



NORDICHI 2014 WORKSHOP

INNOVATION IN HCI: WHAT CAN WE LEARN FROM DESIGN THINKING

MOTIVATION FOR THE WORKSHOP

The importance of innovation is commonly acknowledged. As stated by the innovation theorist Chesbrough: “companies that don’t innovate die” [4]. At the same time, concern has been voiced on the failure of design processes currently applied within the field of Human-Computer Interaction (HCI) to support breakthrough innovation [3]. In particular, HCI design processes are held to lead mainly to incremental innovation and small changes [8].

In parallel with the critique of the lack in innovative power in HCI design processes, design thinking has emerged as an area of human-centred research and practice that is argued to be geared towards breakthrough innovation [2]. Design thinking is seen as a human-centred innovation process concerning complex real world problems, which are solved through empathy with users, rapid prototyping and abductive reasoning [6]. Successful educations applying design thinking, such as the one by d.school at Stanford, also show that design thinking goes beyond a designer alone, engaging competent multidisciplinary teams in innovation through design processes, making sure that innovation is feasible, viable and addresses human values. At the surface, the design processes rooted in design thinking and HCI are seductively similar. To exemplify, a model design processes for both HCI and design thinking can look the same. Arguably, the differences between service design and HCI must be sought at different levels than at the level of a high-level design process. This format is to be used for submissions that are published in the conference publications.

Key to design thinking is the capacity to generate and explore design alternatives, to reason as to which of the alternatives are worthy of being continued, as well as to be able to combine parts from different design proposals into the best solution to the problem [6]. This same problem-solving procedure, it is argued [2], may be applied to design of anything from designing organizations, to designing products, services or systems. Furthermore, while HCI design processes rarely aim to bring about organizational changes, a design thinking approach to innovation can affect the whole organization [2,7]. Culén and Kriger [5], in their framework for long-term competitive advantage of ICT intensive organizations, consider design thinking to be an important factor for creative leadership, organizational vision, values, culture, and knowledge distribution.

We acknowledge that within HCI, and in particular within participatory design, there is a long tradition of work with issues along practical-political and theoretical-conceptual lines that correspond to those of design thinking [1]. However, whereas design thinking may follow an abductive approach to problem solving, HCI design processes more strongly follow an analytical approach through specifications of user needs and requirements [8] – something that makes HCI approaches more aligned with the engineering tradition, though possibly at the cost of being less encouraging of breakthrough innovation. Furthermore, HCI design processes are developed to reduce risk of new solutions not fitting their context of use.

We believe that deeper exploration of similarities and differences between design thinking and HCI design may reveal new paths for HCI design practitioners to explore towards increased impact of HCI in shaping innovative technologies for the future.

The workshop is intended for HCI researchers and HCI design practitioners, design researchers and practitioners, and others interested in innovation. The goal of the workshop is to gain deeper understanding of how HCI design practices can benefit from design thinking, by integrating or combining approaches and practices. In fact, considering the practice as a unit of design [4] might be an approach to have in mind at the workshop, in order to re-think and re-imagine ways in which these practices may enrich each other and better support their practitioners in defining the future of technology, technology intensive businesses, and social innovation

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The following call for papers invited participants to explore a range of topics aiming to understand influences of design thinking on innovation and creativity in HCI.

CALL FOR PAPERS

Design thinking, a methodology originating from design disciplines, oriented towards problem solving through human-centered approach, rapid prototyping and abductive reasoning, has huge impact on innovation in business, education, health and other crucial domains. Many similarities, and differences, can be found between design thinking and HCI design approach to innovation. The aim of the workshop is to explore these similarities and differences, with a goal of re-thinking possibilities, including combining practices towards increased impact of HCI in shaping innovative technologies for the future, based on human values and technological feasibility.

The workshop is to gather researchers and practitioners from HCI design and from design disciplines who use, or are interested in, design thinking approach to innovation. Participants will together explore areas where the synergy between fields already exists. The position, or short research papers, are thus invited in, but not limited to, the following

- HCI, design thinking and innovation towards sustainable future
- Design of social innovation
- Design thinking, HCI and service innovation
- Design thinking, HCI and values
- Design thinking in HCI education (or vice versa)
- The role of multidisciplinary teams in innovation
- Participatory design, design thinking and re-infrastructure
- Innovation and decision-making processes
- Living labs and design thinking

Focusing on larger patterns around ways in which innovation is supported in these areas, we hope to be able to find more feasible, repeatable and reliable, alternatives to current human-centred design approaches, benefitting from the strengths of both HCI design and design thinking.

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Design thinking and Innovation in HCI

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ABSTRACT

This position paper outlines previous work on design thinking and creativity methods in interaction design, followed by a proposal of topics for discussion at the workshop Innovation in HCI: What Can We Learn from Design Thinking.

Author Keywords

Design thinking, creativity, innovation, design theory, design methods.

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION

The agenda of exploring the intersections and divergences between innovation in HCI and design thinking is intriguing. Both topics have received much interest in recent years, and yet only few scholars have examined the connections and the potential cross-pollination of the two.

As an interaction design researcher, my primary research interest in this field is how we can understand and orchestrate creative interaction design processes, hopefully leading to useful and potentially innovative products and solutions. This entails both the examination and development of design theory, design methods, and tools for supporting creative design activities. In this brief position paper, I will outline my past work in this field and point to topics that I find pertinent to discuss at the workshop. As an initial clarification, I will address both the concepts of creativity and innovation in this paper. Here, creativity broadly refers to the generation of novel approaches or ideas; innovation refers to the application of ideas in a specific context, often in the development of a specific product or service, and as such creativity is a prerequisite for innovation, although it is not in itself a sufficient condition for it (Amabile et al. 1996). Design processes often entail both creativity and innovation, and they may occur throughout an interaction design process, from the initial ideation phase through creative mock-up sessions to iterative refinements based on evaluation of prototypes.

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PREVIOUS WORK ON CREATIVITY METHODS IN INTERACTION DESIGN

Together with colleagues at CAVI, the Center for Advanced Visualisation and Interaction, I have explored creativity methods for a number of years. An early example of this work is development of the Inspiration Cards Workshop method (Halskov & Dalsgaard 2006).

Inspiration cards workshops are collaborative design events involving professional designers and participants with knowledge of the design domain, and in which domain and technology insight are combined to create design concepts. Inspiration Card Workshops are primarily used in the early stages of a design process during which professional designers and their collaborators narrow down potential future designs.



Figure 1: Inspiration Card Workshops

The method has proved to be quite successful, and we have done follow-up studies, including an examination of how ideas emerge in this type of co-ideation event (Halskov & Dalsgaard 2007). Recently, we have begun to develop collaborative multi-surface installations that support this and similar techniques for ideation and concept development.



Figure 2: A multi-surface installation for ideation and concept development

In a broader perspective, we have examined a selection of methods that scaffold ideation and concept development in the early phases of design in (Biskjær, Halskov & Dalsgaard 2010). As a conceptual frame for discussing these methods, we introduced four aspects that are particularly salient in the field of interaction design - *tradition and transcendence, convergence and divergence, degree of structure, and sources of inspiration* - and outlined how the methods relate to each of these aspects. Subsequently, we have examined in more detail how the concept of constraints from creativity research can inform the study of creativity and innovation in interaction design (Biskjær & Dalsgaard 2012; Biskjær, Dalsgaard & Halskov 2014). As part of this research, we also organized a DIS workshop on innovation in interaction design processes (Dalsgaard & Halskov 2008).

PREVIOUS WORK ON DESIGN THINKING

The concept of design thinking has been the center of much attention in recent years, with researchers and practitioners from a range of fields contributing to discussions of what constitutes designerly ways of knowing and doing, and how such insights might inform and inspire domains beyond traditional design disciplines. However, as emphasized by Kimbell (Kimbell 2011), this mounting interest has not led to a clear understanding of design thinking. Indeed, it may have resulted in a blurred picture as stakeholders with disparate perspectives and agendas take part in the discussion. In a recent article (Dalsgaard 2014), I have argued that the discourse of interaction design, and by extension the practice of interaction design, can be developed by drawing upon central understandings and concepts from an established and well-developed theoretical position, namely pragmatist philosophy. One of the benefits of this move is that pragmatism offers a set of coherent concepts and articulations for addressing key issues in design. In the article, I thus draw out and examine the following aspects of design thinking:

- Theory-practice and reflection-action are intertwined in design.

- Design is characterized by emergence and interaction.
- Design is situated and systemic.
- Design is experimental.
- Design is an interventionist and transformative discipline.
- Designers employ tools and techniques that are essential to their work.

FORTHCOMING WORK: SYSTEMS, TOOLS, AND TECHNIQUES TO SUPPORT DESIGN CREATIVITY

The previous work outlined above feeds into a newly started research project entitled CIBIS, Creativity in Blended Interaction Spaces¹, which will run for four years. Many creative practices, including design and architecture, still rely to a large extent on analog materials and tools, for instance, pen and paper, Post-it[®] notes, and whiteboards, which are neither connected to, nor supported digitally. This is interesting since evermore forms of human activity involve a repertoire of digital devices, ranging from cell phones and tablets to electronic whiteboards and wall-sized displays. Whereas some integration across multiple devices is supported by access to shared data, for example, via cloud computing services, more sophisticated kinds of integration that connect devices and amplify their potential are limited. In CIBIS, we seek to examine how integrated tools and system can support creative and innovative work practices.

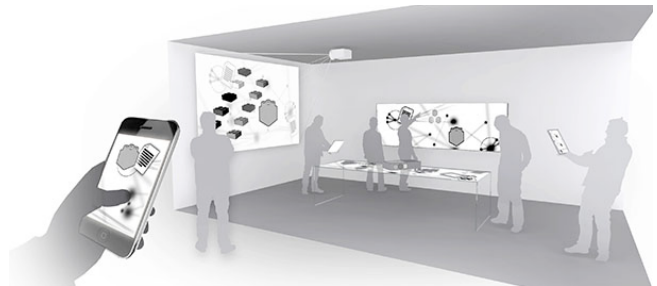


Figure 3: A collaborative Blended Interaction space

The main objectives are to 1) demonstrate the potential for integrating multiple digital devices and analog materials in a shared environment, to support individual and group creativity, and 2) develop the theoretical foundation for the study of constraints on creativity, design ideas, generative design materials, and creative methods in design processes. As a foundation for achieving these objectives, CIBIS has established an interdisciplinary collaboration among researchers from the computer sciences, interaction design, and creativity research. This research is taking place in partnership with two major, innovative international

¹ <http://cavi.au.dk/cibis>

companies (LEGO and DesignIt), three high schools, and the Danish Academy for Talented Youth.

