build and how to build in the construction process. Then the residents move into the houses and create an everyday life. Then as a result the house has an energy use and an indoor environment. It is still believed that it is possible to enlighten how to approach passive houses in Denmark in a holistic way (meaning both focusing on architecture, energy demands and indoor environment of the building so it 'fits together' in a whole) in the future by giving some of the study fields less focus. It is still possible to understand the connection between the design decisions made in the design process and the experience of the architecture and everyday life of the residents without an in-depth analysis of the construction process.

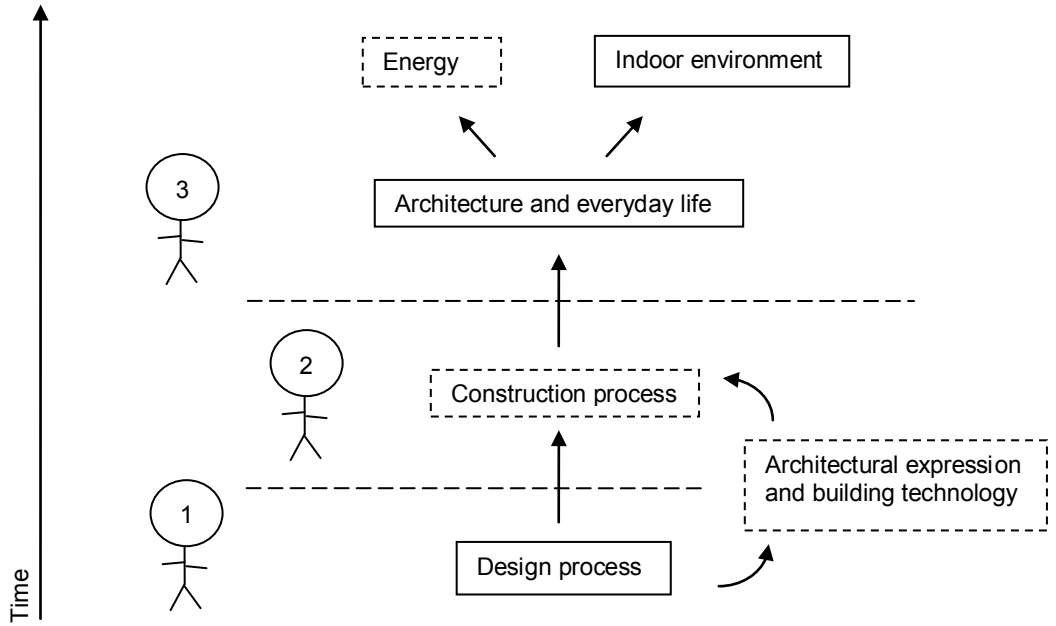

Figure 2: The illustration shows the different study fields and how they linearly take place in time. The matchstick man illustrates how the different fields involve different actors and a need of knowledge transfer.

Methods

The project is based on a case study design. The project consists of ten cases which are THE COMFORT HOUSES and the actors connected to them. The actors are the consortiums that have designed the houses, the craftsmen and the resident in the houses. To be able to achieve a holistic understanding as described above each case will contain more study fields; therefore it can be defined as an *embedded multiple-case* design (Yin 1995).

The first step is to examine each study field in each case and conclude upon them. Then a comparative study of the study fields is made across all cases. Furthermore a comparative study is done across research fields if possible, illustrated in figure 3. In the comparative studies there will be searched for patterns, consistency, new potentials and any dependency between the research fields to be able to develop a holistic understanding of passive houses in Denmark. In each study field different methods is used, both quantitative and qualitative. The quantitative methods are e.g. measurements of the energy use and indoor environment, questionnaires and calculations and simulations of building details. The qualitative methods are e.g. interviews, observations and photo documentation. The methodical approach of this research can be called *mixed methods* (Bryman 2008).

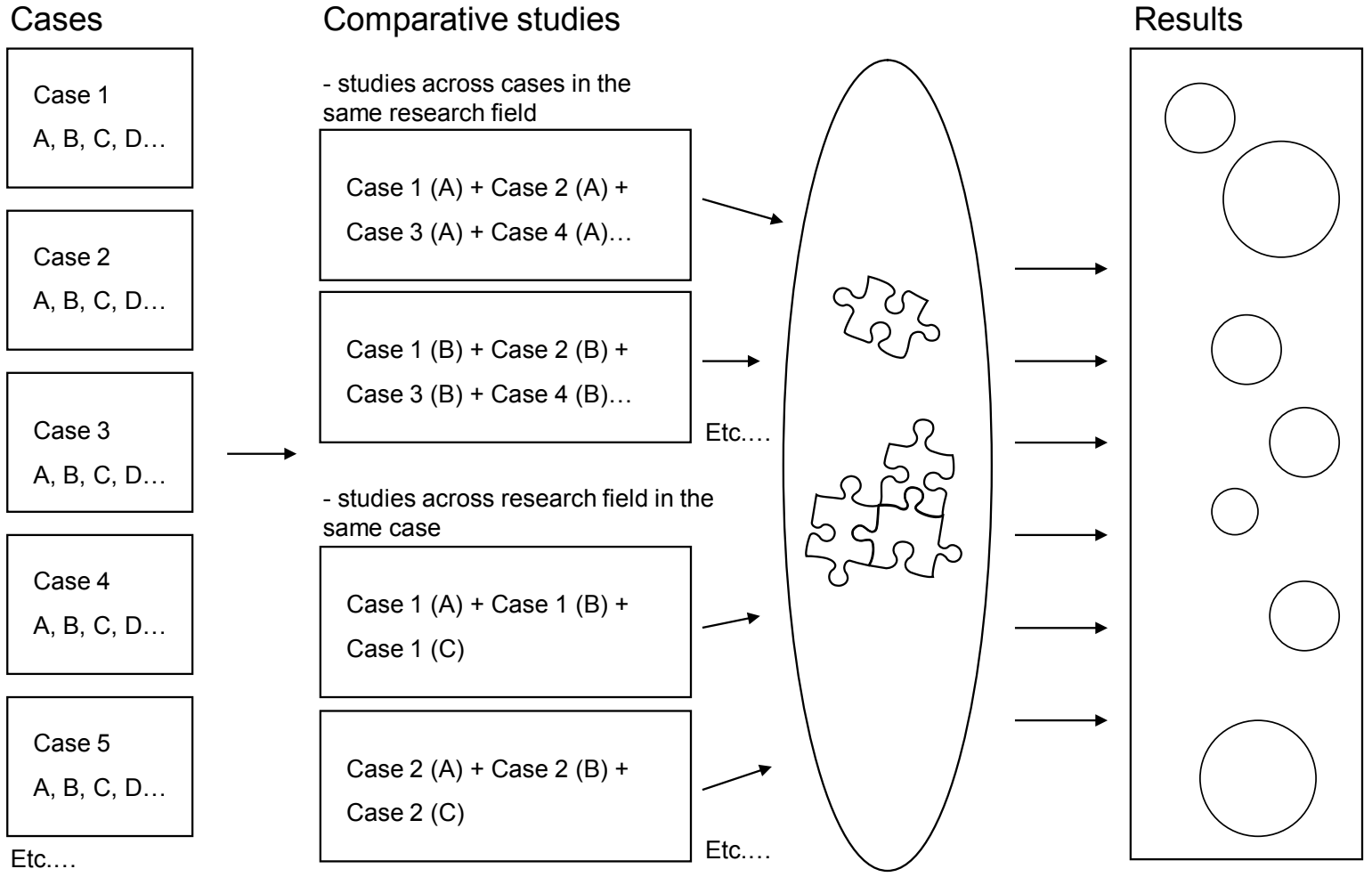

Figure 3. The illustration show how the results are developed through the different cases and research fields in a comparative study. A, B, C, D etc. have to be understood as the different study fields in the project.

Mixed method

Previous some researchers argued that it was not possible to combine qualitative and quantitative methods because a) the embedded methods are not feasible or even desirable. They argue that the two research strategies provide different procedures and therefore different epistemological implications. b) The other argument is that qualitative and quantitative research belong to each there paradigm and according to Kuhn, paradigms are incommensurable. Since the 80´s the argument for combining research has increased. There are areas of overlap and shared aims between qualitative and quantitative research and the paradigmatic war is almost over (Bryman 2008). Looking at e.g. the field of architecture in practice, which works with aesthetic as one of the main aspects, also works with aspects from other professions like engineering, sociology, psychology, politics and more. Some of these professions belong to different paradigms but can easily be combined - or ells architecture would not make sense. Therefore I believe it is necessary in many cases to work with mixed methods, both when you design architecture in practice and when you do research about architecture.

There are different ways in which mixed methods have been carried out, and can be categorised under different terms e.g. *triangulation*, *completeness*, *process*, *different research questions*, *explanation*, *illustration*, *diversity of view etc.* (Bryman 2008). The mixed method in this project can be categorised as *completeness*, *different research questions and diversity of views* according to the categories in Social Research Methods by Alan Bryman. *Completeness and different research questions* are about using different methods – qualitative and quantitative, because some methods do not provide you with all you need to know or the answers to your research questions, then you have to use more methods to get a more comprehensive view of the research field. These two approaches cover the overall approach of the PhD project, where *Diversity of view* is used as an approach in some of the study fields within the thesis to be cross-disciplinary between engineering and architecture. An example is an investigation of the optimal solutions for how a window is build into a passive house according to the linear thermal transmittance and to the architectural expression of the solution (Brunsgaard 2008). By looking at the research with *Diversity of view* it shows that the best technical solutions is not necessary the best architectural solution. To evaluate different solutions presented in this research you need to switch between quantitative simulations and qualitative subjective experiences of architectural expressions.

Theoretical frame

Overall this PhD. thesis takes off in the passive house standard of the Darmstadt Institute in Germany. This is not a profound theory but the standard is based on international norms and standards which original is based on theories developed from empirical experiments and analysis within natural science. The passive house standard is developed and refined from the late 80´s and consists today of three criteria listed in table 1.

Tabel 1. The passive house criteria (www.passive.de)

Space heat demand	max. 15 kWh/m^2 per year (net m^2)
Primary energy demand	max. 120 kWh/m^2 per year (net m^2, incl. household)
Air tightness	max. 0,6 h^{-1} at pressure difference of +/- 50 Pa

The standard also includes a calculation method which is different from other energy calculation methods. This calculations method has to be used to document if a building project fulfils the criteria of a passive house or not. It is also called the passive house *concept*. The passive house concept states that by fulfilling the tree criteria you save the most energy in the building during operation, which makes the concept into a kind of theory to save energy in new buildings. Besides the standard the concepts have some recommendation according to the building design and the technical installations which can be found on the webpage of the Passive House Institute (www.passive.de).

Because of the wide approach in the project it is also necessary to approach the project wide theoretically as well. It means that the theoretical frame changes according to specific research field. In the following I have listed theories that the main study fields draw upon.

The design process

To be able to understand the different design processes behind the ten cases, an insight in different theories in approaching the design process is necessary. Here I have looked at how a traditional design process generally works in practise and different Integrated Design Processes (Brunsgaard 2008). The most central theories are the integrated design process developed by IEA Task 23 Subtask B - Optimisation of Solar Energy Use in Large Buildings – Integrated Design Process Guideline (Löhnert 2003) and as a result of that Mary-Ann

Knudstrup, Architecture & Design at Aalborg University developed a the Integrated Design Processes for problem based learning (Knudstrup 2004). The theory of integrated design states that by working integrated or cross-disciplinary by combining architecture, design, functional aspects, energy consumption, indoor environment, technology, and construction, you eliminate mistakes and bad performing buildings and you end up with a more holistic building design (Löhnert 2003).

Architecture and everyday life

In the analysis of how the passive house architecture influences the resident's *everyday life I use the theories of everyday life and life-modes* (The Danish word "livsform" is translated in Michael Hviid Jacobsen "Encountering the Everyday – an Introduction to the Sociologies of the Unnoticed" to *life-modes*, but others use the word *life-forms* - his paper will use the first). Alfred Schutz (Schutz 2005) and Birte Bech-Jørgensen (Bech-Jørgensen 1997 and 2002) work with the concept of *common sense* which describes a kind of natural attitude which can describe the life - how it seams given and natural. Birthe Bech-Jørgensen states that by using a double perspective you get an understanding of people's everyday life. The everyday life has to be observed from the *conditions* of a certain everyday life (perspective 1) and how the people *manage* the everyday activities (perspective 2), illustrated in figure 4. Birthe Bech-Jørgensen´s research is about the meting between people, but in this research it is more about the meeting between people and the architecture and its technique. Therefore I believe that the architectural design solutions can have an influencing on our behavior in our everyday life. Therefore, besides the demographics, the architecture is a part of the *conditions* to understand the everyday life. Lone Rahbek Christensen has defined three different life-modes of how people relate to their work and free time – *the self-employed*, *the wage earners* and *the career professionals* (Christensen 1994). This theory is included because it offers and alternative perspective and useful tool to categorise lifestyle or everyday life according to the relation between work, family and spare time. The idea is not to use this theory equally to the theories of everyday life, but I will borrow elements that can be useful to understand the everyday life of the residents (I will get back to why it should not stand alone as a theory). The life-modes are seen as a part of the double perspective by Bech-Jørgensen - the *conditions*, to understand people's everyday life in the home, because that contains the family and spare time and sometimes also the work, which the life-modes tell us something about. Some think the theory behind life modes is too ridged, but the idea is not to place people in one category, but it is a theoretical analytical tool and is not found in reality in the society. The theory is also criticised for not taking modernised families into account e.g. dual-career, single parents and division of labour in the home (Jacobsen 2009). This critique will of course be taken into account when labelling the families.

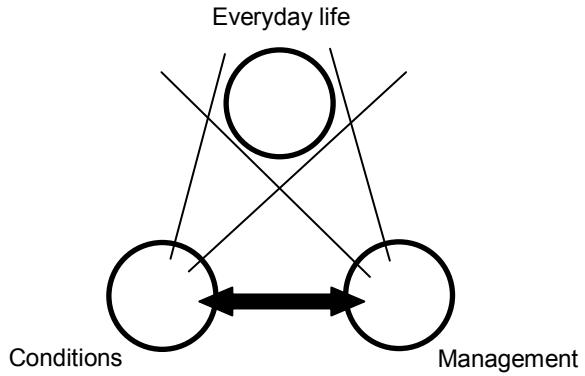

Figure 4. The illustration show the double perspective of Birthe Bech-Jørgensen (Bech-Jørgensen 1997).

The indoor environment and The building technology

Danish and international standards are used to document the indoor environment or to investigate different building details of the houses e.g. CR 1752 (DS/CEN/CR 1752 2001).

The above theories belong to different scientific traditions which will be discussed in the following section

Epistemology

As mentioned above different methods and theories are used in the process of collecting knowledge and experiences from THE COMFORT HOUSES because architecture can be divided into two parts; the measurable and the immeasurable. It means the project both takes qualitative approaches based on subjective sources of information, and quantitative approaches based on objective sources of information. Scientifically these two approaches are founded on two lines in the scientific field: natural science and social science.

Different scientific positions

Natural science is based in the empirical analytical scientific approach and has been dominating since the 1920´ies. At that time there were a clear distinction between objective and factual knowledge on one side and the subjective norms and values on the other side. The clear distinction was later doubted and resulted in different kinds of empirical analytical approaches, but generally empirical analytical scientists are focused on what is positively given and sticks to the verified sayings and refrain from emotions and opinions. The development in the empirical analytical approach today is not so much to set up specific normative instructions for how research should be done, but more to achieve an image of what research is as correct as possible (Andersen 1994). But what is empirical analytical science?

In the empirical analytical field is the object taken out of its natural environment and idealised – it becomes an artefact. It means you will leave out elements which is not relevant to the "experiment". Yet there can still be different ways to outline or define boundaries for an object, not of empirical character but founded in the ontological assumptions. An experiment presupposes a theoretical frame for it to be interpreted and often the ontology lies implicit within it. *Generalisation based on empirical findings* (specific level) or *principals* (general level) can be understood as theories and becomes preconditions for the scientific work. (Kragh 1991)

Social science on the other hand is often more subject orientated and often uses qualitative methods because they are good to discover new fields of knowledge and can tell something about people's motives of actions. In this field we find among many others the phenomenological and the hermeneutical approach. (In the following the discussions will limit to these two approaches of social science, because the goal with this publication is not to describe all scientific approaches). When working with qualitative methods it is important to be aware of what scientific field you place your self in, because they have different ideas of how the human acts, it differs what part the scientist plays and you need different qualitative methods and analysis which also produce different kind of knowledge (Jacobsen 2008).

The phenomenological and hermeneutic approaches both have similarities and differences. They both take off in the individual. An individual that can think, feel and act independently, which thereby influence the social life. These approaches also have in common that they concern about *why* people do, think or act as they do and not just *what* they do. The phenomenological and hermeneutical approaches differ by the way knowledge is understood. It will be described shortly in the following. In hermeneutic you want to understand the part in connection to the whole, meaning that the data have to be understood in connection to the context

it is produced in. The data do not speak for it self; it has to be interpreted in its context to make sense. Therefore the researcher itself and his/hers pre-understanding becomes an important part of the findings. In phenomenology the phenomenon is studies on the basis of how the individuals experience reality. The phenomenon does not need to be interpreted but can be described and understood out of how the individual experience them. Therefore the researcher need to step back and be an objective observer and his/hers opinion should not be put in action (Jacobsen 2008).

Scientific position(s) in this Ph.D. thesis

The study fields of this Ph.D. can not be positioned in one scientific position, because they are founded in theories that are based in different scientific positions – eclecticism. In the following the scientific position of each study field will be described and discussed.

The theories behind the passive house standard are based in the empirical analytical field as it is founded in *generalisations based on empirical findings and principals* related to scientific work of indoor environmental and energy engineering. These *principals* is enlighten through national and international standards. That way different "experiments" or in this case calculations of buildings energy use can be produced or reproduced and be compared.

The study of the *architecture and everyday* life wants to find out how the residents experience the architecture of the passive house and want to know if these types of houses affect the everyday life in the house, and in that case how it affects it. A hermeneutic approach would contain an interpretation of the statement (the part) in relation to the context (the whole) to be able to generate insight. An example could be that a resident thinks he feels too exposed in the house because of the big windows to the south. To able to understand why he feels too exposed we need to understand the context. The context could be several e.g. the culture, the society, the background or even the childhood of the resident and more. Additionally the researcher has to take his or hers own pre-understanding into account. In a hermeneutic approach there is not one truth or result, it is more a process where more and more interpretations will cover the field better and better (Jacobsen 2008). The outcome of a statement often leads to more comprehensive description than the original statement (Kvale 1997). In the phenomenological approach on the other hand it is interesting to find out how the phenomenon appear and manifest itself based on how people experience them. Often architecture and the life inside is something you sense and experience and the phenomenological approach will produce knowledge that describes that experience as unprejudiced as possible. Alfred Schutz created with a conceptual universe a phenomenological foundation for how to use everyday life as a basis of the analysis of the social life. The actions that people (or the residents in this case) do in their everyday life on the basis of their consciousness of the everyday life are full of information about how the social life functions and are appointed. Alfred Schutz work with the term inter-subjectivity which is what is common and general for various individuals (Jacobsen 2008). The results are often a condensation of the original statement which still makes sense for the people in their everyday life based on their opinion about their actions (Kvale 1997). Therefore a scientific position in phenomenology would in this study field about the *architecture and everyday life* create knowledge that can be used and understood by other individuals than the ones involved. In this study field the theory about life modes is also involved as mentioned earlier. Life modes are different from the phenomenological inspired everyday life analysis. The life modes were developed by Lone Rahbek Christensen together with Thomas Højrup and were theoretically inspired by structural Marxism and dialectics. The reason is that the research had a different take-off. Thomas Højrups started off by studying the regional planning and legislation and wanted to develop a method to understand the conflicts in the living conditions of different social groups (Jacobsen 2009).

This offset in social formation is fare away from the aim of this thesis; therefore should the theory not be a big part of the theoretical foundation. But as explained earlier, the life modes say something about the family life and the spare time in relation to work – and this relation also has an influence on how they use and live in the house. Therefore I only take element of this theory – the characteristics of the different life modes, and join them with the everyday life theory as described earlier. It means that I will not theoretically touch upon Marxism and dialectic.

By studying the design processes you should at least be aware of what scientific position you, as a researcher, have to the research field, but it is also worth to be aware of what scientific field the artefact you study moves around in.

Let us start to look at the scientific field of the artefact. Two design processes will never be the same and sometimes they actually need to be different – it depends on the project. Each project has individual goals and demand and different design teams have different experiences and knowledge. It means that the theoretical understanding of the design processes do not necessarily take-off in the same theoretical position or balance between theories (knowing that rarely a design process is looked upon theoretically in practice). Looking at the theory behind the integrated design process, it wants to combine both technical and architectural aspect at the same time in the process. The balance between the fields will as mentioned before vary according to the scope of the project – a factory and a dwelling will generally not aim at the same architectural or technical level, but still both fields are in play at the same time. If we look at the traditional design processes, which is a more linear process (Brunsgaard 2009), each scientific understanding takes care of each their field. It means that the design process is looked upon by one set of "glasses" at a time. The scientific approach in the integrated design process is therefore to constantly switch between the empirical analytical and the phenomenological "glasses".

The scientific position I, as a researcher, has to this study field, is to stand on the side and study the artefact – the design process and the constellation of the teamwork. It results in findings of where the different artefacts are positioned according to the different theories of design processes. The results will be unprejudiced descriptions as possible of how the design team experiences the phenomenon – the design process. The scientific position in the research of the design process is phenomenological.

Tabel 2: The theory input, methodology and epistemology of the different study fields in focus in the thesis.

Study fields in focus	Theory input	Methodology	Epistemology
The design process	The traditional and integrated design processes	Interviews	Phenomenological
Architecture and everyday Life	Everyday life theories (Life-modes)	Interviews	Phenomenological
Indoor environment	International standards	Measuring/calculations Interviews	Empirical analytical Phenomenological

The study field about the indoor environment and building technique is originally founded in the empirical analytical field, but we see a bigger and bigger interest in viewing the fields of energy and indoor environment more widely. An example is the PhD thesis of Charlotta Isaksson *"Sustainable learning about indoor heating? – Domesticating energy technology in passive houses"* (Isaksson 2009), which has a sociological approach. She is interested in understanding how the tenants experience and learn to live with energy related technology as a part of their everyday practises. In my thesis I both ask the resident about their experiences and opinions, but also measured the indoor environment. The qualitative and quantitative results are analysed in a comparative study. It is therefore again necessary to use two set of "glasses" – the empirical analytical and the phenomenological.

A thought experiment

Would it make sense and what kind of knowledge would the thesis generate if only one perspective was taken e.g. the empirical analytical? If all research fields were to be looked upon with the same scientific approach, the knowledge produced would without any doubt be different. In the following I will try to make a thought experiment to clarify what will change within the thesis by looking at the three research fields in focus; *the design process*, *architecture* and *everyday life and the indoor environment*.

Let us start with the area of indoor environment were the empirical analytical approach already is in play. The standard of indoor environment forms the basis of the work e.g. CR

1752 (DS/CEN/CR 1752 2001). The outcome tells us *how* the indoor environment is. E.g. 75% of the time the house has temperatures between 20 and 22 ó C and the last 25% it is below 20 ó C. The situation is seen as an isolated object, an artefact, as described earlier. Can the standard give us the answers to why the temperatures are lower in 25% of the time? Maybe if we for example can observe that the window has been open. But the standard cannot tell *why* the window has been open. The researches can have some ideas, but they are based on his/hers previous experiences and not based on empirical scientific work. If the researcher needs to know *why*, he/she has to step out of the observable "experiment" and involve e.g. the occupants, but than the epistemological approach is changing.

To imagine an empirical analytical approach to the research of the design processes can be difficult, because the approaches of social science has become such an incorporated approach for me that anything ells seems wrong. To be able to take an empirical analytical approach it is necessary to look at the design process as an object that can be observed. And that can be difficult in this situation, because the design process has already taken place, so it is only in the participants' memory. How can that be observed as an "experiment"? Are memories and opinions observable? If so how can different opinions of the same experience be taken into account? Etc. These are all questions that needs an answer within an empirical ontology to be empirical analytical. The study field of *architecture and everyday life* will more or less go through the same thoughts. Answers could be to use methods as structured interviews or questionnaires. You will not only have *measures*, like thing you can be counted e.g. age, income and numbers of children, but you have to define *indicator* of different situations which related to the studied (Bryman 2008). But where do those *indicators* come from? Usually it comes from the researchers understanding of the examined – and that is based in the common-sense understanding, which theoretically is founded in social science and not in natural science.

All these thoughts return to were it all begins – the research question. It reflects the scientific approach of the work and what kind of knowledge that comes out of it. If the research question was changed to fully live up to an empirical analytical approach, the idea of the whole research will disappear. As the research question is today it reflects what is needed in the building industry today. And that is more important than what scientific approach is applied as long as the approaches is used "correct".

Summing up on what we just have been through, it shows that to be able to achieve an integrated, holistic understanding for the future development of passive houses both the empirical analytical and the phenomenological positions are necessary. This also fits well with the overall methodical approach – the case study and mixed methods. It is therefore important, during the whole research to be aware of which approach is in play and when to switch. It requires an awareness of method and reflectivity.

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5. The Study of Social Play through Sound and Musical Games

- The understanding of social interplay in the co-creation of sound and music with multimodal interfaces

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Timeline: 01.02.2008 - 05.01.2012 (including one year of maternal leave)

Keywords: Non-verbal social interaction, play and learning, interaction design

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Project/chapter	Theory input	Methodology	Epistemology
The Study of Social Play through Sound and Musical Games	Sociology, Ethnography, Engineering science, Design theory, Music theory	video observation and micro video analysis measuring joint interaction	Empirical analytical Phenomenology Hermaneutics

Introduction

How can wireless physical computer interfaces be used to connect people through social and musical games? Today's nummerous iphone applications have introduced relatively simple ways of interaction, where the physical interface (the iphone) works as a tool and an interconnected unit in a social setting. Many wireless physical computer interfaces like the iphone contain a combination of a sensor interface and a networked game application. This creates opportunities for users to act within sets of physical modalities and interact with each other in through game mechanisms that address interlinked user input. We start to see an interaction scenario like the ensemble type of setting, where players act simultaneously and continue to add to each other's content. A branch of interaction design, where the sum of player actions is in focus possible: Common player actions can be measured and considered by the game application. Adaptive game mechanisms can address social scenarios by generating new content from measured user actions. They can act as as "social modifiers" and address the level of social awareness amongst the participating players.

This Ph.D. study focusses on interaction design where players are participants and perform together in an ensemble type of setup. It studies the interaction dynamics that appear between participants when introduced to the possibility to contribute to sonic and musical content with a physical interface that has a limited set of modalities. The objective is 1) to design and test game mechanisms tht adapt to the sum of player action, 2) and to to characterize interaction scenarios through the measurements of simultaneous player action.

Related Work

By finding inspiration and drawing upon experiences from the research within tangible interaction, multi-modal toys and electronic music instruments it is possible to select commercial interfaces as well as to construct and test prototypes that work with musical and sonic games. Some physical interfaces work as tools of navigation, manipulation and expression (electronic music instruments and game controllers) while others use embedded sensor technology in order to bring the interface to live (tangible toys). Various types of interaction and game studies where children evaluate and sometimes even participate in the design process provide ideas how to measure different aspects of the interface and game design.

