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Defining user experience goals to guide the design of industrial systems

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The key prerequisite for experience-driven design is to define what experience to design for. User experience (UX) goals concretise the intended experience. Based on our own case studies from industrial environments and a literature study, we propose five different approaches to acquiring insight and inspiration for UX goal setting: Brand, Theory, Empathy, Technology, and Vision. Each approach brings in a different viewpoint, thus supporting the multidisciplinary character of UX. The *Brand* approach ensures that the UX goals are in line with the company's brand promise. The *Theory* approach utilises the available scientific knowledge of human behaviour. The *Empathy* approach focuses on knowing the actual users and stepping into their shoes. The *Technology* approach considers the new technologies that are being introduced and their positive or negative influence on UX. Finally, the *Vision* approach focuses on renewal, introducing new kinds of UXs. In the design of industrial systems, several stakeholders are involved and they should share common design goals. Using the different UX goal-setting approaches together brings in the viewpoints of different stakeholders, thus committing them to UX goal setting and emphasising UX as a strategic design decision.

Keywords: user experience; user experience goal; experience-driven design; industrial systems;

1. Introduction

Good user experience (UX) is nowadays the goal of most products and services intended for the consumer market. UX is also receiving increasing attention in the development of industrial products and services. Hassenzahl and Tractinsky (2006) claim that the notion of UX has been so well adopted because the previous narrow focus on interactive products as tools did not capture the variety and emerging aspects of technology use. According to Hassenzahl (2003), UX consists of both the pragmatic and hedonic aspects of product use. Similarly, Mahlke (2005) sees UX as stemming from the instrumental and non-instrumental qualities of product use. The pragmatic or instrumental refers to the utilitarian aspects, such as usefulness and ease of use, and hedonic or non-instrumental to the emotional and experiential aspects of product use.

Experience-driven design focuses on the non-instrumental, meaning that its function is not so much utilitarian as experiential (Hekkert, Mostert, and Stompff 2003). Experiential issues have been included in earlier approaches, but rarely as the main objective of the design process. For example, trust has been an important factor in many e-commerce user studies (Järvenpää and Tractinsky 1999; Karvonen 2000; Gefen 2000). Usability and user acceptance studies include some experiential elements, while in experience-driven design, emotional and experiential elements are the main focus.

Our work focuses on industrial environments, and especially on the use of tools in workplaces. We base our UX definition on the UX White paper by Roto et al. (2010), in which UX refers to the experience(s) derived from encountering systems. We define UX at work as: 'The way a person feels about using a product, service, or system in a work context, and how this shapes the image of oneself as a professional'.

The field of human–computer interaction (HCI) has defined a process for ensuring product usability, where the key is to define usability requirements in the early phases of product development. When designing for good usability, the general usability criteria from the ISO 9241-210 standard (effectiveness, efficiency, and satisfaction) can be taken as the starting points, and precise user requirements for functionalities can be defined accordingly. No similar lists of universally applicable qualities are available for good UX, as different products may target entirely different experiences. The ideology behind experience-driven design is first to define the intended experience and only then to think about the possible designs that might evoke such an experience: 'One of the basic claims of experience-driven design is to consider the experience

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before products' (Hassenzahl 2010, 63). Thus, the key prerequisite for successful experience-driven design is to define what experience(s) to design for.

An early example of experience-driven design is Kansei engineering, used proficiently in the Japanese car industry from the 1970s onwards (Nagamachi 2002; Levy 2013). However, the research on experience-driven product design started to boom only in the late 1990s, probably due to the establishment of the Design and Emotion Society[1] in 1999. Since then, the importance of designing for emotions and experiences has been acknowledged by several design experts (Sanders and Dandavate 1999; Jordan 2000; Shedroff 2001; Hekkert, Mostert, and Stompff 2003; Norman 2004, among the early ones). Experience-driven design 'takes an intended UX as the primary objective of the design process' (Hekkert, Mostert, and Stompff 2003). It is naturally impossible to force people to have a specific experience, but designers can aim at facilitating a certain type of experience, that is, they design *for* an experience rather than design an experience (Sanders and Dandavate 1999; Wright, McCarthy, and Meekison 2005). Terms experience design (Hassenzahl 2010) and experience-centred design (Wright, Wallace, and McCarthy 2008) also refer to designing for UX.

From the literature, we have found several different approaches to experience-driven design, each with a different process for defining the intended UX. For example, Sanders and Dandavate promote co-designing in order to gain access not only to what people say and do, but also to their experiences and dreams (1999). Hekkert, Mostert, and Stompff, in contrast, leave the experience to be defined by the designer (Hekkert, Mostert, and Stompff 2003; Hekkert, van Dijk, and Lloyd 2011). Hassenzahl (2010) utilises a list of basic psychological needs when defining experiential goals for design, while Wright and McCarthy (2008, 2010) emphasise a dialogue and co-production to build empathy. We have not found publications that would analyse the differences of these experience-driven design approaches, although they seem to introduce striking disparities in their starting points.

In this article, we focus on those approaches in which the design is driven by the intended experience, which we call a 'UX goal'. The first academic workshop to collect cases of UX goal utilisation was organised in 2012 (Väätäjä et al. 2012). Even if there were several approaches to experience design reported in academic publications at the time, there were few workshop submissions in which researchers would have concretised the targeted experience as experiential goals. The lack of UX goals in academic experience-driven design cases may be due to the small scale of academic experience design cases, in which the whole team consists of experts in experience design, the mindset is relatively similar, and the outcomes are concepts rather than actual products. Concrete UX goals may be most useful in experience-driven design in an industry context, where various stakeholder groups need to agree on what to design. UX goals can help to keep UX in focus through the multidisciplinary product development and marketing process.

This article is based on our experiences in four different case studies focused on work environments: moving within office buildings, working in metal workshops, and operating cranes in factories and ports. The cases shared the aim of experience-driven design with concrete UX goals. Otherwise, each case used its own methods and approaches. The cases started at the same time and lasted from 9 to 22 months. The variation in the length is due to the industrial environments where, for example, organising user studies requires a suitable time window. As the cases had each defined their own UX goals, we gathered together to integrate the results and to learn from each other. We found that, even if the cases were using different design approaches, they used similar sources for insight or inspiration in order to define UX goals. From the literature, we did not find studies that had studied the process of defining UX goals. We decided to extend our focus more widely to related research: the kinds of approaches to experience goal setting that we can find in the literature. We chose two research questions that focus on the first phases of experience-driven design:

> Research question 1: What kinds of approaches are there for defining UX goals?
>
> Research question 2: What kind of contribution do these approaches make in defining UX goals: What kinds of UX goals do they produce? What are the benefits and challenges of the approaches?