The intersections between HCI and Design Thinking outlined in the workshop proposal are prominent in this project in at least two ways. Firstly, it will examine how design thinking unfolds in real-life processes such as the ones at DesignIt; secondly, it will build on insights from HCI to examine if, how, and why digital systems can meaningfully support design thinking in practice.

TOPICS FOR DISCUSSION

Based on the previous work and the four-year research project that we are initiating this fall – intended to explore and develop how blended interaction spaces can support creative design work – there is a triad of topics that I hope to bring to the discussions at the workshop.

1) How can we use understandings of central aspects of creativity in interaction design processes – constraints, tradition and transcendence, convergence and divergence, structure, combinatorial creativity – to better understand and develop the potential of new interfaces and systems to support innovative and creative work? By this, I refer to recurring topics in the literature on design processes and creativity, which I hypothesise can help us create systems and tools that can better support innovative and creative work processes.

2) How and to which extent can design thinking – in as much as we can settle on a definition of it – help us orchestrate HCI design practices with a clearer focus on the innovative potentials of the end product?

3) Would it be worthwhile to challenge the prevailing discourse on radical innovation? Not to discourage the search for radical innovations, but rather to emphasise that not all innovation needs to be radical. Most innovations are small-scale and incremental, yet of much value in their domains of use, and the fact is that most HCI practitioners are in the business of doing incremental innovation.

ACKNOWLEDGMENTS

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carried out at CAVI, the Center for Advanced Visualisation and Interaction, also at Aarhus University.

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The Value of Empathy in Design Thinking

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ABSTRACT

In this position paper I take a closer look into one of the main attributes of design thinking that has been under-researched: *Empathy*. The motivation for doing so has its roots in the post Design Thinking period, which we are entering now, following a rich decade of use of this approach to innovation. I wish, in particular, to address the “designerly” part in Design Thinking, so that HCI field can further use relevant tools from this method. Empathy is one of these relevant tools. Empathy is addressed by exploring two main aspects, the emotional and the cognitive. The theoretical perspective of Design Thinking, seen as a reflexive practice, or as creator of meaning, or even as a problem solving activity, is used to understand how empathy can be used in HCI design contexts.

Author Keywords

Design Thinking; Designerly Thinking, Empathy.

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION

During the last decade, Design Thinking was considered by many to be one of the best ways to foster innovation and creativity in companies and organizations, to attempt to solve complex problems, also named wicked problems [3], and to innovate products and services. But the future of design thinking is unsure. From the management research field, some of the previously strongest supporters of Design Thinking believe that it's dead [4,11,13,18], while others from the field of design research argue for taking more ownership of relevant parts of the method [10], and abandoning those that do not work. This situation has many reasons, but risking oversimplification, we can say that the two fields, business management and design research, have been pulling design thinking in two very different directions. On one hand, the field of management adopted Design Thinking on their terms, best explained by Nussbaum [13]: “*Companies absorbed the process of*

Design Thinking all too well, turning it into a linear, gated, by-the-book methodology that delivered, at best, incremental change and innovation.” On the other hand, the design research developed a different approach. For the latter, thinking as a designer is not exactly a new *savoir-faire*, and therefore possibly, some of the relevant attributes of Design Thinking have been overlooked [10].

In this position paper, I will address the “designerly” in the Design Thinking method by focusing on *Empathy* and the relationship it has to the design process. Other interesting elaborative forces of Design Thinking, like rapid prototyping and abductive reasoning, are also interesting, but cannot be analyzed in this short writing.

DESIGNERLY THINKING

Designerly Thinking addresses how the practice of being a designer, and the theories trying to explain and understand the act of designing, coexist in the same sphere, and how, in an academic way, we can understand the two [10]. To emphasize and describe this approach Johansson et al. [10] have divided the theoretical discourse in five groups:

- Design and designerly thinking as the creation of artefacts.
- Design and designerly thinking as a reflexive practice (The reflection after the creation process, helping the cyclic process with added competence and understanding, is interesting).
- Design and designerly thinking as a problem-solving activity (Especially suited for complex/wicked problems).
- Design and designerly thinking as a way of reasoning/making sense of things (Based on the practical activity designers do).
- Design and designerly thinking as creation of meaning, (Relevant as it links theory and practice).

Each of the five discourses has their own theoretical foundation and background [10], and describes also the concepts they address.

The relation between empathy and the aforementioned theoretical discourse of Design Thinking is not so obvious. Using this pluralistic perspective, and how empathy works

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in the design process, I will try to point out what can be the contribution to the “designerly” part of the process.

EMPATHY

It is possible to divide reflections around empathy into two main dimensions. The first one may be seen as an *emotional empathy*, being an instinctive, affective, shared and mirrored experience [16]. More specifically, as a person, one *feels* what other people experience. The other one dimension of empathy is *cognitive*, where one *understands* how others may experience the world from their point of view [12, 16]. But a state that is constructed within a person who empathizes, by the nature of empathy, may suffer from misunderstandings and subjectivity. The lack of a scaling (how much of empathy one experiences) may reinforce this problem [7].

In a design process, we can address and use empathy in different ways. As a tool to design with, requiring the transformation of this emotional feeling in an attribute, so designers can apply it as a method [8]. Another way designer can use empathy is to acquire insight of users needs and in doing so, inform the design process [1]. For instance, in a Design Thinking process all the participants in a design team need to be empathic with the users they are designing for in order to create relevant solutions. Using an approach toward cognitive empathy, designers apply different methods to build up that competence and insight, enabling them to prioritize the needs of the users and make the results of the process more desirable [1].

To gain a cognitive empathic insight, designers may use a variety of approaches. The following two examples illustrate how this can be done. First, designers can use an “experience prototype”. Using themselves a medical wearable device [8, 14] , like a small heart remote monitoring device, over a period of time, would inform a design team of how a person wearing the device feels in everyday situations, which would be very difficult to understand otherwise. For example, driving to work, taking a bus or eating, are easy tasks that, for a person with special needs, may be extremely hard to perform. The design team then may get insight into how difficult it is to perform these simple tasks and can, then, empathize by understanding. The second example is related to how a group of interaction design students solved their project task. The task was to design a rescue boat. In order to gain an understanding of the experience and feeling of getting rescued at sea, they rescued each other in a swimming pool, and the empathic insight helped them to develop a very interesting and relevant prototype. Both examples show how to acquire a cognitive empathic understanding and insight, but here, the designers did not need to *feel* what the *real* experience was.

The design thinking invites participants in a design process to share their own empathic insights related to the task at hand. In fact, this is one of the strengths of the approach: all participants bring empathy into the process.

Cognitive empathy has also an effect on the way participants of a design team work together. It is observed in [17] that differences in competence and knowledge between members of a design team do not affect the overall team performance, since the empathy for others participants points of view, expressed as a cognitive based “social sensitivity”, functions as an equalizer [9].

In the design process, the participants contribute to the process through different roles: as themselves, as designers, librarians, managers, IT-people and so on [2], bringing with them the cognitive empathy represented by the roles they hold. In addition, they may also have empathy for the role of a user they argue for or against in a given context of the project.

DESIGNERLY THINKING AND EMPATHY

Mapping the pluralistic perspective of the theoretical discourse of Design Thinking, also the Designerly Thinking aspect, and how we can use empathy in the design process we can tentatively produce the following table:

Theoretical Perspective	Core Concept	Empathy
Design and Designerly Thinking as the Creation of Artefacts	The science of the artificial	Emotional
Design and Designerly Thinking as a Reflexive Practice	Reflection in action	Cognitive and Emotional
Design and Designerly Thinking as a Problem-Solving Activity	Wicked problems	Cognitive (Holistic)
Design and Designerly Thinking as a Practice-Based Activity and Way of Making Sense of Things	Designerly ways of knowing	Cognitive (Constrained)
Design and Designerly Thinking as a Creation of meaning	Creating meaning	Cognitive (Interpretation of context)

Table 1: Cross view of Design Thinking/Designerly Thinking and empathy

DISCUSSION

Table 1 shows some interesting points to be discussed. In the first row, the Designerly Thinking perspective, invite to understand the making of an artifact as the core result. In the Design Thinking process, when creating artifacts, one of the generative drives is the making of various prototypes in a rapid way.

An instinctive and affective experience, as in emotional empathy, can be necessary to foster creativity and innovation [5] when a designer is prototyping in a rapid way. The use of tactile, visual and audio inputs in the creation process, can explain the necessity of the designer of not using cognitive empathy.

Also the “quantity” and “quality” of empathy applied probably cannot be equal in all the prototypes. In this case a graduation of empathy can be used as an extra indicator to help designers choose the most relevant prototype.

The next phase of a design process can be the selection of the best prototypes. The type of empathy used in this situation seems not to be cognitive, therefore it can be more relevant to focus on emotional empathy. To sort out all the prototypes, an instinctive, emotional, affective experience can be a valuable first insight and can make the design process more effective. For instance, trying a new model of a bike or a clock, gives naturally a better insight then imagining how a user *experience* the ride.

The second row has also some points worth to be mentioned. The reflexive practice based on Schöns [15] approach, implies a reflection-upon-the-creation effort from the designer. As a result, the practical competence can have an incremental learning boost [15]. Cognitive empathy may explain partly how the designer embodied the improved new competence gained from the practice and their tacit knowledge. Using emotional empathy, on the other hand, we may explain what the effects of instinctive, affective and emotional new experiences, are in relation to their own abilities as designers, creativity and their learning processes. A possible use of this relation between reflection-upon-the-creation and empathy can be in the context of the educational curriculum to form design practitioners [6].

The third row is straightforward when it comes to empathy. Large complex problems, also known as wicked [3], can only be solved if the design process takes in accounts a holistic view of the user needs. Point eight in the definition of the properties of a wicked problem state the necessity to take in account that “solving a wicked problem is one shot operation with no room for trial and error.”[3] This definition requires from the designer a deep insight of the problem area and the user perspective. Cognitive empathy can, in this regard, be a valuable source of information.