Electronic Music Instruments

This Ph.D. study is inspired from some of the electronic music instruments that were designed and prototyped through the last 30 years. Especially the mappings from sensor input to sound output has been studied in order to come up with musical and sonic game types that work with a multi-modal interface. For example, interfaces have been designed to perfectly fit a musician's or an artist's specific performance needs. [Bongers, 2007, 2000 and Tanaka 2000]. Also sonic interfaces that approach a wider audience are studied. [Harris and Bongers 2002]. JamSpace is an example of how a simple hardware and software interface can allow novices to play music together anonymously from isolated locations connected by a local network. [Gurevic, 2006]. Some of the 'electronic sound creation tools', like "The Sound of Touch System", "Jabberstamp", "Squeezables", "The Musical Playpen", the "Jam-O-Drum" and the "Pendaphonics" are very playful and invite to social interaction between children and adults. These are both software and hardware experiments on how multiple users can contribute to the making of music and sonic environments through fine- or

rough motoric movements. Players are able to control tonal and rhythmical structure and effect layers, where the two have been interdependent through the multi-user interface or interface parts. [Merrill and Raffle, 2007, Raffle et al., 2007, Weinberg and Gan, 2001, Weinberg, 2006, Blaine, 2002, Blaine and Fels, 2003 and Hansen et al., 2009].

Multi-modal Tangible Toys

Currently, physical toy- and gaming designs including the iphone are more complex than push-button interfaces and the mouse/keyboard/joystick/game-pad interfaces. These toy interfaces can roughly be grouped in three sub-categories: a) Assembly robotics that can be programmed to move and observe the surroundings. b) Robotic "pets" that can adapt to the way the person interact with the toy. c) Toys for expression and physical exercise.

In category a, worth mentioning is the LEGO Mindstorms, developed at MIT based on previous concepts of the LOGO programming language. [Papert, 1993]. Here the children work like an engineer next to the toy unit on a computer screen to "program" different behaviors and capabilities and load them onto the toy unit. The ideas about learning by constructing with pieces of code are heavily inspired from Piaget's play theories that suggest specific stages of child development. [Piaget, 1962]. A more 'hands on' approach is seen in the programmable toy unit is the Topobo construction parts that consist of assembly parts, where children program movement into the parts that you have assembled by physically moving the actual toy units. [Raffle et al., 2007].

In the category b, there are already commercial products like the AIBO robotic dog from Sony and the Paro robotic seal, developed by Takanori Shibata, PLEO, the robotic dinosaur developed by Caleb Chung and manufactured by Ugobe, and Furby made by Tiger Electronics. Worth mentioning is also Cynthia Breazeal's studies of adaptive and auto-biographic humanoid robots, Kismet and Leonardo. These robots perceive the human as a "teacher", who through gestural and postural movements guides the behavior of the robot. It was found that mapping created by one person can be used by others without teaching the robot again. Further work, such as robotic imitation of facial expressions are still being pursued. [Brooks et al. 2004].

In the category c, the commercial toys for expression and physical exercise are toys similar to the Dance Dance Revolution, Guitar Hero, Eye Toy Kinetics and the Nintendo Wii interface. These toys appeal to groups because they can be played in teams or have a performative element to them. Experiments with collaborative sound interfaces as mentioned in section 2.1 have mainly explored the technological solutions behind the interfaces and the software architecture (sound mappings). Although these studies have explored ease of learning, ways of expression and inter-subjectivity in player action, more detailed studies need to be done that dive into the investigation of the social mechanisms.

Interaction Studies and Play Theory

A variety of interaction studies have been published that are based on play, learning and development theories presented by Callois, Huizinga, Sutton-Smith, Piaget, Erikson and Papert, just to mention a few. Some play theories rely on the idea that children play in order to learn [Piaget, 1962 and Papert, 1993], while another play theory states that children learn skills in order to be able to participate in play in order to socialize. [Sutton-Smith, 1997]. Yet another play theoretical framework focuses on the role of play as an important factor of cultural integration. [Huizinga, 1955] James P. Carse presents an interesting destinction between 'finite' and 'infinite' games: Finite games are goal oriented and a winner is declared at the end of the game. Infinite games declare no winners, and the goal of the game is the continuation of play. [Carse, 1986] The game designs that are presented and

tested in this Ph.D. study are typically infinite games, where the purpose is socialization and to some degree cultural integration.

In order to measure the degree of social awareness and social learning in musical/sonic games, this Ph.D. does rely on common practices within the field of interaction design and children where children's play is video documented and children draw, fill in questionnaires and are interviewed about design aspects.[Markopoulos et al., 2008 and Norris, 2004]. It also partly relies on a design process, where children develop the design alongside with the designers. [Guha et al., 2005]. However, recent studies within interaction and children also propose data logging methods in order to provide a more 'neutral' evaluation of an interactive product: An example is the quantitative study of the 'fun' aspect of an interactive playground based on heart rate measurements. [Yannakakis et al., 2008]

Research Description

In this Ph.D. study a selection of commercial interfaces together with the author's rapid prototypes are used in experiments where the social aspects of musical games are tested. The goal of this research is to present a set of interaction styles and game mechanisms that support social and musical gaming with interconnected tangible toy units. In the previous section three areas of research were described: The area of multi-modal electronic music instruments, tangible toys and interaction studies. This Ph.D. research combines these three research areas in order to come up with new forms of interaction that help users interact socially with each other in an arbitrary space with wireless wearable tangible devices. The physical toy units, i.e. the Nintendo Wii® or similar interfaces, appeal to precise manipulation, excactly like a tool or a joystick. When users interact with sound, this tool becomes a music instrument. The research area of electronic music instruments is used to give some basic understanding of the user's ability to express him/herself through a specific combination of sensors embedded in a tangible interface. Furthermore it provides ideas how to limit the musical content to each specific physical interface, so that fine- and rough motoric movement can be used ergonomically within the available field of musical expression. In a similar fashion the research within tangible and multi-modal toys provide information about usability aspects regarding the physical design. This area of research also provides different kinds of test methods in order to compare the tangible interface to a desktop interface and/or non-technological physical toys. The physical interface units that are used in this Ph.D. research consist of commercial interfaces like the Nintendo Wii, and prototypes made from a combination of sensors and the SunSpot® hardware platform as well as the Create USB Interface. (http://www.create.ucsb.edu/~dano/CUI/). These physical interface platforms make it possible to interlink content, which means that musical games can extend from one unit to another, and therefore incorporate the users in a common field of interaction. The research within interaction and game studies provides game theory and test methods to evaluate particular interaction scenarios for children, where specific game mechanisms are tested.

The Ensemble Interaction Model

It is the goal of this Ph.D. study to present new interaction models where the interlinkage between tangible toy units encourage players to become participators and create content together. The interaction models fit within the concept of 'the ensemble', where players work together instead of competing. The musical/sonic games that the players enter encourage them to support each other in their expression

and performance. By inviting players to participate in an ensemble type of setup, the game mechanisms for this kind of interaction suggest users to listen and be aware of each other, to contribute within a common framework and to express themselves within a social setting. In order to establish game models that lie within the ensemble framework, the following types of social interaction and expression are considered:

A) Turn taking - the musical definition: "call and response"

B) Solo and accompaniment – seen in jazz music, where one player leads and the other players support the leader. Typically the leadership rotates among all players.

C) Simultanous play – inspired from polyrhythmic ensembles in African music culture. Here all players equally contribute with small parts to a larger whole.

Below is a concept model of how the idea of the ensemble can function as an interaction model:

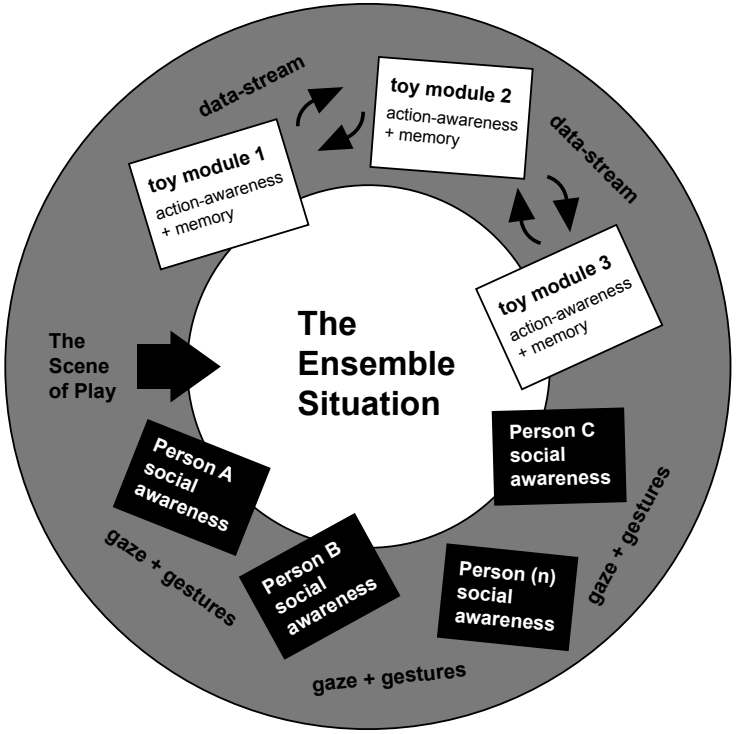

Figure 1: The ensemble interaction model

The ensemble model contains non-human players – the 'toy modules'. These are the tangible interfaces that facilitate the musical and sonic games. In the facilitation of musical/sonic games the tangible toy modules do not not only function as tools of expression for each player. While connecting each participating player, they also 'listen' to how each player contributes to the game. Game designs for this type of setup can include adaptive game mechanisms that adjust to the joint activity of all players.

Music Theoretical Background

As a background for the design of musical/sonic games this Ph.D. study mainly relies on a combination of two music theoretical frameworks: The first framework is presented inside the field of music therapy: In "Improvisation", Tony Wigram describes a set of techniques for music therapists to use in the treatment of children with physical and mental disabilities. [Wigram, 2004] The techniques help the music therapist to listen to the patient through the music and 'guide' the patient to communicate through his/her musical performance. This happens with a traditional music instrument that is easy to manage, such as a drum or a xylophone. For example, *call and response* play is used to listen to the patient's musical voice and respond in a similar fashion in order to indicate sympathy as a basis of further communication and treatment. Furthermore, *solo and accompaniment* play is used to support, develop and articulate the patient's musical speech. If such techniques can be used in adaptive game mechanisms, musical/sonic games can adjust to player action and develop a gameplay that 'listens' to each participant's individual expression, while 'responding' with musical and sonic content that is constructed from the sum of each individual player's actions. In this way the game 'guides' each player to listen to the other players while he/she contributes to the game. The second music theoretical framework, studied and documented by Simha Arom is the Central African Polyrhythm framework. Here both *call and response* and *solo and accompaniment* techniques appear as cultural constructions within a musical and often spiritual performance. Each player has a role to perform within the musical framework, so that a story can be told and a rite completed during the performance [Arom, 1985]. In the design of musical games, this kind of 'roleplay' can inspire the design of games, where each participator's musical/sonic 'voice' is an influential part of the common gameplay.

Sonic and Musical Material

User contribution to both musical and sonic games is studied. In the design of musical games, synthetic sounds that resemble traditional music instruments are used. In the design of sonic games, recorded sounds and digital sound processing methods are used in a combination. The designs are realized in the software application Max Msp. (http://cycling74.com/products/maxmspjitter/) In the musical games, the users can interact with the physical interface and manipulate low-level aspects of the musical output such as pitch, volume, tone-length and timbre. On a higher level, they can also influence aspects of the musical composition, for example rhythm and melody patterns, tempo, chord structure etc. In the sonic games, the users can create different kinds of sonic atmospheres through the adjustment of sound layers, regulation of sound textures and the manipulation of sound effects. If necessary, narration is added in order for the users to be able to interpret the sonic output.

Research Question

Within the ensemble interaction model as a framework for this Ph.D. study the research question sounds as follows:

Can musical/sonic game designs for tangible interconnected toy units encourage children to play and perform in a social setting and thereby obtain social skills through the participation in music performance and sound exploration?

Research hypotheses

The following hypotheses relate to the main research question by covering three social and musical scenarios. The first scenario is the *turn taking/call-and-response* scenario. Here participants 'speak' with each other by taking turns: a 'conversation' can develop over time. The second scenario is the *solo and accompaniment* scenario, where one player is regarded as 'leader' while the other players support the 'leader'. In the third scenario *simultaneous play* is possible: all participants play together on an equal basis.

Hypothesis one, regarding "call and response":

How do participants communicate with each other through musical/sonic content? Can they imitate each other precisely? Can they be encouraged to compose variations of a theme?

Hypothesis two, regarding "solo and accompaniment":

How do participants distribute the leader and the accompaniment roles? Can they be encouraged to create meaningful accompaniment to a 'leader'? Can they be encouraged to switch leadership over time?

Hypothesis three, regarding "simultanous play":

How do participants contribute equally to musical or sonic output? Can they distinguish their own sonic contribution while listening to the other contributions? Will two or more participants understand that they can jointly influence a specific musical/sonic output?

Method

Designs of musical and sonic games are tested with children at the age of 7 to 9. The games are designed according to the music theoretical framework described in the sections 3.2 and 3.3. The game types investigate the three forms of social and musical interaction that are described in 3.1. The game designs contain adaptive mechanisms that measure and adjust to the actions of each player and the total of all player actions. At first, games for the interaction between an adult and a child is chosen in order to be able to determine how difficult the game is to learn. Then games for the interaction between two children are tested. Possibly also games for the three or more players will be tested. The musical and sonic games are programmed to function with a selection of tangible interfaces. In order to test some rapid protoypes that can be used with musical and sonic games, the Sun Spot development platform is expanded with a selection of sensors that give the users a limited range of modalities. In the tests of the musical and sonic game designs, measurements and video observation focus on the social awareness between the players. For this purpose a combination of qualitative and quantitative measurement methods are used: For the quantitive measurement of social awareness and social and musical skills, data logging methods and signal processing analysis is used. This is further described in section 4.2. Qualitative video micro-analysis methods are used for the verification of the quantitative measurements. These are also expected to give an overall impression of how the users interact with the physical interface as well as how they interact with each other in terms of eye contact, gestures etc. These methods are described in section 4.3.

Two Test Scenarios

Two test scenarios are planned for the tests of musical and sonic games. Both test scenarios are exploratory studies where the purpose is to investigate the social awareness between the participating players. [Markopoulos et al., 2008] The first test scenario takes place in the afterschool activity centers where the 7-9 year old children have other competing activities and freely can select which kind of activity they want to engage in during the weekday afternoons. A

separate room, where the children dance or do other types of performance is reserved for the tests that happen on a weekly basis over a period of a couple of months. In this test secnario two children at a time are invited to play a game with two tangible interfaces – either a Nintendo Wii or another commercially available controller or a rapid prototype constructed from the Sun Spot hardware platform. The test facilitator (possibly a music therapist) introduces the physical device to the children by demonstrating how they can play sounds with it. Then each game is introduced and played. Each play session that lasts approximately two minutes is recorded with a video camera in order to capture the interaction between the two children. The analysis of the video is further described in section 4.3. Also, each child's interaction with the physical device is logged by the game application, so that the sensor data can be displayed on a graph. At the same time, important events in the game are registered. This is further described in section 4.2. The second test scenario differs from the first in that it happens as part of a music teaching in a ground school. Here the music teacher is the facilitator. The goal of the second test scenario is to compare it to the first test scenario in order to see, if a more structured introduction to the musical games makes a difference. After the game sequence has been logged, the children participate in a two-minute open-ended interview about their game experience.

Hermeneutic Data Logging Techniques

In order to measure quantitavely how children interact with each other socially when playing sonic and musical games, a hermeneutic data logging process is necessary. It is not enough just to log and then display the sensor data on graphs, where x is time and y is the sensor value. While this is a 'first step' in the analysis of the children's social interaction, it does not provide enough precise information about the social situation that the children engage in when playing the musical/sonic games. Interpretations of the social situation can are predefined as programmed as data logging functions in each game. In order to formulate definitions that cover the social and musical awareness that is needed in order to play a specific game, assumptions about each child's phenomenological experience is taken into consideration. For example, regarding the first hypothesis about *call and response* interaction, the phenomenological experience may include aspects of mirroring and reflection – here the data logging function could look for interaction patterns that are repeated between the players. The phenomenological experience may also include each player's ability to partially reflect the other players. For example, variations and expansions of a theme can be registered in a data logging function. By including realtime signal processing analysis into each game, it is possible to visualize selected aspects of the interaction between the participants. However, hermeneutic data sets should always be compared to the un-interpreted data in order to see if some interaction patterns were misinterpreted or completely overlooked. Studies within the field of systematic musicology have used various realtime data logging procedures in order to understand how a musician expresses him/herself through gestures while playing a piece of music. [Godøy, 2008]. Other studies within systematic musicology have studied how people synchronize their movements when they dance together. [Demey et al., 2008] This Ph.D. study will draw upon the realtime data logging methods used in the field of systematic musicology in order to be able to chategorize social awareness among players when they engage in musical and sonic games.

Observation and Video Micro-analysis

Since the quantitaive analysis described in the previous section is hermeneutic, it is essential to verify the results from this kind of analysis with qualitative analysis. First of all the qualitative video analysis can give an overall impression

of the children's engagement in the musical games and in the social interplay that the games may encourage. Here video analysis of the players' eye-movements can reveal levels of engagement and joint attention. Furthermore, the video analysis can provide information about usability aspects, so that the game designs can be optimized, if the mapping between the sensors on the physical device and the sound output is difficult for the children to understand. Because the analysis regards social learning in musical and sonic games, the following video micro analysis used in music therapy sessions is considered relevant: For example, Bruscia's Improvisational Assessment Profiles (IAP), can characterize the musical and social relationship between two players. The IAP analysis suggests some continuums to grade the relationship between therapist and client, such as the autonomy continuum, where the leader-follower relationship is characterized [Abrams, 2007]. The IAP method can be combined with the Microanalysis of Interaction in Music Therapy (MIMT) method. Through a systematic analysis of a video sequence of a music therapist and a client, it is possible to evaluate how the music therapist guides and supports the client in his/her musical expression and improvisation. This method characterizes the social interplay by taking notes concerning eye contact and body language: It investigates frequency of behaviors, eye gaze etc. [Scholtz et al., 2007].

From Hermeneutic Data Logging to Adaptive Game Mechanisms

The combination of hermeneutic data-logging and video micro-analysis also forms a basis for further development of musical and sonic game designs. The video micro-analysis gives an idea of what kinds of interactions that should be further addressed within each game design. The built-in hermeneutic data logging functions may also serve as adaptive mechanisms that influence the realtime progression of a game by challenging the players. For example, a data logging function that has been programmed to count how many times one player imitates a given theme can introduce new themes after a certain amount of successful imitations. In another game designed to investigate the *simultaneous play* two players may influence the development of a rhythmical sequence, if they synchronize their movements. In general, as a hermeneutic data logging functions provide new material for the analysis of interaction patterns, they may also provide material for the design of adaptive game mechanisms that add challenges and complexity to the games.

Theoretical Frame

This Ph.D. positions itself within the fields of game design, human computer interaction and tangible interaction design. Since HCI originates from the engineering sciences, HCI mainly has an empiric-analytical approach to determining product efficiency and usability. This Ph.D. uses an empirical-analytical approach in the logging of sensor data and signal processing analysis of interaction patterns. However, because of the high involvement of human factors, the field of HCI calls for other research approaches. This Ph.D. study investigates how new technology influences the social dynamics between users and it uses a phenomenological approach to determine which categories that the empiric-analytical analysis should be determined by. Based on an iterative process where the empiric-analytical analysis is based on a phenomenological understanding of the user situation, which again is revised by new empiric-analytical results, one could argue that a hermeneutic approach is used to categorize important aspects of social dynamics. In order to draw on the experience from other fields of study that use a combination empiric-analytical- and phenomenological approaches this Ph.D. study borrows methodologies from two music-

related fields: music therapy and systematic musicology. It is important to notice that the field of systematic musicology is an umbrella term that involves a broad spectrum of fields such as empirical psychology and sociology, acoustics, physiology, neurosciences, cognitive sciences, and computing and technology.

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6. Heterogeneous networks in multifunctional spaces

BY VALINKA SUENSON

Timeline: 01.03.2009 – 01.04.2012.

Keywords: Indoor public spaces, Performativity, Multifunctional spaces, Movement behavior, RFID tracking, Heterogenous Networks, Social relations, Spheres

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Project/chapter	Theory input	Methodology	Epistemology
Heterogeneous networks in performative spaces	Actor-Network-Theory, Foam Theory	RFID tracking, GIS, questionnaire, qualitative interviews	Post structuralism, Social constructivism

Background

Indoor public spaces can hardly be defined as a new phenomenon. The tradition can be taken all the way back to the Roman Empire with their public bathes also known as Thermaes. These buildings functioned as a cultural, social and political centre were both physical activities as well as intellectual facilities were to be found. Hot baths, sports facilities, restaurants, bars, libraries, theaters, art exhibitions, music and lectures were all gathered under the same roof, always in extraordinary surroundings and great architecture (Wikke and Skousbøll, 2010:19).

After centuries where the division between the physical and the cultural activities has been divided in different and often monofunctional public spaces, there is today an ambition for bringing the different functions back together again. The new demand for integrating various functions in a public space also affects how these new spaces are being designed: The architecture becomes flexible, multi functional and the individual user is put in to focus. The result is a public space that combines experiences with daily routines, and to carry through these ideas the architecture becomes an important player for creating a unique experience. Focusing on the physical surroundings, the aim for creating an experience can be viewed from two levels; or as an overall renovation where different cultural institutions are put together in a multipurpose centre or from an internal perspective where the single institution is opening up the space to different forms of use and by that becomes multifunctional.

Whether the multifunctionality in the public space is seen as an integration of different activities or a cultural institution open up its space for different activities the underlying aim is the same: to open up the space for the user so they can create their own unique experiences.

An example of a Library which now can be inscribed as a part of the experience economy this is the Seattle Public Library, constructed by OMA/Rem Koolhaas in 2004. The intentions have been to create a holistic environment that expands the conventional library program and make the space open for experiences only vaguely predefined in the programme. The library is divided in spatial definitions linked with different functions to formulate a unique experience and provide a sense of orientation to the users (Klingmann, 2007: 122). The aim with this arrangement of the space is for the user to register the experience and their presence in the library as a part of their own identity (Schultz, 2009: 35). Koolhaas himself defines the library as an attraction which has become an important part of the urban landscape, and a desirable social meeting place for the inhabitant in Seattle (Koolhaas, 2009: 13).

In the abovementioned case we see an example of expanding the traditional function of a library to a social and cultural meeting place by integrating the architecture as an active player which transforms the common routine of visiting a library into an experience. The case can by its new user demands combined with an iconic architecture be inscribed in the experience economy, where the performative space is in focus (Kiib, 2009; Pedersen, 2005).

Another example is the Brazilian Social Service of Commerce (SECS), a private, non-profit organization which promotes cultural and educational activities all over Brazil. The following example is taken from the SESC Vila Mariana located in São Paolo. The center was inaugurated in 1997 and covers nearly 24.000 m² with a capacity of 6000 users per day. The activities offered spreads widely from a fitness center for dancing and training, a theater, an exhibition area, a library, a cafeteria, rooms for multiple uses, to an auditorium. All facilities are located in two towers connected by two bridges, one on the lower floor, one the upper floor. Only between the

cafeteria and the swimming pool there is a visual connection which create a sense of community between the two activities.

Though in different ways both cases illustrates how the user becomes the central part for creating their own unique experience every time they visit these multifunctional spaces. Thus the space is now being defined by the users and the dynamic their interrelations create, and the space has to be understood as something emerging and not a container wherein action takes place (Blackman & Harbord, 2010: 5). With a definition of space as something developing through action a connection between the users, the activities and the materiality are emphasised. As spaces emerge through the dynamics of the users and their interaction with the surroundings, it affects the idea of one overall monofunctional space.

> *"The viewer no longer expects to experience a representation of the world according to any pre-defined scheme and is capable of being open to various possibilities, to participate, to be creative and to modify her expectations according to the specific potential of the experience. Potential space. Many different spaces"* (Oxvig, 2010: 208).

In the quote there is put a focus on the coexistence of different emerging spaces. Spaces that is potential in the physical surroundings but not necessarily unfolded. This stresses out a performative element of the architecture, and as a result the space becomes non-linear in which the subject has to perform (Johannesen, 2007: 2).

When public spaces as the Library of Seattle or the SESC in São Paolo become multifunctional it is not just a solitary example, but it reflects a change in the discourses from what Foucault would call one practice regime to another (Foucault, 1991: 75) where the spaces reflects a shift in the dispositive, moving from the disciplinary society to the project society (Jensen, 2010).

A dispositive is defined by Foucault as:

> *"A thoroughly heterogeneous ensemble consisting of discourses, institutions, architectural forms ,regulatory decisions, laws, administrative measures, scientific statements, philosophical, moral and philanthropic propositions – in short, the said as much as the unsaid (…) The apparatus itself is the system of relations that can be established between these elements"* (Foucault, 1980: 194).

A dispositive is in other words an apparatus which organize and distribute what gives meaning to be said and done in a specific historic context and the dispositive is reflected in and passes through all different parts of society as quoted above. The dispositive creates the project society, which again creates the possibility and need for the multifunctional spaces. The spaces can therefore be seen as a materialisation of the dispositive always with the linkage to a more overall apparatus that is carried through the whole society. The intention in the thesis is not to do a thorough analysis of how the ideas about projects as a dispositive is affecting and creating what Jensen defines as the project society. What will be the focus is how the architectural forms can the inscribed in the project society as a part of the overall dispositive.

The project society is in opposition to what Foucault has defined as the disciplinary society, and as the society changes, so does the architectural forms. In the imprisonment Foucault finds the ideal type of constructions for the disciplinary

society which is later on seen carried through in the architectural programmes of factories and almost all other public institutions such as the public school and build in the last century. The ideal in the constructions was in elongation of the disciplinary dispositive to concentrate activities, dividing space and organize the time (Deleuze, 1990: 212). What in other words characterizes the material space in the disciplinary society is a merging of function, space and time (Jensen, 2009: 45). This influenced the architecture which was centred inwards and the physical form was used with the main purpose for defining the space (Jensen, 2009a).

As a contrast to the disciplinary society today's architecture needs to have space for passages where the users can meet in the movement. By this the passages is what become central and is no longer just transportation from one place to another (Jensen, 2009: 52ff). This is what McKenzies put at stake in the following quote: *"performance will be to the twentieth and twenty –first centuries what discipline was to the eighteenth and nineteenth"* (McKenzie in Pedersen, 2005: 77). What Mckenzie here talks about is not the architecture but the concept of performance and he makes a clear division between the eighteenth and nineteenth centuries discipline from where the performance has now taken over. Bringing in the idea about the dispositive as understood by Foucault the shift is not only seen in the human behaviour. The shift is also affecting the way we design the spaces from where the human behaviour unfolds. When the Danish architect Bjarke Ingles exclaims that:*"the city is not a constant but a process that is created by the human beings…All the spaces that you live in is architecture which creates possibilities and at the same time constraints"* (Ingels, 2010: 67) he goes in line with the idea about the project society and that space is something emerging through the activities of the users and is not defined by a physical framework. Taking these two quotes together they highlight what is characterized in the project society and how a new dispositive is taking over the former disciplinary ideas and passes through the society in different levels, both in the human behavior and in the materiality that surrounds this behavior; it is within this project society that the human performance and the dynamic space becomes interrelated where none has priority above the other but are two sides of the same coin.