In this article, we first discuss UX goals in Section 2, namely, what these goals are and how they are used. Then, in Section 3, we describe the four case studies that we have carried out. We describe the UX goals utilised in each case, and how these UX goals were defined. In Section 4, we widen the perspective to related research, and we identify experience goal-setting approaches from earlier research. Based on our own work and the literature, we present a framework that includes five approaches to defining UX goals. In Section 4, we also aim to find answers to the second research question: what kinds of UX goals does each approach produce? What are the benefits and challenges of the approaches? Finally, in Section 5, we analyse and discuss our findings and propose directions for future work.

2. UX goals

An experience goal describes the intended momentary emotion or the emotional relationship/bond that a person has with the designed product or service (Lu and Roto 2014). We prefer to use the term goal instead of the term requirement for the experiences to design for, because a designer can only facilitate, not guarantee, a certain UX. Experiences with interactive products and services are context-dependent, dynamic, and subjective (Law

et al. 2009; Roto et al. 2010). What a designer can do is design *for* an experience (Sanders and Dandavate 1999). As Desmet and Schifferstein state, it is challenging to find the right experience to design for (Desmet and Schifferstein 2011). In this article, we focus on this challenge: how to get insight and inspiration to define UX goals that concretise the intended experience.

There are similarities between UX goals and other concepts used as the starting point for design. Lu and Roto (2014) analyse how experience goals differ from the earlier concepts: from user requirements (ISO 2010) by focusing on the emotional aspects; from value propositions (Rintamäki, Kuusela, and Mitronen 2007) by leaving cost–benefit thinking behind; from a design brief by stating the wanted experiences in a compact form; and from a design driver (Wikberg and Keinonen 2002) by focusing on experiences. In industry, UX goals are often defined on a very abstract level, such as 'superior UX' or 'wow'. 'Good user experience' as such does not guide design; to design for UX, more specific, concrete UX goals should be defined. In the following, we will review the literature in which the design goals have focused on the experiential aspects.

Hassenzahl (2003) introduces hedonic be-goals that differ from pragmatic do-goals, and calls for the definition of the be-goals before the functional do-goals. Rogers, Sharp, and Preece (2011) list several UX goals that describe different emotions and felt experiences. In both the aforementioned views, UX goals are concerned with how users experience interactive products from their personal perspective. This is different to usability goals that define how useful or productive a system is from its own perspective. Usability goals address neither the overall quality of the UX (Rogers, Sharp, and Preece 2011), nor the higher level concerns that have become widely recognised as part of UX literature (Beauregard and Corriveau 2007). As a consequence, an increasing amount of interest has been focused on UX goals (see, e.g. Hartson and Pyla 2012).

In the UX goals workshop by Väätäjä et al. (2012), a good UX goal was seen to guide design towards a positive experience, to help in communicating objectives, and to be measurable. However, it is hard to define a UX goal that would both give guidance for design and, at the same time, be measurable. This can be seen from the UX goals presented in the workshop cases, such as sense of control, feeling of presence, stimulation, competence, self-efficacy, freedom from pain and distress, freedom to express natural behaviour, comfort, and various playful experiences (PLEX) (captivation, submission, fellowship, humour, good mood, amusement, and relaxation). The sources for defining these goals were user studies, theory, standards or guidelines, or common sense, and the cases presented in the workshop combined several of these sources.

UX goals guide the substance of design, but within business contexts, the UX goals can also be used as a means of communication between decision makers and UX professionals. As shown by Olsson et al. (2013), general-level UX goals can serve well as design inspiration and guidance; for example, they can form fruitful starting points for brainstorming, as well as constant reminders of the rationale of design. As the design process proceeds to a more specific level, the UX goals should be defined at a more specific level that can be interpreted in terms of design implications. During the later design phases, each design solution implementation should be traceable back to the originally defined UX goals (Karvonen, Koskinen, and Haggrén 2012a).

3. The case studies

In this section, we will describe four case studies where we have applied experience-driven design in designing industrial systems. For each case, we will describe the general set-up of the case and how the experience-driven design process proceeded. Then, we describe the UX goals and how they evolved in the design process. We focus on the early phases of the design where UX goals were set before the actual implementation activities.

3.1. Mobile interaction with elevators

In complex environments such as office building blocks, moving between buildings and floors can be challenging and time-consuming due to several issues. For example, each block can consist of several buildings, which in turn may contain multiple elevators. The elevators are further divided into segments, carrying people to different floors/parts of the building. Thus, people often need to use multiple elevators to reach their destinations during a day. Typically, elevators are also in constant use. Finally, each building usually contains several access control points. In this study, we aimed to address some of these challenges by introducing a mobile application for elevator control.

3.1.1. Design process

We first analysed the problems faced by elevator users based on earlier studies. There are several challenges with current systems that could potentially be improved with mobile elevator control:

- People may not know how elevators work in a building (which elevator goes where)
- People do not know in advance if there is space available in the elevator
- People may not know the optimal way to their destination
- Normal elevator door closing times do not support special (slow) movement patterns (e.g. heavy load, wheelchair users, etc.).

UX goals for our mobile application were identified based on these challenges. An agile development process was utilised in this case. We iteratively designed and developed a prototype application that enables users to place elevator calls remotely to real elevators inside an office building. The mobile application communicates wirelessly with the elevator scheduling system in the building. The design and development process was continuously informed by feedback from elevator industry professionals, who also provided us with the opportunity to evaluate the prototype application in a real context of use. More details of the application can be found in Turunen et al. (2013).

For the first application prototype, we organised an initial UX evaluation and subsequent long-term evaluation with four participants. The second prototype was evaluated long term with 29 participants, 12 of whom were interviewed in detail about their experiences.

3.1.2. *UX goals*

The UX goals address the identified challenges in current elevator systems through the lens of supporting 'People flow', which is the brand promise of the corporation:

(1) Expediting movement in large buildings
(2) Feeling of control of elevator action
(3) Reduced feeling of waiting
(4) Possibility for remote operation of elevator.

Expediting movement facilitates a positive experience of the overall indoor journey from entry to the destination. The moments of waiting tend to cut the movement flow; thus, a specific goal is to affect positively the *feeling of waiting*. *Feeling of control*, that is, the feeling of the user having an influence on elevator actions, is important to facilitate. *Remote operation* further extends the feeling of control and promotes a more personalised feeling. Findings from the user studies indicated the value of personalised scheduling options that take into account daily movement patterns.