Row five advocates for a Designerly Thinking approach to the act of creating meaning. In this case the artifact is only a medium to articulate and transmit the result of the creation

[10]. The Design Thinking process already from the first immersive stages of discovery and interpretation process [1, 2], seems to gain substantial support from cognitive empathy, giving insight of user needs and the context.

The row four is not discussed. It is hoped that this point is going to be addressed during the workshop.

CONCLUSION

In this position paper I have presented an overview where the use of different types of empathy in the pluralistic perspective of the design process seems fruitful. It gives an overview of this attribute in regards to the theoretical discourse of Designerly Thinking, but address also the necessity to understand how different types of empathy work during a design effort.

The use of emotional and cognitive empathy in the design process needs to be addressed by the research community to better understand how it can be used to gain better user insight.

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Fostering innovation through participation: What can we learn from service design?

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ABSTRACT

It has been argued that participatory design and service design share many of the basic ideas, such as the perspective of design as a participatory and co-creative effort involving designers and stakeholders alike. Interestingly, when participatory approaches are applied within design thinking these seems to support change and breakthrough innovation. However, when the same approaches are used within HCI the link between participation and breakthrough innovation is far less obvious. How can this be? And what can we, as HCI researchers, learn from design thinking in terms of how participatory approaches are employed? In this position paper, we consider these questions in the light of a particular case: The design of new service concepts in a telecom provider.

Author Keywords

HCI; design thinking; participatory design

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION

At ServDes 2009, Holmlid [4] explored the connection between service design and participatory design, arguing that both disciplines share the same basic ideas concerning *participation*, *co-operation*, and *emancipation*.

Within participatory design, these basic ideas have been thoroughly elaborated. As a basic premise, it is held that parts of the knowledge needed for design is held by the stakeholders, in particular the end users. Furthermore, as the design process will return artifacts that might change the lives of stakeholders, these have a moral right to be

involved in the design process. Furthermore, the mutual learning between designers (and developers) and stakeholders is vital for a beneficial outcome of the process. To support the needed involvement of stakeholders, as well as the needed cooperation between stakeholders and designers/developers, a range of participatory methods and approaches have been developed such as cooperative workshops and prototypes to explore ideas and design directions.

Likewise, within the service design literature it is also argued as necessary to put the stakeholders at the centre of the design process [7]. Polaine, Løvlie, and Reason [8] argue that a key characteristic of service design is to design *with* people, rather than to design *for* them. Participatory approaches to service design may be instantiated as co-creative workshops involving customer service personnel [9] as well as customers [5].

DIFFERENT LEVELS OF INNOVATION

It is interesting to note that though the principles and methods of participatory design have been widely known and applied within HCI for the last three decades, we can boast few if any success stories of breakthrough innovation in our field. Norman and Verganti [6] argue that the design process as practiced and preached within HCI, with its concern for "iterated observation, ideation, and testing", while ideal for incremental innovation is unlikely to lead to fundamental changes related to an offering (e.g. products and services).

Within the discipline of service design, on the other hand, participatory approaches may be employed in design process that might lead to either breakthrough innovation or incremental improvement. The ambitions of service designers concerning breakthrough innovation is for example seen in how Polaine and colleagues [8] discuss the needed changes to the welfare state and the needed transfer to sustainable global consumption as among the major challenges that face service design; challenges that clearly require breakthrough innovations.

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NordiCHI'14 workshop Innovation in HCI: What can we learn from Design Thinking?

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A CASE OF PARTICIPATION FOR INNOVATION IN SERVICE DESIGN

To exemplify innovation through participation in service design, we briefly present a case from Telenor Group in which the second author was involved. The case is meant to illustrate what we see as characteristics that may be of importance if a participatory approach is to lead to breakthrough innovation.

A key strategic goal for Telenor is to provide superior customer experience. On the path towards this goal, an interdisciplinary team of business developers and service designers conducted a series of co-design workshop to generate *future concepts* for the purchasing process.

The goal of the workshops was, in line with the overall corporate strategy, to redesign the customers' purchase processes so as to provide a superior customer experience. The goal was seen as ambitious. For example, the current purchasing processes did not sufficiently support the provision of customer support across the involved channels. An interaction started by a customer's interaction in one channel (such as e.g. the web shop) could not be completed in another channel (such as e.g. the physical store or the customer care). This was seen as frustrating both to the customers and to the employees interacting with the customer.

To reach the goal, it was argued to be necessary to challenge the current organizational setup for cross-channel purchasing processes. Merely iterating on the current purchase processes was not seen as sufficient, as existing organizational silos made it difficult to provide a consistent cross-channel customer experience. As explained by an executive interviewed as part of the insight phase leading up to the workshop, "[...] sales personnel in the web store are only measured on sales. They have no incentives to route the customer to the physical store."

Given the relevance of the challenge for multiple parts of the organization, the workshop participants were set up as cross-functional teams involving middle managers responsible for e.g. customer care, sales, marketing and brand management. The team work was facilitated by professional service designers empowering the business developers to be open-minded and to think out of the box of daily operational practices.

During the workshops, the ideas being discussed and developed were continuously visualized as simple drawings by the facilitating service designers. The visualizations supported the articulation of the participants' thoughts and tacit knowledge and helped the participants' to efficiently explore various ideas. This way of working in the teams was seen as valuable by the participants as they got access to unfamiliar views and opinions, were able to see their role in the service process in a new light, and were motivated to explore and expand ideas in a collaborative way.

On the basis of the exploration of ideas in the workshops, a novel concept for a multi-channel purchase process was developed. After the completion of the workshops, the concept was submitted for feedback from Telenor customers through a social design feedback approach [3]. The customer involvement served to validate the concept and to point out possible modifications in subsequent development.

The aim was to develop a service concept that prepares the organization for change towards increased customer experience. The concept has served to drive strategic discussion on a management level concerning needed organizational change to support superior customer experience for purchasing processes in a multi-channel context. The concept thus has implications for innovation both in terms of the suggested onstage service process visible to the customer, as well as the underlying backstage processes and organizational structures such as organizational hierarchy, performance indicators, and incentive structures.

WHAT TO LEARN?

Though the aim of the process was not to develop implantation ready services, the presented participatory process suggests four learning points for HCI researchers and practitioners, if the objective of participatory approaches is to support breakthrough innovation and change:

- 1. Set ambitious goals.** In the presented case, an ambitious goal was chosen: to provide superior customer experience. When the goal is sufficiently ambitious, it can no longer be reached just through iterating the current solution, motivating explorations of novel alternatives. We find such ambitious goals concerning the outcome of the design process to be more clearly explicated within service design than within participatory design. Within participatory design, the key ambition seems to concern the process itself – such as its ability to democratize work or innovation [1] – rather than its outcome.
- 2. Question constraints.** The discipline of service design discussed by Holmlid [4] springs out of a design thinking tradition. At the core of the design thinker's personality profile, as argued by Brown [2], is the posing of questions and creative exploration of constraints that lead to entirely new directions. In the case, the service designers sought to go beyond the onstage challenges of the purchase process by questioning the current organizational setup.
- 3. Strategic involvement.** Cross-functional participation on a management level can be critical to support innovation across organizational borders. The importance of cross-disciplinary and cross-functional collaboration is highlighted both in design thinking [2] and service design [4]. In the presented case, the

customers were given the role of providing feedback on the developed concept; the creative part of the concept development was conducted by the cross-functional teams. The participatory involvement of the cross-functional teams also facilitated beneficial strategic conversations at the right level in the organizational hierarchy.

- 4. Explore multiple directions.** The parallel exploration of multiple directions is seen as critical to support the generative thinking desired within the design thinking tradition [2]. In the presented workshops, multiple ideas were elaborated and discussed, supported by continuous visualization. This parallels the rapid prototyping of participatory design, while accentuating the importance of using the prototypes to efficiently explore multiple directions. Such exploration is advocated also by Norman and Verganti [6] as a means to mitigate the lack of breakthrough innovation within our field.

There, of course, is no simple or definite answer as to whether and how the participatory approaches of service design are better suited for breakthrough innovation than similar approaches within HCI. We have in this paper suggested some points on which the participatory approaches of service design might differ from the participatory approaches of HCI. Though we do not expect our suggested set of learning points to be neither sufficiently complete nor detailed, we hope that they may generate fruitful discussions concerning how we might apply participatory approaches for breakthrough innovation also within HCI.

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Making an argument: Rhetoric and Design Thinking in Computational Journalism

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ABSTRACT

In this paper rhetoric and design thinking are explored as possible theoretical frameworks to understand a workshop where journalists, peace researchers and designers together create journalistic content based on simulations set up to forecast global developments of conflict and democracy. Five uses of rhetoric will be outlined relevant to the perspectives of the stakeholders participating in the workshop. Then the practice of doing computational journalism is linked to design thinking. Preliminary reflections on the workshop are given to support rhetoric and design thinking as good theoretical approaches to understand computational journalism as a transdisciplinary and innovative practice. This understanding prepares for developing guidelines for how workshops in information visualisation and journalism can be informed by rhetoric and design thinking.

Author Keywords

Rhetoric, Design thinking, Computational journalism

ACM Classification Keywords

H5.2 [User Interfaces] **D.2.2** [Design Tools and Techniques] **K.4** [Computers and society] General.

INTRODUCTION

This paper develops an integrative perspective on rhetoric and design thinking in the context of a workshop on simulation-based computational journalism that was held at the Peace Research Institute Oslo (PRIO) on September the 16th 2014. A group of journalists, peace researchers and designers, were invited to the workshop with the aim of creating journalistic content based on simulations set up to forecast global developments of conflict and democracy [7].

The aim of the workshop was to answer three questions related to Philip Meyers claim that investigative journalists would benefit from knowing and using methods from the social sciences when making their stories [11]. Meyers advice has received attention through the years from the CAR (Computer Assisted Reporting) scene, but lately has become even more relevant with the increased use of highly innovative practices coined *computational journalism*. This practice has recently been investigated in a Norwegian context [9].