With the assumption that the multifunctional spaces reflects a shift in a dispositive that also comes to expression in other parts of the society the use of the indoor public spaces becomes important. How are these new multifunctional spaces being used? What kinds of relations are being created? How can the use of the spaces reflect a more overall perspective of what is characterized in the contemporary society?

These questions will be discussed in a Danish context, and will therefore indirectly function as a framework throughout the thesis.

The research question

Being multifunctional the indoor public spaces offers more than just a specific function, as lending out materials, but become a centre for cultural and social meetings and interaction – examples of new public domains (Reijndorp & Hajer, 2002). With a dynamic conception of space as something that emerges through the activity of the users the relations between all different kinds of elements become essential as it becomes a part of the activity and the space created (Jensen, 2010: 158).

Taking departure in the understanding of the space as something dynamic the research question asked is as follows:

How do heterogeneous networks get established in multifunctional indoor public spaces?

From ontology to epistemology

To examine the abovementioned question, the thesis mainly draws on the Actor-Network Theory and inscribes thereby itself in the paradigm of post structuralism/constructivism. Working in this academic field a few words about this perception of what is science seems relevant, as it defines the premises for working with both methods and theory and thereby influences the structure of the thesis.

A good place to start is with the conception of objectified truth. As the logical empirical paradigm perceives the truth as something outstanding of the subject, the truth becomes equal with what can be taken for granted, what is objective and unchangeable (Esmark, 2005: 16). This has the consequence that the target field examined ontologically is taken for granted (Andersen, 1999: 13). The question asked regarding the methodology is related to which procedures will provide a scientific acknowledgment, and the methods are used for the purpose to verify and falsify a given theory, with the aim to reach in to the objective in itself.

On the contrary to the objectified truth the constructivism understands the reality as a socially constructed phenomenon (Esmark, 2005:16). Truth is not something that exists, it is created. Thus the conception of truth becomes pluralistic - not to be confused with relativism! (Hansen, 2003: 348). This means, that the scientific purpose is no longer to question whether a theory's argumentation is true, objective, or scientific. The perspective is instead moving from an ontological theory of science to an epistemological theory of science. This means as well, that the perspective of matters of facts is replaced by matters of concerns (Latour, 2005). Matter of concerns describes how the reality has to be seen as something in fluctuation and not something unchangeable. The social world consists neither of subject or objects sui generis but of meaning. It is only through the network between the subjects and objects meaning occurs. When network gets established through the activity between subjects or between subjects and objects, it becomes a dominant concern. But as networks are established only through the interaction between subject or subjects and objects, matters of concerns define this continuous fight between networks (Latour, 2008: 6). The social order therefore always has to be renegotiated (Latour, 1996: 2).

A construction thus has to be seen as the stabilisation and dissemination of relations that make subjects and objects interrelates in a way where meaning is created (Esmark, 2005: 17f). The question asked regarding acknowledgment has therefore changed from *what* is a given phenomenon to a question about *how* the social world is being constructed (Andersen, 1999: 14).

The meaning that arises through the relations between subjects or subjects and objects is exactly what the constructive research wants to examine (Esmark, 2005:19). With a social world where meaning only can be found in the relations between subjects or subjects and objects, the conception of theory and method is changing. As constructivism is working with an empty ontology it is no longer possible to talk about an ontological target that has to be studied (Andersen, 1999: 14) and the aim for the theory is to shape the social world, not to test the theory. The use of theory defines in other words the target in itself has to be constructed as it defines the perspective through which the social world is examined. This is done by unfolding some analytical notions that can be carried through in the analysis (Esmark, 2005: 9). The analytical strategy is a way to unfold the theoretical notions through which the social world comes to appear. To call it a strategy as opposite to methodology emphasize that it is build on decisions, which could have been different and if such another social world could have emerged (Andersen, 1999: 14).

Regarding the objectives of the thesis it is important to emphasize that social relations are not understood as independent variables. They are always based on activity and therefore never fully stabile. This causes the fact, that social relations can never be explained with causality (Hansen, 2003: 350). Inscribed in the paradigm of constructivism thus the objective of the thesis is not to explain why the multifunctional spaces are used in the way they are.

In the following the theoretical notions for the thesis will be presented, and through them it will be discussed how the target field emerges.

The theoretical perspective

The thesis takes its theoretical standpoint in the world of Actor- Network Theory (ANT) which is a theory about points and relations (Elgaard Jensen, 2005: 186). When examine the users interaction with the physical surroundings in multifunctional spaces, it will be within this conceptual framework. ANT can be seen as a material semiotic where every entity takes shape and get its attributes through its relations through other entities. No entity is something in itself, but is defined only through its relations to other entities in the network (Jensen, 2005: 188). The thesis also draws on Sloterdijks theory about foam, as he in this theory emphasises the fact, that a spatial perspective will always be embedded in social interactions (Borch, 2009: 3). We are always *in* a space. This is what Sloterdijk calls spheres (Latour, 2008:8). By combining ANT with Sloterdijks foam theory, it emphasises the conception, that space cannot be taken for granted, as some outer physical structures, but is interrelated in the network, equally with the other entities. By the understanding of space as an entity that interacts in a network, both Latour and Sloterdijk extirpate the tradition from Heidegger and his understanding of *Dasein*, where materiality is two folded; a tradition that is rooted to the 17th century. Instead of focusing on objects and subjects as divided ANT talks about things or entities, and these objects that define the network are always assemblies or "gatherings" (Latour, 2008:6). This opens up the possibility to put through a spatial analysis which is no limited to only examine how the organization is structured spatially and architecturally, and the complexity of the organization can be fully embraced (Borch, 2009: 2). Thus both theories open up the possibility to analyse the interaction in the multifunctional spaces in a perspective where the distinctions between what is social, subjective and lived on one side, and material, real and objective on the other side is irrelevant, as it is all part of the same network or what Sloterdijk calls sphere(Latour; 2008:6). The thesis confine the networks established in the multifunctional spaces, as those established inside the physical surroundings. Thus the physical walls will be bifunctional as they serve both as a demarcation and at the same time as an entity in the network. The function as a demarcation is not theoretical grounded but is made only with the purpose of limitation.

ANT draws its ideas about relation and networks from Gabriel Tarde. As Tarde describes it, there is for everything a basis for another proper and possible thing (Latour, 2004: 35). By things all assemblages that a thing consist of is in focus, in other words the connections between humans and non-humans (Latour, 2008:13). A network is therefore heterogeneous as it can consist of different kinds of relations (Jensen, 2005: 188) between both humans and the nonhumans. An actor is not limited to a person as seen in other sociological theories, but it is seen as an entity to which action is ascribed to it from the other entities in the network. An entity, or actant is also used to describe those nodes to whom action is ascribed (Jensen, 2005: 189). Actors can therefore also be networks, that has gained so much stability that they're conceived as *black boxes*, which means,

that they react predictably on certain inputs (Jensen, 2005: 189). An actant can be a part of a network but is in itself also an established network. When the users are entering a space they are enveloped, entangled, surrounded by these networks (Latour, 2008:8).

To incorporate are more spatial perspective in the heterogeneous network that emerges, the theory of Actor-Network will be supplemented by the conception of spheres (Borch, 2009: 6). In common with the Actor- Network-Theory the philosophy shares an agreement with Gabriel Tarde and his understanding of the social as consisting of a small amount of thin and standardized relations which Tardes links to monads (Latour, 2004: 40). These relations are both between human and non-human entities. According to the German philosopher Peter Sloterdijk, all human being is related to a spatial context and this he defines of spheres (Elden & Mendieta, 2009: 5). The spheres come to present in three different levels expanding form the initial personal or intimate bubble to the wider concepts of globe and foams. To live in a sphere it is necessary with elements which keep the sphere stabile (Latour, 2008: 9). This is how the ANT supplements the sphere philosophy. The theory of spheres will not be fully unfolded at this stage, what is in focus is the co- existence of cells as part of a foam structure within public spaces designed for different and cross-disciplinary activities occurring simultaneously. The activities co-exist but are not necessarily related. With the concepts of sphere it is the idea of foam as a co-existence of different smaller spheres that can be seen at a contemporary multifunctional indoor public space.

Taking departure in the notion of spheres and ANT in relation to the Multi Purpose Centers it opens up the possibility to study the user's interaction with the physical surroundings in a setting where multi functionality and different user groups are the main elements that conditions the space. The classical scientific distinction between structures and actors is no longer an issue and the structures (here understood as the architecture) are no longer just an aquarium which delimits the actions of the individuals (the users). The architecture is in the thesis understood as a structure that gives different possibilities of actions (Hansen, 2003: 345).

When asking the question what architecture does, there is an underlying pre-understanding of space as something that emerges through movement, action and creation (Krogh Jensen, 2010: 85). In this perspective it becomes interesting to track different users' movement patterns, as a method to understand the use of the contemporary indoor public spaces.

Collection of empirical data

To examine the constellations of the heterogeneous networks and the emerging of spheres the project will develop an RFID tracking system to register users' movement patterns in indoor public spaces. As tracking with RFID is a new method regarding indoor positioning a "Research by Design" (Travlou, 2010) process will be underlined throughout the whole PhD work. Research of Design covers the process where the combination of a theoretical perspective with tangible human activities takes place. Through this an exploration of the affordances of the emerging technologies can be found.

RFID is an abbreviation of Radio Frequency Identification, and as a technology is has existed for many years, originally developed for military purposes for positioning the enemy and other military targets. Today it has become more popular in the society and is commonly used for tracking and identification of goods and persons through the

communication of radio waves. Many organizations utilize the RFID system when using key cards as an access card to enter the building (RFID Journal, 2005). To register movement patterns drawing upon the RFID technology is however an innovative phenomenon with only few national and international examples (as an example see Millonig & Gartner, 2008).

The RFID tracking consist of a tag and a receiver from where radio waves are send and received. The information is then sent to a database which collects all the data, and is then transformed into maps.

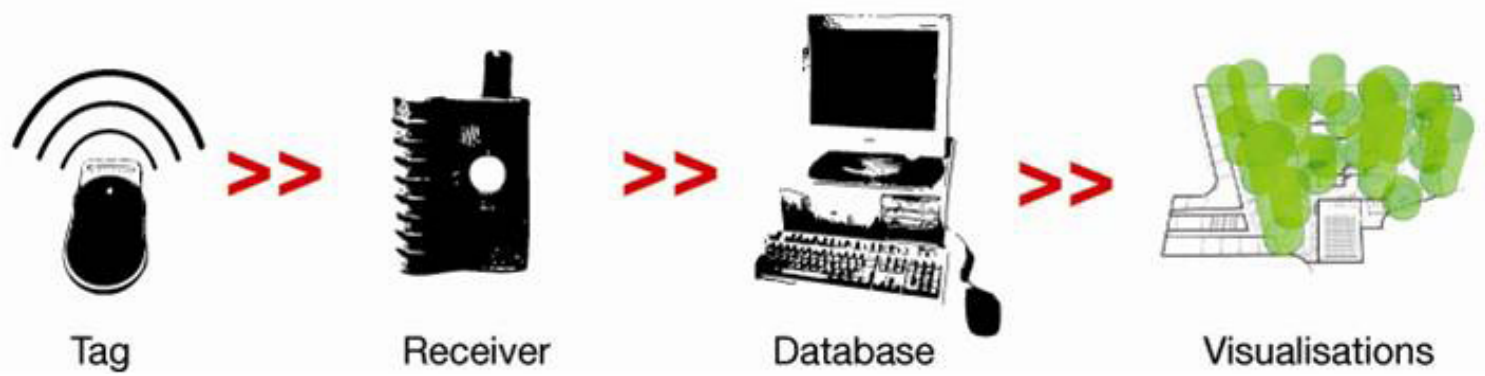


Figure 1. This diagram shows The RFID tracking.

To carry through a survey using the RFID tracking system it also requires a questionnaire survey that is carried through simultaneously with the tracking part. When the users enter the public space they are asked to participate in the survey. When agreed to this, they have to fill in the questionnaire and afterwards carry an RFID tag when moving around the building. Beforehand scanners are placed in the public space to register signals from the RFID tags. In this way all activities from the users carrying an RFID tag is registered and is being send to a database.

The users in the thesis is not to be understood as something with own intentions and behaviour. The subject is someone who is always defining and redefining himself in accordance with the surrounding space (Krogh Jensen, 2010: 81). This means, that the survey it is not the personal intentions for visiting the public space that's in focus. What is interesting to observe is how the users interact with their surroundings and creates unique spaces and experiences.

When gathering the data from both the questionnaire and the RFID tracking it become possible to create a web interface where the accumulated time spent in the public space is visualized through maps. Since all the information from the survey becomes related to a location the interface functions as a computer based systems of presentation of geographically related data, also known as GIS (Skov-Petersen, 2002: 3). The definition is though more broad then the traditional semantic meaning of the word GIS defined by geographers (Goodchild in Schuurman, 2009: 573).

In the process of collecting data through RFID tracking together with the questionnaire, some similarities with crowd sourcing can be drawn as it generates data from a large group of users and the data become accessible and shareable as a web based service (Hudson-Smith, 2008: 4). The respondents carrying an RFID tag become human sensors as they by their movements provide information about the use of the indoor space. And as they're a local in the environment the information becomes much richer compared to an inert sensor (Goodchild in Schuurman, 2009: 575).

The information in the web interface can be divide in different categories such as age, gender and day of the survey; week day vs. weekend for instance. The web interface becomes interactive in the way that the users of the interface can range the categories depending on the information they're seeking. On the other hand, it is rather passive as the user groups have no access to change the data (Hudson-Smith, 2008: 7). As a consequence the geo information maps become pure representations of the movement patterns in the multifunctional space. When using the RFID to register movement patterns focus is mainly put on the actual movement, and each user is turned in to a single movement pattern. This emphasizes the intention to examining the pure movement and not each user's personal intention with the visit to the public space.

The two maps presented on next page shows an example of accumulated time spent for women and men above the age 65. The maps are taken from a case study at a library in Hjørring, 2009.

Figure 2. These diagrams show an example of accumulated time spent for women and men above 65.

The maps produced based on the RFID and questionnaire survey shows the accumulated time spent divided in different small spaces in the overall space. These accumulative columns are seen as where a network between the user and the materiality is at stake. The intention with the tracking is therefore to map out in the public space where these networks occur. The advantage using the RFID is that the system collects an enormous amount of data that can be transformed into and visualization of the movement pattern in the indoor space – in this case the columns of the accumulated time spent. What the tracking and questionnaire survey can't register is *what* the users actually are doing in the small spaces and *how* they are interacting with the physical surroundings in these small spaces where the network occurs. The RFID and questionnaire is therefore helpful to register and map where the networks are, but it cannot tell what the network consist of. For the purpose of the thesis it will therefore be necessary to supply the RFID with a more qualitative part where each network is put in to focus.

It is often seen that more attention is paid to the method rather than the content when working with tracking and GIS– in this context a common question would be *how has the collection of data been carried through?* (Brodersen, 2009a: upag.). What becomes interesting to discuss taken departure in ANT and the concept of sphere is *how* the maps produced from the survey can tell us something about the use of the indoor public space where small microspheres emerges and disappear reliant on the dynamics from the users.

When asking this kind of question the function of the maps as an expression of different microspheres, the maps are transformed to purely represent a phenomenon (Brodersen, 2009a; Brodersen, 2009b: upag.) – In this case different microspheres and networks in the multifunctional space. From here meaning has to be found.

Two cases

When looking at buildings – or designs - the ordering of space is about ordering the relations of people. That's how society enters into the form of buildings and the two distinctions mentioned above between micro and macro, nature and society seems dissolved. When talking about buildings we also need to talk about systems of spatial relations (Hillier, 1989: 2). The thesis will take departure in two case studies where the RFID tracking system will be tested and used for registering the different movement patterns. The two cases are a library in Hjørring, built in 2008, and a public swimming pool named Haraldslund, originally from 1969th but was restored in 2002. Each case represent an indoor public space but from different perspectives. The library in Hjørring is one big room in which multi functionality is represented through different activities all integrated with full access and overview of the library. The public swimming pool is multifunctional as it offers different kinds of activities i.e. a library, a café, a fitness centre, but all the different spaces for these activities are monofunctional: in the fitness centre it is only possible to do fitness. In the swimming pool it's only possible to swim and so forth. Why the Haraldslund case becomes interesting in this context is because in its original plan view it had an representation of an ordering of time and space different from the library in Hjørring, but the most recent renovation from 2002 was an attempt to open up the spaces so that different activities could emerge. Instead of being a physical border the space becomes a space of possibilities. In the entrance hall there is now the possibility for different kind of activities, such as reading the newspapers, pay a visit in the café or play in the children's corner. From the library there is now a visual access to the swimming pool so the library user can sit with a book and still follow what is going on in the swimming pool and vice versa. With the linkages between the library and the swimming pool the space is now more in line with the ideas of a multifunctional space where the user creates their own individual experience.

Where the library of Hjørring can be seen as representing a contemporary space developed in the project society, the Haraldslund case in its plan view is representing a more disciplinary ordering. How these two cases are being used differently will be examined. At this point only the survey in Hjørring has been carried through.

The library of Hjørring – work in progress

At this point a survey in Hjørring has been carried through with the aim to register the different movement patterns taken place in the library during opening hours. A need that has appeared in light of the fact that the library now functions as a public space were one half of the users visit the library for other purposes then lending materials. Through the registrations it becomes possible to map out where and for how long the users stay when visiting the library. During four days a total of 252 respondents were participating in the survey that was taking place in November 2009. When working with the RFID data the library was divided in five different areas, all representing different functions. The five areas are illustrated on the overview plan.

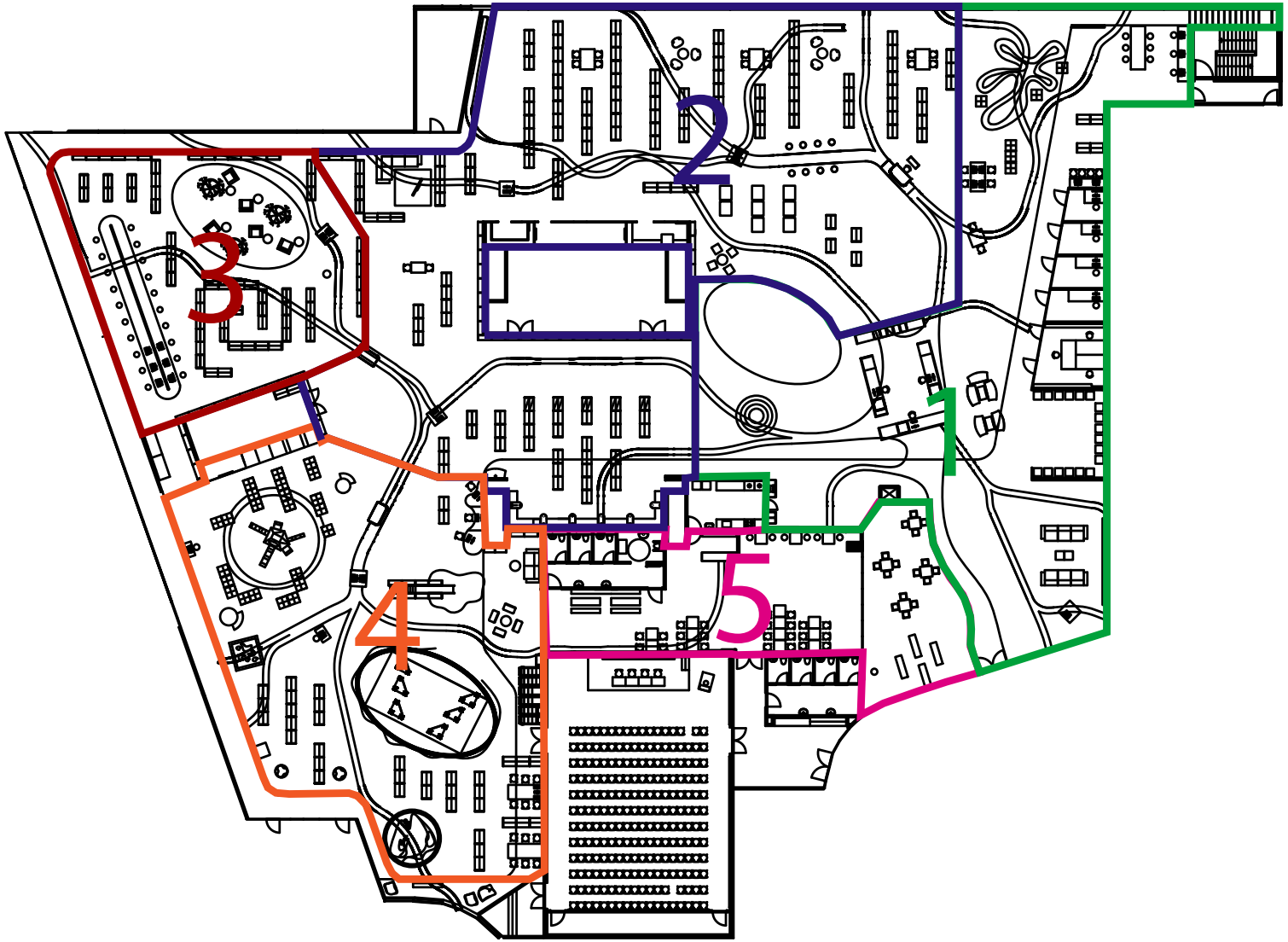
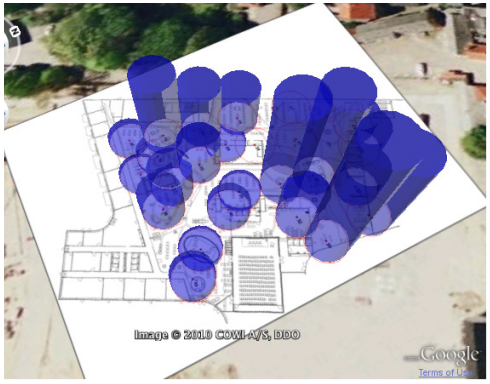


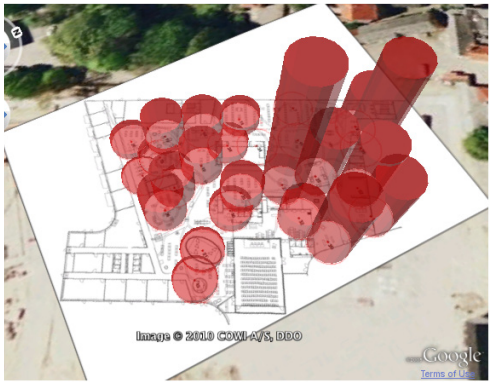
Figure 3. This diagram show the five areas that the library was divided into.

When combining data from the questionnaire with the RFID tracking three kinds of movement patterns distinct from each other emerged. These patterns are all related to certain places in the library and are developed in the combination of elements all entangled such as the light, the furniture, the other users and artifacts, whereby they all three maps become representations of different microspheres.

Three maps are illustrated below each showing a different movement pattern.



Map 1: Men, all ages, Tuesday



Map 2: Women, all ages, Monday

Map 3: Men & Women, all ages, Saturday

Figure 4. These diagrams show the different movement pattern.

All three maps show that the main activity during a day is taking place in the upper right corner where the main entrance is located, area 1. All activities regarding lending, handing in or renewing materials are carried through in this area, why these columns doesn't seem to cause much attention. A micro sphere developed from the activities from this area seems to be quite stabilized during the four days of research indifferent to whether it's on a week day or during the weekend.

What is of interest here is where the other one half of the respondents are located – presumably those who mainly use the library as a public space, rather than lending materials. The three maps show how both men and women use the library differently during the week (map 1 & 2), while map 3 shows how both user groups stay in the area called the children's zone, area 4, during Saturday. From the questionnaire survey it became clear that throughout the week most of the respondents came alone or with friends,

while the major part were in a companionship with their family in the weekend. In this perspective the children's area becomes highly desired among the users.

Map 1 illustrating movement patterns from the male respondents during a weekday a concentration of activities in the 'old department' area 3 is shown. This area is containing omitted books and journals which normally would be in storage but is now a part of the library decoration creating an atmosphere of an old library. The book shelves in this corner of the library are kept in brown colors and the zone is centered towards four big Chesterfield armchairs all in brown. Sitting in the armchairs allow the user for looking up the sky and watch the clouds passing by through a big sky light in the ceiling. The chairs are surrounded by olive trees which contribute to the calm atmosphere in this zone. What is shown on map 1 is an example of a micro sphere that has emerged based on the imitation from the male respondents all gathering in this area. Put differently the combination of the elements in the zone affects the users and the process of imitation can be described as the micro sphere is emerging.

Map 2 shows another narrative concerning the women's movement patterns. As earlier explained, there is an immense activity registered in the entrance area. This is the case for almost fifty percent of the female respondents. As a contrast to the male respondents the female registrations are spread all over the library with no clear point of gathering. Does the map shows that there is no particular imitation taken place amongst the female respondents? And does this lack of imitation prevent the emergence of a certain micro sphere? If this is the case there is no particular design thorough enough to create a space mostly affective for the female users. Maybe this is what the map illustrates?

Map 3 shows the collected movement patterns men and female all together. As opposed to the two maps shown above this map illustrate the data collected on a Saturday. Again a different pattern stands forth. This day most of the activities are gathered in area 4, which contain the children books. The area offers all different kinds of possibilities such as a big climbing tree, a video recorder, a 'Very Important Parents' area, big blue madras with the purpose for playing and relaxation, a stage, cloth for dressing up and of course lower book shelves representing children books. In this zone there are not any elements centering the activities as in the case with the 'old library'. All different kind of activities is taken place simultaneously, and the conception of a multifunctional space seems to be fully unfolded in this area, obviously in a minor scalar compared with the library as a whole. What draws the attention is that both men and women are together in this area where different kinds of small micro spheres seem to emerge. The imitation is in this case no longer limited to the same gender.

As in the case with map 2, there is no single activity making the opportunity for one sphere to emerge as seen in the 'old department' area. How smaller micro spheres are embedded in this bigger sphere is not possible to register. The RFID tracking therefore seems useful to give an idea of where the most activity is taking place during the day. On Saturday it is centered in the children's area, during weekdays women are spread more a less evenly all over the library. To give a more enriched registration of the emerging micro spheres, would require another and much more detailed RFID setup, which was not the case with the Library of Hjørring survey.

The web interface provides much different kind of maps, with the possibility to change the parameters for the data shown. The three maps presented are only meant ad an example of how to work with RFID tracking in multifunctional spaces, and to illustrate how the sphereology of Peter Sloterdijk and the perspective of ANT can provide with analytical tools to capture the complexity of the interrelation between the users

and the architecture. All the maps produced for the survey at the library Hjørring can be found at: http://aod-dus.cs.aau.dk/abs-gui/map_ge.php.

Concluding remarks

A discrepancy can be found regarding the quantitative dataset and the post structural epistemological standpoint. This discrepancy has to be overcome before the analysis can be fully unfolded. However both national and international examples can be found where this is succeeded thus the challenge doesn't seem overwhelming (as an example see Leszczynski, 2009). At this point of the thesis this discussion is still in progress.

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7. Changeability and Decision-making in the product development process

BY NIS OVESEN

Timeline: 01.06.2009 – 01.06.2012

Keywords: Industrial Design, agile development process, change management, team communication

Supervisors: Kaare Eriksen, Department of Architecture, Design and Media Technology, Aalborg University

Thomas Arvid Jaeger, Department of Architecture, Design and Media Technology, Aalborg University

Biography: Graduation in 2007 from Department of Architecture & Design, Aalborg University, as civil engineer with a specialisation in Industrial Design.

