

How Design-inclusive UXR Influenced the Integration of Project Activities: Three Design Cases from Industry

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ABSTRACT

In this paper, we discuss how the implementation of design-inclusive User Experience Research (UXR) has influenced the composition of UXR and design activities in the industrial setting of Philips Design. We present three design case studies that were executed in a time span of three years: a baby sleep project; a pregnancy project; and a baby bottle-feeding project. Through a retrospective analysis we conclude that the approach adopted in these cases progressed from complete separation of UXR and design activities to design-inclusive UXR in which design forms an integral part of research. This is reflected by a rearrangement of project activities to *identify*, *envision*, *enable* and *evaluate* user experiences. Previously the UXR (*identify* and *evaluate*) and design (*envision* and *enable*) activities were executed sequentially. Now, these four project activities merge in studying design interventions in context over a prolonged time, to iteratively explore and advance UX design qualities.

Author Keywords

User Experience Research; Design-Inclusive User Experience Research; Design; Activities; Design Processes; Personalized Systems; Case Studies; Design Practice; Philips; Industry.

ACM Classification Keywords

H.5.2. User Interfaces: User Centered Design, Theory and Methods

INTRODUCTION

Over the years, the design space expanded to digitally driven products, services and systems that are interactive and connected. These solutions have the ability to move away from market-segment based solutions [21], that are tailored to a group of people, and become personal

solutions [3, 8, 25] that are user, usage and context dependent [24].

An example is Philips Hue [16], a connected light bulb which behavior can be programmed according personal preferences. The interaction can be context dependent (i.e. it can change color according weather conditions), usage dependent (i.e. it can learn about routines) and user dependent (i.e. it can adapt light settings to users in the room). We argue that designing for systemic solutions with high interactivity, context dependency and personalized uniqueness increases complexity. In the remainder of this paper we refer to these solutions as *personalized systems*.

User Experience Research (UXR) is challenged by these personalized systems as they operate in a design space with innate complexity. To cope with this complexity the UXR community articulates a design-inclusive approach to UXR [5, 7, 12, 22, 26]. Design-inclusive UXR proposes an active role for design prototypes as an enabler of experiences and a vehicle for asking questions in the established UXR methods, such as focus groups, questionnaires, contextual experiments and interviews. Following Vermeeren et al [26], design-inclusive UXR is “*UXR where design activities form an integral part of the research, that is, design as a part of, and contributing to UXR*” (p.22). Gaining user experience insights that are directly related to embodied design opportunities (prototypes) has two benefits: firstly, it helps to frame and gain insight into the user experiences which are otherwise hard to grasp, and secondly it iteratively advances the design itself [26].

We recognize the potential of design-inclusive UXR, as introduced by Vermeeren et al., in designing personalized systems and the role design can play in this [26]. However, current literature only lightly touches upon structuring and composing activities in the UXR processes to facilitate design-inclusive UXR. Therefore, we see value in sharing our experience of applying design-inclusive UXR in practice. Exemplified through three cases studies, that were executed at Philips Design over a timespan of three years, we reflect on the changing composition of UXR and design activities. By sharing our retrospective analysis, we set out to the CHI community to, in collaboration, formalize the application and integration of design-inclusive UXR in industry projects.

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BACKGROUND & RELATED WORK

In our understanding one can distinguish two perspectives on the integration of design and UXR: (1) research into involving design in UXR and; (2) research that sets out to involve UXR (qualities) in design.

Design in User Experience Research

Over time multiple perspectives arose on what user experiences entail. We follow Hassenzahl and Tractinsky [9] who reflected upon these perspectives and state that “*UX is about technology that fulfills more than just instrumental needs in a way that acknowledges its use as a subjective, situated, complex and dynamic encounter. User experience is a consequence of a user's internal state, the characteristics of the design system and the context within which the interaction occurs*” (p.95). This formulation of user experiences considers a big influence of design next to the user, the context of use and the interaction between those.

In the UXR field Vermeeren et al. [26] further underpin the potential of design in UXR through their design-inclusive UXR approach. They distill opportunities for the UXR discipline to be (more) involved in generative phases of design projects by using design prototypes as vehicles for asking questions over UX design testing in the final phases of the project only.

Van Velsen et al. [25] further highlight design-inclusive evaluation techniques tailored to personalized systems. Their work suggests (1) iterative evaluation of personalized systems by providing users with a version (prototype) of the system and suggests (2) information gathering about the usage through triangulation of subjective (qualitative) evaluation methods and data logging (a video recording of usage) [2, 10, 25, 27]. To embrace complexity, Velsen et al. suggest (3) to execute these evaluation methods in real-life settings with a longitudinal character [11, 25].