3.2. *Gesture-based interaction in metal workshops*

In a factory automation system, the loading station environment is dedicated to loading and unloading machining pallets. The load can be transferred, lowered, rotated, and/or tilted to give the operator the best possible access to the work pieces. Traditionally, the operator controls the movements of the loading station by push buttons or switches placed away from the pallet for reasons of operator safety. In crowded workshop conditions, the controls can be hard to reach, and their operation requires constant movement from the pallet to the controls and back.

This case study aimed to address these challenges with a radically new gesture-based interaction concept. The focus of the design was to provide a natural interaction concept for controlling the loading stations and to investigate how different design requirements (naturalness of gestures vs. robustness of gesture detection) can be accounted for in the design of the gesture set.

3.2.1. *Design process*

An agile development process was also utilised in this case. The design process consisted of an examination of the metal workshop domain, including the context of use, current interaction methods, and the work process, followed by an iterative development cycle. Domain experts from the participating company were used as informants in order to form an understanding of user requirements. A set of preliminary gestures was analysed in laboratory studies to show that performing the gestures was associated with emotional UX. This understanding was utilised later in the field studies.

A design workshop was conducted to form the basis for the robust gesture set used in the prototype. This gesture set, and the accompanying visualisation, was then refined iteratively until the final prototype stage was reached (Figure 1). During this process, researchers demonstrated features of the gesture recognition technology through interactive prototypes, and domain experts proposed changes and provided feedback. The user acceptance and UX of the concept were evaluated in real contexts of use in metal workshops. More details about the findings are presented in Heimonen et al. (2013).

3.2.2. *UX goals*

The UX goals defined for the gesture-based concept were:

(1) Using the system feels like magic
(2) Sense of control over the system.

The *feels like magic* goal indicates a need to provide something radically new that would surprise the user. Entertaining and intuitive interaction should not require excessive effort. However, the user should still have *sense of control*. This goal indicates the need for gestures that are easy to learn, simple to perform, and whose detection is robust. Both UX goals contribute towards desirable customer values of increased productivity, attractiveness of the workplace, and a cutting edge image of the company.

3.3. *Smart interaction with a crane*

The goal of the Smart interaction with crane (SmartGUI) case was to understand how automated smart features of an electronic overhead travelling (EOT) gantry crane affect UX, and how this should be taken into account when designing new user interfaces (UIs) for the crane.

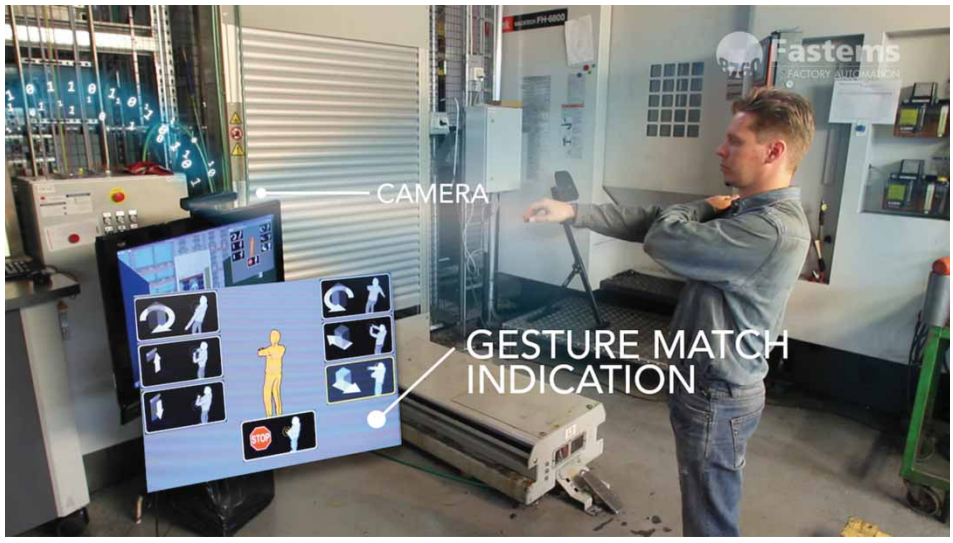

Figure 1. Loading station environment with gesture-based interaction.

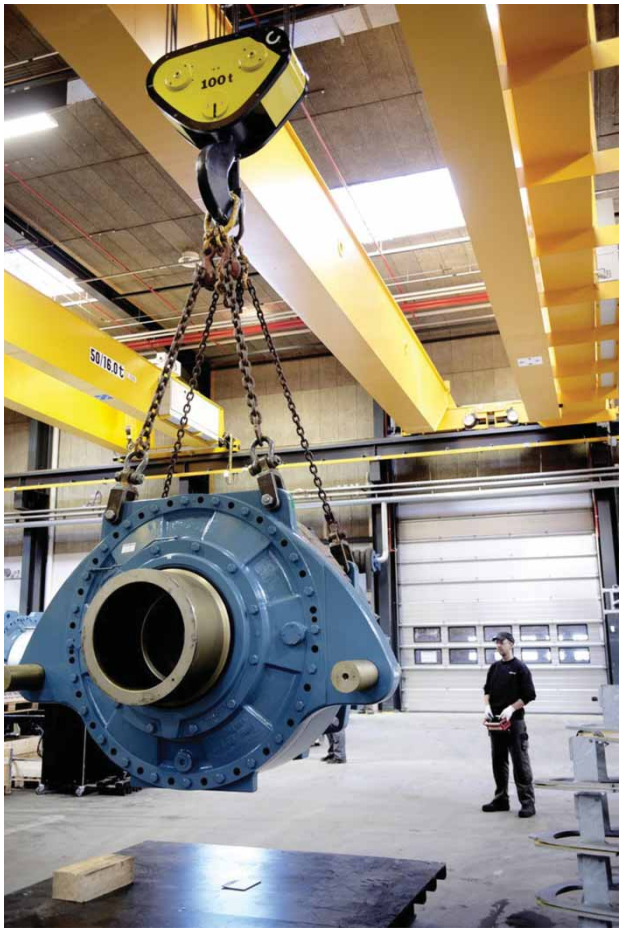

Figure 2. Operating an EOT crane in a factory.

The EOT crane is a crane with a hoist travelling along a girder between parallel runways (Figure 2, crane controller in Figure 3). EOT cranes are typically used for material handling in industrial processes.

Figure 3. The crane controller.

3.3.1. *Design process*

The design framework in this case was based on user psychology (Saariluoma and Oulasvirta 2010). The core of this design approach is that every design solution should be based on psychologically valid and coherent concepts and theories of the problem domain. The case started with 11 semi-structured interviews with crane operators. The main finding from the interviews with crane operators was a set of subjective experiential goals and problems relating to crane operation, especially in the context of increasing automation.