Project/chapter	Theory input	Methodology	Epistemology
Changeability and Decision-making in the product development process	Project management theory Theory on decision making Theory on creativity and iterative processes Team dynamics	Interviews Action research Video documentation Interaction analysis	Empirical-analytical social constructivism

Introduction: Agility in the development process

The Situation: introducing the present

The days of meticulously planned and thoroughly controlled product development are gone! *Now* is a time in flux. Markets for lifestyle and fashion products are seemingly moving faster and faster, dragging other markets with them as they accelerate. The industries involved in this transition are challenged by the needs of faster and more dynamic navigation within their development processes. To some, the scenario outlined here may seem exaggerated or even provocative, but the statements are by far fiction.

The statements open up discussions about consequences of sticking to the plan despite market change and difficulties in fundamentally changing the organizations around product development in order to adapt to the new and dynamic agendas of these markets. Attention towards these issues has been growing during the last years, and the concept of "Time to Market" has gained footing as one of the primary measures of successful product development. This new attention signals the acknowledgement of a gap between the moving markets and the development teams trying to keep up.

Without doubt, chances are good that market research adds to the success ratio of a well prepared development project and the ability to launch products that are in sync with the market, but when addressing the concept of "Time to Market", what really seems to matter is the length of the period from the last point in time where changes in the specific design are implementable to the product ships, that decides the level of sync with market.(Smith 2007:ix) When considering the claim of increasingly faster moving markets, this understanding of "Time to Market" implies the importance of remaining flexible to changes throughout the development process.

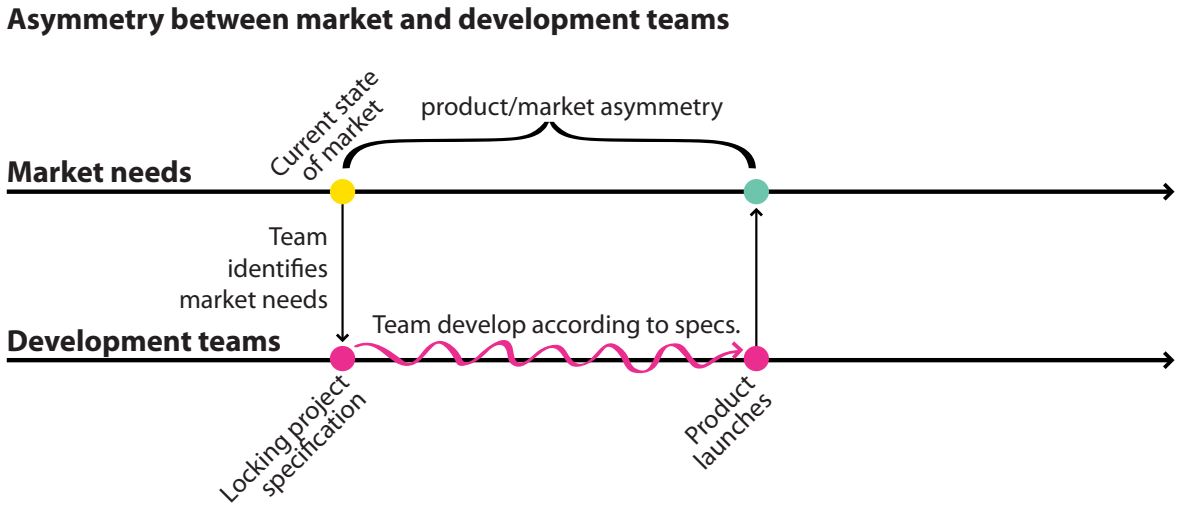

Figure 1. Market synchronisation asymmetry

In the considerations about how to facilitate this level of flexibility throughout the development process, attention is turned towards other professions dealing with processes of creation under similar circumstances in order to learn about their way of working. This is initiated believing that product development teams can learn from associated professions when considering robustness towards the state of the market and the future in general. Implicit in this idea underlies a notion of some possible weaknesses in the way design managers organise the development process, but equally important to mention is the fact, that this research project is motivated by a curiosity in learning from others and thereby improving the product designer's way of working - and learning - within the broad field of design.

Learning from Software and Web

During the last decades the software industry and Internet has gradually become more influencing on the way we organise ourselves and communicate with each other. The expectations to these relatively new platforms and demands for new opportunities have pushed new ways for developers to handle faster development and shorter time-to-market intervals. A wide range of new and lightweight programming methods, such as Extreme Programming, were developed during the late nineties (extremeprogramming.org) to accommodate this need, and in 2001 the "Agile Manifesto" was authored by a number of these pioneers in programming, thereby making some tendencies in Web- and Software industry explicit.

The Agile Value set

- **Individuals and interactions** over processes and tools
- **Working software** over comprehensive documentation
- **Customer collaboration** over contract negotiation
- **Responding to change** over following a plan

(www.agilemanifasto.org)

Agile Development has since the authoring of the manifesto and its 12 principles proven to be a highly successful alternative to traditional phased development in the software industry, enabling software- and web-developers to create solutions in sync with the fast moving markets.(Smith 2007:24)

Research questions

Returning to the initiative of learning from other professions, this research project will attempt to investigate the applicability of Agile Development in our own domain of Industrial Design. The research project therefore seeks to find answer to the following questions:

Research question 1

How can procedures of Agile Programming from the domain of software- and web-development improve flexibility in the product development process in the domain of Industrial Design and thereby improve market synchronisation of the derived products?

Research question 2

How can procedures of Agile Programming from the domain of software- and web-development strengthen the decision making of project managers and the communication of design teams?

The two research questions are co-dependent as product development (question 1), to a large extend evolve around decision making (question 2) at its core.

Methods

Initial research method and substantiation of the problem area

As indicated above, this research project has been initiated with the aim of learning from related professions in regards to improving the product development process for the conditions of increasingly changing markets. To accomodate this, the first step has been to identify professions capable of handling fast changes within their own domains. To support this part of the project a series of *qualitative interviews* (Kvale & Brinkmann: 2009) were performed with a relatively broad spectrum of professions, all involved in various creative processes of creativity and making. The professions represented by the interviewees ranged from a movie director and an architect to programmers and managers within the fields of website production and software development in the mobile phone industry. While being interviewed the interviewees were asked to draw sketches of their development processes on a sheet of paper in front of them. This addition had the purpose of establishing a better understanding of the procedures in the respective companies and thereby resulting in a richer output from the interviews.

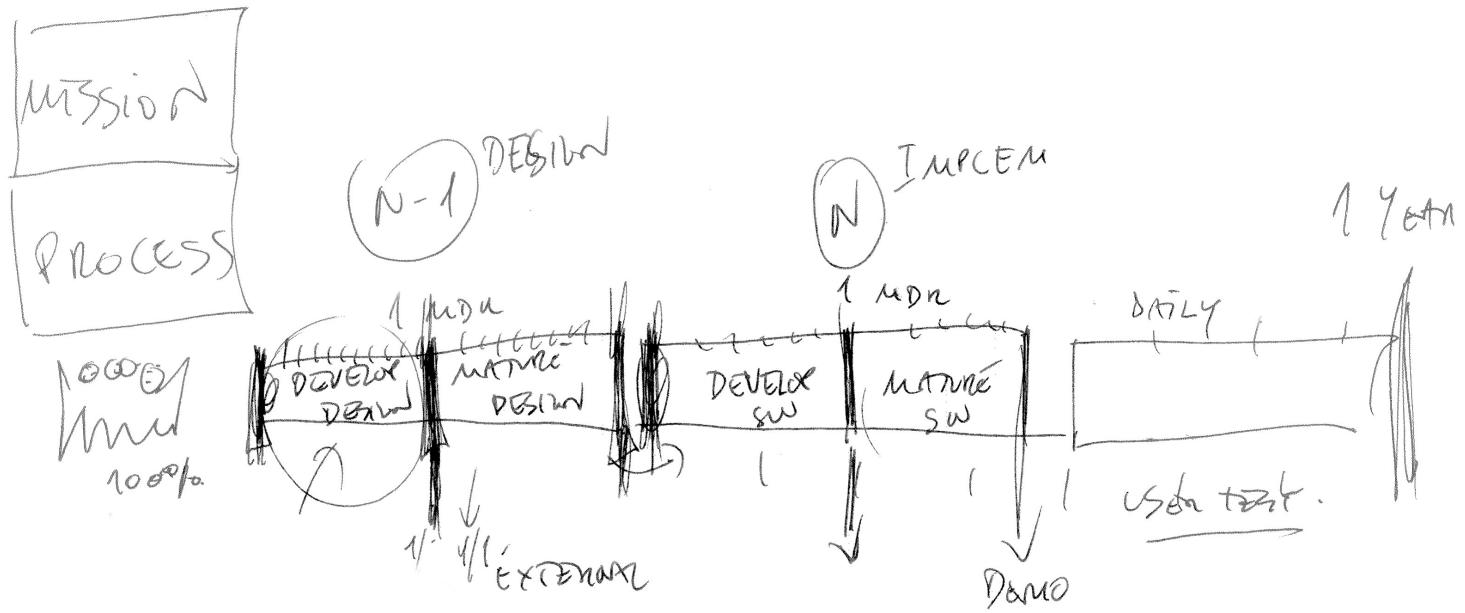

Figure 2. A Sketch showing the process of mobile software development project. The sketch is made by interviewee during interview.

From these initial activities, Agile Development has become known to this project, and the two primary research questions have been qualified on basis of these the interviews. For further exploration of the problem area, a new series of interviews with design and project managers within areas of the industrial design domain needs to be performed, supported by a survey based on a larger number of respondents within the same domain. This exploration should include questions such as:

1) To what extent are changes in product specifications allowed or possible within an ongoing development process?

2) How are changes in customer requirements, markets, technology, zeitgeist and their own surrounding organisation handled within the development period?

3) How is the decision-making on product specification-issues structured and who are involved?

These questions aim at investigating the practices of product development in the companies when changes in the surrounding environment occur and action in regards to the development projects' further process may need to be taken.

Choosing a research method

The initial research activities are all of supporting character to the actual research design, and as this project is still in its early phase, it still holds certain openness in regards to selecting the research methods for data collection and analysis. The residual considerations in respect to the research design are primarily on whether or not to base it on Action Research as the primary tool for data collection. As for now, two possible strategies for carrying out this research project are considered. These are outlined below:

1) **Action Research as research method**
   At this point in writing, the preferred strategy is a research design with data collection and analysis as Action Research within a number of companies. This strategy could be based on a "one-to-one experiment," capturing the agile development methods from domain A (software and web development) in an attempt to apply them in domain B (industrial design). This strategy will, hence the nature of Action Research, focus on the applicability of agile methods in practice and ways of documenting the experiment. A fundamental part of Action Research is the deliberate purpose of influencing the research object. The very important prerequisite to this strategy is therefore not only the availability of company relationships as these will play a significant role in the action based activities, but also their willingness to implement certain changes in their development processes as part of the research cooperation. This latter part may be difficult to push through and this is why an alternative research setup is also considered.

2) **Observation and mapping of problem areas**
   An alternative to the action research based strategy will also rely on established company relationships, but in contrast to the first alternative, this research design holds a strong focus on observation, identification of problem areas in development activities of the companies, which all could seem more acceptable from the companies' points of view. A presentation of problems and potentials in the companies' development processes could be the output in the form of a set of recommendations based on agile procedures from software. Feedback on the findings from company representatives would then finish the loop and possibly open up the opportunity of testing the recommendations in the companies and thereby ending with action based activities.

Theoretical frame

Speed and the tools for handling speed.

The outset of the present research project is the assumption of increasingly faster changes in some markets, and as a result of this, new demands for more effective tools and processes in the development. This initial assumption is supported by the theory of Dromology coined by French philosopher Paul Virilio. (Brügger 2001) Virilio suggest that the concept of Dromology refers to the fastest speed of society which will influence slower moving elements of society as in a trickle-down effect (Brannon 2007:83). When applying this theory on the current research project, it supports the suggestion

that the speed of faster moving markets, such as fashion, web- and software-industries will influence the speed of other markets, such as markets for general consumer products, in which Industrial Designers normally operate.

The above mentioned industries have each formed ways of handling product development for markets in flux. Whereas the most common tools of the fashion industry are fast and effective copycatting and trendspotting, the web- and software-industries are beginning to facilitate the use of agile methods. Because of the highly structured and well described toolsets in agile methods, knowledge about Agile Development is acquired as a fundamental part of this project. This knowledge is the subject for the attempted transfer to the domain of industrial design.

Agile development as Extreme Programming		Initial translation to the domain of Industrial Design
The Planning Game. Light initial planning, but detailed planning within each sprint. Strong interplay between customer people and technical people in the planning.	→	**Iterative Planning.** Direct transfer from XP. Light initial planning, but strictly planning within each sprint. Client and Designers work closely together in the planning of the output of each sprint.
Small Releases. Emphasis on small and frequent releases (updates), thereby enhancing feedback opportunities and flexibility	→	**Fast feedback.** Difficulty in working with small releases as in software, but fast feedback can be obtained by emphasising user feedback in development phase.
Product Metaphor. A vision of the product, held in common by the team. Works as a compass, securing that all team players move in the same direction.	→	**Concept frame.** Direct transfer from XP. Create a product vision in order to avoid specifying the product on a too detailed feature-by-feature level.
Simple Design. Only satisfy today's requirements as the landscape is constantly changing, and speculating about tomorrow will likely be wrong.	→	**Barely sufficient.** Put more emphasis on adapting to customer's needs than on anticipation, if your project is subject to change.
Test-Driven Design. Designing the test before coding the feature. Code the feature to just "barely enough" pass the test.	→	**Prototyping.** Clear pass/fail-criteria when screening product concepts and prototypes. Emphasis on testing with models.
Pairing. Code written by two programmers sitting together (a driver and a navigator) in order to reduce defects. Rotation in the team enables a shared understanding.	→	**Sparring.** Direct transfer from XP. Coupling designers enables sparring and creates a basis for discussing problems and solutions. Rotation in the team enables a shared understanding.
Collective Code Ownership. Everyone has the right to change and clean the code. Code thereby not hostage to one single specialist.	→	**Collective Idea Ownership.** All team members have the right and an obligation to build upon ideas, concepts and solutions from other team members, and not only stick to one's own.

Figure 3. Initial translation of Agile Development in the form of Extreme Programming to the domain of Industrial Design.

Supporting knowledge and theory

Diving further into this project on the chosen path of Agile Development reveals some surrounding areas of knowledge and theory that are critical areas to explore. The areas are:

1) Project management
2) Theory on decision making
3) Theory on creativity and iterative processes
4) Team dynamics

As Agile Development is a set of tools and processes suitable for managing and navigating development processes in the domains of web and software through changing environments, it is at the same time a break with traditionally phased development and other top-down management systems, such as Stage-Gate, Six Sigma and LEAN development. In order to position Agile Development in this landscape of management systems applicable to the domain of Industrial Design, knowledge about these other common systems are needed for a comparative analysis.

One of the key aspects of which Agile Development is radically different needs to be further explored. It is the process of decision making. As mentioned earlier, project management is at its core almost solely about decision making. The way decisions are made dictates the level of flexibility in a project and how a project progresses. When managing development projects in unstable environments, a too thoroughly controlled and accurately pursued development plan can be dangerous and even disastrous. Decision making in an agile process is to a much larger extend dynamic and welcomes new opportunities which are normally seen as adverse deviations from the initial plan. The concept of "Last responsible moment mentality" is a key aspect of a decision making in flexible development contrasts the typical phased development process.

Whereas theory on project management and decision making concerns the structuring of the team based activities in development projects, theory on the content of the activities should also come into consideration

Activity = Structure + Content

(Kagan & Stenlev 2006:22)

This research project revolves around the management of design and development activities in physical product development projects, so in order to cover this area, content specific theory should also be covered according to Kagan and Stenlev. Theory on creativity and iterative processes is therefore covered in the project as well. In many ways, agile methods are similar to the way designers usually work. Most agile methods are solution focused and structured as iterative loops, both which are also subject to design (Cross 2006:15). Furthermore, theories on team dynamics seem to be fundamental in order to fully understand and decode to the design and decision making processes that are going on in the multidisciplinary teams. According to Smith, the people factor plays a significant role in the team's ability to reach agreements and is by far the most influencing place for improvement compared to tools and process improvements (Smith 2007:152).

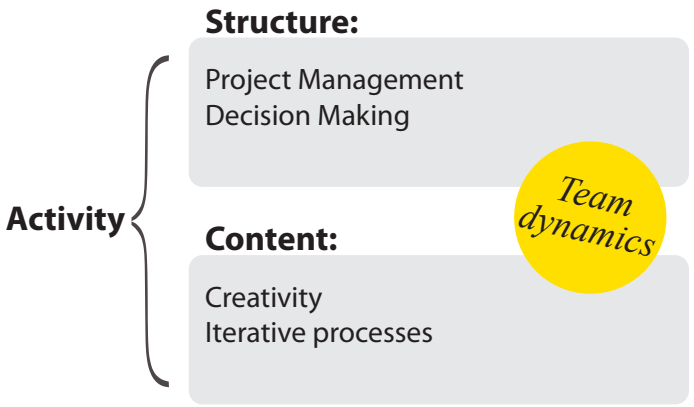

Figure 4. This diagram shows a basic structuring of the theory in this project.

Current status and expected contribution of knowledge

When looking at the outset of this research project, it has been a fundamental assumption from the start that we, as designers, can benefit from learning about processes and methods from professions traditionally not directly linked to our profession. With this mindset the project set out to look for professions dealing change and unpredictable markets and came across Agile Development. The project focus has as a result of this been narrowed and how to benefit from the intriguing advantages of Agile Development within the software industry has developed into becoming the main interest in this project. As it can be seen in the research questions, which are at the present state heavily influenced by Agile Development, the project has transformed into a project with a strong reminiscence on decision making and team dynamics. So, how does this relate to the initiating challenges about designers and design teams struggling to keep up the pace of the ever-changing market, and how does the contribution of this project address this challenge? Even though still early in the project, the contribution of this project should cover the following aspects of the problem area:

1. The contribution from this project should broaden the field of knowledge about how development projects can maintain a higher level of flexibility in their later stages.

2. The contribution from this project should furthermore broaden the field of knowledge about how multidisciplinary development teams can communicate about concepts and product features in a common language in order to maintain openness in product specifications in the later stages of product development.

The specific output from this PhD will obviously depend on the chosen research strategy, and could therefore range from being empirical-analytical to an almost social constructivist point of view. This will to a large extend also depend on the chosen theory input covering team dynamics and team communication, and this still needs to be further explored and decided upon in the following stage of this project. Another important factor in this project is not so much about what kind of knowledge the project *should* produce, but more about what kind of knowledge it is *able* to produce. Whereas the project deals with human factors and teams with certain tasks that have to be done for their respective employers, what is measurable will be influencing the knowledge contribution of the project.

In a way it can be said that this project is a product of itself. Just as one of the characteristics of Agile Development is about maintaining an open design specification, this project moves dynamically concurrently with new knowledge about the covered topics and theories are surfacing. To a certain extend this should be the natural process when uncovering new areas of knowledge, but still it makes a line of thoughts as the one presented here into solely being snapshot of the project status.

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8. Hospital Foodscape Design – considering if dining environment influence patient healing?

BY TENNA DOKTOR OLSEN

Timeline: 01.08.2009 – 01.08.2012

Keywords: Foodscape Design, Healing Architecture, Dining Interior, Meal Experiences

Supervisors: Anna Marie Fisker, Department of Architecture, Design and Media Technology, Aalborg University

Poul Henning Kirkegaard, Department of Civil Engineering, Aalborg University

Collaboration: None, but using Aalborg Hospital and the project MORE as main case study

Biography: MSc. in 2008 from Aalborg University, the Department of Architecture, Design and Media Technology with speciality in Architecture. Single courses (BSc./MSc. Level) in Sensory and Consumer Science, Food and Meal Sociology, Food Culture, and Food History from Copenhagen University, Department of Food Science and Department of Human Nutrition.

Research Output: Design Guidelines on patient dining facilities and theoretical framework on Foodscape Design

Project/chapter	Theory input	Methodology	Epistemology
HOSPITAL FOODSCAPE DESIGN – considering if dining environment influence patient healing	**Social Science** (everyday life, Actor-Network Theory, Socio-Spatial Theory) **Food Sociology** (meal behaviour) **Consumer Science** (meal experience) **Architectural Theory:**Healing Architecture Dining Interior Space Perception & Sense of Place Dwelling & Wellbeing	**Strategy**: abductive **Approach:** CASE STUDY (embedded multiple case) **Methods:** Qualitative: Interviews, observations, participant observation, photo documentary, drawing Quantitative: measuring patient output	**Viewpoint:** Holistic **Approach:** Empirical-analytical Hermeneutic-Interpretive **Philosophy:** Phenomenology Semiotics

Introduction

During the next ten years Denmark is facing the task of designing and constructing five new "Super Hospitals". (SUM 2009) This task represents a historical and political important awareness on public healthcare in Denmark, but further poses a unique opportunity for updating and rethinking hospital designs, as well as improving current challenges on patient healing. However, health related research show that one of the main challenges in today's patient healing is the *nutritional healthcare* during hospitalization and the risk of patients suffering from malnutrition or undernourishment. (Rasmussen et al. 2004, Edington et al. 2000) Because undernourishment can be associated with increased risk of complications, increased length of stay, more prescriptions, higher rate of infections, and diminished quality of life (Lindorff-Larsen et al. 2007 p. 372) the clinical outcome and treatments, as well as the cost and effect of patient healing procedures are highly influenced. (Niewenhuizen et al. 2009) To be able to overcome this, hospitals need to start focusing more on modifying diets and nutrition to support the needs of each patient as part of the hospital treatment. (Rasmussen et al. 2004, Rasmussen et al. 2006b) However, back in 1990 a Danish study on malnutrition among hospitalized children found that the problem of undernourishment possibly was not just a matter of wrong nutrition and a poor diet, but as well a social and cultural matter bound to the entire eating situation. (Holm 2003b p. 279) The hypothesis behind the study speculated that nutritional wellbeing not only depends on physically obtaining the right amount of nutrition, but as much about consuming *a meal* and being part of a larger social context. (Holm 2003b, Holm & Jacobsen 1990) Relative hereto, Holm & Jacobsen (1990) further found that both the social context and the ability to create *a meal* were strongly dependent on the *eating environment*; the spatial settings and the specific room configuration, as well as the specific dining interior embracing the meal. (Holm 2003 p. 284,293)

Problem Definition

At Aalborg Hospital a small group of doctors, nurses and nutritional staff back in 2008 initiated a project called "MORE". Their goal was to improve the treatment outcome and healing process by focusing more on the nutritional wellbeing of the patients, and by focusing more on the individual needs and desires when eating and having a meal during hospitalization. (MORE 2009) The group initiated nutritional therapy with direct improvement of the food and focused on how to improve the nutritional values obtained by each patient during eating through initiatives of screening, monitoring and developing nutrition plans as well as introducing "in-between snacking". (MORE 2009) The group further had ideas about improving the entire eating situation and patient meal experience, by means of altering the specific eating environment and dining facilities, but this has not been implemented yet partly due to lacking economy, but also due to lacking knowledge on the influence of the eating environment and *how to design* these dining facilities to improve patient meal experiences? (MORE 2010) Despite the above observations made by Holm & Jacobsen (1990) seemingly very little research and scientific knowledge exists on patient dining and designing hospital dining facilities.

State-of-the-art Research

A review of the existing research performed on patient eating, hospital dining interior and the direct relationship between hospital dining interior and patients' nutritional wellbeing show in general very sparse results. Most contemporary research specifies only the direct importance of physical exercise, easy access to fruits and vegetables, and fatty types of foods and in-between snacks as means

to overcome malnourishment from a treatment point of view (Bere & Brug 2009, LEV 1997), or looks directly upon the logistic, educational and administrative challenges of meal servings in hospitals. (Gibbons & Henry 2005, Almdal et al. 2003, Rasmussen et al. 2004) Same research rarely considers nutritional healthcare as a matter ranging beyond the specific food items eaten and patients' nutritional wellbeing. Nor relate to the wider contextual aspects as the eating environment, its inherited social values as seen from the perspective of the individual patient and how to actually design the dining facilities to *facilitate* a good meal experience. This is evident whether studying research based on empirical or hermeneutic methods, and whether we look upon architectural research in general, food and meal science, health science or social science. (Olsen 2008) The meal as a separate concept from the specific food eaten and a precise theoretical definition of how the spatial aspects of the eating environment impact on eating behavior and nutritional wellbeing has not been given much priority, and there is apparently no linking in contemporary research between aspects of hospital architecture or design of hospital dining interior and the eating behavior possibly causing malnutrition among patients. The sparse amount of research existing possibly linking architectural and interior design with meals, relate directly to qualitative and quantitative research on behavioural studies, theories on human interaction, and theories of sociology in general. (see e.g. Holm 2003, Murcott 2009) As well as knowledge on product experience from a consumer and retail point of view (see e.g. Schifferstein & Hekkert, 2008, Desmet & Hekkert, 2007), research on contextual influences in food choice, consumer preference and food acceptability during eating (see e.g. King et al. 2004, Gustafsson 2004, Meiselman 2000, Stroebele & De Castro 2004). Only recently with the introduction of *Evidence-Based Design (EBD)* and *Healing Architecture* have researchers begun arguing the influence of built environment on patient wellbeing and healing processes (see e.g. Ulrich et al. 2004, Frandsen et al. 2009, Zimring & Herd 2008). However, most research in EBD and Healing Architecture focus only on how the latent architectural aspects of the hospital environment like; noise, lack of space, light, ventilation, surface coverings, nature, art, sound, medical equipment possibly influence human wellbeing, as well as medical-related errors ascribed for instance; active failures, mistakes and misunderstandings in medication or surgical procedures, or physical injuries and infections obtained by patients during the healing process. (Zimering & Herd 2008, Ulrich et al. 2004)

The Problem

I find that the specific area of *nutritional wellbeing* and the understanding of the contextual influence of the dining environment on patient eating is overlooked and neglected both in contemporary design research and professional design practice. And it is my claim that a large gap exists in the contemporary knowledge, practice and research on patient healing and hospital design in general. Both research and practice related to hospital design lacks, in my opinion, the understanding of the eating environment; *the foodscape* and how the specific dining interior and spatial setting (room configuration and spatial layout) around eating mediates our behavior and social relations when having *a meal.*

The Hypothesis

The hypothesis of this PhD project is that when our understanding of eating and the aspects shaping the *meal experience* is broadened beyond the specific food item eaten, to further depending on the entire social and cultural context, an important aspect of nutritional wellbeing becomes the specific eating environment; *the foodscape.* Here the *"foodscape"* is to be understood as a holistic perspective on nutritional wellbeing and the meal experience, encompassing both the physical dining environment; the room configuration, the spatial layout, the dining interior, the décor, the furniture,

the tableware and utensils, but also the social, cultural and personal values of eating. It is an environment, a *"scape"*, framing the entire meal and staging the meal experience. With this understanding of the foodscape patients' nutritional wellbeing and healing process can possibly be improved by providing better eating facilities embracing their meals, and the task of *providing* a setting for eating in hospitals becomes suddenly a very different task from consciously and intentionally *designing* a dining facility for having a meal.