User Experience Research in design

From the design perspective a similar movement can be recognized aiming to integrate (qualities of) UXR in design activities. Methods such as co-design [19], co-reflection [23], participatory design [14], living labs [13], and Experiential Design Landscapes [3] are clear examples of this. According Zimmerman, Forlizzi & Evenson [28] the increased complexity present in current design challenges is the reason for design to move towards settings in which user, design and context come together (qualities of UXR). They highlight that complex challenges, which are often named *wicked problems* [24], do not require “*true understanding*” but “*real understanding*” and request the “*right solution*” instead of the objective or “*true solution*”. In other words, they set out to find understanding that is situational and build towards a solution that resonates with that user in that context.

Design in User Experience Research and vice versa

It is distinct that design is in need for more situated experiments and explorations as their problems become ungraspable. And UXR wants to embrace complexity of experiences that are, next to the user and context also, design

dependent. Therefore, these two disciplines have started to involve (parts of) the other discipline.

The arguments for involving UXR in design and vice versa are clearly expressed. Vermeeren et al. [26] even literally answer the questions why it can be useful to include design in UXR and how UXR outcomes can support the design practice. What could be investigated further is *how* design-inclusive UXR can be carried out in design practice. More specifically we want to reflect how to set up and align UXR and design activities for design-inclusive UXR in an industrial context like Philips Design.

DESIGN AND UXR IN OUR COMPANY

Earlier we deliberately exaggerated the separation of the UXR and the design community to clearly outline how these relate to each other. The relation between these communities is much more blurred with hybrid members being present in both communities. This is not different in industry, but the way these disciplines are organized in our corporate context is distinctive. To clarify, we briefly outline the setup of our groups and teams at Philips.

Philips, a Dutch one-century old multinational, developed itself into a company with multiple businesses, ranging from consumer to professional health related products, services and systems. The company vision is to deliver meaningful solutions that improve people's lives. To do so, we are structured in different businesses (such as Mother and Childcare, Sleep and Respiratory Care, Diagnostic Imaging, Domestic Appliances, etc.) that know the stakeholders' needs, drive sales and manage their product portfolios. Break-through innovations are not solely developed in the separate businesses but are fueled by an overarching innovation group. This group consists of two large departments: a technology/science research department (1200 employees) and a design department (400 employees). These innovations can be picked up by the separate businesses to further develop and introduce to the market.

With a strong industrial design heritage, Philips Design has come to focus on front-end innovation projects next to classical formgiving tasks. To drive people-focused innovation Philips Design has a dedicated UXR of about 30 people worldwide, group. The UXR group is appointed to gain insight in user experiences and to transfer these to designing market-potential products, services and systems that are meaningful and relevant to people. Other design teams within Philips Design take up the challenge to design these meaningful product-service systems. In-house design competences include e.g. interaction design, service design, product design, design strategy and data visualization design.

In the setup of these groups one can recognize a clear split between design and UXR disciplines. It is expected that these groups become experts in their field and bring the best to the table when coming together in multidisciplinary project teams.

At this moment, Philips is going through a radical transformation from a hardware manufacturer to a digital product service company. This requests a different approach and mindset to designing digitally driven products, services and systems, which we earlier introduced as personalized systems. The front-end innovation teams work hard to come to new ways of working that fits this digital transformation.

NAMING ACTIVITIES

Design-inclusive UXR projects that are currently presented in literature [26] do not describe how UXR and design disciplines, represented by different people, need to cooperate to embrace complexity. Neither does it tell us how the distinct design and UXR activities need to be re-arranged. This also makes that there are no activity-labels available helping us to analyze the arrangement of activities in the three case studies.

For categorization of UXR and design activities we build on Schön's *reflective practice design process* [20] steps. We choose this process as a starting point because of its iterative character where, through reflection, design opportunities and knowledge gaining go hand in hand. We recognize this as a good fit for addressing the challenges of personalized systems. This process consists of four activities: (1) *naming* the relevant factors in the situation, (2) *framing* the parameters of the problem, (3) *moving* towards a solution, (4) *evaluating* the moves and framing step. Since we approach these activities from a UXR perspective, we slightly alter the formulation of the activities to (1) *identify*, (2) *envision*, (3) *enable* and (4) *evaluate* user experiences. The *identify*-activity aims to identify opportunities for design, based on existing user experiences. The *envision*-activity has the intention to put these user experience insights in a future perspective; how do we wish to transform them? In the *enable*-activity the focus is on enabling participants to experience envisioned design concepts. In the *evaluate*-activity the earlier activities come together to evaluate the future vision through design prototypes. By renaming the original activities for UXR we aim to give more focus to the understanding of user experiences and designing for these.