Positive and negative experiences were analysed separately, and were given an emotional theme. This resulted in defining two UX goals: supporting competence and avoiding anxiety. To understand the goals in more detail, a laboratory study was conducted with 20 users who were not familiar with operating cranes.

After the UX goals were defined, their experiential aspects were assessed, and a set of heuristics was proposed.

In a design workshop, the participants were presented with the UX goals, their experiential aspects, their relation to crane automation, and a set of heuristics to be utilised in the conceptualising process. The workshop resulted in multiple concepts, which were evaluated against the UX goals and heuristics. The most suitable concepts were implemented, and the prototype was evaluated in a field experiment with four crane operators and one designer. The field experiment revealed that the interface supported the set UX goals, but also suggested a set of improvements for the next iteration of the interface.

3.3.2. *UX goals*

In this case, we had two high-level UX goals:

(1) Supporting competence
(2) Avoiding anxiety.

Competence refers to the user's ability to conduct tasks efficiently and skilfully and the feeling that results from an understanding of how one's own skills led to efficient task completion (Saariluoma and Jokinen 2014). Anxiety, on the other hand, is the result of not being in control of the automation and being obstructed from an efficient task accomplishment (Saariluoma and Jokinen 2014). *Supporting competence* UX goal indicates that all design decisions should support a positive understanding of one's own abilities. This combines experiential goals such as determination, motivation, and freedom of choice. *Avoiding anxiety* goal indicates that possible UX problems, such as being alarmed or nervous during crane operation, should be foreseen and avoided with the design decisions.

3.4. *Remote operation of a container crane*

In this case study, we developed a new remote operator station (ROS) UI concept for the remote operation of semi-automated container cranes. The cranes are operated manually from a remote office environment through dedicated ROSs during loading and unloading of external road trucks and other types of chassis in the landside loading zone (see the fenced area in the mid-right-hand side of Figure 4).

3.4.1. *Design process*

The aim of this case was to differentiate the new ROS UI design from the existing solutions by focusing particularly on the crane operator's UX in the design. The main vision for the new ROS was defined to be a hands-on experience in remote operation, as we wanted the remote operation with the UI to feel as vivid and safe as it would be carried out on-site where the crane is located. The design activities of the case were conducted in a similar way to most concept development processes (Keinonen and Takala 2006), but with a particular focus on UX-related matters, as depicted, for example, in the Understand–Envision–Create process by Desmet and Schifferstein (2011).

In defining the UX goals, we first used the systems usability framework (Savioja and Norros 2013) as the starting point. In particular, the framework's 'User experience: The development potential of use' (Savioja, Liinasuo, and Koskinen 2013) perspective on activity was utilised. These considerations resulted in a first set of UX goals, which included, for example, the goals of feeling of a well-functioning tool, appropriate trust in technology, and sense of control (see Koskinen, Karvonen, and Tokkonen 2013 for a complete list of UX goals in this phase).

Figure 4. A visualisation illustrating cranes in a port environment.

Next, the concept specification phase was embarked on. In this phase, we first familiarised ourselves with the domain environment and the crane operation work by conducting literature-based investigations. The literature review included, for example, a benchmarking study of other similar remote operation solutions. After this phase, we created an initial and broad set of possible UX goals, which included, for example, a feeling of presence in addition to the previously mentioned goals. In order to validate and refine the generated broad set of UX goals, we conducted pilot interviews with two domain experts. Based on the results of these interviews, sense of control and feeling of presence were chosen as the main goals to be investigated in the field studies.

The actual field studies (see Karvonen, Koskinen, and Haggrén 2012b for a detailed description) were conducted in two international container terminals with altogether 12 crane operators. The studies focused on the analysis of the chosen UX goals (i.e. what they actually mean in the operators' everyday work) and on the analysis of the domain and crane operation work activity. Methodologically, the studies included interviews and observations, which were based on core-task analysis (Norros 2004) and critical decision method (Wong 2006). The field studies resulted in adding the feeling of safe operation and experience of fluent co-operation to the list of potential UX goals, since the study results highlighted the importance of these goals.

Afterthe field studies, we analysed the gathered data according to the core-task analysis framework and, based on this analysis, chose the final UX goals to guide the concept development work. On the basis of the UX goals and user requirements, a virtual reality-based prototype system of the ROS (see Figure 5 for a concept illustration) was built in the project.

3.4.2. *UX goals*

The final set of UX goals to guide the concept design work in this case included:

Figure 5. Concept illustration of the ROS system.

(1) Feeling of safe operation
(2) Sense of control
(3) Feeling of presence
(4) Experience of fluent co-operation.

Feeling of safe operation is especially important in this context as the cranes are lifting heavy loads, and human lives can be in danger if something goes wrong. *Sense of control* is crucial as the remote operator is not directly in touch with the crane. Similarly, *Feeling of presence* is important as the remote operator is not physically present at the site and (s)he still has to perceive the prevailing conditions in the object environment vividly and at a sufficient level of realism. Finally, experience of *fluent co-operation* was also chosen, because the crane operation work is – against our initial conceptions – a very social activity with a great deal of communication between different professionals.

3.5. *Analysis of the case studies*

The case studies were each using several approaches to UX goal setting. All four cases focused on developing radically new interaction concepts by introducing new technologies to the usage context. It is no wonder that the possibilities and challenges of new technology can in all the cases be identified as a source of UX goals. The anticipated possibilities offered by new technology can be identified in UX goals such as *possibility for remote operation* (mobile interaction with elevators) and *feels like magic* (gesture-based interaction). Technology also influences UX goals so that the goals aim to prevent or minimise threats raised by the technology, for example, *feeling of competence* that automation and smart features may reduce (Smart GUI). Another example of preventing the threats of technology is *feeling of presence* and *sense of control* that remote operation may tend to reduce (remote operation of a crane).

A common denominator for the cases was also a strong emphasis on user needs, values, and preferences. Thorough user understanding was a source for UX goals in all the cases. The cases aimed at stepping into the users' shoes and understanding the users' world with empathy. The empathy was gained from user observations and interviews, as well as interviews with domain experts. Empathy-based UX goals can be identified, for example, in the Smart GUI case, where emotional aspects are clearly present in the high-level UX goals *avoiding anxiety* and *competence support*. In the case of remote operation of a crane, empathy was crucial in understanding the importance of the UX goals *feeling of safe operation* and *fluent communication*.

In addition to understanding the users with empathy, a theory-based approach to user understanding can also be identified in the cases. Emotional UX (Saariluoma and Jokinen 2014) was used as the theoretical background in the cases of gesture-based interaction and Smart GUI.