Objective and goal

The objective and overall goal of this PhD project is therefore to develop more relevant research and widen existing theoretical perspectives on hospital design with the objectives of *how* architecture and foodscape design possibly can help improve meal experiences and eating satisfaction among hospital patients. And as part hereof furthermore develop a conceptual proposal for design guidelines on future patient dining facilities at Danish Hospitals exemplifying this. Together the research- and design inquiries should contribute to guide future professional practice in "super hospital" design. This motivates the following research question:

The research Question

- *How can the design of dining facilities in hospitals possibly help improve meal experiences among patients, thus indirectly help improve their nutritional wellbeing and overall healing process?*

Epistemological Background

The claim that large gaps exist within contemporary knowledge, research and practice in hospital design is based on the initiate definition of the foodscape and the overall hypothesis that dining interior and eating facilities influence nutritional wellbeing. An **implicit assumption** in this hypothesis is, however, that health and healing processes is linked to both our physical, mental and social wellbeing, and that the nutritional wellbeing is an important aspect of these. That patients' health therefore partly depends on nutritional wellbeing and eating properly, and that nutritional wellbeing is not just a matter of getting the appropriate amount of nutrition and being satiated physiologically. But as much about the social satisfaction and enrolling oneself in a community; showing or articulating a sense of belonging through the concept of *a meal* and its surrounding spatial environment.

With this hypothesis we automatically adopt a particular ontological worldview and a philosophical foundation. We take a very precise epistemological stand, and relative hereto develops a specific set of assumptions about human behavior and how to understand it and the interaction with space. It is a holistic understanding initially based on the findings and theoretical considerations of the study performed by Holm & Jacobsen (1990). Here hospital meal servings are perceived as more than mere nutrition, taking place in larger context and serving higher means than nutritional satiety, and Holm & Jacobsen (1990) specifically emphasize the "forgotten" architectural knowledge on hospital design to create spaces and places for eating and having a meal. And further emphasized how the hospital architecture influenced the children's' nutritional wellbeing by means of social values and feeling at home. (Holm 2003) However, we further lean on existing theories on nutritional wellbeing, food behavior and social interaction derived within respectively food science

and nutrition, as well as sociology and social science who supports the stand of Holm & Jacobsen (1990), and whose empirical studies performed in canteens at universities, schools, in the army and at restaurants across these different research areas show that food preference, food choice and consumer satisfaction are dependent on the contextual environment and social interactions (see e.g. Meiselman et al. 2000, King et al. 2004, Gustafsson 2004, Stroebele & De Castro 2004, Sobal & Wansink 2007).

However, the specific study by Holm & Jacobsen (1990) seemingly pays little interest in the profound understanding of *how* the hospital architecture and dining environment on a design level influence the nutritional wellbeing of the children. They neither theoretically nor practically describe how the specific interior and spatial elements are relevant for achieving this state of social wellbeing and feeling at home, or how they should be shaped to achieve this feeling. *Why does a single grand table work better than small, why does a common central kitchen work better then decentralized units, and*

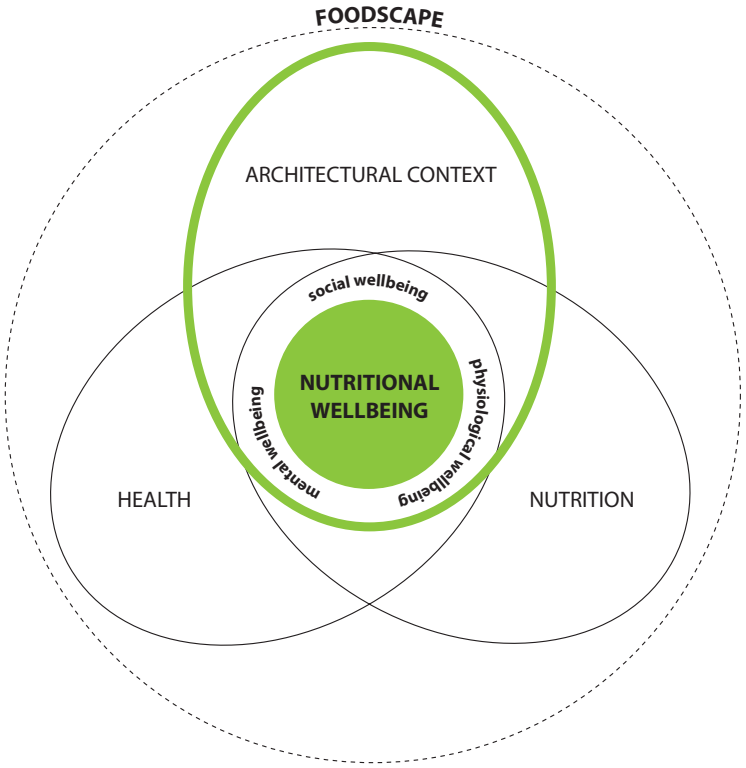

Fig. 1 "A Holistic Viewpoint" Nutritional wellbeing not only depends on eating the specific food item and obtaining the right amount of nutrition, but further relates to the general health, wellbeing and built environment embracing the meal.

why is colored glasses and china better then steal containers? What is the architectural quality in these different elements and how does they relate to the overall atmosphere and social interaction created? Instead of clarifying some of these questions, it seems like the specific interior regulations conducted in the study are based on an intuitive and rather latent basis, not necessarily including any architectural considerations on the practical decisions on the interior and spatial configuration.

As with the study by Holm & Jacobsen (1990), neither the research, the research methods nor the specific studies within nutritional science, sociology and sensory science include in general any theoretical considerations on the specific architecture and *how* the spatial settings or interior design influence our eating environment and meal experiences. I wonder why that is? Because, within architectural theory it is often argued, from a phenomenological perspective, that architectural design is not an isolated matter of built form and spatial configuration, but a sensuous *phenomenon* framing our lives and behavior. (Groat & Wang 2002) Understanding architectural space as phenomena suggest further from a semiotic point of view that the built environment encompass the potential of a "disguised meaning" contrary the obvious function or immediate physical form. (Bek & Oxvig 1999, Peirce 1998) The theoretical importance is relative to patient meal servings that the meal experience is a constructed *phenomenon*, communicating a certain "idea" and "sense of place" through the dining interior and its physical appearance, which can be changed and altered according to specific intentions on food behaviors and creating a social context. This understanding is based on a phenomenological and semiotic epistemological viewpoint as derived by Peirce (1998) and partly supported by for instance Merleau-Ponty (1994) and Hall (1966) where architectural spaces relates to human existence and behavior. But it also relates to aspects of the social science and sociology, where the aspects of human behavior and interaction can help us understand how to design spaces and specific architectural settings to create certain atmospheres inviting for specific social relations. An important knowledge contribution of this PhD project is therefore the development of a theoretical framework reflecting the social and emotional value of space and sense of place in nutritional wellbeing by merging existing theories within social science/ sociology, nutrition and health with architectural theory.

Fig. 2 Theoretical background

Contemporary nutritional research often includes theoretical perspectives of health and sociology, but rarely considers the spatial and architectural aspects.

Methodological Considerations

There are many ways to frame such a research problem and within architectural research we can choose from various quantitative and qualitative methods for gathering information on spatial configuration and human behavior, as well as for analyzing and understanding the qualities of architectural design. (Groat & Wang 2002) The specific pick of research methods and research strategy then traditionally depends not only on the purpose and goal of the project, but often also on the particular research tradition our branch represents and its' inherited ontological and epistemological backgrounds. (Yin 2009) With this PhD project, the purpose and goal is to develop both a scientific body of knowledge for creating a theoretical framework on foodscape design and generating a conceptual proposal for design guidelines on future patient dining facilities. However, as argued for above we do not have any predefined research branch within foodscape design to help define our research strategy and methodological approach. But touch upon a range of affirmed and well established research areas like food and meal science, as well as health and medicine, whose epistemological and methodological backgrounds often stand in stark contrast with the branch of architectural theory and design.

Research Traditions

For instance, historically healing patients at hospitals were a matter of strict surgical or medical treatments, where patients' sickness had a causal objective explanation either being a matter of chemical or physiological dysfunctions. (Gabe & Calnan 2009, Sohlberg 2004 p. 141) A strict division between physiological and psychological aspects of health dominated hospital procedures, and healing processes were often stripped off any healthcare involving subjective or emotional awareness on sickness. (Sohlberg 2004) This understanding is rooted in the logical positivism and a material ontological view on reality, where scientific knowledge is defined as logical, understandable and confirmable, based on an empirical reality separate and independent from any individual subjectivity. (Sohlberg 2004 p. 85) It is a deductive and causal way of reasoning free of any interpretations or speculations, and scientific knowledge can only be verified by mathematical and statistical analysis, quantitatively and numerically verifying the generalizability of the findings. (Sohlberg 2004 p. 84) Not until recently, has research and practice in health and medicine acknowledged that patients' healing process and health possibly can be improved by greater awareness on healthcare involving perspectives of both *physical*, *mental* and *social wellbeing*. And fields of psychology and social science are, as seen from the above study by Holm & Jacobsen (1990), more frequently being included in hospital healthcare to broaden understandings on patients' healing processes. (Gabe & Calnan 2009)

The move from strict medical and surgical *treatments* to patient healthcare and *healing* as a more humanistic or naturalistic process expresses a general shift in the ontological and epistemological viewpoints, and ways of performing medicine at hospitals today. (Sohlberg 2004) However, the EBD researchers performing studies on different effects of the built environment on patient healing processes draw on quantitative research methods to collect empirical data on different environmental variables studied. (Ulrich et al. 2004) They utilize statistics such as; the length of patient stays, the rate of infections acquired during hospitalization, and the number of medication errors to determine whether built form impact on healing processes or not. (Ulrich et al. 2004) Part of the existing research on the meal experience is like the EBD rooted in this modern materialistic ontological viewpoint as well. For instance the research produced within the fields of sensory science,

consumer science and food science. Here research is mainly based on experimental studies performed in laboratories or in controlled eating environments. (Meiselman 2002) Research objectivity is the key goal, and like most surgical and medical research this knowledge rests on a general understanding that every phenomenon can be reduced to measurable physiological-chemical matter; molecules and atoms. (Sohlberg 2004 p. 85)

The opposing stand

Within parts of the nutritional research as well as contemporary design societies arguments exist against the use and implementation of evidence-based knowledge strictly obtained from experimental studies utilizing quantitative research methods like the above performed within EBD, as well as Food Science. Because research objectivity is achieved by systematically keeping any potential bias or interference out of research procedures, the causal knowledge is per definition only available if we are able of handling, controlling and measuring the different variables and nothing unexpected is allowed to dominate or affect the outcome. (Sohlberg 2004 p. 116)

Experimental studies on influences of the built environment both within EBD and research on nutrition and food, often holds the implicit assumption in their quantitative research methods that as long as the spatial settings of each experiment are kept stable, the appearance of physical space is not a disturbing variable. However, from a phenomenological point of view, considering the built environment as a "single collective variable" strongly interferes with the complex understanding of architectural space as phenomenon. Relative to the theoretical considerations above, architectural space is from a hermeneutic point of view strongly influenced by various cultural and contextual aspects; being a phenomenon and choreography of elements *together* forming a setting, a specific atmosphere and a certain behavior, and involving various subjective and emotional values. (Sailer et al. 2008, Bek & Oxvig 1999) Architecture is a *"gesamtkunstwerk"* and can therefore not with its complex composition be ignored in the empirical investigations, but must be considered as the complex combination of a series of dependent variables it is. Architecture is both built form and a specific space, but it is also atmosphere, "idea" and a certain sense of place. (Norberg-Schulz 1965, Tuan 1977) Trying to deduce these elements from each other and evaluate them one by one like in the experimental studies of EBD and food science ignores the system of the whole, and the impact of the built environment and sense of the architectural space will possibly affect and disturb the findings of the experiments. The architecture will start acting as a set of confounding variables in itself. (Sailer et al. 2008) The result is simply influenced by too many elements, and the specific information needed is a complex mixture of latent and unconscious knowledge. (Sailer et al. 2008) With the strict positivist approach and the quantitative research methods we risk losing the significance of the architecture, lose the meaning, intent and emotional effect. But we also risk losing the aspects of validity in the research methods themselves. Because the more complex the problems and experiments are, the more complex the human interaction are, the more difficult it becomes to operationalise and keep disturbing variables constant, and thus be able to generalize the findings. (Sohlberg 2004:118) It can therefore be argued that the existing empirical studies in general lack the ability to take into account not only the personal, social and cultural values, but also the **architectural values** of experiencing, perceiving and reading space. Opposing stands therefore often affect not only the methodological approach of quantitative research, but the entire ontological basis defining how to read, analyze, and understand the architecture and the built environment. (Groat & Wang 2002 p. 25-29, Sailer et al. 2008)

Providing a "thick description"

The above opposing way of thinking is based on a holistic ontological viewpoint where multiple realities exist, rather than just one single. Here individual ideas, language and perceptions cannot be separated from the outside world, and individuals create their own subjective realities. (Sohlberg 2004) It is an ontological viewpoint belonging to the naturalistic tradition and an important epistemological difference is that the "knower" and "knowledge" are interrelated and interdependent; that research methods therefore naturally incorporate subjective reasoning and interpretation from the researcher. (Sohlberg 2004) Contrary the positivist research tradition, this means refining the understanding of building scientific knowledge and acknowledging qualitative research methods like; interviews, participant observation and focus groups, together with hermeneutic interpretations and quantitative research methods to obtain empirical data and achieve as nuanced and precise a picture of human behavior as possible. (Filstead 1970, Sohlberg 2004) Building scientific knowledge and performing research thereby becomes a matter of achieving; *credibility*, *transferability*, *dependability*, and *confirmability*, rather than *internal validity*, *external validity*, *reliability*, and *objectivity*. (Groat & Wang 2002 p. 35)

Most important is that the idea behind the research criteria *credibility* similar to the positivist *validity*, should establish "truth value" by taking into account the natural complexities inherited in the specific situation studied. (Groat & Wang 2002:38) Methodologically this is mainly achieved by building a *"thick"* set of descriptions using a variety of information sources, multiple investigators, and/or a combination of research methods, in order to cross-check information and interpretations, as well as to insure a systematic and transparent process verifying the neutrality, consistency and applicability of the knowledge developed. (Geertz 1973, Groat & Wang 2002) In our specific case for instance the mixture of theoretical observations with different empirical observations, and the mixture of qualitative and quantitative knowledge.

However, because the hypothesis and the existing theoretical framework is based on both empirical and theoretical knowledge ranging across very different research fields, we balance many different kinds of information and types of knowledge. We therefore need an overall research strategy and methodological approach allowing for a combination of the narrative and non-numerical values, as well as hermeneutic perspectives together with existing empirical and quantitative measurements within the cross-disciplinary area of the foodscape.

The Research Strategy

In western research cultures we traditionally distinguish between two primary research strategies; the deductive approach or the inductive approach. The inductive approach builds on a bottom-up research strategy utilizing empirical information gathered either quantitatively or qualitatively to describe or predict rules to a specific phenomena and on this basis develop a hypothesis and build theory. (Groat & Wang 2002) The deductive strategy on the other hand builds on a top-down approach utilizing quantitative or qualitative research methods to verify an already existing theory and its hypotheses. (Groat & Wang 2002) As mentioned above, no specific research tradition is yet built on the matter of foodscape design, and there are as such no predefined theory or research methods to pick from in our specific case when building scientific knowledge to support the hypothesis and answer the research questions. We can therefore not engage in an overall deductive research strategy seeking empirically to verify an existing theory. But, we must build on top of the

existing research and the empirical inductive investigations already existing within healthcare, sociology as well as food science and nutrition, as performed by for instance Holm & Jacobsen (1990). We must continue the *inductive strategy* towards the building of a theoretical framework, and then use this theory in a *deductive manner* to establish a set of design guidelines on future patient dining facilities.

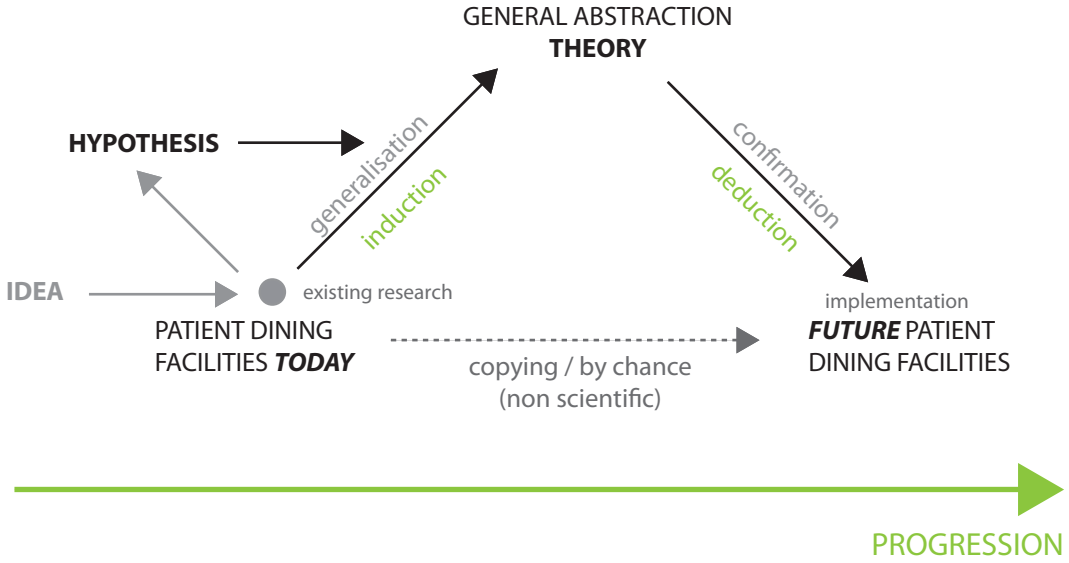

Fig. 3 Research Strategy

The idea of the foodscape developed out of a general wonder about the relationship of architecture and food. Then on the basis of a review of existing research the hypothesis developed. Because no contemporary theory exist supporting the hypothesis we must build a theoretical framework to be able in a scientific manner to argue for how to design the future patient dining facilities. (model by inspiration of Brodersen 2007)

Developing a theoretical framework

According to Yin (2009), a possible more humanistic validity-seeking methodology to build such a theoretical framework is the specific approach of the case-study. The case study in his terms gives the ability to understand and analyze a real-life phenomenon and its contextual conditions in depth without manipulating relevant behaviors. (Yin 2009 p. 18) This ability is based on the case study's' unique capacity as a research design to deal with a full variety of qualitative and quantitative evidence *together*. (Yin 2009 p. 11)

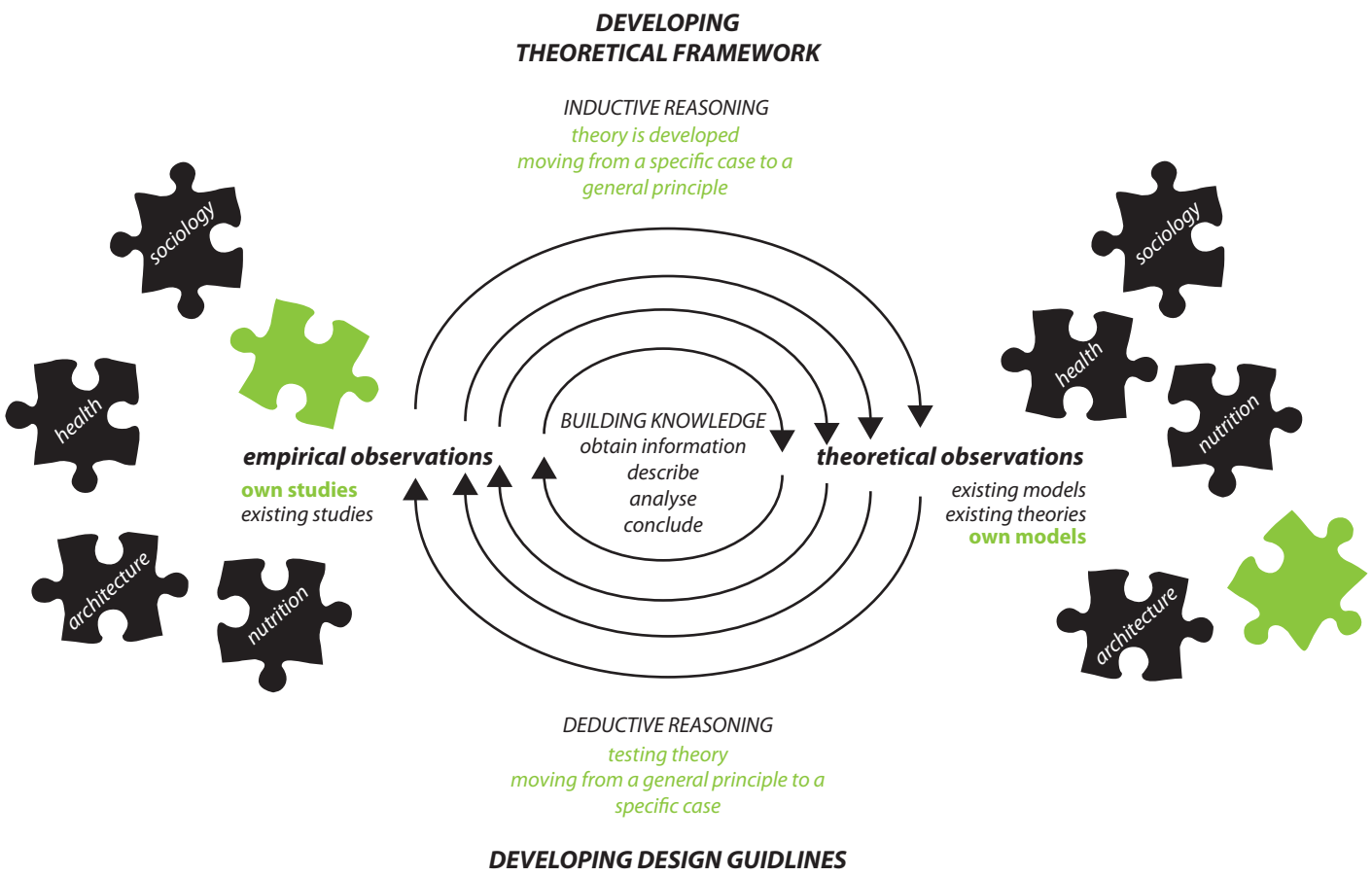

Fig. 4 Developing a Theoretical Framework

Developing a theoretical framework merging knowledge from distant research areas and utilizing different qualitative and quantitative research methods demands a research strategy encompassing a combined inductive and deductive way of reasoning allowing the various kinds of knowledge to support each other and build scientific evidence together.

The case study

The case study approach utilizes in a triangulating fashion the information gathered with different research methods to establish a strong chain of evidence or the "thick description", together supporting the theory from multiple sources. (Yin 2009 p. 18) However, according to Yin (2009 p. 18-19) the case study and its research methods benefits from the prior development of a theoretical proposition to guide the data collection and analysis process, otherwise too complex for survey or experimental strategies. In our case that means that to be able to build a theoretical framework using the case study approach, it is essential that we develop an initiative theory as part of the overall research design, so this can work as a guiding tool for how to perform further studies to verify the general theoretical framework. The initiative theory is meant as a hypothetical story about why acts, events, structure and thoughts occur, and the result is according to Yin (2009 p. 38), that the theory development not only facilitates the empirical data collection phase of the case study, but further provides the level of generalization. This is by Yin (2009) characterized as analytical generalization as opposed to statistical generalization ordinary used within the positivist research tradition, and can be described as an ongoing circular process. The point is that within our research process we continuously move between a deductive and inductive process; from a theoretical level of knowledge establishing a general set of guidelines or hypothesis on why and how built environment influence the nutritional wellbeing of patients, to testing the hypothesis empirically on the hospital dining facility. The theoretical knowledge is then used as a practical template on how to gather empirical information in the specific field studies, but also on how to compare the empirical results from different sources. (Yin 2009 p. 38)

Research Design

From figure 5 we see that answering the hypothesis and research question is based on an overall deductive research approach, building a theoretical framework and developing a conceptual set of design guidelines, based on both hermeneutic and empirical investigations and utilizing qualitative, quantitative and interpretative research methods. The purpose of the specific methodological design is to gain as much insight and knowledge as possible on how the architecture and design of the patient dining facilities influence the nutritional wellbeing and healing process of the patients. However, investigating the experience of eating and built environment is a very complex task including various known and unknown emotional dimensions to consider. Therefore a multilayered methodological approach obtaining knowledge from three different kinds of "observation"; *theoretical hermeneutic observations*, *empirical qualitative observations* and *empirical quantitative observations*, are chosen within the overall frame of the case study as means to capture the character and atmosphere of the eating culture, the personal and social affiliations as well as the architecture. Together these three kinds of "observation" utilizes three different levels of information or "knowledge"; *descriptive*, *analytical* and *explanatory* knowledge. Each of the three levels of information represents different levels of abstraction which cannot be compared across the different levels, as they represent different kind of knowledge. But different situations providing same levels of abstraction can be compared. If two or more cases show to support the same theory, then replication may be claimed, and the empirical results may be considered yet more potent if two or more cases support the same theory but do not support an equally plausible rival theory. (Yin 2009 p. 39) In our case that means, that when approaching the specific research question and the specific sub-questions we should be aware to gather information and

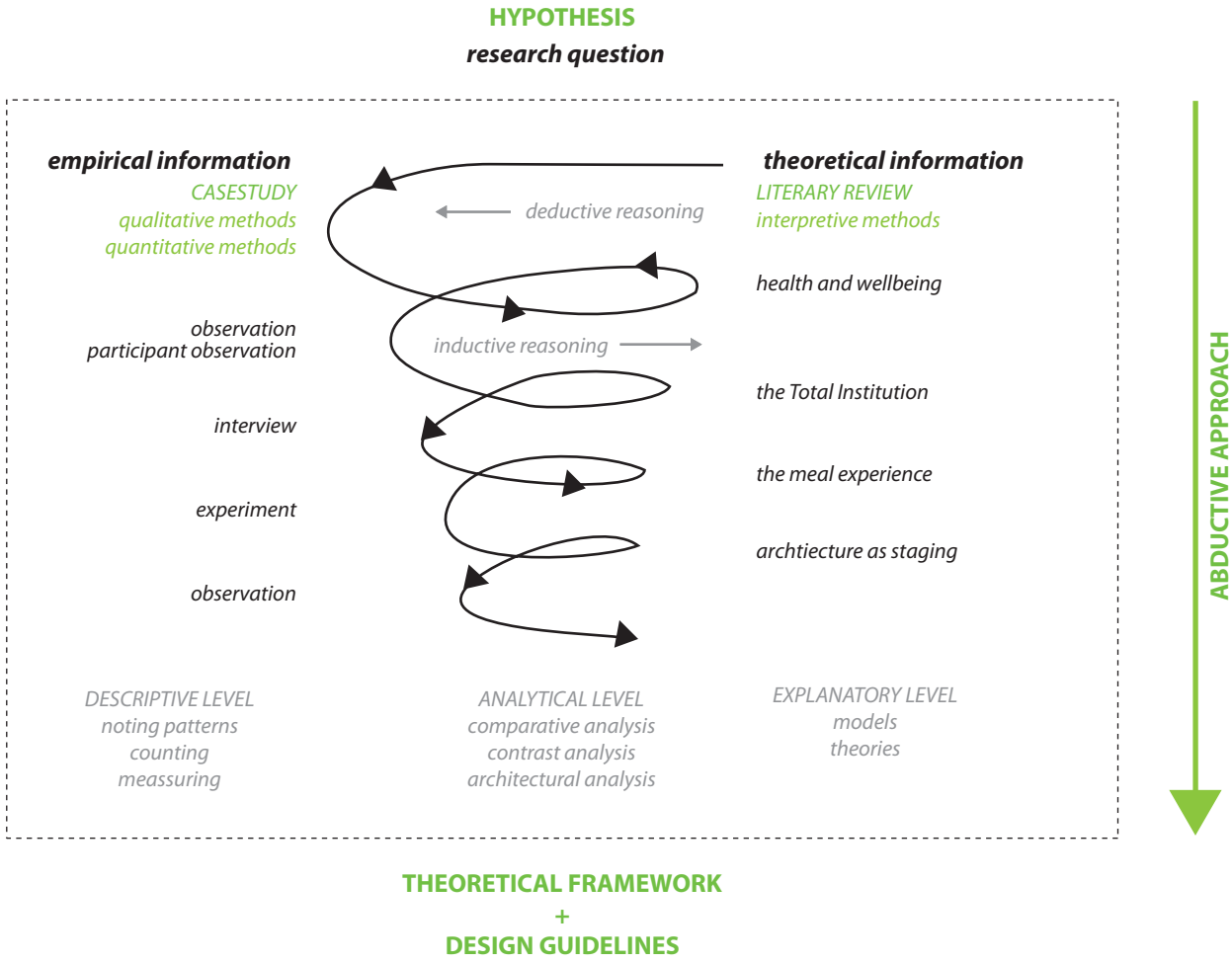

Fig. 5 Methodological Approach

The overall research strategy is moving from the hypothesis to a general theoretical framework, and then towards a specific set of guidelines for how to design future patient dining facilities. It as such utilizes a combination of inductive and deductive reasoning.

build knowledge on the basis of various sources and by means of various methods to perform a hermeneutic triangulation and cross-check our findings.