The first question is if it makes sense for journalists to collaborate with social scientists and designers when doing computational journalism? What do they learn and in what way are the practices of social science, computational journalism and design complementary? The second question is how the social scientists, the journalist and designers apply computational thinking when making sense of the simulated data [16]. Do they “meet” in a common language of data manipulation and analysis? The third question is how the social scientists, the journalist and designers develop rhetorical strategies to convey how well the forecasts predict the future?

These questions are related to the aim of this short paper, but here rhetoric and design thinking is explored as theoretical lenses for understanding computational journalism as a transdisciplinary and innovative practice. Richard Buchanan, one of the proponents of design thinking, references rhetorician Richard McKeon [10] to make rhetoric relevant to innovation across disciplines. He writes:

“McKeon argued that rhetoric is an unusually clear example of a general tendency among the arts and sciences for doctrines and devices to move across disciplinary boundaries and stimulate innovation in new circumstances. Rhetoric provides this example precisely because it is universal in scope and shared among all intellectual disciplines. Furthermore, only rhetoric is traditionally characterized from antiquity by many of its leading theorists and practitioners as an art of invention and discovery.” [3]

In an earlier paper, Buchanan interprets design thinking as *making arguments* about the how the world should be through “new integrations of signs, things, actions, and environments that address the concrete needs and values of human beings in diverse circumstances.” [4]

To investigate this line of thought further, five uses of rhetoric will be outlined relevant to the perspectives of the stakeholders participating in the workshop. Then we will describe how computational journalism can be understood using concepts from the field of design thinking. After this we will give some preliminary reflections on the workshop

and see if rhetoric and design thinking give insights into what took place.

USES OF RHETORIC

In the context of the workshop there are at least five variants of rhetoric that come into play. The rhetoric of design [2], the rhetoric of procedure [1], the rhetoric of scientific inquiry [15], the rhetoric of narrative visualizations [8] and the rhetoric of journalism [12]. This is an initial exploration of how rhetoric are addressed in these field not an extensive literature review. Three of the contributions are related to journalism studies, two of them are from the fields of design and science.

Rhetoric of Design

Buchanan himself has applied rhetoric to the understanding of design, using the basic concepts of *logos*, *ethos* and *pathos* to describe how design can be seen as a demonstrative rhetoric by suggesting possibilities for the future. The *logos* of design are technological reasoning where the designer "...manipulates materials and processes to solve practical problems of human activity." The *ethos* of design is character which is about how the designers "...choose to represent themselves in products, not as they are, but as they wish to appear." The *pathos* of design is the how the designers provide a "...clarifying and fulfilling experience that may even remind us of fine art, although the objective is practical and perhaps mundane." [2]

Rhetoric of Procedure

When Bogost defines what he calls "procedural rhetoric" he emphasize the relationship between reality and how it can be represented by computer simulations [1]. Mechanical, organisational and conceptual systems in the world can be modelled and programmed to run on a computer. These processes can, when made available as games, be used to create convincing arguments about how the world works. Persuasion is taking place when a user or player gets meaningful response on his / her input that contributes to the understanding of the underlying process that represent how the world works. When making what Bogost coins persuasive games, it is important to find a balanced expression, combining; a model of a real process, an interesting visual representation and a set of relevant possibilities for interaction.

Rhetoric of Scientific Inquiry

Chad Wickman conceptualizes science as a "situated rhetorical activity". He wants to demonstrate: "[...] how the Aristotelian concept of *technê*, and the four causes in particular, can be used to conceptualize scientific practice as a productive technical art and thereby locate rhetoric in the actual production of artefacts, including visual inscriptions and texts, as they emerge out of scientists' complex interactions with a range of material, technical, and symbolic resources in the process of inquiry." [15]

He exemplifies this perspective by describing specific cases of scientific inquiry using Aristotle's theory of causation. The different researchers in his sample use different material (material cause), applying techniques (efficient cause), producing visuals (formal cause), that is usable (final cause). An important aspect of *technê* is to be able to give an account of how the outcome can be traced back to its causes. The persuasiveness of this account decides if the research will be added as a "legitimate contribution to existing knowledge". Wickman emphasize how scientific inquiry is less a mode of discovery than a process of invention and generation of possibilities.

Rhetoric of Narrative Visualizations

Hullman and Diakopoulos use the term rhetoric to "refer to the set of processes by which intended meanings are represented in the visualization via a designer's choices and then shaped by individual end-user characteristics, contextual factors involving societal or cultural codes, and the end-user's interaction." [8] They describe four editorial layers of narrative visualizations, data, visual representation, annotations and interactivity where rhetorical techniques can be applied. By analyzing 51 samples of professional narrative visualizations they discover 5 main classes of rhetorical strategies commonly used. The first is *information access rhetoric* that is about choosing what data to represent. The second is *provenance rhetoric* that aims to signal transparency and trustworthiness. The third is *mapping rhetoric* that is about configuring the relationship between data and how it is visualized. The fourth class is *linguistic-based rhetoric* that is the use of rhetorical devices from conventional language. The fifth class is procedural rhetoric where the authors refer to Ian Bogost' concept described earlier.

Rhetoric of Journalism

Ivor Shapiro develops rhetoric of journalism to facilitate assessment of the quality of journalistic work [12]. He believes rhetoric, as an ancient well-studied discipline, with common categories, can help scholars, practitioners and teachers find a common language to evaluate journalism. He claims that rhetoric is a good framework to understand not only journalistic output but also journalistic practice. Grounded in how rhetoric was framed as a process to begin with, with the stages of *inventio*, *dispositio*, *elocutio*, *memoria* and *pronuntiatio*, he proposes a slightly altered division of the journalistic process into, discovery, examination, interpretation, style and presentation. For each stage he proposes standards of quality. An overarching concern is with the ways that journalists should be careful "...not only of communicative techniques but also the reliability of their reporting and analytical discipline." Shapiro recruits rhetoric as means for reporters to produce *new understandings* not only as means of persuasion. This ethical concern is addressed for each of the five stages of journalistic practice. Journalists need to be independent when posing questions, applying methods and collecting data (discovery).

Journalists should verify facts with all means and ensure coherence between them (examination). When telling their story the journalists need to be transparent (interpretation). The (style) applied should be vetted by at least one editor. When (presented) the story should be uncensored.

DESIGN THINKING AND COMPUTATIONAL JOURNALISM

The practice of computational journalism can be understood as *making* news stories with the help of digital technology. Subfields of design like information visualization and interaction design are central to the practice, and some of the practitioners hired by the Norwegian newsrooms call themselves designers. Most of the practitioners call themselves investigative journalists too, probably because their main material is raw data that needs to be mined for interesting facts [9]. They also identify with a tradition of investigative journalism that is labelled computer assisted reporting, that stretch back half a century [5]. The practitioners see themselves as driven by curiosity and use of tools for data handling to uncover and disseminate knowledge. In the light of this, the school of thought in the design-field that can be used to understand this process of producing knowledge by making, are design thinking. James Wang frames the concept of knowing by making by the Aristotelian term *technê* that is the root of both technology and art [14]. According to him *technê* can be explained with reference to the four causes put forth in Aristotle's ontology, material, formal, efficient and final causes. Finding an appropriate form, by using the right kind of materials, applying salient techniques, to achieve what you want, is *technê*. To use Nigel Cross, this is not knowing by deduction or induction but a third kind of knowledge expressed in the "thing" that is being made [6]. This knowing can be both tacit and explicit, and are based on experience. Wang's discussion of the final cause is instructive and addresses an important debate among proponents of design thinking. Does the output of design need to be useful to society? Richard Buchanan interprets design thinking as *making arguments* about the how the world *should be* [4]. He echoes a perspective on design as improving the human condition, championed by Herbert Simon in his influential book "The sciences of The Artificial" [13]. Wang uses Aristotle to criticize this perspective and claims that according to Aristotle's concept of the final cause the justification for the design can be its internal completeness; the thing is justified by itself. The journalists will more likely be attracted to Buchanan's and Simon's views of design thinking. The "knowing by making" they undertake will always address the common good, by being related to the strong values of journalism, that is to tell stories that are aligned with the journalists obligations to society. In the workshop at PRIO, where journalists worked with datasets on causes of regime change and conflict, they applied "designerly" strategies when working with the possible web applications, but never

lost the goal of making this relevant and useful to the public.

QUESTIONS CONCERNING RHETORIC AND DESIGN THINKING

These brief outlines give little ground for thorough analysis and synthesis, but it is possible to see how the different uses of rhetorical concepts, together with a perspective on design thinking will make sense as theoretical lens to open the workshop for interpretation. Since both rhetoric and design thinking are practice oriented, this investigation can give valuable insights back to the practitioners.

Preliminary notes from the PRIO Workshop

The material from the workshop at PRIO hasn't been analysed in full yet, but the following preliminary reflections have been informed by the theoretical concepts outlined above.

The participants in the workshop displayed a keen sense of what the workshop was for, to reach out to a larger audience by making an interactive visualisation. A sense of doing well by working towards a concrete application seemed to prevail.

The participants never questioned the representative power of what they were making. Both researchers and journalists were at ease with visuals and graphics as proper expressions of knowledge.

The participants were eager to stick to the facts when making the interactive visualisation. Even if the journalists constantly dug for simple measures, they respected the concerns of the researchers when designing their concepts.

The participants rarely got lost in details relevant to their own disciplines. It seemed that the researchers enjoyed approaching their research through something tangible and gamelike. At the same time the journalists appreciated the knowledge and methodological frugality of the researchers.

The participants were comfortable about submitting themselves to the structure of a design workshop with several short iterations with prototyping and evaluation. The journalists seemed familiar with this type of work and expressed the need for testing aspects of the concept with users along the way. The researchers weren't afraid to be hands-on and visualize their ideas quickly by pen, paper and post-it notes.

The participants were quick to choose a main solution to work on and refined the concept after that. The final concepts would have benefitted from more experimentation with both content and presentation. It actually seemed that the journalists and designers, even if they were more familiar with design methods, were more eager to narrow down the scope more quickly than the researchers.

The journalists and designers were more fluent when it came to talking about interactive visualisations. They

seemed to have a larger repertoire to draw upon when working on the concepts. The researchers had a better understanding of the individual graphs, and their representational power.

The researchers were more fluent when it came to talking about data, models and methods to discover uncertainties in analysis. At the same time the journalists and designers were familiar with the stepwise process of mining data for facts. The journalists seemed to be able to switch easily between research and design approaches.