CONTEXT OF CASE STUDIES

We present three case studies for which we describe their arrangement of UXR and design activities and their outcomes. From the big pool of internal Philips Design projects, we selected case studies: (a) that were executed in the past three years; (b) that aimed to design for personalized systems and thus faced the earlier outlined complexity challenges; (c) that were executed by a team of which at least one of the authors of this paper was part (to know the activity arrangement and project outcome details); (d) that had an activity arrangement which was representable for a bigger group of projects (unique project setups were excluded).

From the projects that met the inclusion criteria we selected three cases that were all executed in the same application domain (a domain of family care) making it easier to compare the projects.

In the domain of family care Philips aims to deliver health solutions anywhere on the timeline from fertility to two-year-old children. From an experience point of view, the focus is on delivering meaningful experiences, which we try to achieve by making them more personal, continuous and connected. The first project focusses on babies and their sleep, exploring service opportunities for sleep-monitoring technology. The second is a pregnancy project, which aims to design a coaching service that stimulates pregnant women to be more active. The third is a baby-feeding project, which explores how to design for personal and connected feeding experiences.

All three case studies set out to investigate or deliver a personalized system, but the arrangement of UXR and design activities varies. We will reflect upon the different cases to define what characteristics of design-inclusive UXR (earlier described in literature) they employ and what influence it has on the arrangement of design and UXR activities. To recap, design-inclusive UXR is characterized by using design as an enabler of user experiences; having design activities as integral part of research [26]; and considering user, context, design and the interaction between those when studying user experiences [9]. To evaluate design-inclusive UXR in personalized systems we review the case studies on the characteristics described by Velsen et al.: situated testing; combining qualitative methods with data logging; and having a longitudinal character [11, 25].

In a retrospective analysis, we evaluate the outcomes of the case studies through three criteria, of which two were earlier introduced as the benefits of design-inclusive UXR: (1) the level of UX insights and (2) the level to which UX design iteratively advances. We add one evaluation level that is ever present in the industrial context we are in, namely (3) the level to which UX design of the personalized system is scalable. With scalability, we refer to the feasibility and effort needed to make a UX design market-ready.

CASE STUDY 1: BABY SLEEP

The start of this case study was in the research department of Philips, where they developed a new technology that could monitor baby sleep. Based on video analysis, the technology can detect when a baby is in or out of bed and awake or asleep. The request for the design department was to come up with a meaningful product, service or system building on the value of such technology. This design project took place in 2013 and had a lead time of 4 months.

The design team (consisting of two interaction designers, two service designers and a project manager) needed understanding of existing experiences and behaviors of parents in the context of baby sleep. Therefore, they requested two members of the UXR team to *identify* existing user experiences and behavior through desk research (e.g., reading parenting blogs and forums). The resulting insights on parenting dilemmas, limitations and needs were communicated back to the design team in the form of an experience flow [15] and a persona [17].

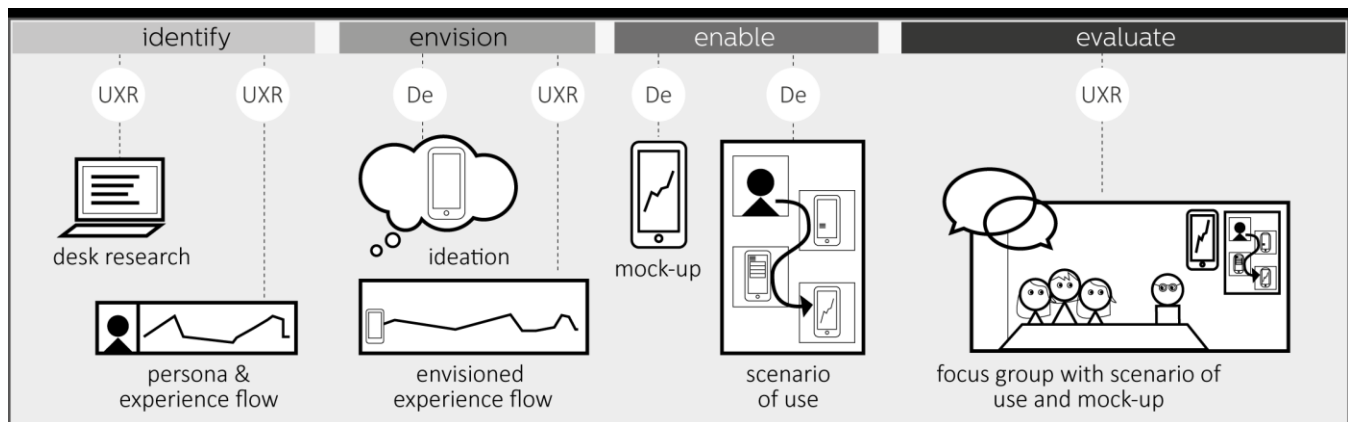


Figure 1: Process overview of activities in the Baby Sleep case. A linear process with separated activities for UXR and design (De).