Theoretical background on human activities in work environments based on systems usability and core-task analysis (Savioja and Norros 2013) helped in identifying an initial broad set of UX goals in the case of remote operation of a crane. Theory-based approaches helped to set up a framework for UX goals, whereas empathic understanding of the particular users helped in identifying the most crucial UX goals in the individual cases.

In two cases, the company brand can be identified as a source of UX goals. In the case of mobile interaction with an elevator the 'People flow' brand of the company is, as such, UX-oriented: it describes how the company wants the users to feel about using their elevators. In the case gesture-based interaction in metal workshops, company brand can be seen as a source for UX goals in another way: the company wanted to emphasise their image as an innovative forerunner company with a radically new interaction concept, which is reflected in the *feels like magic* UX goal.

Another source for the *feels like magic* UX goal is a vision of renewal. Renewal was also a common theme in the cases: we wanted to show that UX can be a source of radical renewals. The aim of radically renewing current interaction or operational practices can also be identified in the cases mobile interaction with elevators and remote operation of a crane. The time span of renewal can vary, from products that could be realised quickly on the market to more futuristic concepts. For example, the gesture-based interaction case was an exploration of future interaction possibilities without an immediate plan to shift into product development. The other three cases were targeting actual products in the near future, and in one case (mobile interaction with elevators), the concept development launched product development within the partner company, which resulted in a commercial product.

The UX goal setting proceeded in the cases in different ways. In the gesture-based interaction case and in the mobile interaction with elevators case, different research activities and participating individuals produced knowledge that was analysed, and UX goals were defined accordingly. The cases Smart interaction with a crane and remote operation of a crane refined UX goals gradually, based on successive research activities. Multiple viewpoints were used in the UX goal setting, to integrate the views of users: what kinds of experiences they value; of designers: what kinds of experiences can be facilitated; and of the company: what kinds of experiences the company wants to provide for customers.

The case studies revealed that there are several different approaches to defining UX goals, and that using different approaches together brings in the viewpoints of different stakeholders. In Section 4, we will analyse our case study findings further, and we will integrate them with related research to identify, classify, and analyse different UX goal-setting approaches.

4. Approaches to defining UX goals

Partly parallel to the case studies, we carried out a literature study to ascertain what kinds of approaches have been used to define goals for UX. Three researchers independently searched publications that focused on design rather than mere evaluation of the UX. We studied publications from 1995 to 2013, and used 'UX' and 'design' as the main search criteria. Most of the papers did not use the term 'UX goal', but in the papers, we could still identify design targets related to UX. The findings were shared and then each researcher studied selected papers in more detail. We finally chose 46 papers that dealt with UX goal setting. In three consecutive workshops, the three researchers discussed the similarities and differences between the approaches, and iterated a framework in which the papers could be positioned. We started with a framework that included four viewpoints:

(1) UX inspiration from a designer's empathic understanding of the users' world
(2) UX inspiration from UX in a different field
(3) UX targets identified starting from basic needs and user values
(4) UX targets identified based on possibilities and challenges of a new technology.

During the iteration, we complemented the framework with an approach based on company brand. There were not many papers focused on this approach but we clearly identified it as an approach on its own. We also refined the definitions of the other approaches. We considered whether co-design, meaning user involvement in the goal setting, should be defined as an approach on its own, but we decided to include this viewpoint as part of the empathic understanding of the users' world, according to the original idea of co-design, to better understand users' dreams and experiences (Sanders and Dandavate 1999).

We ended up with a framework of five different approaches to getting insight or inspiration for UX goal setting:

(1) Company or brand image (Brand)
(2) Scientific understanding of human beings (Theory)
(3) Empathic understanding of the users' world (Empathy)
(4) Possibilities and challenges of a new technology (Technology)
(5) Reasons for product existence and envisioning renewal (Vision).

In our own cases, we could identify these approaches as illustrated in Table 1. The approaches were used in parallel or sequentially. When used in parallel, each approach contributed information to setting UX goals. When used

Table 1. An overview of the approaches used in our four cases to define UX goals.

Case UX approach	Mobile interaction with elevator	Gesture-based interaction in metal workshops	Smart interaction with a crane	Remote operation of a crane
Brand	People flow brand	Company image as an innovator	–	–
Theory	–	Emotional UX (Saariluoma and Jokinen 2014)	Emotional UX (Saariluoma and Jokinen 2014)	Systems usability (Savioja and Norros 2013) Core-task analysis (Norros 2004)
Empathy	Existing understanding of users' challenges in complex environments	Existing understanding of user tasks and context of use	User interviews	Field observations and user interviews based on the core-task analysis method
Technology	Mobile interaction	Gesture-based interaction	Automated, smart features	Remote operation technologies
Vision	Remote elevator operation	Freeing the user from physical control devices	–	Hands-on experience in remote operation

Table 2. Approaches to UX goal setting identified from the literature study.

Approach	Case studies	Other papers
Brand	Roto and Rautava (2008), Stompff (2003)	Schifferstein, Kleinsmann, and Jepma (2012)
Theory	Lucero and Arrasvuori (2010), Olsson et al. (2012), Savioja and Norros (2013)	Abeele and Zaman (2009), Desmet and Hekkert (2007), Hassenzahl (2003), Hassenzahl, Diefenbach, and Göritz (2010), Korhonen, Montola, and Arrasvuori (2009), Saariluoma and Jokinen (2014)
Empathy	Blythe and Wright (2006), Gruen et al. (2002), Kujala (2008), Mattelmäki and Battarbee (2002), Nielsen (2002), Özçelik Buskermolen, Terken and Eggen (2012), Sanders and Stappers (2012), Väätäjä et al. (2012), Gaver, Dunne, and Pacenti (1999), Leonard and Rayport (1997)	Edvardsson et al. (2012), Kaasinen et al. (2012a), Kouprie and Sleeswijk Visser (2009), Sanders and Dandavate (1999), Sanders and Stappers (2008), Sleesswijk Visser (2009), Wright and McCarthy (2008), Wright, Wallace, and McCarthy (2008)
Technology	Bowman and McMahan (2007), Häikiö et al. (2007), Jumisko-Pyykkö, Weitzel and Strohmeier (2008), Ljungblad (2008), Mäntyjärvi et al. (2004), Olsson (2012)	Kaasinen et al. (2012b), Väänänen-Vainio-Mattila, Väätäjä, and Vainio (2009)
Vision	Desmet and Schifferstein (2011), Hekkert, Mostert, and Stompff (2003)	Hekkert, van Dijk, and Lloyd (2011)
Other	Buxton (2007), Shedroff (2001), Sweet (1999)	Forlizzi and Battarbee (2004), Roto et al. (2010)

sequentially, each approach refined the UX goals defined in the earlier phases.