The relevance of rhetoric and design thinking to the PRIO workshop

It is possible to relate what happened at the workshop to Buchanan's perspective on design thinking and the rhetorical guidelines outlined above. The process of arguing by making, connecting rhetoric and design, were practiced by simple iterative prototyping and involved discussions addressing data, form, techniques and justifications (Aristotelian causes). The researchers, journalists and designers accepted and strengthened the rhetorical premise of the workshop, not mainly by working with logic and writing, but by trying to design an entertaining and playful experience for a wider audience. When it came to trying out different means of expression, the participants didn't use concepts from rhetoric themselves, but they worked with many of the elements described in the rhetorical frameworks outlined above. When working with solutions for narrative visualizations, they cared about relevance, trustworthiness and the representation of the underlying facts (pathos, ethos, logos). In several instances they expressed that they wished to create a gamelike interface, where the user get knowledge of the underlying model by playing with the application (procedural rhetoric). The researchers, but also the journalists and designers, included meta-information in their concepts, explaining how the underlying research had been done (rhetoric of scientific inquiry). When working with specific questions of filtering, explaining, justifying and mapping between visuals and data the participants kept evaluating the persuasiveness of the interface (visualization rhetoric). The concern for what happened to the representative power of the story in each stage from data to visualization was shared among the researchers, journalists and designers.

CONCLUSION

After outlining some theoretical concepts relevant to rhetoric and design thinking, we have given some preliminary reflections from the workshop at PRIO. The goal of this short paper is to see if these concepts can be fruitful when interpreting this case. A preliminary conclusion is that this approach is promising and gives a theoretical lens that integrates several aspects of computational journalism. Evident in the brief reflections given above, the relationship between making and telling can be framed properly (design rhetoric) and also the

specifics of different persuasive strategies (media specific rhetoric). The theory of rhetoric and design thinking transcend disciplines and seems like a good starting point for investigating transdisciplinarity and innovation in computational journalism further. As further work we want to explore how rhetoric and design thinking can inform the planning and execution of workshops in information visualisation and journalism.

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Can HCI education benefit from design thinking?

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ABSTRACT

HCI education needs re-thinking. In this paper, we explore how and what design thinking could contribute with, if included as part of the HCI curriculum. The findings from the course that we thought, where design thinking was included, indicates that design thinking may contribute to increased innovation, creativity, and prevent too early fixation on a single solution in the initial design phases in HCI education.

Author Keywords

Human-computer interaction design; design thinking, creativity, innovation, education.

ACM Classification Keywords

Human-centered computing → Interaction design → Interaction design process and methods → **User centered design**.

INTRODUCTION

Design thinking with its human-centered approach has been considered to be a powerful innovation method. It has been argued that businesses would benefit from incorporating design thinking into all phases of business processes [1]. With its emphasis on observation, collaboration, fast learning, visualization of ideas, rapid concept prototyping, and concurrent business analysis, it influences innovation and business strategy [14].

Preparing today's students for tomorrow's working practices requires that we teach them the fundamental principles, theories and state-of-the-art research on one side, and the methods and tools used or envisaged to be used by practitioners, on the other side. The question is if and how should we teach Design Thinking to Human Computer Interaction (HCI) students. Would they benefit from using it in their students project? Can this knowledge be useful to them tomorrow when entering job market? Can it be useful to them in 30 years when it is replaced by completely

different approach to innovation?

We believe that introducing design thinking in HCI education would help students to be better prepared for working practice, even if they do not use design-thinking explicitly. Multidisciplinary work is becoming predominant in the field, and understanding design thinking prepares students better for working in multidisciplinary teams. Design thinking also makes students aware of drawbacks of too early commitments to a solution, thus even if they never apply design thinking again in their future workplaces, this knowledge remains with them and has a potential to make them better software designers or new technology designers. This paper describes how we introduced design thinking to HCI students and argues that exposing students to design thinking principles had benefits beyond the context of innovation.

TEACHING HCI AND DESIGN

The ACM SIGCHI Curricula for Human-Computer Interaction defines Human-computer interaction as "a discipline concerned with the design, evaluation, and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them" [12]. Teaching HCI typically includes teaching of user-centered requirement analysis, design, implementation and evaluation [9]. HCI's interdisciplinarity brings in tensions between the breadth and the depth in teaching, as well as between diverse theories and practices [5].

Furthermore, different skills should be mastered when teaching design, than when teaching, for example, evaluation. Defining the residue knowledge that should result from the design teaching process itself is difficult [18]. Design education should aim to *build a conceptual understanding of the knowledge domain* [7, 15]. Whereas creative problem solving is a core activity of design [3], [4], teaching evaluation requires thorough knowledge of the evaluation methods and a more systematic approach. During the limited time, the HCI students should master numerous topics, learn relevant theories and gain practical experience. The teaching approach we present is a part of the Informatics; design, use and interaction education program within department of informatics. The course in question teaches traditional HCI research methods. It is the third course that teaches about HCI and interaction. The first course covers the material from the book [21]. The second one is covering theoretical and practical knowledge

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on how to study situated use of technology and how such studies can inform design. In order to address the real-world settings, the third course, described here, uses [13] as a course book, and defines course related projects based on the needs of local companies and organizations. All three courses use a classical teaching model consisting of two hour-long lectures, in a lecture hall, and two hour-long sessions in smaller groups. The later provides help with exercises from the book, questions around the material covered during the lectures, or issues related to the project work. The third course also offers an hour-long design feedback session with the instructor and a representative of a company for which the students are designing. It is during these sessions that some student groups were exposed to design thinking. The projects are carried out in project teams of 3-4 students. Although the course addresses the issue of real-life problems, there is still a gap between multidisciplinary teamwork in professional circles and what students can experience in terms of teamwork in the context of this HCI course.

CASE: TEACHING DESIGN THINKING

During the fall semester 2013 we had 20 groups of 3-4 students working on their project tasks. At the beginning of the semester, the students were presented the list of the topics proposed by the teachers and our industrial partners. The presented topics were part of real-life industrial or research projects, addressing business needs of the involved companies and organizations. The scope of the student's projects was defined having in mind that time limitations and learning objectives. The students were expected to use a considerable amount of work on the evaluation of their solutions with end-users having thus limited time for design and implementation. Two of the groups were introduced to service design at additional workshops. Both groups had their topics within the context of design for the university library. The first group was addressing tagging people's opinions on the books and academic papers they read (see Figure 2). The second one was addressing issue of visibility of e-books, in particular within the physical building of science library, see Figure 3.



Figure 1. Use of service design cards in a workshop with one of the student groups.

Both groups were first presented to the service design cards [6], see Figure 1, during a one-hour long joint meeting. After that two separate workshops were organized, one for each group of students. At these workshops, the students were first introduced to the design thinking and service design. This was followed by a practical session where the students used service design cards to develop concepts.

The use of design thinking

The students were free to follow the approach they wanted as long as they followed the given deadlines for delivering the design brief (three weeks after the semester start), delivering high-fidelity prototype (six to eight weeks after the semester start), and delivering the final report including the evaluation results (14 weeks after the semester start). We have noticed that one of the groups actively applied design-thinking principles, whereas the other group looked for the inspiration among the commercially available tools. At our regular meeting with them the student from both groups said that service design cards helped them to in concept development. The final prototypes developed by the two groups are shown in Figures 2 and 3.

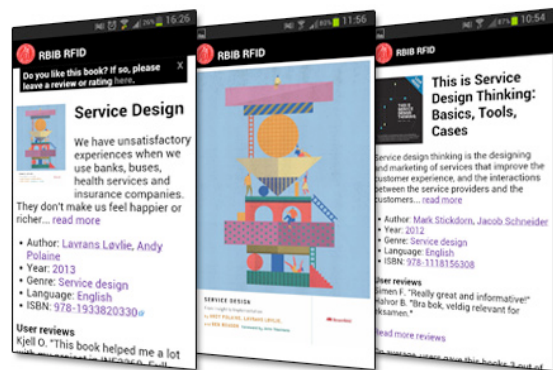


Figure 2. The rating system and user reviews [10].



Figure 3. Leap Motion based e-books search and the design team, [16].

DISCUSSION

Differences and similarities between interaction design as though in design schools and HCI have been heavily

discussed within the design community [8, 23, 24]. Design thinking is just one component of design, the component that became a buzzword in strategic management and innovation. When applied to product design, including technological ones, design thinking stands on three main pillars: empathy with users, rapid prototyping and abductive thinking [2].

The first one, empathy, is a multifaceted construct that includes emotional recognition, vicarious feeling, and perspective taking [22]. Similarly, compassion involves concern or caring in response to another's suffering and a motivation to act on their behalf [19]. They both come relatively easily and naturally for HCI students who are used to conducting user studies. However, they seldom try taking the place of a user themselves and try to develop empathy with users in that way. In part, because of the objectivity-subjectivity issues, but in part because they are not thought to value own experience, in line with phenomenological approach characteristic for the latest wave of HCI [11]. Both groups had no problems understanding student users, who are technology savvy. However, researchers, who also are a user group in both student projects, still come in large variety, from those who still use very basic technology and are elderly, to those who are more similar to student user group. One of the authors has taken active part in usability testing for one of the projects, as well as volunteered to be interviewed. It was interesting to observe how students expected implemented gestures to come naturally. The fatigue that developed in the lower part of the arm, while expected in a long run, was not expected to be there in a short time during the testing. However, simulating elderly users by, for example, adding extra weight on the arm, could give a better estimate of the comfort zone and the amount of time when it is comfortable to use gestures for search purposes. So, empathy with users, and being creative around how one can get more input on experiences that different user groups may have, is something that HCI students can learn from design thinking.