This user experience knowledge, together with the technical features of the baby sleep algorithm served as input for the design team to further *envision* the service proposition. The design team created an app concept that shows baby sleep data while the baby is in bed (figure 2-left), presents visualizations of baby sleep data over a longer period (figure 2-right), and provides parents with advice, either generated by the system or through online remote expert consultations. When the *envision* activity ended, the UXR was asked to execute a new activity. Namely, to map this ‘envisioned’ user experience on the original experience flow. This helped the design team to recognize potential areas for novel, meaningful user experiences and showed possible improvements of the concept. With the ‘envisioned’ user experience flow the design team finalized their concept and created a clickable demo app presenting fictional baby sleep data. The data was neither actual data of the participants’ baby, nor real data of any other baby.

To *evaluate* the potential of the design, the two UX researchers were approached again, this time to set up focus groups. Twenty parents participated in two consecutive focus-group sessions, held at the company’s venue. During their first visit, the clickable demo app was presented by the UX researchers, accompanied by four scenarios of use (i.e. a parent opens the app while the baby is in bed to see if the baby is sleeping). Participants could respond to these scenarios by using verbal feedback, or by writing/drawing on printouts of the mock-up app screens. Comments of the first focus group were mainly about the look and feel of the product enabling the design team to undertake design updates. The new design was presented (via same means) in the second focus group (with same participants) to notice whether the look and feel suggestions were understood correctly. The insights and conclusions from the *evaluate* activity were captured by the UX researcher and communicated in a digital report to the design team.

After the project a business transfer occurred, meaning that the Mother and Childcare business together with Philips Research continued developing the solution towards a market launch.

Case Study 1: Reflection

Reflecting on the level of design inclusion in UXR activities this project scores low. The *identify* activity did not take any design into account. By contrast, the evaluation activity did involve mock-ups and scenarios aiming to be a vehicle for asking questions. However, the enablers for *evaluation* were presented out of context, contained artificial (i.e. fake) sleep data only and required users to imagine interacting with the system instead of a longitudinal test where users could experience the concept. When comparing these activities with the characteristics of design-inclusive UXR earlier identified in literature, we argue that this project, aiming at designing personalized system, did not follow the design-inclusive UXR approach. Neither in the *identify*, nor in the *evaluate* UXR activities.

Level of insights gained in UX

From a business perspective, the sequential arrangement of activities of this project (see figure 1) and the predefined UXR and design roles seemed a relatively fast way to gain understanding in the user experience and to design for these.

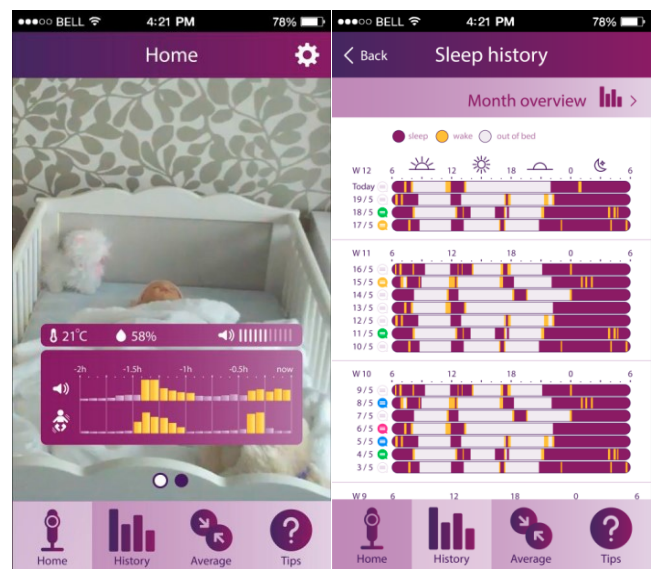


Figure 2: Artificial baby sleep data visualization while the baby is in bed (left) and over a longer period (right)

However, we argue that this setup limited the user experience insights since the feedback of users was based on imagination only (supported by a scenario and mock-up) and did not emerge in interaction of user, context and design. Besides, the design mock-up used artificial data in their representations that may deviate from real data and thus feedback of the user might be based on never existing scenarios. Since participants' feedback was more about the look and feel of the mock-up than the possible added value to their lives, one can question whether this project gained any insight in the experience designed for.