The empirical studies

The empirical investigations are used in two levels throughout the research process; as *explorative studies* taking their point of departure in the specific case of the project MORE at Aalborg Hospital and the current challenges on patient eating at the department of infection medicine, and as *comparative studies* gathering insights from *similar* and *contrasting* dining environments. The empirical studies are chosen first of all as means to unfold evidence-based in-depth understanding of *how* patients today use the spatial environment when eating and the goal is to be able to identify if certain patterns exist within different types of interiors and spatial configurations, as well as if different settings mediate different behavior and social interaction when eating. The specific qualitative research methods have been chosen as mean seeking together an in-depth account of the social context and insight in the dining behavior. The qualitative methods are primarily used for information gathering to build the theoretical framework and support the hypothesis, whereas the quantitative methods are primarily used to support the qualitative findings and verify the effect of the spatial and interior changes during the experimentation studies. The architectural registrations and spatial analysis are meant as both comparative studies on the knowledge derived, as well as inspirational studies on best-practice for developing an actual design proposal.

The theoretical studies

The purpose of the historical and interpretative studies are the unfolding of existing evidence-based and hermeneutic theory on cultural, sociological, nutritional and aesthetic aspects of built environments impact on human eating and meal behavior. The studies take their point of departure in main theories on healing architecture and meal experience investigating implicit and explicit ways built environment impact, form and interact with its actors when eating, as well as understanding how nutritional wellbeing and health are formed through meals and spatial settings. As part hereof further studying perception and language of space and foods experienced through the bodily encounters, time, culture, social relations and personal affiliations. The purpose of this is providing as "thick" a description as possible, because to achieve transferability within interpretative and qualitative research we must provide a "thick" description of the context, so that similarities can be drawn to other situations. (Groat & Wang 2002 p. 38)

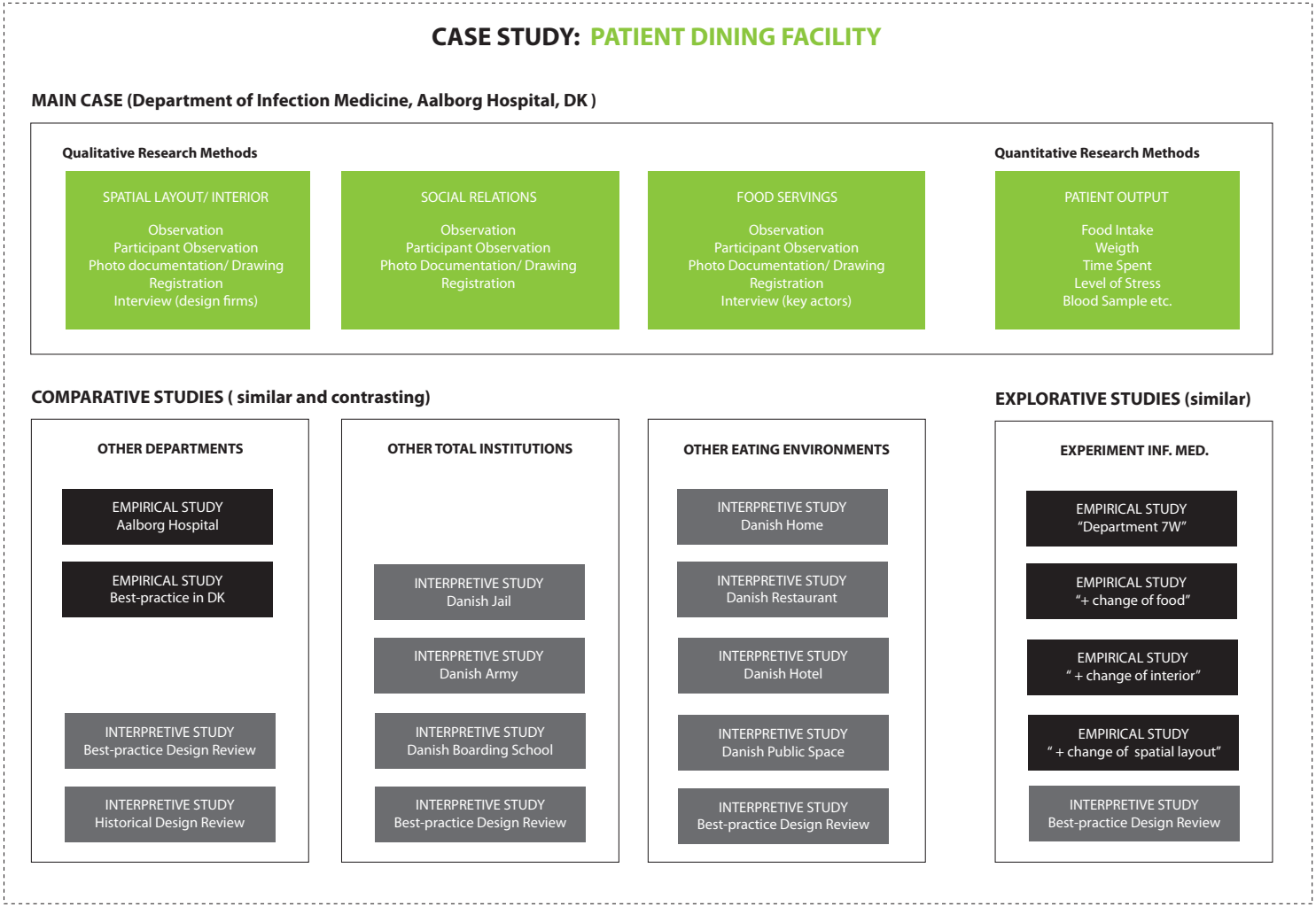

Fig. 6 Case Study Design

Embedded case study utilizing mix method approach

Concluding Perspective

Throughout history, performing research and building scientific knowledge has been described as a systematic and transparent process, developing hypothesis and testing theories. (DePoy & Gitlin, 2005 p. 4) Research is as such often described as a systematic set of ways of thinking and acting, and understood as a strict system of knowledge with distinct vocabularies to be learned and used to be able to both verify and communicate ones findings to others. Traditionally we say that the research design is supposed to represent a logical set of statements, which quality can be judged by the ability to achieve *construct validity, internal validity, external validity and reliability.* (Yin 2009 p. 40) As a researcher we need to be able to adopt these ways of thinking, developing and validating knowledge as well as transmit our knowledge into a system of inquiry, because the validation of scientific knowledge is build on the explication of how and on what basis the knowledge claim is made. (Groat & Wang 2002 p. 39) With this specific paper we were therefore asked to reflect on the kind of knowledge we contributes with to research and practice in general as young researchers, through an explication of how information and knowledge is obtained and asserted throughout our research process. And through a reflection on our overall research question, its' inherited ontological and epistemological backgrounds, as well as the specific methodological consequences the specific choice of research strategy and research methods had on our process of gathering, documenting and analyzing information, as well as building scientific knowledge.

With this specific PhD project we on the basis of the problem definition developed a hypothesis and implicit assumption that patients' nutritional wellbeing not only relates to eating, but is influenced by the entire meal experience and the surrounding dining environment. This PhD project thereby adopts an obvious phenomenological understanding of human existence and behavior, where we ascribe significance to spaces, form and objects we encounter – whether it being hospital architecture, patient dining interior, tableware or the specific meals – and does so on behalf of our bodily and sensuous contact, together with our inherited social and cultural norms and values. This phenomenological understanding contradicts a bit with the existing research within nutrition, health and hospital design. And because we in this PhD project as such touch upon a possibly new and interdisciplinary research area within foodscape design, which not already encompass a specific set of research methods and research strategies, we challenge the contemporary *knowledge* and *methodology*, as well as the prevailing *design practice* on patient dining facilities. The main ontological, epistemological and methodological importance for this project is therefore the divergence from the positivist research tradition within food science, nutrition and health into a naturalistic inquiry, where the legitimacy and value of many distinct types of knowledge, ways of reasoning and gathering information are recognized as valid ways to build scientific knowledge.

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9. Enabling communication and supporting the creation of shared frames in interdisciplinary teams working in the early phases of innovation

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Timeline: 01.10.2006 – 30.09.2009

Keywords: Architecture, Design Process, Sustainability, Simulations, Building Information Modeling

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Project/chapter	Theory input	Methodology	Epistemology
Enabling the creation of Shared Frames in Interdisciplinary Teams working in the early phases of innovation	Creative – and Engineering Design Theory, Innovation Management Theory, Framing and Communication Theory	LEGO Serious Play Workshops, Video-documentation, Action Research, Interaction Analysis	Social Constructivism

Research Questions:

1: How can the creation of physical artifacts enable and stimulate the communication between team members, users and stakeholders in interdisciplinary teams working in the early phases of innovation?

2: How can the creation of physical artifacts enable and support the creation of shared frames within interdisciplinary teams working in the early phases of innovation?

Methods:

The initial idea in this research project was to introduce the creation of physical artefacts in interdisciplinary design teams working in the early phases of innovation. The inspiration for this derives from the later parts of both design- and innovation processes, where models and prototypes are often used to support communication, to test possibilities and compare ideas etc.

The creation of physical artifacts was seen as a way to create a shared reference point between the different perspectives and thereby create a point of departure for a shared project framing. A second reason for introducing the creation of physical artifacts in early phase projects was to help the team members, users and stakeholders to overcome the boundary of not being able to express, what they find meaningful in relation to the project or how they make meaning of their everyday activities.

However, there were a number of demands, which had to be fulfilled in order to introduce the creation of physical artifacts in the early phases of innovation:

• The requirement for creating the physical artifacts has to be kept at a minimum in order to involve as many relevant users and stakeholders as possible (since it is not given, that everyone in the interdisciplinary team or among users/ stakeholders has modelling-experience).

• The creation of the physical artifacts has to handle a great diversity in terms of different backgrounds and assumptions as well as kinds and levels of knowledge. And it has to contain both the complexity and ambiguity, which may appear in relation to the project.

• Finally the creation of the physical artifacts has to involve a shared experience or shared output – in order to build on the insights from previous research, in which 'sharing' is identified as an important tool to handle diversity, complexity and ambiguity in teams.

The first process, which was tested as a possible way to create physical artifacts in interdisciplinary teams working in the early phases of innovation, was a consultancy process for business and organizations called LEGO Serious Play™ (henceforth: LSP).

LSP seemed to fulfill the demands described above, and it was directly accessible in this study. However, LSP was not directly adopted. Since it was mainly developed to a business context, it was found necessary to develop a new set of LSP variations, which could be used in projects positioned in the early phases of innovation. This was done by adapting and also further developing some of the main features of the original LSP based on the insights from creative design.

In the following sections, the original LSP will be reviewed in terms of development, background as well as key features. After this there will be a review of, how the design perspective was used to further develop LSP and to make it applicable to projects in the early phases of innovation.

Lego Serious Play – development and background

LSP is often described as an accidental spin off from LEGO Group. David Gauntlett (2007) explains the development of it as follows: Lego Serious Play developed out of a problem within the Lego company itself.

(...) In 1996-7, Kjeld Kirk Kristiansen [owner of Lego and grandchild of its founder] was feeling disappointed that his staff meetings did not seem to be able to generate imaginative strategies for the future of the company. He knew that his employees were talented people, and so felt that some kind of tool was needed to unlock their imagination and creativity. During this time, he had discussions with Bart Victor and Johan Roos, both professors and consultants from the Swiss Business School IMD, who had seen this kind of situation elsewhere. Together they realized that a solution to Lego's problem might be found in the Lego product itself: just as had been telling children to 'build their dreams' for decades, so perhaps adults could be asked to 'build' their vision for future strategy. (p. 129)

According to its developers, LSP is based upon four theoretical directions, which are referred to as 'The Science of Lego Serious Play'. The directions are: 1) Constructivism 2) Constructionism, 3) Play and 4) Imagination (Lego Serious Play, 2006). In figure 1.1 there is a brief review of the four directions.

Constructivism and Constructionism:
The notion of constructivism is developed by Jean Piaget and concerned with how learning takes place – especially for children. Piaget discovered that information and knowledge is not just absorbed, but actively built into knowledge structures. This means that incoming experience is combined with previous experiences into a set of active theories (Gruber & Vonéche, 1977). Seymour Papert extended the constructivism theory into what he called Constructionism. Apart from the building of knowledge structures, Papert argues that learning happens especially when engaging in creation of physical objects – for example with clay or Lego bricks (Papert, 1993). Papert's theo¬ries are often referred to as 'thinking with your hands' or 'learning by making'. Furthermore, Papert noticed that when people are making something with their hands, they are in a more deeply engaged state, compared to situations where they are solving abstract questions in their mind. This deep engage¬ment, which Papert noticed, is what Mihaly Csikszentmihalyi later defined as 'flow'.

Play and Imagination:
Play is often associated with children; however, a growing literature is encour¬aging adults to engage in play as well. It is argued that surprising insights and innovative ideas are more likely to occur in playful environments and through playful behaviour (Terr, 2000; Schrage, 2000). In LSP play is defined as:
(...) a limited, structured and voluntary activity that involves imagina¬tion - that is an activity limited in time and space, structured by rules, conventions and agreements among the players, (...) and drawing on elements of fantasy and creative imagination. (Lego Serious Play, 2006:4)
Imagination is seen as a central part of playing. Imagination can be divided into three categories: descriptive imagination, creative imagination and chal¬lenging imagination. Below, these three categories are defined:
Descriptive imagination not only reveals what is happening in the often confusing world out there, but it enables us to make sense of it and to see new possibilities and opportunities (...) Creative imagination allows us to see what isn't there. It evokes truly new possibilities from the com¬bination, recombination or transformation of things and concepts.(...)
Challenging imagination, often using deconstruction or sarcasm, over¬turns all the rules and wipes the slate clean.
(Lego Serious Play, 2006:14-17)
Especially 'creative imagination' is seen as a central part of playing, in gen¬eral. However, in relation to LSP the 'descriptive'- and 'challenging imagina¬tions' have significant roles, too.

Besides the role of imagination, it is further argued that when adults are play¬ing, it also involves 1) social bounding, 2) emotional expression 3) cognitive development and 4) constructive competition.

Figure 1.1: The theoretical background or 'Science' of Lego Serious Play

Today LSP has been developed to cover a range of applications and is used in various situations and industries. Some of the applications are reviewed below.

• *'Real Time Strategy for Enterprise' – a sequence of activities in which participants build metaphorical models representing their organization and then combine these into a shared identity of the enterprise; then build 'agents' (any external entity which the organization may have to connect or deal with) and place these in a landscape in relation to their main model; then build different kinds of connections; then consider future scenarios; and ultimately arrive at 'Simple Guiding Principles', which emerge from the activity and help to make future decisions.*

• *'Real Time Strategy for the Team' – a version more oriented towards teambuilding, in which participants begin by constructing models representing what they bring to the organization; then create a part of an identity perceived by colleagues which they have not included themselves; then they are asked to review what has been built so far and to build a model representing 'the feel of the team'; then to build connections showing how the parts of the team relate; then to reflect on the past ways of dealing with events to ultimately arrive at 'Simple Guiding Principles' for the team.*

• *'Real Time Identity for You' – a simpler process in which individuals build a metaphoric model of their identity at work, then change it to show how they think they are perceived and then again to represent an aspirational version, 'what you could be at your best', and to reflect upon the differences.*

(Gauntlett, 2007: 135)

For more information about LSP's history and development please see the Lego Serious Play homepage (seriousplay.com), Imagination Lab (imagilab.org/research) or the book: 'Creative explorations – new approaches to identities and audiences' (Gauntlett, 2007). However, be aware that some of the suggested material is marketing material and not research-based communication.

Key features

In practice, LSP is a facilitated workshop, where participants are asked different questions in relation to an ongoing project, task or strategy. The participants answer these questions by building symbolic and metaphorical models of their insights in LEGO bricks and present these to each other. An essential part of the LSP is the non-judgemental, free-thinking and somehow playful interaction between the participants (Gauntlett, 2007).

A LSP workshop is divided into four parts. First part is the introduction or 'skills building', where the participants become familiar with the Lego pieces and the democratic process of building and presenting, as well as some of the key features like the hand-mind connection and the use of symbolic/metaphoric models. The next part is modified or tailored to fit each project, situation and context, in which it is used. This part often holds a sub-session where the participants first build a number of individual models and present these to each other; this is followed by a sub-session where they build these models together into one shared model. And finally, there is a reflection and summary of the workshop in relation to the participant experience and the future work. This is also illustrated in the figure on next page:

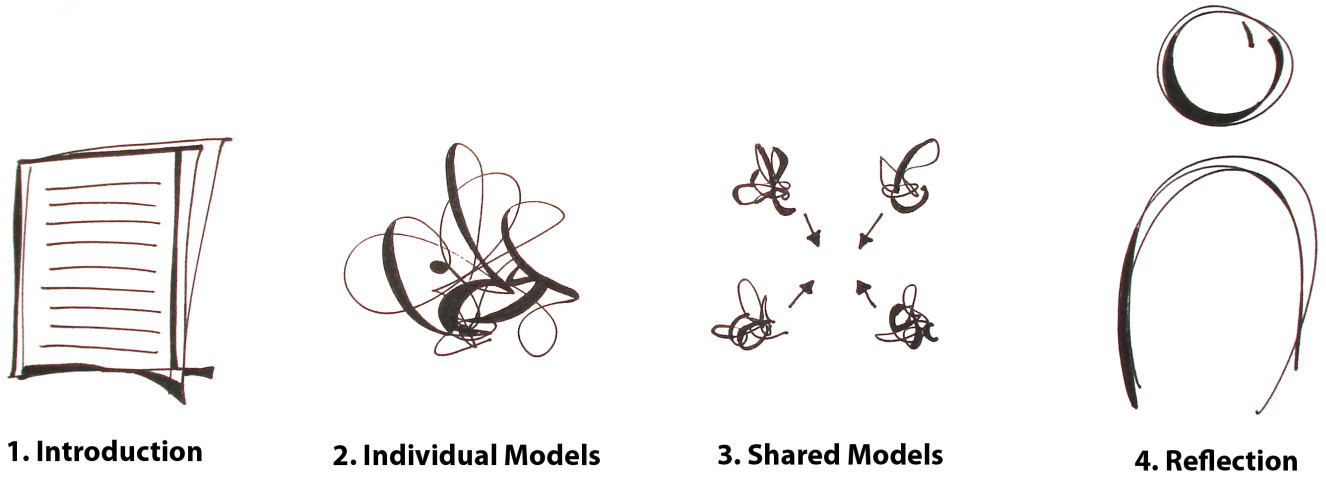

Figure 1.2: The four parts of the LSP workshop

LSP can be seen to have similarities with a shared framing process, as described by Hay et al. (2007). First, the objective of the workshop is set, based on the present understanding of the project, task or strategy (pseudo frame setting), and the facilitation of the workshop is adjusted to fit this. This is often done by the facilitator and the project manager a few weeks before the workshop. Then, in the workshop (after the introduction/skills-building) each participant builds an individual model, which represents their personal view on a question in relation to the project, task or strategy. When presenting this individual model, they are making the insights and perspective from their personal model explicit to the other participants (individual meaning making made explicit). In the next step of the workshop, participants are asked to build the Lego models together. In this process they are free to select one a few or all the models – and even to build new models – to be built together, as long as everybody in the group agrees that it is a shared model. In so doing, the conflicts between the different individual models becomes salient (conflicts made salient) and a shared model is created (common frame negotiated). This is also illustrated on next page:

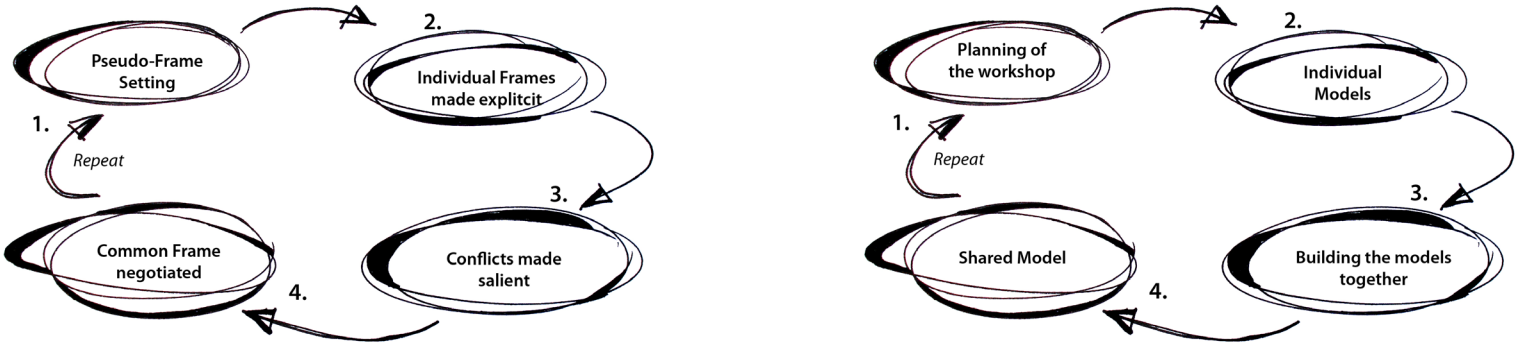

Figure 1.3: The LSP workshop as a simulation of a shared framing process.

Another important key feature in LSP is that each participant has equal opportunity to express his/her feelings or ideas and become part of the outcome, which emerges during the workshop. This means that the facilitator strives to give each participant the necessary time to explain the individual models as well as the opportunity to become part of the 'building together' process. This is for instance done by controlling the line of speakers, when the individual models are presented and by asking clarifying questions about the models. In the 'building together' process, this may be done by making sure that only one discussion is happening at a time and by reminding the group that everyone has to agree on the decisions taken in relation to the shared model.

Another important feature of LSP is that the facilitator (consultant) is not providing 'the solution' to the project, task or strategy or 'the answer' to the questions. Instead, the facilitator is concerned with the interactions between the participants, the coordination of the assignments - and the time.

Further development of Lego Serious Play

When this research project was initiated, there was no specific application of LSP, which could be used in the early phases of innovation. Therefore, the main focus in the first part of this research project was to design such an application. After some preliminary tests, it was found necessary not only to design one, but two different LSP applications, which could be applied in two different stages of the early phase projects. The first application was only intended for the interdisciplinary team to be used as a help to create a shared (and perhaps pseudo) framing of the project. The second application included the interdisciplinary team as well as stakeholders and users, as a means to help the

interdisciplinary team to understand users' and stakeholders' perspectives on needs, problems and opportunities in relation to the project. The first application was called the team application, and the second one the stakeholder application. The reason behind the creation of two applications was mainly to keep the time frame of a single workshop down to maximum 8 hours (with breaks) – and to be able to suit different projects in terms of their development. The creation of the two new applications was accomplished by adapting and further developing some of the original features of LSP combined with insights and understandings derived from the creative design.The first perspective from design, which influenced the team application, was the designerly understanding of problems as wicked and ill-defined. In other words, it was assumed that the initial project descriptions in early phase projects were ill-defined and that the problems to be approached were wicked. In the team application, this can for instance be identified in the workshop questions. The workshop questions were often open-ended and asked in order to ascertain, whether participants had the same understanding of the project focus. An example of a question from one of the team workshops was: *What is a Medical Treatment House?* Another way to identify it was that even though many of the project managers asked for it, their workshop was never initiated by a presentation of the project, because this could indicate that there was one 'right' problem understanding or one 'right' solution. Another feature from design influencing both applications, but especially the stakeholder application was human-centeredness. This can be identified in different ways in the workshop. First of all, a broad set of stakeholders and users participated in these workshops. Secondly, the questions were often related to the users' and stakeholders' understandings and meaning making in relation to their everyday life. An example of a question from one of the stakeholder workshops was: What are the challenges in a professional guitarist's life? A third perspective from design, which influenced the stakeholder application, was the co-development of the understanding of the problem parallel with the development of the solutions. In the stakeholder application, this is for instance identifiable in the combination of the questions, which included a question (or set of questions) with focus on the present problems and challenges, and a question (or set of questions) with focus on ideal solutions or future opportunities.

Besides the influence from creative design, both the team – and the stakeholder application include all the key features of LSP such as:

• The four parts (skills-building, individual modelling, building together, and reflection).

• The democratic understanding of the process with equal opportunity to express insights, and

• The facilitator's focus on the interactions, assignment, coordination etc. in relation to the workshop – and no interference with the content of the workshop.

The two new applications can also be summarized as follows:

• The team application – a sequence of activities, where the partici pants in the interdisciplinary team reveal their different perspectives, perceptions and assumptions about the project by building individual models as an answer to an open-ended question; then, the participants combine these into a shared model of the project. And together they figure out what is necessary to approach first, in the shared model. Ultimately, the workshop concludes with a reflection on its impact in relation to the project and the future development of this.

• The stakeholder application - a sequence of activities, where the interdisciplinary team together with key stakeholders

and users construct different individual models. First the individual models are asked to tell something about the main problems or challenges the users have (or are assumed to have) in their everyday activities or life, in general. Then the participants build an individual model, which represents the ideal solution or future opportunities. Finally, all the different models are combined into a set of 'guiding principles' or 'design principles' for the project – with respect to the user. The workshop is completed by a discussion of the outcome in relation to the project and in relation to the users' and stakeholders' experiences.

Research approaches, which inspired the research design

Since LSP is such a significant part of the situation in which the research material is collected in terms of the workshop set-up and conduction, the research design also has to be suitable for the perspectives and understandings underlying LSP.

Action Research

In the review of different research approaches, Action Research was identified as the most appropriate approach. First of all, because Action Research makes room for the researchers' intent to change a situation. Or as Raelin (1999: 16) expresses it: *Action research, itself, constitutes a process wherein researchers participate in the studies both as subjects and objects with the explicit intention of bringing about change through the research process.*

In this research, the intention to change the situation can be seen as the intention to enable the communication of personal meaning making and creation of shared frames within the interdisciplinary teams participating in the workshops, and thereby supporting their collaboration and development of their project.