Second, rapid prototyping enables easier communication of ideas, in particular across groups with different backgrounds and levels of knowledge [20]. In our case, design meetings were attended by the student design team, one of the instructors, a PhD students in interaction design, as well as a rather large, interested, group from the library (between 5 and 8 persons at each meeting) with diverse backgrounds. Using pen and paper or tangible items such as service design cards for rapid ideation or construction of customer journeys was found to be helpful in such situations. Visualizing ideas using service design cards was valuable in creating common understanding of ideas. In particular, it fostered good discussions around feasibility of solutions, where library experts could at once provide information on existing solutions and how the proposed new solutions could (or not) fit with the existing ones. The group concerned with e-books finding has also tried several

different high fidelity prototypes related to displays of books on the large screen, offering different layout possibilities, possibilities for spacing between books, and different gestures for selecting a desired book. These were evaluated using traditional HCI methods. The authors also participated at the design meetings and evaluation activities of the groups taking classical HCI approach. What we observed was that most of the groups have selected a favorite design before our first meeting. Actually, some of them have selected a project based on their wishes to try some solutions they consider as being cool on a particular problem. Many of the groups started their work by looking for the inspiration at Internet and checking designs and applications already developed. Due to the short time the students have and the emphasis of the course on the evaluation, it is natural that student cannot explore many different solutions.

The last pillar of design thinking, abductive reasoning, is related to being able to synthesize solutions and optimize design, seeking to find the best option given the series of constraints. This is something that comes easier to people in design disciplines rather than those using analytic way of thinking and reductionist principles [17] and it is the most difficult to teach to computer science students. Yet, it is perhaps this that is actually a game changer, a way of bringing more of radical, rather than incremental innovation in HCI. Again, the group working with finding e-books has implemented this principle to a larger extent, both through high fidelity prototype testing and through initial ideation and rapid prototyping in the conceptual phase of the design process. They have been able to see how to combine best aspects of diverse prototypes to give an overall better solution. How to effectively teach abductive reasoning to non-design students is a pedagogical challenge and something that our limited experience with the two groups does not even begin to answer. Yet, consciously considering options and knowing that they could combine them has benefited students, as well as engaged them at a deeper level with their project.

CONCLUSION

Teaching Interaction Design to HCI students requires teaching them both scientific and design perspectives and methods. We believe that introducing design thinking to HCI education might help integrating these two approaches in the education context and benefit students when preparing for the challenges of working life.

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Design To Fail: Using Design Thinking in Mobile Interaction Research

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ABSTRACT

Mobile phones are not designed for mobile interactions. This work addresses the need for novel approaches in interaction design of devices for real mobile use. I believe that Design Thinking can contribute to explore and disregard alternative interaction techniques in a mobile context and assist researchers to create new models and theories for mobile interaction by using the broad set of found solutions. Especially the explicit stated mantra *fail early and fail often* can be a key ingredient for the creation of a comprehensive and deep understanding of mobile interactions, though we will discover new facts even or maybe especially if we are allowed to fail in research.

Author Keywords

design thinking; mobile interactions; design to fail;

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION

As of 2014 smartphones provide us with a computing environment that is ubiquitous, invisible, embedded, tangible, virtual, active, integrated, interconnected, interoperable, and mobile [15]. They are truly universal devices from a technical point of view, but not from a user experience perspective. Smartphone users are often in motion while interacting with the device. They can only dedicate minimal attention for interacting with the mobile device. Regardless of this fact, device interfaces and associated interaction techniques are still based on traditional graphical user interfaces (GUI) for static context, focusing mainly on visual displays and touch interaction, making it challenging, sometimes even impossible to

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interact with smartphones in distracted context [13].

MOBILE INTERACTION RESEARCH

Adapting Lowengren [12] for a mobile context we can define mobile interaction design as shaping digital things for people's mobile use. My research goal is to understand and design for people's mobile lives by exploring especially the mobility dimension of mobile interaction research. Following the definition above, I argue that most mobile devices are in fact portable devices or wearable devices but not mobile devices, since interaction with these devices in a truly mobile way is limited. I see interaction on demand with anything anytime and anywhere as a subsequent result of real mobile devices.

Carrying the mobile phone along for running or biking has become popular. It allows users to record and share exercises and it provides connectivity as well as a feeling of security for the users. Still user satisfaction is rather low. There are many factors influencing the user experience of mobile devices besides traditional usability, such as wearability [8], environmental factors as well as aesthetics and comfort. Furthermore the broader interactivity of the user plays a vital role if an interaction technique is accepted or not during exercising.

My research on mobile interactions in the field of outdoor sports applies a research through design approach "with the intent to produce knowledge" [21]. I use design to investigate complex problems connected to mobile technology usage. By creating artifacts I can explore how we can and want to interact with mobile devices during exercising. The produced design artifacts can constitute, contain and construct mobile interaction theory [18].

I have used a traditional user-centered four-stage design model and project oriented design methods to understand, design, build, and evaluate each cycle. Understanding and studying the problem is a fundamental requirement for successful design artifacts. Participatory design methods such as the future workshop are designed to help researchers to gain empathy and understanding for all stakeholders to design inclusive solutions [20].

But what happens if we cannot understand the problem enough before designing a solution? This is the case for so called wicked problems [1].

Conklin and Jeffrey [4] define wicked problems as:

1. Problems, those are not understood until after the formulation of a solution.
2. Problems, those have no stopping rule.
3. Problems with no right or wrong solution.
4. Problems, there each of them is essentially novel and unique.
5. Problems, where every solution is a 'one shot operation.'
6. Problems, those have no given alternative solutions.

Designing mobile interactions for mobile use such as interactions on demand during exercising is such a wicked problem. There is no complete knowledge about interacting with mobile devices while exercising. Much research is done for distracted contexts such as navigating on a device while going on a treadmill or stepper [19] or messaging on a mobile device while driving [5]. Interaction in the wild during physical activity is more complex, with changing parameters for both users and context. How we interact with mobile devices during physical activity depends on more than who we are as users: place, time, activity, cognitive load or social setting. Running outside is different from running on a treadmill or going for a walk. The complexity of running cannot be broken down for design purposes. Each design artifact must be developed to solve the whole problem to study its success and user experience.

Trying to understand such wicked problems through contextual inquiry, participatory design methods or other user-centered methods in HCI is challenging and the chance of poor solutions through insufficient knowledge is high. As Feyerabend states, "all methodologies have their limitations and the only rule that survives is anything goes" [7]. Even though I do not agree fully with Feyerabend, design for wicked problems demonstrates evidently restrictions in analytical scientific methods we are used to practice in HCI so far. Mobile Interaction research needs new directions to explore wicked problems and handle high risks of failure more efficiently.

DESIGN THINKING TO FAIL EARLY AND OFTEN

Design thinking is a formal method for problem solving in a practical and creative way. It is a form of solution-based thinking with the intent to improve the future situation instead of solving a specific problem [1, 6, 14]. Starting with present and goal conditions and parameters the design process can develop multiple alternative artifacts, compare and evaluate them against their ability to achieve the goal.

Design thinking has shown to be beneficial in domains such as architecture [1], business innovation processes [14] as well as educational purposes [6]. The idea of Design Thinking is that by trying to approach and solve complex and multi-dimensional problems in a practical form using specific methods to ideate, select and execute solutions, we will be able to learn new skills to improve future problem solving processes.

Design thinking consists of five phases: **Empathy, Define, Ideate, Prototype** and **Test**. All of these phases can be matched to traditional HCI design processes such as contextual design. *Empathy* phase can be mapped to contextual inquiry, *define* phase is similar to interpretation session and creation of models, scenarios and personas. *Prototyping* and *testing* can be found in both approaches. So by first sight design thinking may be just a new packaging of a well-known process?

A major distinction can be found in design thinking's mantras. **Fail early to succeed sooner**¹ or **Fail and fail often** is not a common thinking in HCI design processes. Usually designing a solution means finding a successful solution for the problem and measuring its benefits through testing; evaluating a prior hypothesis by a generalizable group of users. So why is it valuable to fail? **Build to learn and not to last** another design thinking mantra hints the answer. Design thinking solutions help designers to understand the problem better to create new solutions. Instead of finding *the* solution, the process allows them to find *a* solution, evaluate and consider that solution as a potential starting point to explore alternative paths, redefine the initial problem and develop *other* solutions. By this design thinking differs from the analytical scientific method such as contextual design. Contextual design starts with a thorough problem definition through an extensive user inquiry phase before visioning a solution, trying to minimize the risk of failure through completely understanding of the problem.

EXAMPLES OF FAILURE IN RESEARCH

Three examples from research show that failure can be beneficial and how researchers have learned from failing projects.

Learning to Fail: Experiencing Public Failure Online Through Crowdfunding [9]

Greenberg and Gerber studied public online failure within the context of Kickstarter, a crowdfunding platform for creative projects. They used quantitative data from Kickstarter and qualitative data in form of interviews with failed project owners to answer the question: What do project creators on crowdfunding platforms learn and change through the process of failing? They present two major findings. Relunched projects succeed 43% of the

¹ David Kelley founder of IDEO - <http://www.ideo.com>

time and that most project owners experience failure to be a positive experience afterwards. All interviewees reported learning and reflection on the skills necessary to run an effective crowdfunding campaign.

Failing to Learn and Learning to Fail (Intelligently) [3]

In their article, Cannon and Edmondson provide a strategy for learning to fail intelligently in organizations. Their framework relates technical and social barriers to three key activities: identifying failure, analyzing failure and deliberate experimentation. The paper presents six recommendations for action that can be implemented to shift thinking about failure away from disappointment to possibilities for exploration and learning.

The More We Know: NBC News, Educational Innovation, and Learning from Failure [11]

In 2005 MIT and NBC tried to revolutionize education by launching iCue, but ended up failing. iCue was an attempt to provide history, politics, and literature education online using archival material. The main unit of content was a short video like a broadcasted news clip that appeared on a "CueCard." The back of the card presented data and room information for the user. iCue featured course syllabi, test questions, games, as well as social networking. It presented a collaborative and self-directed tool for future education. The system was launched public in 2008 and shut down in 2011 due to only a few thousand users, mostly adults. Analyzing the iCue failure the authors offers guidelines for academics, entrepreneurs, and media companies on how to create more successful massive open online courses (MOOC) most pointing to the necessity of an open-minded multidisciplinary project group for success.

DESIGN THINKING FOR MOBILE INTERACTION RESEARCH

How we use technology in mobile contexts is a wicked problem, it depends on more than usability alone. Mobile interactions need to match the broader interactivity of the user and integrate into the user experience of the wider context of the activity. For example can design factors compete with each other, such as a big display size for readability versus a small device for better wearability [7].