Level to which UX design has iteratively advanced

This case study illustrates a process in which UXR and design roles are separated and in which formal transfer of knowledge and concepts occur. Like how the UXR team handed over experiences flows, capturing the insights from the *identify* activity, to the design team to *envision* possible solutions. This sequential, non-circular arrangement of activities is a result of the limited consultancy role of UXR. Only in the *evaluate* activity the (look and feel of the) design was iteratively advanced through UXR insights.

Level to which UX design of personalized system is scalable

The project outcomes of this case study were picked up by the Mother and Childcare Business Unit for further development on the roadmap but was delayed at a later stage. Even though the project started with a prototype of the technology at hand, the project missed a nuanced translation of UX insights into a scalable application of the technology. This might be effected by strong simplifications of the concept and mock-up, such as artificial data implementation and not defining how the system could be personalized. In developing mock-up screens for the personalized system, we think we might have required more conscious considerations of the implications of our design decisions and thereby less easy step over the limitations of the technology.

CASE STUDY 2: ACTIVE PREGNANCY

The goal of this project was to design a service that would stimulate pregnant women to walk more during the day, as the Philips Research department had concluded that most pregnant women are not physically active enough for a healthy pregnancy. Philips Design took this as a relevant challenge to design for. The project was executed by a team composed of three UX researchers, an interaction designer, service designer, a research scientist and a project manager. This case study dates from 2014 and took 5 months.

The UX researchers of the team started the project with desk research and interviewing healthcare professionals to *identify* current behaviors and experiences of pregnant women around physical activity. The coaching strategies described by Cialdini [4] appeared to be relevant to the challenge at hand. The UXR team members created an experience flow accompanied by four personas that each matched one of the four coaching strategies of Cialdini. Both the experience flow and personas were *evaluated* and

updated based on interviews with six pregnant women and (the same) four professionals.

As a follow-up, the project team, with both UXR and design members, *envisioned* a concept for a mobile application in which pregnant women are coached according coaching strategies inspired by Cialdini. In this concept, users are appointed to a certain coaching strategy and a personal goal (number of steps to take per day). In case this strategy shows not to be effective (i.e., the step count did not increase), the user will either be presented with a different coaching strategy or the goal will be adapted. An experience flow captured the envisioned, dynamic service flow and associated envisioned user experiences of this concept.

To *enable* experiences in context, the project team, again both UXR and design team members, specified functionalities of an experiential prototype. Based on a pre-defined action plan and a list of specifications, an external software development team built a simple Wizard of Oz [6] version of the mobile application. This prototype could collect and visualize the number of steps taken and could display coaching messages. The data analysis, coaching messages and effectiveness monitoring were not automated in the experiential prototype. Instead, data of each walking session was sent to the project team via e-mail. By sending an email back to the experiential prototype, the team could display a so-called coaching message in the app.

In a four-week test with twenty pregnant women the envisioned coaching strategies were *evaluated*. The participants started with a collective introductory meeting to explain the functionality of the app. Participants were not informed about the 'human back-end' of the application that *enabled* the team to explore different predefined ideas during the evaluation. After every week of testing, participants individually filled out intermediate online questionnaires. These online questionnaires aimed to evaluate the pregnant women's perception of her physical activity level and coaching strategy. The test ended with a collective evaluation interview with the pregnant women to reflect upon their experiences of the coaching application.

The project insights on the coaching strategies for pregnant women were captured in a presentation that landed in a behavior change group of Philips Research but the design concept was not picked up yet by a business unit for further development.

Case study 2: reflection

Different from the previous case study this project clearly employs design-inclusive UXR characteristics. In the evaluative activity, it met all design-inclusive UXR requirements. For example, it used the Wizard of Oz prototype as enabler for UXR research and involved design as an integral part to find out what coaching services resonates with pregnant women. Likewise, the experiment was executed in a real-life setting for a period of four weeks

and did collect both qualitative (experience) insights as well as data logging (behavioral) insights. However, the design-inclusive UXR characteristics were not present in the *identify* activity; UXR insights were still gained without design involvement.