An overview of our literature study findings is presented in Table 2, showing the papers that we connected to each approach. Based on our analysis, it seems that different experience design 'schools' lean on one chosen approach rather than combine the approaches aforementioned. The reason may be that scientific papers typically only report the most effective, influential, and context-dependent starting points of experience design (Hassenzahl, Diefenbach, and Göritz 2010; Korhonen, Montola, and Arrasvuori 2009). Thus, it is difficult to trace the origins of the study to reveal how many sources of experience goals have actually been explored and trialled in a specific design case. Therefore, we can only conclude that the most reported starting point in the scope of our literature study is empathic understanding of the users' world and scientific understanding of human beings. On one hand, the way we categorise an individual study in one category is helpful in identifying which source is dominantly reported in current experience design research. On the other hand, we assume that experience goal setting leans on more than one approach in practice, but the current lack of knowledge about these approaches makes it hard to analyse and report this process. Our present work addresses this lack.

In what follows, we will define and describe the five approaches to UX goal setting in more detail. We will give examples of how these approaches showed in our own case studies and in related research.

4.1. UX goals derived from company and brand image (Brand)

Perhaps, the most obvious source of UX goals is company and brand identity. In the mobile interaction with elevator case, we utilised the brand promise that was focused on UX (People flow) as a source for UX goals. In the gesture-based interaction case, we identified a more general need to highlight the company as an innovative forerunner, and this was also shown in UX goal setting.

The brand-based approach is based on the idea that UX of products should be in line with brand experience, the image that a company wants to convey to its customers. The web sites of many companies are good examples of how brand identity is visible in design. Stompff (2003) addresses the problem that brand values are typically not visible in physical products. Stompff sees that a long-term relationship between the company and the designers is needed until the brand values become visible in products. Roto and Rautava (2008) describe how Nokia's brand promise can be taken into account when defining UX goals for all of the company's products. They include both instrumental and non-instrumental aspects in four high-level UX goals.

Schifferstein, Kleinsmann, and Jepma (2012) talk about experience-driven innovation rather than plain product design. They claim that it is not enough to change the UX-driven product design process, but UX has implications at three levels of an organisation: at the level of the company, at the level of the brands within the company, and at the level of the individual product or service offerings. Experience-driven innovation aims at a consistent company, brand, and product experience.

In the research, there seems to be a gap as regards the brand-driven approach to experience-driven product design. We believe that this is because academic UX research has been relatively distant from brand experience research. In industrial cases, brand should be a self-evident source for UX goals.

4.2. Deriving UX goals from scientific understanding of human beings (Theory)

Psychological theories can be used to explain why some experiences are satisfying and engaging for a user. In our studies, we were using emotional UX (Saariluoma and Jokinen 2014) as well as systems usability and core-task analysis (Savioja and Norros 2013) as theoretical sources for UX goals. From the literature, we identified many other theoretical frameworks that have been used to define the goals for UX. In the following, we discuss some of those.

In 2003, Hassenzahl presented an influential hedonic-pragmatic model of UX that highlights the importance of pleasurable experiences, such as stimulation, identification, and evocation, in addition to the traditional pragmatic, that is, instrumental, aspects, such as efficiency and effectiveness (Hassenzahl 2003). According to him, the hedonic aspects address a person's be-goals, such as being competent, being related to others, or being special. In their recent work, Hassenzahl, Diefenbach, and Göritz (2010) found that be-goals, or rather the universal psychological needs, are related to positive affect. Seven of these needs in particular, competence, relatedness, popularity, stimulation, meaning, security, and autonomy, are sources of positive experience with interactive technologies (Hassenzahl, Diefenbach, and Göritz 2010).

Desmet and Hekkert (2007) introduced a general framework for product experience applying to the affective responses that can be experienced in human–product interaction. They discuss three distinct components or levels of product experiences: aesthetic experience, experience of meaning, and emotional experience.

As an example of a practical tool for setting UX goals based on scientific understanding of human beings, we take the framework of PLEX (Korhonen, Montola, and Arrasvuori 2009). Based on the 22 different categories of PLEX in this framework, Lucero and Arrasvuori (2010) introduced PLEX cards to help the different stakeholders in the design process. An example of utilising PLEX cards as the starting point in designing for PLEX is reported by Olsson et al. (2012).

The existing scientific UX frameworks include several UX factors that can be employed as the basis for setting UX goals for design. Since the factors in the frameworks are at different abstraction levels, they may need either to be generalised or specified to serve as UX goals.

4.3. UX inspiration from designers' empathic understanding of users' world (Empathy)

By understanding users with empathy, the designers can obtain inspiration for products and services that provide good UX. In our cases, we used observation and interviews to gain empathic understanding of the users. User studies are, indeed, a frequent way to determine UX goals (Väätäjä et al. 2012). Empathic design was introduced as a concept by Leonard and Rayport as early as in 1997, even if at that time they did not use the term UX. They saw empathic design as a complementary approach to marketing research, contributing to the flow of ideas that still need further testing. When a company representative explores their customers' worlds with the eyes of a fresh observer, the company can redirect existing organisational capabilities to new markets. Wright and McCarthy (2008) see empathic approach to design as a part of the broader pragmatist approach to design. They see that 'knowing the user

in their lived and felt life' involves understanding what it feels like to be that person, and what their situation is like from their own perspective, that is, empathy.

Wright, Wallace, and McCarthy (2008) remind that good experience-centred design requires designers to engage with the users and their culture in rich ways in order to understand how the users make sense of technology in their lives. Empathy is at the heart of this approach. Kouprie and Sleeswijk Visser (2009) propose a framework for empathy in design 'Stepping into and out of the user's life'. Based on psychological literature, they distinguish two components of empathy: affective and cognitive. The affective component includes emotional response, feeling, and identifying with the user: becoming the user. The cognitive component includes understanding, perspective taking, and imaging the other: staying beside the user. Mattelmäki and Battarbee (2002) propose empathy probes to induce design empathy. With empathy probes the users can document their physical and social context, life style, attitudes, and experiences. The probes can be used to create an empathic and respectful dialogue between users and designers, and the probes support designers' empathic understanding of users. Sleeswijk Visser (2009) emphasises that knowing the users' world is important for designer motivation, and stories are good tools to contribute to this understanding. Successfully communicated user information provides empathy for users and inspiration for product ideas.