Secondly, Action Research was identified as an appropriate approach because it echoes the democratic understanding embedded in the LSP workshops and is consistent with LSP's aim to give the participants equal opportunity to express their insights. In Action Research projects the striving for democracy is based on different backgrounds and with different aims, however:

Making (...) cooperation transparent is a big challenge to any Action Research Process in order to give it democratic legitimacy, but also in order to anticipate democratic structures in the field of society, where the researchers and scientists are involved. (Nielsen & Nielsen, 2006:81)

And finally, Action Research was selected because the role of the Action Researcher often takes the form of a facilitator or learning coach. In this dissertation, this extension of the typical researcher role into a facilitator happened both in the form of planning, running and moderating the workshops. However, the role of the facilitator was always in accordance with LSP understanding of the facilitator, and the basic idea that the significant knowledge and insights are not in the hand of the facilitator/researcher, but in the hands of the participants. And accordingly, that the attention of the facilitator is on the process and not on the content.

In the planning of the workshop, this means that the facilitator plans the different activities and questions to be asked in the workshop based on a conversation with the project manager. In the workshop, it means that the main role of the facilitator is to present the assignments to the participants and moderate the presentation of the models, which are built on the basis of the assignments, but not to interfere with the content of the models as such. And finally it means that, in the last part of the workshop, where participants are asked to build their models together, the researcher's role is mainly to observe. Sometimes the

participants might ask practical questions like 'How much time have we got left?' or 'May we add new bricks?' These questions are all answered, if possible under the parole: 'If you all agree on it, then that is fine'.

The only time the facilitator interrupts the 'building together session' is 1) if the participants speak all at once, 2) if two different discussions are happening simultaneously or 3) in situations where one of the participants is speaking for more than five minutes or about topics outside the assignment.

Interaction Analysis

In the development and facilitation of the workshops Actions Research was of great inspiration in terms of clarifying the engagement with the situation and the workshop participants, as well as defining the role of the researcher. However, for the analysis of the research material, the descriptions and recommendations from Action Research did not seem as thoroughly developed and described in detail. Therefore it was decided to take inspiration from Interaction Analysis, and use this as the basis for analysing the data.

Interaction Analysis (Jordan & Henderson, 1995) is an interdisciplinary method for investigating interactions between human beings and objects in their environment based on video documentation. Interaction Analysis is developed on the basis of several fields including ethnography (participatory observation), sociolinguistics, ethnomethodology, kinesics, conversation analysis and ethnology.

First of all, Interaction Analysis was selected because of its documentation style. By video-taping the workshops, the distinction between the role of the facilitator and the role of the researcher was made very clear. In the workshop it was facilitator, when watching the video it was researcher. A second reason for selecting Interaction Analysis was that it assumes that knowledge is social in origin and can be found in people's interaction with each other and their environment. This understanding of knowledge was in accordance with the understanding of knowledge in LSP, which sees knowledge as constructed and learning as something that happens especially when engaging in creation of physical objects. And finally Interaction Analysis was selected because its main assumptions are that verifiable observation provides the best foundation for analytic knowledge, and that the theories built in Interaction Analysis are accountable to its evidence. This resonated very well with the understandings behind this research project.

Many understandings and approaches from Interaction Analysis have been taken directly into the research design of this study. However, it was decided to reduce the collective analysis, and strengthen the individual analysis, in order to enable a focus on the process and on the single models' development throughout the workshop.

Typically, Interaction Analysis can be described in a number of steps. First, the main researcher creates a content log of the video material in order to make the data easier to access. Then, several researchers with different insights and perspectives are collectively viewing data and initiating the analysis of this by stopping the video-tape and discussing the incidents, which they find interesting. Finally, the main researcher unfolds these incidents by comparing the other researchers' discussions with the data – for instance in terms of transcribing the incidents or making a detailed analysis.

In this study, the main researcher's initiating analysis was more in-depth. This means that the data shared with other researchers was more categorized and prepared. In the initial analysis of the workshops, all the video-documentation from the workshops was uploaded in the video analysis program called ATLAS.ti. After this a content log of the material was

made, which showed who was speaking at what time; about what etc.

In the process of creating the content log, it was found that some of the models played a significant role in the workshops, and these were therefore traced throughout the workshops.

The presentations, discussions or questions related to each of the significant models, which were found in the process of tracing, were transcribed and translated into English and then positioned in documents along with the pictures of the models. The outcome of the initial analysis was a number of documents, which held descriptions of events, pictures and transcriptions along with some small video clips. This was shown to researchers both from the Department of Architecture and Design, Aalborg University as well as to researcher from Stanford Centre for Design Research either individually or in smaller groups. The material was discussed and the other researchers' insights, questions and explanations in relation to the significant models were collected. Based on the other researchers' insights and explanations, a more detailed analysis of the videos was made in order to underline and check the findings, for instance by comparing the significant models across the workshops. Finally, the findings of the research were documented.

In the end the research design became as a hybrid between LSP, Action Research and Interaction Analysis, where LSP and Action Research were used as the driver for creating the data and Interaction Analysis as an inspiration in relation to conducting the analysis.

Theoretical foundation

Parallel with the creation of the research design, there was also created a theoretical foundation to support the analysis of the research material. More specifically, the theoretical foundation consisted of three different parts – each with a particular objective.

Part one was a review of the challenges, which face interdisciplinary teams working in the early phases of innovation. This review was created in order to positioning this research project within present knowledge, and to identify potential gaps in the present knowledge to be approached in this study. The literature review included insights from areas such as creative design, engineering design and innovation management. Based on the literature review it was found that the main challenges, which face interdisciplinary teams working in the early phases of innovation is:

1) Diversity (Hay, 2007; Ancona & Caldwell, 1992; Pelled et al,1999; Sessa & Jackson, 1995).

2) Complexity and Ambiguity (Eisenhardt & Tabrizi, 1995).

3) Asymmetry or Stickiness of information (Von Hippel, 2005)

It was further found that in current research, the focus is either on the team and how to handle the diversity, complexity or ambiguity within the team (internal challenges), or the focus is on the interaction between users and stakeholders and how to manage the asymmetry or stickiness of information (external challenges). However, no one looks at the intersection between the two. Accordingly, the intersection between the internal and external challenges was identified as a gap in the present knowledge and the focus of this study.

The second part of the theoretical foundation provided a review of understandings and perspectives on which the study was based. In general this study is directed towards an interdisciplinary audience; it is, however, built upon a design perspective and a 'designerly' way of understanding the early phases of innovation. Therefore, it was found necessary to unfold the implicit insights and understandings from design and also to explain why the design perspective is relevant in respect to the early phases of innovation.

The final part of the theoretical foundation is the theoretical framework. The theoretical framework was identified and developed in order to understand and interpret the empirical findings. In other words, the theoretical framework was used as the lens in which the empirical data could be framed and understood. The theoretical framework had an overall focus on Meaning. First of all, meaning was reviewed in relation to how individuals are creating meaning, and how this meaning is communicated. Secondly, meaning was reviewed in relation to how teams are creating shared frames. And finally, meaning was unfolded in relation to physical artifacts - in terms of how they impact the communication of meaning as well as the creation of shared frames.

Position the research project and its findings

A final issue, which needs to be unfolded in relation to this study, is the view on knowledge and the view on creating knowledge, which has been applied in the study. As described above, both LSP and Interaction Analysis assumes that knowledge is social in origin. In relation to the workshops this means that the knowledge, which is presented and shared via the Lego models, does not represent measurable or observable truths about the world; instead these models represented a number of social constructs[1],which are existing, true or valuable to the participants in the workshops. In other words: personal truths based on personal experiences.

In order to describe how this understanding of knowledge as social constructs influences this study, it is necessary to review some general insights about social constructivism.

Social Constructivism

In general, social constructivism can be divided into three categories (Wenneberg, 2002). In the first category, social constructivism is used as a critical perspective. This means that the intention is to show that phenomena, which appear to be 'natural' on the surface, are actually socially constructed. This category includes for instance SCOT (social construction of technology). In SCOT, it is the understanding that the development of technology is not driven by technological rationality, but instead by different actors and their interests, practices and worldviews (Bijker, 1995).

The second category of social constructivism is concerned with how the society or social order is possible. It offers different theoretical explanations on how the social reality or concrete social phenomena are constructed and functioning (Wenneberg, 2002).

In the third category, social constructivism becomes an epistemology, which argues that all knowledge about reality is constructed. It is argued that facts are created through convention, regardless of whether they are related to social reality or to physical/natural reality. If we agree to add certain attributes to a phenomenon, we create that social fact (Wenneberg, 2002).

1 A social construction or social construct is any phenomenon "invented" or "constructed" by participants in a particular culture or society, existing because people agree to behave as if it exists or follows certain conventional rules (cited from Wikipedia).

In this study the aim is not to reveal a natural phenomenon as a social construction (category one), or to explain how society or social orders are possible (category two). It is to observe a number of workshops, where meaning is constructed and shared among a group of people, and to determine how and in which way a number of significant Lego Models influences this. However in doing so, there is actually a social construction happening as well, in terms of the description (or construction) of the phenomena Personal- and Shared Experiential Concepts. As explained above, the main findings in this dissertation were created collectively, in that several researchers were part of the analysis. This means that social constructivism is used as an epistemology (category three).

Still, the study aims at providing as much observable evidence to substantiate and clarify its findings as possible. Like in Interaction Analysis, this study assumes that verifiable observations provide the best foundation for analytic knowledge, and that the theories built in this study must be seen in the light of its evidence. Likewise, an effort is made to make the research design and the data as transparent as possible.

Outcome of the study

Based on empirical evidence, it was found that not all physical artifacts were able to enable and stimulate the communication between team members, users and stakeholders in interdisciplinary teams working in the early phases of innovation. Nor were all physical artifacts able to enable and support the creation of shared frames. However, a small group of physical artifacts with a specific set of characteristics was. For more information about these physical artifacts please see the dissertation: *Personal and Shared Experiential Concepts* (from department of Architecture and Design, Aalborg University).

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10. INTERIORITY – Architecture in the Future Prefabricated Home

BY MARIE FRIER

Timeline: 01.10.2007 – 01.04.2011
(The PhD project has included a 6 months leave of absence in 2009, consisting in a full time project employment as Project Leader in a development project at Boel Living A/S as well as a 3 months research stay at TU Munich in 2008.)

Keywords: Domestic architecture, Prefabrication, Interiority, Architectural quality, Construction technique, Furniture, Joints.

Supervisors: Anna Marie Fisker, Department of Architecture, Design and Media Technology, Aalborg University

Poul Henning Kirkegaard, Department of Civil Engineering, Aalborg University

Collaboration: Boel Living A/S, Danish prefab-housing manufacturer based in Herning, Denmark.

Biography: Graduated in 2007 from the Department of Architecture & Design with specialization in Architecture at Aalborg University.

Project/chapter	Theory input	Methodology	Epistemology
INTERIORITY – Architecture in the Future Prefabricated Home	*Architectural theory*, herein specifically aesthetics and interiority in relation to domestic architecture. *Engineering science*, herein specifically construction technology and management in relation to prefabrication.	*Deductive theory development*, herein literature studies and spatial analyses. *Inductive prefab case study*, herein field studies and 1:1 experiments within prefab practice at Boel Living A/S.	The project takes its point of departure in *phenomenology*, herein aiming to actively confront and develop subjective-aesthetic and objective-technical epistemologies mutually.

Introduction

Within domestic architecture prefabrication has been envisioned as the means for improving not only the economy and technology, but also the architectural quality of the ordinary dwelling for over almost a century, a task which is still crucial in our continuously growing cities. This vision of establishing 'the mass-production spirit' as proposed by Le Corbusier as early as in 1919 was originally motivated by the challenges and opportunities posed by the industry and the intention to utilize technology in spatially establishing and hereby improving 'the elements of the house on a mass production basis' (Corbusier 2000 p.6). Thus, already in 1919 Le Corbusier expressed a need to unite technology and aesthetics; home and construction in order to improve the ordinary dwelling. However, throughout all these years this idea of uniting home and construction system through prefabrication has been a persistent challenge. Especially spatial detailing has been lost within the actual technical and economic practical realm of prefabrication, where constructive challenges concerning joints and tolerances have left the eventually produced houses as monotonous box-like constructions rather than inhabitable *homes* (Herbert 1984, Arieff, Burkhart 2003): Often these boxes are completely lacking particular spatial invitations such as the bath in Corbusier's 'Villa Savoye' or the built in seats in Frank Lloyd Wright's 'Fallingwater', spatial details which, it is my claim, signify the quality of these pioneering works as *homes*. Thus, even though today the belief in prefabrication seems to flourish again especially motivated by the development of novel CAD/CAM and rapid prototyping technologies, as recent publications such as (Arieff, Burkhart 2003, Anderson, Anderson 2007, Davies 2005, Kieran, Timberlake 2004) exemplify, there are still both spatial and constructive challenges to be overcome in order to reveal the potential of prefabrication as originally envisioned by Le Corbusier.

Not only has the general idea of shifting from traditional 'bit by bit' on-site construction to a systematic factory manufacture caused constructive challenges, today the booming development of novel digital technologies has increased these issues further as argued in (Hensel, Menges & Hight 2009). Thus, at a general level there seems to be a need to readdress the question of spatially defining *home*, and to let this particular issue be the point of departure for future constructive ventures in pursuing an improvement of the ordinary dwelling.

In this relation it is my initial hypothesis and particular point of departure for this PhD research, that the inhabitant's spatial experience of *home* is dependent on specific interior details at the threshold of furniture such as the before mentioned built in bath in Corbusier's 'Villa Savoye' described above; detailing which I here describe as *interiority*. It should be clearly stated that villas such as 'Villa Savoye' and 'Fallingwater' are unique and exclusive works of architecture built for specific clients and specific contexts, conditions which are radically different if not contradicting the ones characterizing the ordinary economically feasible prefabricated dwelling. However, it is my claim, that they contain crucial spatial principle necessary in pursuing a spatial definition of *home*. Thus, this PhD research takes its point of departure in an attempt to relate two extremities as within prefab practice, the revelation of such described unique details of *interiority* is significantly dependent on our constructive ability to economically and production-technically join building elements: There exist a gap between the sensuous qualities experienced in pioneering works such as the 'Villa Savoye' and the uninviting prefab constructions. Consequently the PhD project *'Interiority – architecture in the prefabricated home'* explores the potential for developing *interiority* as a theory and design method for transforming constructive challenges within prefab practice into sensuous spatial qualities in the future prefab *home*. Thus, at a general

level the project is concerned with the subject of architectural quality, the question of spatially defining *home*, a subject within which prefabrication (in a Nordic context) forms a particular practical case-study. The project is being developed in cooperation with the Danish housing manufacturer, Boel Living A/S, and this cooperation, in particular, is the starting point for attempting to combine theory development with actual practical achievements, guided by the following general research question.

What are the sensuous qualities spatially defining home, and how to formulate a theory and design method for actually revealing these qualities in an improvement of the architectural quality of the prefabricated house in practice?

In continuation hereof the goal of the research is twofold; intended in part to develop a theory and design method for improving the architectural quality of the prefabricated house, and in part to achieve actual practical results at Boel Living in an attempted testing/application of the developed theory. This twofold theoretical and practical goal set has been the starting point for attempting to methodologically interrelate theory and practice. In this contribution to our publication on 'Research Epistemologies' I have chosen to focus specifically in this methodological duality of my PhD research and used it as an opportunity to discuss the nature of architectural research in general.

Methodology

Architecture is a multidisciplinary field requiring the skills to comprehend and to balance objective-technical as well as subjective-aesthetic aspects in order to realize spatial ideas within a specific social and physical context as formulated originally by Vitruvius (Vitruvius 1960). As stated by the sociologist Linn Mo in her writings concerning 'Theories of Science for Architects' as well as by Linda Groat and David Wrang in their 'Architectural Research Methods', this inherent multidisciplinarity of architecture is reflected within architectural research, where multiple epistemologies are often needed in the approaching of a particular problem, but with no actual recipe for how to make it all work together (Mo 2003, Groat, Wang 2002). Thus, when seen in relation to the particular dual spatial and technological challenges of the prefabricated *home* described above, the questions is how to organize these different modes of reasoning?

Being a highly technically skilled architect but also a painter and a writer, Le Corbusier took this particular question as his point of departure. Le Corbusier tenaciously insisted on attempting to describe the complexity of architectural reasoning as well as its practical implications throughout his career, which makes his theories crucial as a point of departure here. In stating that *'eventually only passion can create drama out of inert stone'*, Corbusier clearly put the main focus on the intangible subjective aspects of architecture in his writings, herein defining architectural knowledge as a complex interrelation of hand and mind, necessarily dependent on a strong aesthetic intention (Corbusier 2000 p. 4). Following this line of thought, the experienced quality of a particular work of architecture eventually springs from our individual interior understanding of space, but what does this mean in a research context?

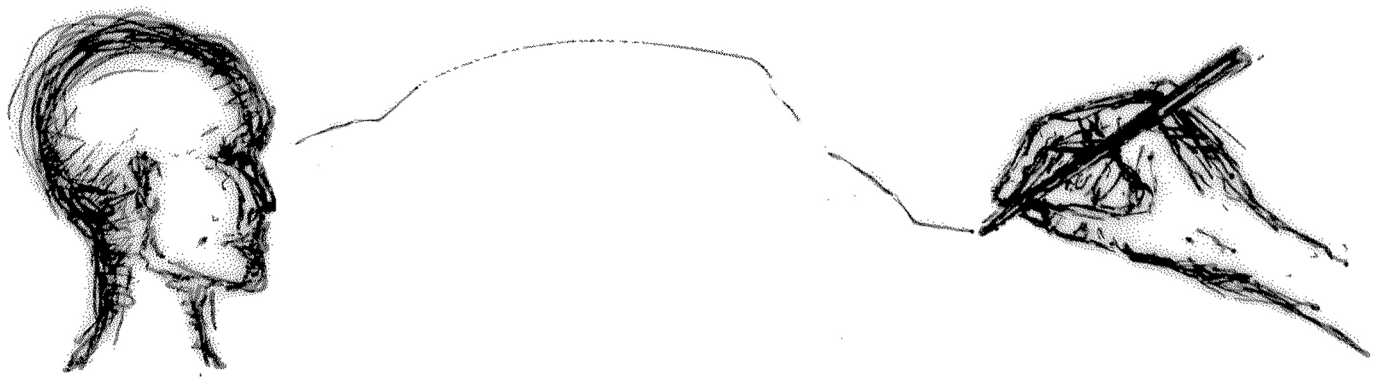

Fig. 1: Architectural reasoning: a complex and inherently opaque interrelation of mind and hand.

Research, is first and foremost a systematic and transparent inquiry, requiring that the hypothesis tested must be verifiable (or falsifiable) within an exterior context as described by Bruce Archer in his 'The Nature of Research' and by Lars-Henrik Schmidt in his 'The Scientific Perspective' as well as by many others (Archer 1995, Schmidt 2001). Thus, in research we need to be able to transmit our knowledge, to describe the steps taken to reach the presented conclusions, a condition which does not immediately correspond to Corbusier's opaque definition of architectural knowledge. Symptomatically, as architects attempting to do research we often refuse the necessary systematic and transparency required, limiting our interest to the historical and narrative aspects of architecture as argued by Christopher Frayling (Frayling 1993). In continuation hereof Frayling already in 1993 made the statement, that it is not until we get used to the idea that we don't need to be scared of 'research', or in some strange way protected from it', that we can as architects begin to approach this dilemma (Frayling 1993. p. 5). However, it is my claim, that there are also examples of how such a statement can lead to an uncritical commitment to these scientific principles, and in doing so, to a neglect of the fact that we are actually passionate architects, as pointed out so clearly by Corbusier, dependent on an aesthetic dimension to our inquiries. Within the context of prefabrication for example a tremendous amount of research is being done into the constructive, organizational and production technical aspects within theoretical fields such as lean construction,

however often completely omitting to relate these studies to any declared aesthetic architectural goals as argued in (Frier, Kirkegaard & Fisker 2008). Thus, both in an attempt to conduct research within architecture and in the general architectural practice it is necessary to ask whether it is possible to develop a research methodology which takes its point of departure in developing and visualizing the interior 'passion' described by Corbusier: But in doing so, to take a closer look at how scientists make their inquiries transmittable, rather than trying to distance ourselves from them. In continuation hereof I look at architectural research in general and PhD research in particular as an opportunity to reflect upon the nature of architectural reasoning as well as our role as architect and as researchers, or one might say as architect-researchers. In this matter I have chosen to use Charles Sanders Peirces' philosophical writings as a point of departure. Peirce was a physicist and a mathematician but also developed an interest in philosophy, pragmatism and semiotics, which makes his particular theories a obvious point of departure in attempting to combine rather than chose between subjective-aesthetic and mere objective-technical epistemologies.

The circle of inquiry

Inspired by early concepts from Aristotle, Peirce defined three basic modes of reasoning; abductive, deductive and inductive inference, together forming a 'circle of inquiry' (Peirce op. 1998-. p. 267-288). Herein Peirce defined abduction as the formulation of a hypothesis developed from a subjective, but specific *idea*, directing the following deductive process. Here a general theory clarifying the relevant consequences of the hypothesis is to be formulated and developed, which is finally documented through an inductive testing of the theory within a specific context. Thus, according to Peirce, neither abduction nor deduction or induction make sense in isolation from each other but comprise a cycle, herein implying that research in general is dependent on our individual creativity: *'Deduction produces from the conclusion of Abduction predictions as to what would be found true in experience in case that conclusion were realized. Now comes the work of Induction, which is not to be done while lolling in an easy chair, since it consists in actually going to work and making the experiments, thence going on to settle a general conclusion as to how far the hypothesis hold good'* (Peirce op. 1998-. p. 288).

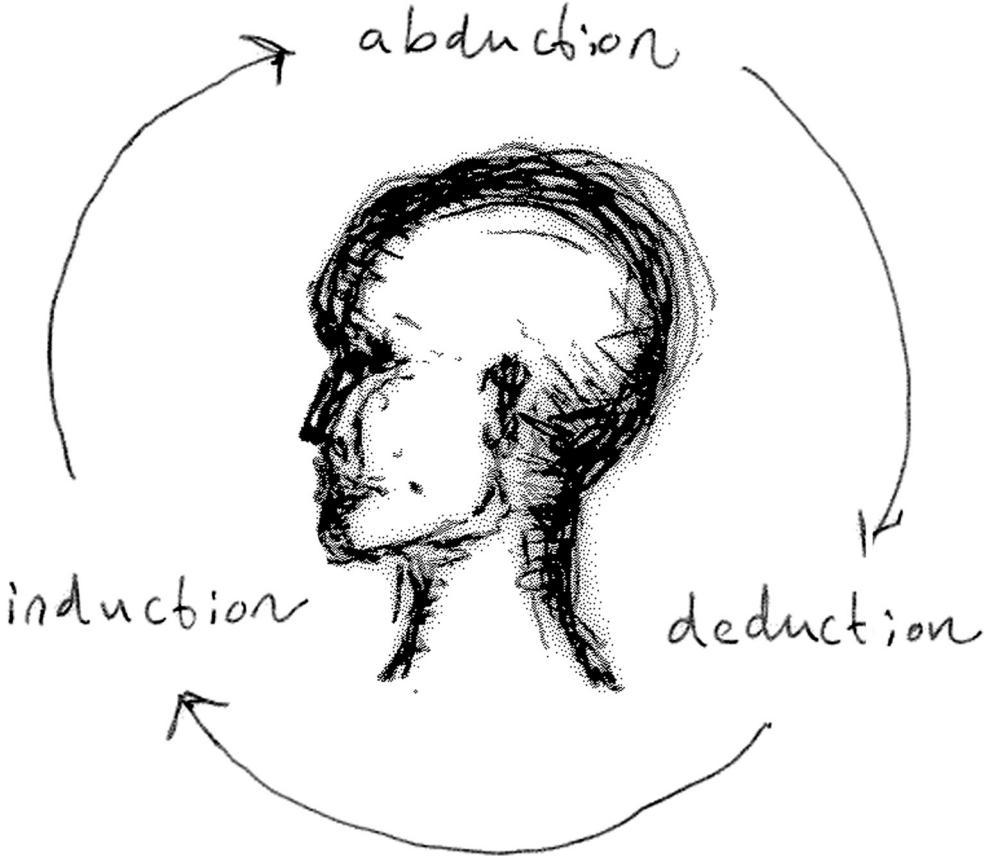

Fig. 2: Graphical representation of the circle of Inquiry inspired by Peirce's theories.

Following this line of thought one could say that mind and hand, subjective passions and objective techniques are connected, even in research within the sciences, and that this connection is necessary in order to eventually transmit the developed knowledge. However, whereas for the mathematician, deduction of a theoretical proof of his initial, and in parallel to Corbusier's theories, passionate idea and following inductive documentation of the proof can be done continuously at the blackboard, for the architect, documentation can hardly be done on paper. One could say that within architectural research theory and practice are necessarily interrelated. Thus, in the case of architecture the quality of a particular space cannot be defined using a general positive rule, it is context-dependent, and in order to understand its qualities we have to experience it; to sense its qualities as a phenomenon. As argued for by architectural theoreticians such as Gaston Bachellard, Juhani Pallasmaa and Christian Norberg-Schulz this means that as architects we need to understand the phenomenology of architecture, herein the multi-sensuous qualities, and dual physical and metaphysical meaning of dwelling, related to the actual built up of architectural space (Bachelard 1994, Pallasmaa 1996, Norberg-Schulz 1985). Thus, in the construction of a house as a phenomenon, it is our 'virtue' as architects to imagine ourselves being its future user, endeavoring to transcend qualities which we hope that the user will experience and appreciate. Consequently, appreciation of a particular space is the result of a kind of dialogue between architect and user mediated via the shaping of the space itself, thus, it is in the experience of the architectural object that the evidence of its underlying theory is to be found. As architects one could say that this is how our theories are eventually proven, but what does this mean with regards to our particular concern for research methodology in general here?

According to Peirce a phenomenon can be endeavored described as consisting in three elements; a referent object, a message, and the persons reading of this message (Peirce op. 1998-). As argued by Lars Brodersen, Peirce herein introduces a classification of the contents of a phenomenon, constituting a system for how to understand phenomena as a methodological transmission of knowledge from firstnesses (potentials, qualities, feelings, ideas) to thirdnesses (relations, rules, theories) to secondnesses (actual instances, action, will) (Brodersen 2007. 179-184). This transformation of ideas into general theories to be applied in specific actions, elaborating upon his circle of inquiry, can simultaneously be looked upon as creation of knowledge or simply; research. Consequently Peirce eventually defines research as communication processes, consisting in individual aesthetic considerations (ideas) motivating the development of general techniques (theories) and the documentation for these theories unfolded in the practical application (Peirce op. 1992-). Thus, in the case of architectural research, Peirce's circle of inquiry methodologically inscribes idea, theory development and practical documentation in a necessary interrelation allowing for transmission of knowledge via communication and hereby development. With the recognition of this affinity of mathematical and architectural reasoning, Peirce's circle of inquiry offers a general methodology for how to make the passionate aesthetic intentions described by Corbusier, the point of departure for research in general. However, this not in accept of the strictly positivist rationale usually associated with mathematics, but as a way of relating the necessary subjectivity of the *idea* with the objective system of reasoning through a deliberate connection of the subjective-aesthetic and mere objective-technical aspects defining architecture. Rather than solely producing works of architecture as it is the task of the architect, the architect-researcher must necessarily reflect upon the architectural work, herein attempting to inscribe it in a wider context. This reflective element moving form idea, to theory, to practical application, to idea etc. can be looked upon as an integrated

and necessary part of architectural practice assuring development and innovation, thus, ideally including research. However, often reflection is pushed in the background within the economy and time pressure of the practical realm, leaving the works as insignificant 'copies' or successes created by the 'luck of chance'. Thus, as architect-researchers I find it our responsibility to engage in this reflection, but also it must be stated, to relate our research to practice in order to make it relevant and eventually applicable.