Different from the first case study, this project was executed by a multidisciplinary team with backgrounds in both design and UXR. To facilitate this cooperative process of UXR and design, prior existing consultancy roles disappeared. This new arrangement of roles prevented formal knowledge transfers and unlocked discussions about UX insights. Besides the project breaks with the strictly linear organization of activities (recognizable in the first case study) as illustrated in figure 3. Namely, an *evaluate* phase follows the *identify* phase. Moreover, there was a large overlap of *enable* and *evaluation* activities towards the end of the project highlighting that the previous designed *enable* activity overlaps with the originally UXR-led *evaluate* activity.

Level of insights gained in UX

The user experience insights of this project's *evaluation* activity were richer than the previous case study as it enabled participants to experience the concept in their own context, instead of asking participants to imagine an experience out of context. Besides, the quantitative and qualitative data gathering combination allowed the team to gain insight in both user experience and user behavior. Interestingly there was a discrepancy between the two as women thought they were more active (result of interview) than they were (seen in the data) and vice versa. This type of user experience insights sparked ideas for coaching strategies.

The *identify* activity did not involve design to gain insight in the user experience. However, the team tried to find a way to deal with the complexity challenges forwarded by

personalization. Namely, they created multiple personas instead of a single persona that need to be the representative of a group.

Level to which UX design has iteratively advanced

The Wizard of Oz prototype allowed for evaluation of real (not imagined) experience in context and over a longer period (four weeks). In this set-up, adjustments could easily be made (change of strategy and/or goals) to explore what resonates with users. Evaluation of these adjustments were informed by both quantitative and qualitative data from participants gathered by enabling the user experiences (number of steps, exercise times and verbal comments). In the change of strategy or goals the team followed the predefined design service flow ('envisioned flow'). Thereby the evaluation considered the dynamic features of the UX design but did not iteratively advance the design service flow itself.

Level to which UX design of personalized system is scalable

The UX design outcomes of this project took the concept of personalization into account but was limited to coaching strategies between which the user could switch (i.e., there was a limited set of options). This was a clever way to design for user experience that might feel tailored and unique but in fact is a multi-pathway service flow.

Unfortunately, the potential to transfer this personalized system and insights to the market was low because the concept did not take any technical feasibilities into account. Namely, the 'human back-end', of the Wizard of Oz prototype, intuitively responded to events. Building an algorithm and system rules with that level of empathy would be very hard. Neither knowing the limitations of an automatic system nor the effect of such artificial equivalent on the user experience questions the business relevance of the obtained UX insights and design from an industrial perspective.

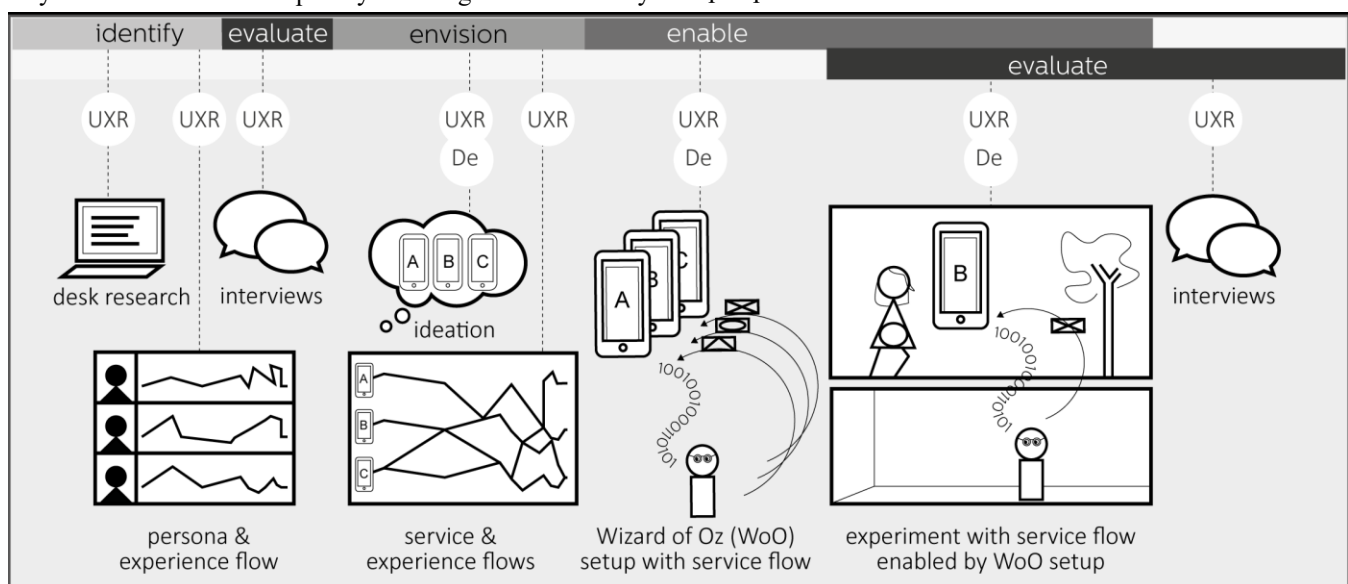


Figure 3: Start of integration of activities and roles of UXR (UXR) and design (De) in the Active Pregnancy project