Voice control [19], gestures [19], tangibles [17], eye-tracking [2], invisible interfaces [10] are all part of natural user interfaces (NUI) and promising approaches in the field of mobile interactions. Though there exists a broad diversity and large number of technologies for mobile interactions, it is still challenging to apply these technologies to our mobile lives. We need to find a way to categorize and match technologies against mobile use. Defining this context of use for technologies, as well as finding appropriate evaluation methods are key issues for my research.

I believe that Design Thinking can provide means to explore the problem with mobility in a more effective way:

Problem definition: Failing design artifacts are useful to discover hidden parameters and open alternative paths, which may lead to the goal especially for exploring wicked problems that cannot be fully understood in before hand. Design thinking can not only help to describe the need of digital devices for exercising such as for motivational, entertainment or security needs, but instead explore how mobile devices can satisfy these needs with good user experience and without limiting mobility.

Solution generation: Design Thinking can generate a large set of solutions without extensive user inquiry or user evaluation. Researchers will obtain a multi-faceted understanding of the problem as well as a chance of finding the right solution amongst all solutions through exploration of alternative paths. In mobile interaction research we can consider different mobile technologies for the same context to understand the impact of and differences between these technologies in more detail.

Distinct evaluation goals: The need to evaluate each solution compared to the previous state and the preferred goal conditions allows to develop step by step improvements of complex problems by adding new knowledge for each iteration. Design thinking defines failure to be a different outcome as expected and all created design artifacts are means for learning and reflection.

Minimizing bias: The fast pace and lo-fi prototypes can help researchers to evaluate concepts more objectively without getting too attached to the design artifacts as this is often the case in a long-term process such as contextual design. It is easier to accept failing prototypes and explore alternative ways if design prototypes are evaluated timely without much implementation effort.

Design artifacts as theory: Design artifacts created during Design Thinking can be used for Research through design approach and are theory themselves [21]. As defined by Pierce [18], we can create theory from both production of artifacts and through presentation of these artifacts, in research mainly as written publications.

Using design artifacts in mobile interaction research I can communicate design thinking as a mean of production of design artifacts as well as a mean of presentation of the artifacts themselves and findings throughout the process such as failures and hidden parameters.

CONCLUSION

Failure in research is inevitable and failure in research is vital for progression. Design thinking encourages failure as part of the process of finding a successful solution. In this way design thinking can inspire the HCI research community to reflect on and engage with failing prototypes more. Examples show that failure can be helpful [10] and that design thinking can allow us to progress [14].

In this paper I propose five possible areas where mobile interaction research can profit from design thinking:

problem definition, solution generation, evaluation goals, bias minimization and the use of design artifacts as theory.

For me design thinking is an efficient way of developing design artifacts as a research through design approach.

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Design Thinking Methods and Tools for Innovation in Multidisciplinary Teams

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ABSTRACT

Design Thinking (DT), a human-centered approach to innovation, is regarded as a system of overlapping spaces of viability, desirability and feasibility. Innovation increases when these three perspectives are addressed. This position paper proposes DT methods and tools to foster innovation in a multidisciplinary team by facilitating decision-making processes. We discuss how DT methods and tools reflect one or more DT perspectives, namely, the human, business and technology perspectives. We also discuss how these DT methods and tools can support decision-making processes, collaboration and engagement in a multidisciplinary team.

Author Keywords

Design-thinking; design-thinking method; design-thinking tool; innovation; multidisciplinary team.

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION

Design Thinking (DT) is not an easy concept to define. From a designer's or Human Computer Interaction designer's perspective, this methodology incorporates ideation and creative process attributes, such as empathy for the user, and methods like rapid prototyping and abductive reasoning [11]. DT's ability to solve more complex problems, so-called Wicked problems [3], has designated this approach in the business milieu as the best approach for innovation and creativity. From a business perspective, one important component of DT is the establishment of a deep understanding within a team of the targeted users [14]. In this context, the goal of DT is to understand, observe and identify what users want from a product, service or experience [5].

The DT process is regarded as a system of overlapping spaces, in which viability refers to the business perspective of DT, desirability reflects the user's perspective, and feasibility encompasses the technology perspective.

Innovation increases when all three perspectives are addressed. The DT process consists of five stages, namely, empathizing, defining, ideating, prototyping and testing [2]. Empathizing relates to direct interaction with users, on whom the definition is based. The ideation phase includes brainstorming and generating solutions, while the prototype phase implies rapidly making numerous prototypes. Finally, the test phase can also include the final implementation. From a design perspective, it is possible to address DT as the creation of meaning [12] and making sense of things [4]. These standpoints offer an additional understanding of why each of the five stages are important. For instance, empathizing, as an instinctive, emotional, affective, shared and mirrored experience [21], is crucial both when making sense of things and in the creation of meaning. The defining phase in a DT process is a combination of user needs and insight. Both aforementioned perspectives are enriched by the perspectives established in a defining stage. Many design methods and tools currently available attempt to make use of and address the aforementioned stages.

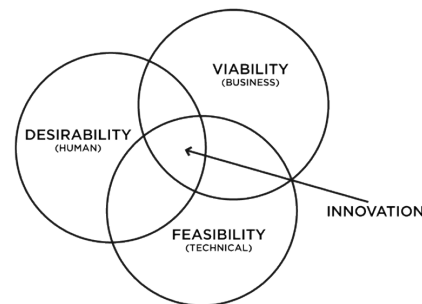


Figure 1: DT innovation as overlapping area [2].

DT can also be viewed as “the application of design methods by multidisciplinary teams to a broad range of innovation challenges” [17]. A large number of design methods and tools facilitate the DT process, and are also supportive of decision-making processes; nevertheless, this aspect has received little attention in DT research. The design methods include, among others, data visualization methods, business model prototyping, innovation strategy, and qualitative and quantitative research. Moreover, companies adopt multidisciplinary teams during DT processes as a strategy to increase teams' performance [23].

Yet, teams with functional diversity, consisting of, e.g., designers, managers, developers and users, need to make use of multiple forms of communication for efficient problem solving and decision making. This position paper aims to propose DT methods and tools that foster innovation in a multidisciplinary team by facilitating decision-making processes. We suggest a list of DT methods and tools that highlight one or more of the three perspectives previously mentioned (human, business and technology), and we discuss how they support decision making, collaboration and engagement in a multidisciplinary team.

BACKGROUND

Companies and organizations need to innovate in response to the competition and rapidly changing market demands. Harhoff, Henkel and Von Hippel [9] argue that “innovation is often a process to which several actors with complementary capabilities contribute”. Meanwhile, Baregheh et al. [1] focus on multi-disciplinarity and the multi-stage process of innovation. The process of innovation and the way in which it is managed constitute a key strategic issue for companies that rely on multidisciplinary teams. The adoption of multiple design perspectives is, in turn, expected to increase performance in terms of the quality of decision-making or the innovativeness of problem-solving [23]. Moreover, higher degrees of multidisciplinaryity are associated with a broader range of knowledge, skills and abilities available to a team [23]. In the innovation process, models of brainstorming imply that group creativity can benefit from multidisciplinaryity, as brainstorming groups often generate creative and novel ideas, and the group setting is believed to provoke a higher level of cognitive stimulation [6].

On the other hand, DT methods and tools allow teams to make informed design decisions, based on a cyclic, iterative process of prototyping, testing and refining a product, a service, an experience, and the like [5]. A large number of design methods or tools facilitate the DT innovation process. The tools can be physical, such as a pen, paper and whiteboard, or software tools with rich graphics that are supportive of the DT process. The tools can also be used to help the team to adopt a broader perspective on design, to balance the requirements and to visualize the systems' complexity. From a DT research perspective, the research community has not prioritized or properly analyzed decision-making processes. For instance, in the design process, the communicative act is often focused on content and process analysis, while discussions about process and content decisions are underrepresented [19]. Selecting the right methods and tools is thus important for effective decision making and communication in a multidisciplinary team.

DESIGN-THINKING METHODS AND TOOLS

In this section, we present six DT methods, combined with a software tool. The selection criteria for the methods

described below were their strong applicability to DT perspectives, their ability to enhance the communication within multidisciplinary teams and their visualization techniques.

Personas

The persona method can help identify the user's needs and desires. A persona is “a user representation intending to simplify communication and project decision making by selecting project rules that suit the real propositions” [10]. Personas represent a “character” with which client and design teams can engage and which they can use efficiently in the design process. The concept of understanding customer segments with coherent identity was developed in 1994 [16]; since then, the method is used for the development of marketing products, for communication and service design purposes, to reflect the human perspective of DT [20]. Personas can be used during the empathizing or defining phases of DT.

One example of software tools for creating personas is Smaply, a web service that hosts and presents personas and other methods, like stakeholder maps and customer journey maps. Smaply provides numerous options for describing personas, such as ready-made avatars, quotes, options for collaboration and engaging visualizations.

Rapid prototyping

Rapid Prototype (RP) is a quick formation of visual and experiential manifestations of concepts [14]. RP can assist in determining which solutions are technologically possible. Prototypes can be created and quickly tested using the RP method. RP systems emerged in the 1980s and established effective and fast communication as an economical and accessible tool for designers, to materialize and support their ideas [14]. RP can thus support communication in multidisciplinary teams in collaborative settings, such as workshops, by facilitating conversations and feedback regarding solutions for a particular product or service. RP reflects more than the technical perspective of DT, and supports the DT prototype phase, which should be robust and fast.

An example of RP software tools is Axure RP, which provides wireframing, prototyping and specification tools needed for RP. It has a graphical user interface for creating mockups of websites and applications. Axure RP can help users generate fast ideas to immediately improve the design and obtain direct feedback.

Business model innovation

Companies and organizations need to relate their decisions not only to users and technology, but also to the revenue perspective. Business Model (BM) innovation is about exploring market opportunities; the challenge is to define what BM actually entails. The term BM first appeared in 1957, and different reflections on the term have sprung up in different fields [15]. The Business Model Canvas (BMC)

is a visual way of handling a BM and related economic, operational and managerial decisions. Generally, a BMC describes the business logic of an idea, product, or service, in a simple and visual representation. BMC mostly reflects the business perspective of DT and can be effectively used in the ideation phase.

Strategyzer is a software tool for creating BMC, a web-based BMC creator. It includes the nine building blocks of a BMC with simple post-it notes that can be placed on the blocks. It also supports economy analysis, conversations between users and an engaging interface.