Our user studies often revealed negative feelings such as anxiety, uncertainty, or feeling alienated. These negative feelings can be transformed to positive UX goals such as avoiding anxiety in the smart crane operations, or sense of control and feeling of safe operation in the remote crane operation case. In the remote operation case, the user interviews emphasised the importance of fluent communication. Many work tasks include cooperation with teammates and fluent communication with them is a source of good UX. Thus, especially when considering work environments, the viewpoint should cover also the work team in addition to the individual.

Co-design can be seen as one form of empathic design. In co-design, the user's role changes from that of a passive research subject to that of an active design partner. Sanders and Dandavate (1999) were among the first to discuss 'design for experiencing', and their work has inspired the co-design movement. They introduced Make Tools to access people's feelings, dreams, and imaginations in order to gain inspiration for experience-driven design. Kujala (2008) showed that user involvement not only provides useful information about users' needs but also increases the understanding of users' values. Kaasinen et al. (2012a) propose that co-design can be supported with inspiring physical or virtual spaces in which users, designers, and other actors can meet informally and participate in design activities as equals.

All the aforementioned empathic approaches can provide information and inspiration for UX goal setting. Empathic understanding of the user's world makes it possible to step into the user's shoes and make decisions on the design details throughout the design phase. Furthermore, co-design enables making design decisions with the users.

4.4. *UX goals identified based on possibilities and challenges of a new technology (Technology)*

Technology push was one driver for change in all our case studies, as we were seeking for renewals through novel interaction concepts. We saw that, with UX goals, we can ensure a smooth introduction of new technologies to the usage context. UX goals help in drawing one's attention to the positive experiences that the technology can facilitate and, on the other hand, UX goals can focus on minimising the anticipated negative experiences such as a lost sense of control or a lost feeling of presence. Technology-driven design, or 'blue sky' technology research as described by Rogers and Bellotti (1997), is focused on developing novel technological solutions that often look beyond immediate commercialisation. Friction exists between these technology-oriented design approaches and the need to ground the designs in the practical needs and wants of users. For example, Ljungblad (2008) summarises previous criticism on the design of ubiquitous computing systems, noting that research often investigates the development of novel technological solutions, and that the actual scenarios are not properly justified or based on existing practice.

Our case studies give evidence that technology-based approaches can support UX goal setting if at an early stage one studies the positive and negative UXs that the technology can cause. UX goals can then be set to strengthen the positive experiences (such as *feels like magic* in one of our case studies) and to overcome the negative experiences (such as *feeling of presence* or *sense of control* as UX goals to minimise the negative experiences or remote control). There are various studies in which UX research has been carried out in relation to the development of new technologies, such as the studies by Kaasinen et al. (2012b) of intelligent environments, Olsson's (2012) studies of mobile augmented reality, the studies by Väänänen-Vainio-Mattila, Väätäjä, and Vainio (2009) of service UX of Web 2.0, and the studies by Bowman and MacMahan (2007) of immersion in virtual environments. The aforementioned studies aim to identify UX issues related to a certain technology by concluding findings from several studies. Even if the studies are based on evaluation results, they do introduce challenges and possibilities that can be utilised in UX goal setting in forthcoming design activities.

As the aforementioned findings show, there are quite a lot of research results of the possibilities and threats of different interaction technologies. These results provide a good basis for defining UX goals in order to utilise the possibilities and minimise the threats. However, focusing

on those possibilities and threats alone may be too narrow a view of overall UX.

4.5. *UX inspiration from investigating the deep reasons for product existence and envisioning renewal (Vision)*

Sometimes UX inspiration comes from investigating the deep reasons for product existence and envisioning renewal: vision from desirable possibilities, often taking inspiration from other fields. In our case studies, the case of remote operation of a crane looked for inspiration from other fields such as space operations, telesurgery, and mining. Mobile interaction in other fields was an inspiration for the case of mobile interaction with an elevator.

Hekkert, Mostert, and Stompff (2003) use the Vision in product design (ViP) approach for experience-driven design. They propose that innovative product design can be achieved by first abandoning presuppositions about the product and then developing the product by formulating three visions: a context vision at an appropriate level of abstraction; this is then advanced to an interaction vision, which states how the user interacts with the product, and finally to a product vision. ViP forces designers to free themselves from apparent restrictions or requirements and, instead, look for desirable possibilities. The designer empathises with the future user, but the user is not involved in the design process. Hekkert, Mostert, and Stompff state that, in this way, undesirable constraints resulting from the user fixations on familiar solution directions are avoided.

Desmet and Schifferstein (2011) do not provide a specific process for designing for experience, but rather a set of activities that one can utilise as needed. They divide these activities into three categories: Understand, Envision, and Create. Activities in the Understand category aim at understanding the user and usage situation. Envision activities help define the UX goal, whereas Create activities help conceptualise, materialise, and test new concepts. Envision activities include envisioning the UX goal and user–product interaction, as well as formulating the target product appraisal and the target product character.

The vision-based approach has good potential in creating something totally new, but as the connection to the user's world is quite loose, user acceptance of the visionary solution may not be guaranteed.

4.6. *Analysis of the UX goal-setting approaches*

In the following, we will further analyse the five UX goal-setting approaches. We aim to answer Research question 2: 'What kind of contribution do these approaches make in defining UX goals: What kinds of UX goals do they produce? What are their benefits and challenges?'.

The Theory and Empathy approaches aim to understand future users and their world, and to find a vision for desirable UX goals from there. The Brand, Technology, and Vision approaches are not as directly focused on users, but these approaches aim to find inspiration for the UX vision from the brand identity, technology, or the reason for existence of the product. Theory and Technology aim to find insights into setting UX goals and measurable targets, whereas Brand and Vision are more focused on finding inspiration. The Empathy approach is focused on both insight and inspiration. The five approaches bring in different viewpoints to UX goal setting and the resulted UX goals differ in the following way:

- *Brand*-based approaches can produce focused and easy-to-share UX goals such as 'Connecting People' or 'People flow'. The high-level UX goal may be directly available as the brand promise. The brand promise may need interpretation, as it may not be self-evident how the brand promise should show in an individual product.
- *Theory*-based approaches often provide a set of UX goals that cover thoroughly different aspects. The most important UX goals have to be chosen from the alternatives, for example, based on the results of user studies or brand identity. UX goals in work environments may be different from goals typically used for consumer systems. General UX goals may mean different things in different domains and to different users; so they need interpretation for each specific design case.
- *Empathy*-based approaches have potential in giving access to the deep emotional aspects of the users' world. When designing for work environments, empathy alone is not enough. Thorough domain and work analysis is needed, based on extensive studies of work activities and domains.
- *Technology*-based approaches may provide focused UX goals, but focusing on the possibilities and threats of a certain new technology does not necessarily cover all aspects of the overall usage situation.
- *Vision*-based approaches can help to define positive UX goals that can renew the product. UX goals may be different when exploring future possibilities vs. developing something to be put into actual use in the near future. Challenges can arise when the vision is far from the users' current practices, as user acceptance is difficult to foresee.