CASE STUDY 3: BOTTLE FEEDING

The third case study is a Philips Design initiated project that aimed to explore parents' experiences related to baby bottle-feeding. This to recognize opportunities for a personalized service around a 'smart' baby-bottle [1] that might give the baby product business a push towards a more digital portfolio. In 2015, this six-months project ran with a team of two UX researchers, an interaction designer, a service designer, two hardware/software prototype specialists, a project manager and two students from data science and child development studies.

The project (see figure 4) started with desk research to *identify* the existing landscape. More specifically the team gained insight in what was known about bottle feeding (how to prepare a bottle, recommendations from parents, etc), what smart baby products exist (a few) and which datasets (none) are available.

In a workshop facilitated by the UX researchers, the whole team *envisioned* what factors, found in desk research, might be relevant in the user experience of bottle feeding. The team wanted to *evaluate* whether the pre-identified factors of the user experience were indeed relevant in the user experience of bottle-feeding. And they wanted to *identify* other influential factors of which they did not think upfront. To do so, the team set out to quantitatively collect data of bottle-feeding behavior with three sensors (an accelerometer, a temperature sensor and a clock). The so-called data-gathering probe *enabled* the team to gain insight in the existing handling of the bottle through quantitative data gathering. In designing the data-gathering probe it was important to think of unobtrusiveness. Otherwise the probe might interfere with current routines and thus would not reveal existing user behavior and experience.

The team invited five families with babies aging from 2 to 11 months to use the data-gathering probes for two weeks. In addition to the unobtrusive collection of sensor data, the participants were visited by duos of the project team (a UX researcher accompanied by a soft/hardware prototype expert) for introduction purposes. In that visit the team also handed out a paper diary [2], aiming to collect qualitative insights of the bottle-feeding experiences. During an evaluation session (with a UX researcher accompanied by a designer) at the parents' home, both the diaries and collected data (in the form of simple visualizations) were discussed in an open interview setting. The investigation of existing user experiences and behavior of bottle-feeding concluded with the creation of one experience flow and one profile per family. These flows captured both data gathered with the probe and the qualitative input received from the diaries and interviews. Instead of making a persona from all information available, the team envisioned what factors might be relevant for later personalization purposes.

Consequently, they set out to make a profile which can be (automatically) filled out (through data) for each user that would buy this product in a store. To do so all team disciplines were present in this activity.

From the first user involvement session parents showed interest in viewing their baby-bottle data, since it reveals details otherwise invisible. However, it was not yet clear what a design proposition exactly had to entail to be of value to families. The fact that a personalized system, like such a smart baby-bottle, might have functionalities that are user, usage and context dependent made it even more difficult to define a UX design concept at that moment in time. Therefore, the multidisciplinary team set out to *envision* what direction the concept might go into and on what levels it could tailor to the families.