Stakeholder map

A stakeholder map is a visual or physical representation of the various groups involved in a particular product or service, such as customers, users, partners, organizations, companies and other stakeholders [20]. A stakeholder approach to strategy emerged in the mid-1980s [7] and documents the people who are involved in the provision and consumption of products and services and their relationships, reflecting the human and business perspective of DT. The interplay and connection between these various stakeholders can be charted and analyzed for various purposes. Curedale [5] argues that it is important to identify key stakeholders and their relationship as part of the defining process in DT. He also claimed that stakeholder maps assist with discovering positive stakeholders to involve in the design process, and ways to influence other stakeholders as well as risks [5].

One example of a software tool that can be used to create stakeholder maps is Stakeholder Circle. The tool was designed to put stakeholders on the ‘management radar’, facilitating regular updating of the assessment as the stakeholder community changes to reflect the dynamic nature of the project and its relationships.

Customer journey map

A Customer Journey Map (CJM), which originated from the technique of Service Blueprinting [18], describes a collection of touchpoints from the beginning to the end of the service delivery, as seen from the customer’s point of view. A touchpoint is defined as “an instance or a potential point of communication or interaction between a customer and a service provider” [8]. CJM helps us identify chances for service innovation and problem areas for service improvement [12]. It is a common perspective shared by design/consultancy firms and experiential service providers [22], categorizing the method in the human and technical sides of DT. It can be used during the empathy phase.

Visualization of a service user’s experience can be presented by Touchpoint Dashboard, a web-based system for creating CJM. It uses common visual notations to unite a team and converts the information into an intuitive, data-rich map of a customer journey.

Service blueprint

The service blueprint introduced by Shostack [18] is a template that shows the steps and flows of service delivery that are related to stakeholders’ roles and the process. Service blueprints show the actions between customers and service providers during a service delivery. It is a process-oriented method for the business and technical perspectives of DT, and shows all actions, including technical activities. Such a blueprint may benefit us in the early innovation process, such as the process of defining a phase, by showing the series of actions of both in-front tasks, actions that can be seen by the customer, and back tasks, actions that cannot be seen by customers, such as actions between employees in the back office.

Creately is a web-based tool that helps create blueprint diagrams based on the early version of the service blueprint made by Shostack. Table 1 summarizes the various DT methods and tools, matching them with DT perspectives.

DT method	DT perspective	Software Tool	Website
Personas	Human	Smaply	https://smaply.com/
Stakeholder map	Human & Business	Stakeholder Circle	http://www.stakeholder-management.com/
Customer Journey Map	Human & Technical	Touchpoint Dashboard	http://www.touchpointdashboard.com
Service Blueprint	Business & Technical	Creately	http://goo.gl/gdZHIk
Business Model Canvas	Business	Strategyzer	https://strategyzer.com
Rapid Prototyping	Technical	Axure RP	http://www.axure.com/

Table 1. DT methods and tools.

DISCUSSION

The use of DT methods and tools in multidisciplinary teams is a way of incubating business ideas and creating innovative solutions. We need these DT methods and tools handled by non-designers because multidisciplinary teams consist of experts in various desirably complementary areas. Thinking like a designer might improve the way in which companies and organizations develop their products and services. Using human- and business-oriented methods, such as stakeholder maps, and thus leaving out the feasibility of the technology, can spark innovation. The human-oriented methods, like personas, focus on the user-centered side by analyzing their desires, needs, and expectations, among other things, which is mainly helpful in the first phases. Fostering good ideas can result in solutions to technological issues. In this context, tools can

help with rapid prototyping and effective decision making. Moreover, tools used in the human- and technical-oriented methods do not visualize the economic viability of the changes generated. For instance, using a customer's journey, the economical effect of redesigning touchpoints can only be analyzed long after the ideation process. The result is low effectiveness in the decision making process. All three perspectives of DT are needed for innovation. For example, when the user's perspective is left out of the process, the results can be two fold. It can be positive at the start of a project, since one can gain a good understanding of how a company works. Similarly, relying exclusively on business and technical tools does not help project effective decisions, especially as the user may wish for another path.

The use of collaborative software tools that support DT methods is an insightful way of working with teams. For example, using Smaply to visualize a stakeholder map can be fun and inspiring, simultaneously providing, in addition to creative activity, a visual exercise and analytical tool. Engaging interfaces and visualizations help different people adopt new perspectives on things that might not have earlier. The value of using DT tools in companies is related to the adoption of a broader view of things and an effective communication tool for multidisciplinary teams. The value for teams is in their shared basis for communication, as they can embody their own ideas in real-time, in collaboration with other partners. This procedure could lead to better decisions and to visualizing complex systems problems and their potential solutions.

CONCLUSION

Understanding how multidisciplinary teams make decisions using design methods and tools to innovate is an area of increasing importance. In light of the fact that organizations are being encouraged to adopt DT in areas in which people may not have prior experience with such methods [17], more collaborative methods and engaging tools are needed. The central proposition of DT that may be helpful for different business challenges and that should be pursued by multidisciplinary teams [17] is the need for DT methods and tools from different perspectives. The list of methods and tools that we discussed here is only a starting point for further work in this field. Further research might focus on how multidisciplinary teams use design methods and tools for innovation in each design phase and what the most suitable DT methods and tools are in these phases. Another future research topic is the functional diversity of a team that could maximize innovativeness using these methods and tools. Case studies, field studies or similar studies, from businesses would be enlightening for this research area.

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Technology Jams to bring new meaning to Human-Computer Interactions

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ABSTRACT

In this paper we introduce Technology Jams as a platform for exploring how novel technologies, when introduced in a specific context, can open up possibilities for radical innovations that change the relationships between people and products or services.

The concept of Technology Jams is based on elements from design thinking and so-called *Jams*. The platform that Technology Jams create, aims to support cooperation as well as exchange of knowledge and ideas between people from different backgrounds. Through rapid prototyping and user involvement in evaluation, these ideas can be tested and explored. This way, Technology Jams provide a more hands-on approach for sparking radical innovation of products and/or services within the field of Human-Computer Interaction.

We provide a detailed description of the setup of Technology Jams and present the content and outcomes of a pilot Technology Jam. Based on these results, complemented with other questions and challenges, we sketch possible ways for further development of the concept of Technology Jams.

Author Keywords

design thinking; design driven innovation; radical innovation

ACM Classification Keywords

H.5.2 Information Interfaces and Presentation (e.g. HCI): Theory/Method, User-centered design

INTRODUCTION

The user-centred design approach in HCI [14] has been

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criticised for only driving incremental (not radical) innovations in technology [15]. Even though it is considered the role of the designer within the (user-centred) design process to be aware of future possibilities of technologies and suggest these for the users that are involved [4], radical innovation often does not follow from a user-centred design approach [13]. Besides, methods that are part of the user-centred approach (see e.g. [12]) focus on the interaction between humans and machines and tend to pay limited attention' to the way in which this interaction, and the context in which it takes place, may influence each other. However, frameworks exist within HCI, such as Activity Theory (e.g. [5]) or situated action, (e.g. [9] or [16]) that do include this backdrop to human-machine interactions. Yet, the theoretical nature of these frameworks give them more value as analytical frameworks than as hands-on tools to support radical changes in the relationship between people and products or services.

Design thinking, on the other hand, has a user-centred approach similar to the one used within HCI, but differs in the sense that it works with a problem statement that allows to establish a realistic set of goals, while leaving room to interpret, explore and discover [2]. This could help to imagine solutions that address the problem(s) that users are facing while not entirely building on what the user says s/he wants to have. That way, design thinking can help to solve problems that people are facing in novel ways, which might not originate from existing products, interactions and/or systems. Besides, the use of multidisciplinary teams in design thinking, consisting of T-shaped professionals [2] also means that not just the designer in the process is tasked with suggesting and introducing of new possibilities in terms of technologies.

In turn, this might lead to a combination of the introduction of new technologies (technology push) in a way that also innovates the meaning that people give to products as well as their relationship with them. Such a combination of innovation on two frontiers is what Verganti [17], in his description of design-driven innovation, calls *technology epiphanies* (p. 61). The development of such technology epiphanies and the process of design-driven innovation as such, however, require substantial investments in time and

content. Firstly, because it takes time to understand the possibilities, limitations and unique added value of a specific technology, required for the expected level of ideation and idea selection. Secondly, and related to this, the ideation phase took longer than expected. This meant that there was only time left for making and presenting the prototypes. Testing and evaluating them with potential users was, however, not possible. On the other hand, after those four hours, participants were more familiar with the technical possibilities and limitations.

FUTHER DEVELOPMENT OF TECHNOLOGY JAMS

Our next step is to improve the format of the Technology Jam based on these findings. In order to create more room in the schedule of the jam, we plan to have two four-hour sessions instead of one. The first session will introduce the technology and determine its unique added value in relation to comparable technologies. The second session will be about developing, prototyping and evaluating ideas and prototypes for applications of the technology. Participants can use the time between the sessions individually for incubation and formulation of possibilities. Besides, we will further evaluate the effect of the multidisciplinary nature of the Technology Jam by including people from more diverse backgrounds than those in the pilot jam in future Technology Jams. This improved setup for the Technology Jam will be a first step towards optimising this platform for steering radical innovation. However, given the fact that Technology Jams are still in their infancy, a number of challenges and questions remain.

One of the main questions is whether Technology Jams can lead to radical innovation or even technology epiphanies despite their short timespan. Related to this is the question of how to prevent that such sessions remain in the domain of technology push and do not reach the level of technology epiphanies. Another challenge is to make the Technology Jam interesting for all participants. This includes taking into account frictions that might occur between designers and technology developers [11] as well as possible reservations that participants might have towards design [3]. Besides, there is the question of what extent of rigor and structure should be added to the originally open and playful character of jams. Should the Technology Jams, for instance, be given a theoretical underpinning in the form of design theories such as C-K theory (see e.g. [6])? Finally it can be interesting to look at how the results of Technology Jams can be developed and detailed further. For instance by doing as suggested by Norman and Verganti [15]: to apply user-centred design methodology after the initial version of the radically new product or service, in order to further optimise the specific innovation.

It is our intention to take on these and other questions and challenges related to Technology Jams while we iteratively improve this concept.

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