In Table 3, we present a summary of the contributions that the five approaches make to UX goal setting. In Table 4, we describe the benefits and challenges of the five approaches, based on our findings.

The interplay between the different UX goal-setting approaches supports the multidisciplinary nature of UX and gives different stakeholders possibilities to contribute to the goal setting. Using multiple approaches can produce multiple, even conflicting, UX goal candidates. On

Table 3. The contributions of the five approaches to defining UX goals.

Approach	Contribution to UX goal setting
Brand	A high-level UX vision to unite products under the same brand
Theory	A collection of possible UX goals to choose from
Empathy	A mindset focusing on the users' world
Technology	UX possibilities and UX challenges raised by a technical enabler
Vision	Getting rid of fixations on familiar solutions, inspiration from other domains

Table 4. Benefits and challenges of the five approaches to defining UX goals.

Approach	Benefits	Challenges
Brand	Pre-defined, focused, easy-to-share UX vision	Interpretation of the vision of UX goals for different products under the brand
Theory	Science-based evidence for the UX goals	Choosing the ones to focus on from a wide set of possible UX goals
Empathy	Mindset focus supports decision-making beyond the goal-setting phase	Gaining insights into the deep emotional aspects of differing users' worlds
Technology	UX goals support successful adoption of new technologies	Focusing on a certain technology may not cover all aspects of use
Vision	Support for renewal with UX goals	User acceptance of the visionary goals

the other hand, the different approaches may reveal similar goals, which give evidence of the importance of those goals. In our cases, we finally chose a set of 2–4 UX goals, which kept the design work focused. Focusing on a few UX goals helps in sharing the selected UX goals, committing the design team to those goals, and keeping those goals in everyone's mind throughout the design process.

5. Discussion

Experience design is gaining ground as an approach to designing interactive systems that address the emotional, not only utilitarian, aspects of product use. The starting point and the core of experience design is the definition of UX goals. Still, there is no prior research on different approaches to defining these goals. According to our literature review, the current approaches to UX goal setting seem to lean on one of several approaches, which keep the different schools of experience design separate. We see that a more thorough understanding of the different approaches would strengthen the core activity of UX goal setting, make reporting of experience design cases more systematic, and bring clarity to this growing but fragmented research field.

Based on the above goal, our first research question was to identify different approaches for defining UX goals. By reviewing the literature and by studying four cases of our own, we identified five approaches: Brand, Theory, Empathy, Technology, and Vision. The second research question focused on the contribution that these approaches make in defining UX goals. The different approaches each bring a different viewpoint. The *Brand* approach ensures that the UX goals are in line with the company's brand promise. The *Theory* approach utilises the available scientific knowledge of human behaviour. The *Empathy* approach focuses on knowing the actual users and stepping into their shoes when defining UX goals. The *Technology* approach considers the new technologies that are being introduced and their positive or negative influence on UX. Finally, the *Vision* approach focuses on renewal – whether a new kind of product experience can be introduced. Due to the multidisciplinary nature of UX, it is beneficial to use as many of the approaches as possible. This, however, may conflict with the need to have a limited set of UX goals for practical design purposes. Thus, UX goal setting requires consolidation of the contributions from the different approaches, so that the selected UX goals represent not just one but several viewpoints. The way in which these viewpoints are emphasised in UX goal selection depends on the case at hand, and may be driven by the perspectives of the stakeholders.

Concrete UX goals are especially useful in industrial contexts, where various stakeholders need to agree on what to design. Without clear UX goals, UX is easily left as a good intention without any concrete influence. Shared UX goals ensure that all who contribute to the design process have a clear conception of the targeted experience, and can make design decisions accordingly. In the design of industrial systems, the concrete UX goals help in keeping UX in focus throughout the complex, multidisciplinary product development and marketing processes.

UX is a multifaceted concept, and it can be questioned whether it is acceptable to try to narrow it down to specific UX goals. Is there a danger that we lose the idea of thinking widely about how people feel in different usage situations, if we focus too closely on a set of pre-defined UX goals? As in any design activity, focusing and concretising are necessary in order to clarify and communicate the design goals. However, we suggest that, at the same time, the wide UX viewpoint should be embraced when carrying out user and customer studies, so that it is possible to refine the initial UX goal setting when needed.

The targeted UX should show at the different touch points with the user, such as marketing, maintenance, and customer service. This emphasises that setting UX goals is a strategic decision that will require representation from

the whole organisation; the designers cannot make the decision alone. Based on earlier research, it might not be easy to convince all stakeholders about the importance of experiential aspects as design goals, especially when dealing with work-related products (Abramov and Roto 2012). Setting UX goals can benefit from multidisciplinary cooperation with the key stakeholders, such as experts from design, marketing, and maintenance. Involving the different units fosters understanding of the different perspectives on product design, builds commitment for the UX goals throughout the organisation, and helps in planning marketing that is in line with the UX goals. In this paper, we have focused on UX goal setting. How the set UX goals serve the actual design and marketing processes will require further studies.

Our four case studies each followed their own UX goal-setting process. However, the cases were part of a common research programme, where the researchers and practitioners shared a common vision of the necessity of concrete, focused UX goals in the design process. Each case involved a multidisciplinary design team, in which the participants brought into the UX goal setting the viewpoints that they, according to their experience, felt necessary. In future design cases, utilising the proposed framework of the five approaches will ensure that different viewpoints and their contribution to the UX goal setting can be considered even in less multidisciplinary design teams.

Our results indicate that the five identified approaches can be used for UX goal setting. There may also be other approaches that future research can reveal. An interesting path for future research is to study the different time spans of UX, namely anticipated, momentary, episodic, and cumulative UX (Roto et al. 2010). Moreover, additional case studies that systematically consider which approaches to use in UX goal setting can provide more evidence of the benefits and challenges of each approach.

Once the UX goals have been defined, the next challenge is to communicate them to the design team and other stakeholders, make the team commit to the goals, and utilise them in the design process. UX goals are not the only goals guiding the design, and there may be other goals from other parts of the organisation regarding maintenance, price, compatibility, and so on. In practice, UX goals need to be integrated with these other goals, in order to make sure that there are no conflicts. Further work is needed in studying the practical consequences of the UX goals in the design solutions. Our future plan is to investigate how UX goals are utilised in the later phases of experience-driven design, how the goals serve the design and marketing processes, and what kinds of challenges are encountered.

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Note

1. www.designandemotion.org

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