Thus, with Peirce's circle of inquiry interrelating architectural theory and practice through research as a starting point, I can hereby return to the formulated initial hypothesis and following research question constituting the abductive level of this PhD research; the specific *idea* that architectural quality is identified and appreciated via impressions of *interiority*. In continuing onto the deductive and inductive levels the PhD project can hereby be divided into two interrelated halves;

- ***Deductive theory development*** (serving the purpose of developing the proposed concept of *interiority* as an architectural theory and design method)

and

- ***Inductive prefab case study*** (serving the purpose of attempting a test/application of the developed interior architectural theory in actual confrontation with prefab practice at Boel Living)

The question is, however, what is implied within the notion of 'deducing' an applicable and verifiable architectural theory, how do we actually approach this matter?

As argued by Linn Mo architectural theories are seldom written with the intention of test and critique, rather they are based merely on lifelong experiences with the field, maybe even based on an experience as a critic rather than as a practicing architect (Mo 2003). These theoretical works, such as Bachelard's 'Poetics of Space', Norberg-Schulz's 'The Concept of Dwelling' and Pallasmaa's 'The Eyes of the Skin' are main sources and stepping stones which cannot be neglected as an important point of departure for further research (Bachelard 1994, Pallasmaa 1996, Norberg-Schulz 1985). However, as Mo claims such historically oriented studies often take the shape of descriptions and personal experiences, whereas in its essence research is forward-minded requiring of the theories developed to be applicable (Mo 2003). Following this line of thought, also paralleled in Peirce's circle of inquiry, what we are after here is the development of a theory applicable in a specific context, namely that of prefabrication. In continuation of the above, an architectural theory must on the one hand be sparked by personal experiences and perception as are the works of Bachelard, Norberg-Schulz and Pallasmaa, but on the other hand simultaneously enable an articulation and relevant application of these experiences and ideas: In following the line of thought of Corbusier, one could say that the most important task in making a work of architecture, and hereby also an architectural theory relevant and applicable is to be able to clarify its idea, in case of this particular PhD research the notion of *interiority*. In the following I will go into the particular theoretical frame of the project in this specific matter.

Theoretical frame

Prefabrication

For over a century prefabrication has been envisioned as a means of lowering costs and improving quality through fast, precise and effective production. Especially within the context of domestic architecture the idea, or as formulated by Gilbert Herbert, *'the dream'* of the factory made house, has been inextricably linked with the intention to meet the still increasing and global need for architectural improvement and cost-efficiency of the ordinary dwelling (Herbert 1984). However, whereas the 'dream of the factory-made house' originally formulated by Modernist pioneers such as Le Corbusier, spread, as described by Gilbert Herbert and later by Colin Davies, the task of formulating actual design principles capable of fostering a practical revelation of this dream has proved to be a challenging matter (Herbert 1984, Davies 2005). As described in Herbert's analysis of the works of the two Modernist architects Walter Gropius and Konrad Wachsmann and in Arieff & Buckhart's more recent prefab study, the necessary sensuous spatial qualities of *home* are here often lost within the technicality of construction as a system (Herbert 1984, Arieff, Burkhart 2003). Wachsmann's early search for the 'perfect joint' is just one example of such technical ventures which never led to any spatial results. Actually the transformation of traditional onsite 'bit by bit' construction into high precision factory assembly in itself has often caused joint and tolerance challenges making prefabrication as expensive as traditional construction as studied in (Frier, Kirkegaard & Fisker 2008 p.533-540). As a consequence the houses which have actually reached production are often experienced as monotonous box-like constructions rather than sensuous inhabitable *homes*, often produced completely without the involvement of architects (Arieff, Burkhart 2003 p.9-10). The illustration below shows a principle sketch of typical plan solutions for a contemporary Danish prefabricated house and how the prefabricated elements, here complete 'boxes' fitted for onsite installation often become decisive in terms of the interior organization of the house. Here partition walls unconsciously follow the modular lines of the rigid prefab 'boxes', making the individual rooms of similar proportions and hereby also similar spatial qualities; the bedroom looks like the kids room, which looks like the bathroom, which looks and like the study, none of which are sensuously inviting. Thus, when held together with Corbusier's initial vision the challenge of the prefabricated house seems to be still both constructive and spatial.

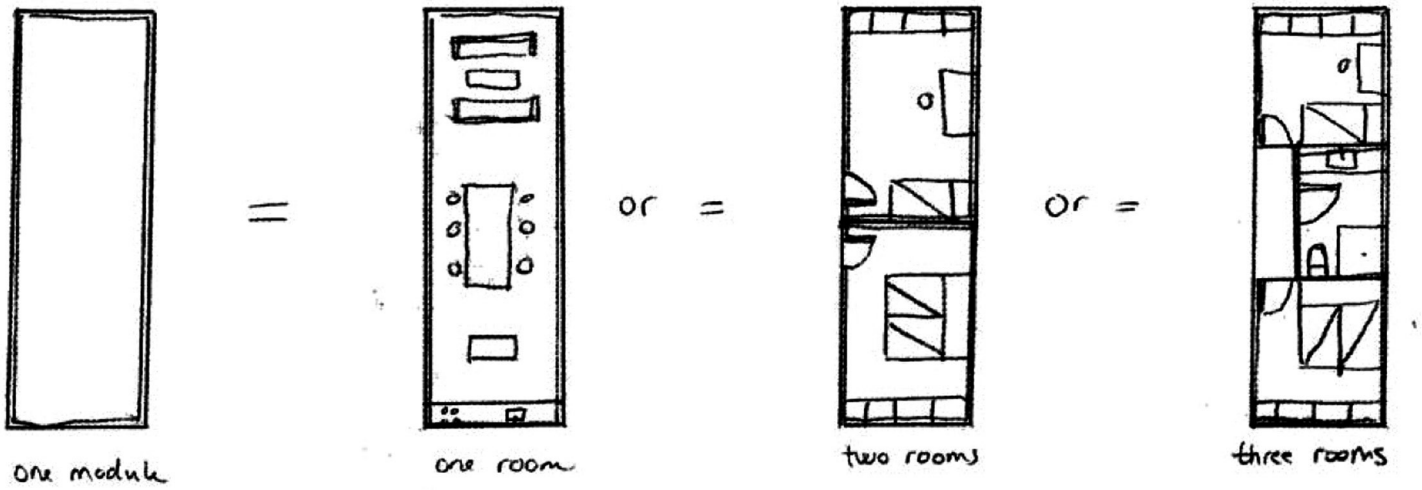

Figure 3. Sketch of typical prefab plan-solutions.

To Corbusier, the revelation of the *'mass-production spirit'* was not solely a technical and constructive practical issue as it has often become in practice, but also a sensuous spatial matter. In stating that the mass produced house should be beautiful not only in the *'way that the working tools and instruments which accompany our existence are beautiful'* but also *'with all the animation that the artist's sensibility can add to severe and pure functioning elements'* this position is evident (Corbusier 2000 p.7). Herein Corbusier aspired to the less tangible but, it is our claim, vital sensuous spatial qualities of *home*. However, whereas this envisioned sensitivity can be experienced in the intimacy of the interior detailing of for example the bath in Corbusier's 'Villa Savoye' or the built in seats and bookshelves of Frank Lloyd Wright's 'Fallingwater' these works were, as many other works of the Modernist pioneers, out of constructive reach of prefab practice and hereby also out of economic reach of the general public as described in the introduction. Thus at a general level there seems to be a gap between the experiential aesthetic knowledge about the spatial principles signifying *home* inherent within the works of architects like Corbusier and Wright and the actual practical prefab ventures realized. This particular gap between *home* and construction caused by the complex economic and technical implication of prefab practice is also reflected within research, where focus is often on either space or construction, seldom their interrelation. As an example a

lot of research is being done by engineers within the technical and organizational aspects of prefabrication related to theory fields such as Lean Construction without the involvement of architects or aesthetic parameters as argued in (Frier, Kirkegaard & Fisker 2008). Likewise architects and historians are concerned with research within architectural theory and aesthetics however seldom directly related to specific practical contexts such as Gaston Bachelard's monograph on 'The Poetics of Space' and many others (Bachelard 1994). Thus, at a general level the success of future prefab endeavors seems to be dependent on our ability as architects to engage with the practical and economical realm of prefabrication attempting to transform the before mentioned constructive challenges into sensuous spatial qualities, integrating space and construction through research: A unique potential in which a readdressing and visualization of the sensuous spatial qualities of *interiority*, signifying the works of pioneering architects such as Corbusier and Wright, are a necessary point of departure in pursuing a thorough spatial understanding of 'the elements of the house' to use the word of Corbusier himself. This is where this particular PhD research takes its point of departure. As described in the introduction it is my initial hypothesis that the inhabitant's experience of *home* is dependent spatially on sensuous impressions of *interiority*, detailing at the threshold of furniture, herein implying that sensuous spatial detailing such as a built in mezzanine or a sky lit shower are crucial elements in our recognition of a particular space as *home*. The question is however, how to progress from this initial intuitive hypothesis to the pursued development of an actual applicable theory.

Interiority

If considering our sensuous perception of space we intuitively recognize the cruciality of Mario Praz's notion, that in its capacity as a molded gesture to the human body, the softness of interior furnishing preconditions our experience of a place as *home*: A soft *interiority* without which *'the human soul would feel like a snail without its shell'*, and which it is our claim, can be rediscovered as a spatial discipline interrelating that of architecture and furniture making in the precisely orchestrated interiors of for example Mackintosh, Loos, Corbusier, Wright, Schindler, Aalto and Fehn (Praz 1964). In the sensuousness of these interiors, we perceive how room and furniture merge as a result of a deliberate engagement with functionality and scenography in the transformation of the architectural volume into a *home*.

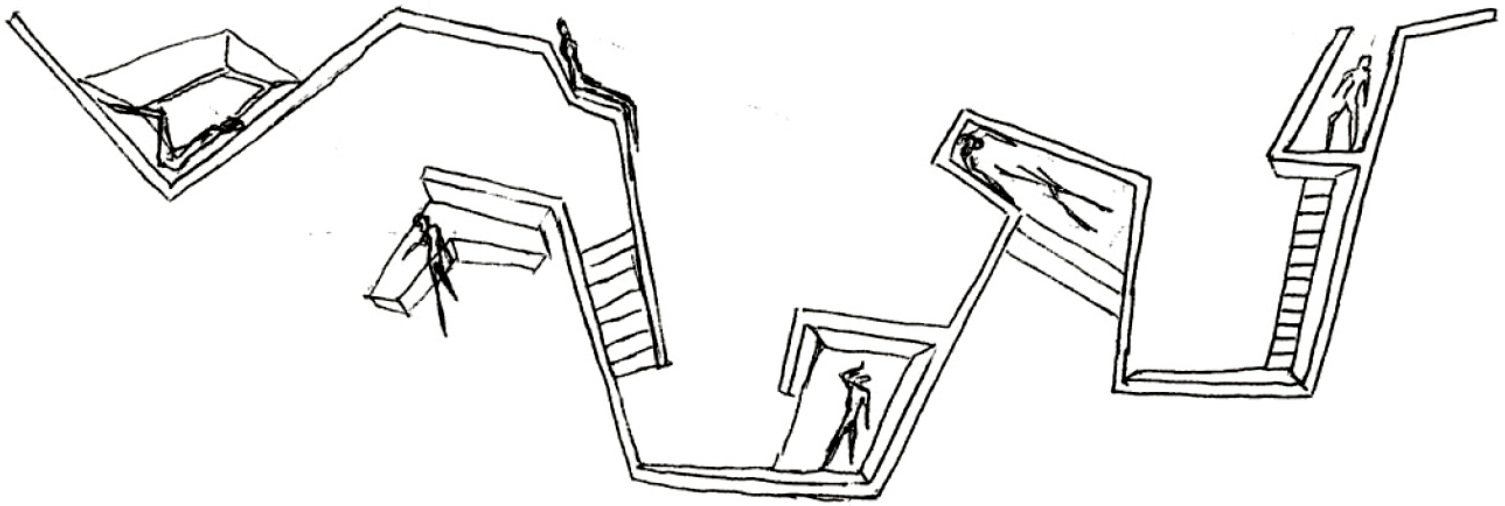

Figure 4. Interiority; sensuous spatial invitations to sit, cook, bathe, sleep etc.

Thus, when utilizing the term *interiority* in an initial attempt to approach a spatial definition of *home*, I herein suggest a necessary venture into a boundary field interrelating that of architecture and furniture. This suggestion of an architectural approaching of the human body akin to that of furniture is rooted in interior architecture as a discipline and a 'virtue'. With its origin in the Bourgeois interior of the nineteenth century as studied by Charles Rice, the interior has emerged not only as a practical discipline but also as a research field (Rice 2007). As described by Charles Rice, the term *interiority* initially described inner subjectivity; however, later it became related also to the interior of a physical space, herein the sensuous aspects of furnishing, as studied by Mario Praz, Anne Massey and John Pile among others (Praz 1964, Rice 2007, Massey 2001, Pile 2009). Besides ongoing publication of now three refereed journals counting *Journal of Interior Design* established in 1993, the *IDEA Journal* published since 2001, and the brand new *Interiors: Design, Architecture and Culture* a number of researchers have published individual monographs as well as edited anthologies on the sensuous, spatial, historical and cultural aspects of the interior and *interiority* as a field. Charles Rice's 'The Emergence of the Interior', John Kurtich and Garret Eakin's 'Interior Architecture' and Mark Taylor and Julieanna Preston's 'INTIMUS: Interior Design Theory Reader' are examples hereof (Rice 2007, Kurtich, Eakin 1993, Taylor,

Preston 2006). However, when related to the above outline of the challenges of prefabrication the revelation of this sensuous potential of the interior becomes significantly dependent on our constructive ability to economically and production-technically join building elements. Thus, in this PhD research I am specifically pursuing a linking of *interiority*, as a sensuous and spatial aesthetic approach to the *home* with a practical and constructive understanding of the technical conditions characterizing prefab practice; an applicable theoretical integration of space and construction. In continuation hereof I can now begin to outline the particular strategy for approaching the actual research, herein the structuring of the deductive theory development as well as the inductive experiments at Boel Living A/S.

Research strategy

As implied in the sketching of Peirce's 'circle of inquiry' the research process cannot be looked upon as a strict linear process, rather as a series of loops jumping from hypothesis to theory development to test/application of the developed theory leading to a refinement of the initial hypothesis initiating a new loop. However, in using Peirce's circle of inquiry as a general methodology in relation to his phenomenological understanding of research as a progression from ideas to theories and to actions, a structuring principle for how to organize these loops can be developed (Brodersen 2007). The figure below shows how the two interrelated parts defining the PhD research, can be structured using this general model.

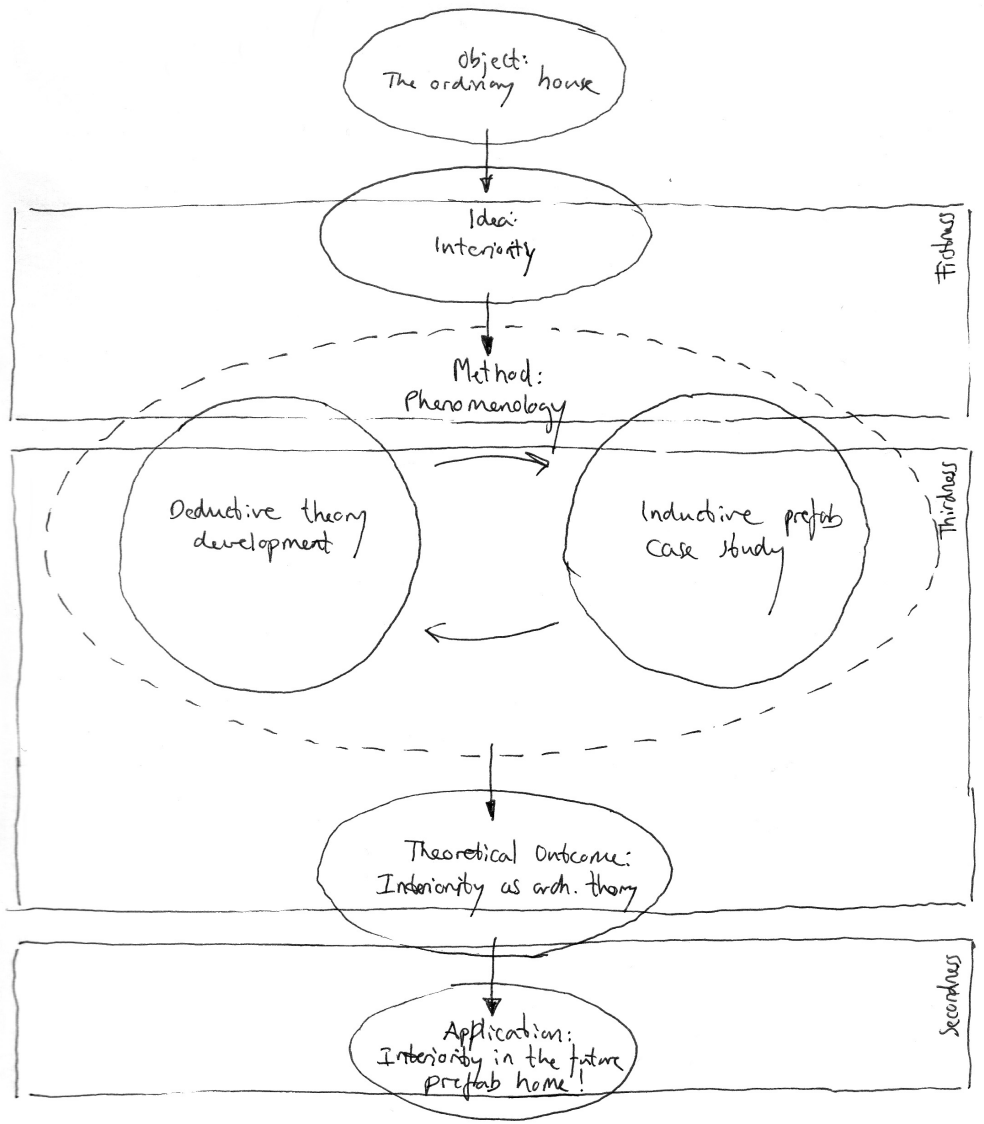

Figure 5. Project structure, inspired by Lars Brodersen's reading of Peirce's phenomenology (Brodersen 2007).

Motivated by the observations made above in reviewing the theoretical frames of prefabrication and *interiority* respectively, the figure also shows the specific research strategies chosen in the deductive theory development and the inductive prefab experiments respectively. Below I will briefly argue for these choices as a point of departure for discussing the preliminary and intended future outcome of the research. Whereas the research necessarily consists in several 'loops' the below description is, however, more linear in character in an attempt to clarify the process. Finally I will conclude with a few remarks concerning the sort of knowledge contributed by the research; its theory of science.

The proposed deductive theory development:

In continuation of the initial hypothesis and the theory review above the proposed deductive theory development takes its point of departure in *interiority* and a development of this concept as an architectural theory. As described, this idea of *interiority* was motivated by the observation that there is a need to readdress the spatial elements of *home*; the fact that there exists a gap between the sensuous qualities experienced in the pioneering works of architects such as Corbusier, Mackintosh, Wright, Schindler, Aalto, Fehn etc. and the uninviting constructions of the ordinary prefabricated house. In continuation hereof this part of the research project takes its particular point of departure in a revisiting of these works, in a search for general architectural 'virtues' and principles for how these perceived qualities can be activated in a future positioning of *interiority* as a theory and methodology for transforming construction into *home*. Herein the mentioned works are analyzed using *interiority* as an analysis method, pursuing a visualization and actualization of their underlying spatial principles.

This search for spatial principles of *home* is combined with a more general hermeneutic study of *interiority* in relation to domesticity, and with studies into the technical origin of architecture as a means for pursuing a theoretical linking of these principles with the actual constructive and economical practical realm. In this matter Gottfied Semper's theories on the origins of construction as a soft wrapping of the human body and Werner Blaser's more direct linking of architecture and furniture focusing on the joint, are mains sources, in attempting to establish this link (Semper 2004, Semper 1989, Blaser 1985, Blaser 1984, Blaser, von Büren 1992). As a preliminary outcome these studies have resulted in a particular focus on the actual physical linking of the constructive joint with the intended sensuous and scenographic ability of furniture, initially described in (Frier, Fisker & Kirkegaard 2008) and more thoroughly developed in a paper accepted for publication in connection with the upcoming international 'Architecture and Structures' conference in Portugal 2010. With this linking of the sensuous spatial principles of *home* with the economy and geometry of the constructive joint there is a potential to progress from a hypothetical idea to an actual application of *interiority* as a theory and an actual design method for physically transforming the joints, the problem areas of construction, into sensuous furnishing qualities within the realm of prefab practice. Thus physically looking at the technical elements of construction; plate, shear wall, beam, column, bolt and screw as possible furnishing details; places in which to sit, eat, sleep, bathe and synthesize.

The proposed inductive prefab case-study:

With regards to the proposed prefab case study, this part of the research takes its point of departure in an attempt to document the developed theory through test/application within the actual practical realm at Boel Living A/S. However, in order to provide a basis for this attempted test and application a thorough study of the practical context of prefabrication is needed. Thus, in continuation of the above theory review concerning prefabrication these studies are based in a hermeneutic study of the history of prefabrication

and of the current development within this field as well as within construction and material technology in general, studies in which Gilbert Herbert, Colin Davies and Stephen Kieran & James Timberlake's writings are main sources (Herbert 1984, Davies 2005, Kieran, Timberlake 2004). These studies are combined with actual field studies at Boel Living, studies which are concerned with prefabrication as a constructive system as well as the organizational aspects of factory production and management. As a general strategy these field studies involve actual participation and involvement in the production at Boel Living, and have shown that at a general level prefabrication differs from traditional 'bit by bit' construction in being dependent on a geometrical approach securing a fast and precise production and assembly process. Seen in relation to the pursued improvement of the sensuous spatial detailing of the monotonous box-like prefabricated house, these qualities must be developed directly within the geometry and economy of the actual construction system, paralleling the theory and design method developed in the theoretical part of the project. Consequently, there are two main (and interrelated) tasks to be overcome in order to achieve this goal; one is to improve the overall constructive geometry and economy of prefabrication as a system, the other is to progress from this general system to an actual sensuous and spatial exploitation hereof in establishing the 'elements of the house' on a production basis, to use the words of Corbusier. At present stage these observations have been activated as means in the development of a novel lightweight sandwich construction system at the factory, described in the paper 'Prefab-Interiority' which is currently being printed in the international journal 'Design Principles and Practices'.

In this relation, the motivation for pursuing a novel construction system and housing series has been to develop a system 'born' within the factory, where the many layers of the traditional wood frame construction hitherto used at Boel Living can be reduced in a tight and easily assembled envelope. These criteria have led to the development of a simple cast lightweight sandwich element with thin high-strength concrete cover layers and high insulating EPS core material, an element suitable for wall, floor and ceiling elements alike, constituting an entire building envelope (Troelsen, Frier & Troelsen 2009). This construction system holds a number of potentials particularly in relation to energy-efficiency and sustainability in general due to its simplicity of production, material use, insulation properties and tightness and is currently undergoing further testing and patenting. At the level of actually progressing from this general system to an actual sensuous and spatial exploitation hereof this is, however, a challenge which will necessarily require extensive future studies and experiments to solve. At present stage these studies have led to the idea of developing a 'connector', as a kind of intermediate mechanism capable of adopting tolerances and assuring a tight module joint between the box-line elements. Thus attempting a practical revelation of the developed theory and design method for transforming the technical elements of construction; plate, shear wall, beam, column, bolt and screw as possible furnishing details of *interiority*. This idea has still only reached a conceptual level; however, from a spatial point of view it holds potentials for future development, which I am eager to pursue.

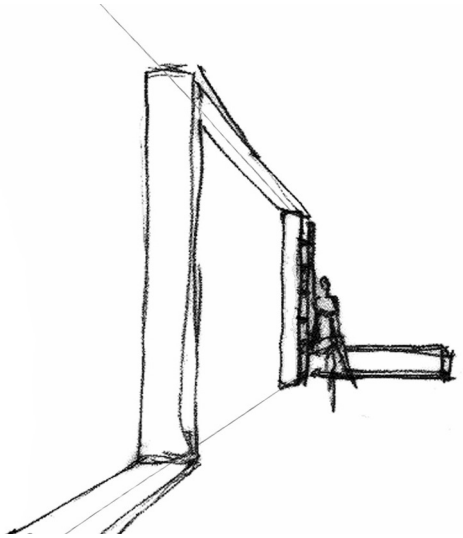

Figure 6. The 'connector' as an intermediate furnishing space-creating joint mechanism.

Theories of Science

In continuation of the general methodology developed with the specific aim to combine rather than chose between the subjective-aesthetic and objective-technical epistemologies constituting the architectural field, the knowledge intended to result from the PhD research is likewise twofold. As put forth in the introduction the research question and consequent research goals are in part to develop a theory and design method for improving the architectural quality of the prefabricated house and in part to achieve actual practical results at Boel Living in an attempted testing/application of the developed theory. The question is, however, if it is at all possible to speak of an applicable architectural theory?

Within a multidisciplinary field such as architecture it is a precondition for application and recognition of our research, beyond our own specialized aesthetic interest in space, that we enter a dialogue with the many fields engaged with architecture; sociology, engineering, production management etc. However, when recalling Corbusier's notion that 'only passion can create drama out of inert stone' meaning that architectural knowledge is in its essence preconditioned by individual ideas and intentions, the concept of an architectural theory within a transmittable research system seems contradictory. When held together with Peirce's general phenomenological definition of research as being dependent on communication processes a linking of subject and object, however, emerges. Within architecture it is precisely the 'drama' and 'passion' described by Corbusier, and experienced in for example his 'Villa Savoye' bath which catches interest and 'speaks' to the inhabitant, a communication actually equaling Peirce's research definition presented above. If following this line of thought it is eventually our sensuous experience of such *interiorities*, detailing at the threshold of architecture and furniture, which has the potential to trigger interest, appreciation, wonder and eventually new ideas, experiences which are individual but in a sense also common human. As opposed to terms such as hierarchy, symmetry, order etc. often utilized in describing architecture and its theory, furniture and *interiority* are immediate matters. Whether being architect, future inhabitant, engineer, worker, salesman or manager we all recognize the quality of for example an embracing window seat, letting us sense *home*. Thus, making these experiences the point of departure for research hereby also forms as particular potential for visualizing and activating these architectural 'virtues' within a systematic and transmittable development process; a potential and a responsibility of the architect-researcher. Especially within the complex constructive, economical and organizational practical realm of

prefabrication, there is a need for theories and design methods for placing these *'interiorities'* at the center of discussion and of production. It is this particular challenge and unique potential which motivates my research.

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