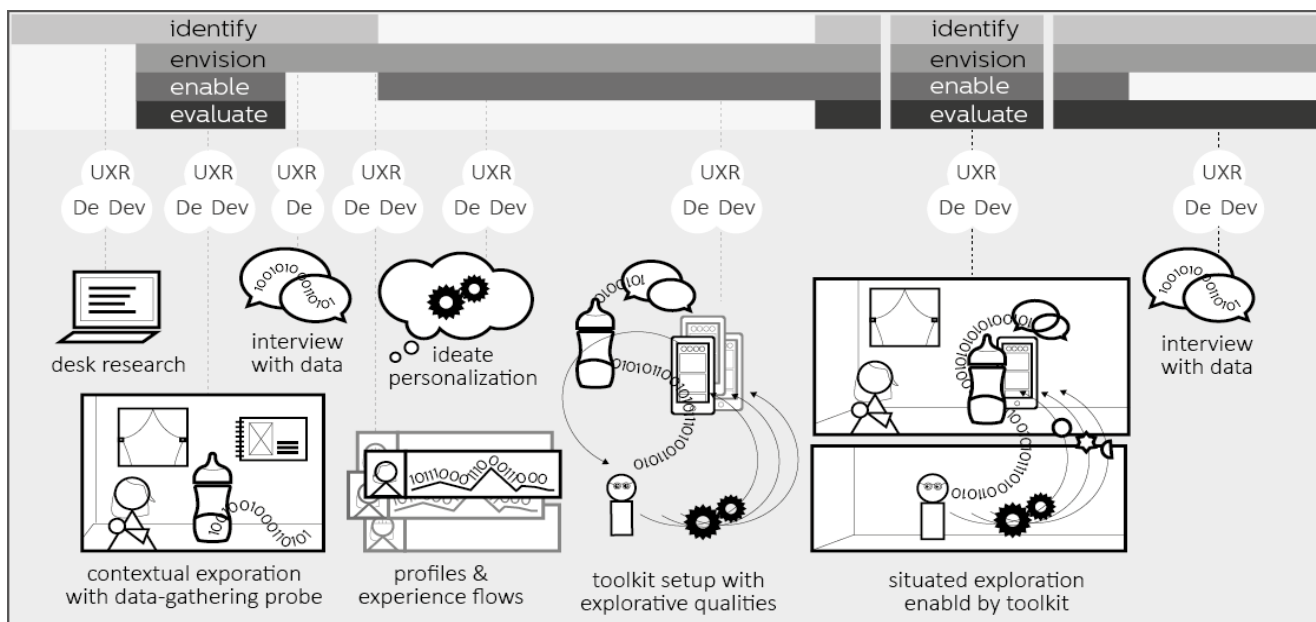


Figure 4: Process overview of activities in bottle feeding project with continuous design-inclusive UXR

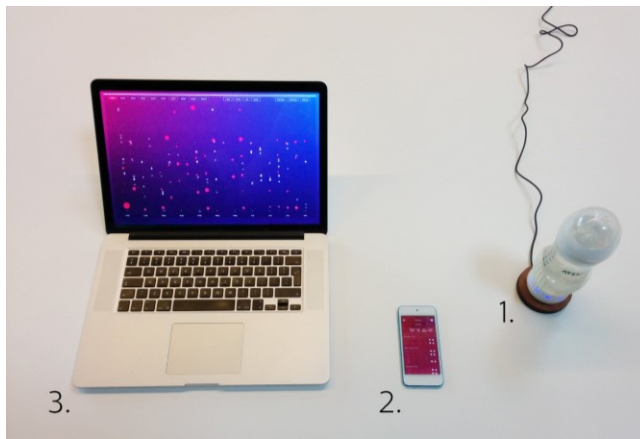


Figure 5. Overview of experiential toolkit elements: (1) Data dashboard, (2) The app and (3) The sensor sleeve.

Instead of predefining a specific service flow (like in the second case study) the team decided to create a toolkit to *enable* exploration of these user experiences. The toolkit (see figure 5) consisted of (1) an updated version of the data-gathering bottle add-on (i.e., light and sound sensors were added as one of the user experience factors not thought of in the first probe). (2) A mobile application for the participants to experience the to-be explored service and to stay in contact with the project team. And (3) a dashboard that visualizes the collected data for the project team.

Building empathy remotely through this combined dataset enabled the project team to act manually as a system. Although, algorithms to automatically detect feeds and update data visualizations were present in the application, all “insights” on the experience were sent manually by the project team. During the field study the team could update the functionalities, data visualizations and the look and feel of the application remotely. Thereby the concept altered from data visualization, to sending the right educational information at the right time to personal insights based on correlations between data points indicating a build up of insights and complexity over time.

The toolkit was handed out to nine, not prior participating, bottle-feeding families with babies aging from 2 to 11 months. The three-week situated exploration started with a collective meeting at the company’s venue in which participants received the bottle add-on and an iPod with the application installed. Thereby they were *enabled* to experience the concept exploration. The application chat functionality, and weekly online questionnaires facilitated participants to elaborately *evaluate* the concept and thereto related experiences.

At the same time, the whole project team could send questions to the parents (via the app or online questionnaires) to *identify* newly relevant factors and *envision* concept updates. These questions were related to the user experiences, presented functionalities, look and

feel, technical errors, and the displayed ‘insights’. The situated exploration ended with evaluation interviews executed by the UX team members. In these interviews families reflected upon their participation which helped the team to *evaluate* the iteratively developed design, to *envision* with end-user what improvements could be made and to *identify* topics that benefit more exploration.

The optimistic responses about the user experiences and the positive routine changes, which can be recognized in the data of the participating families, made the business decide to transfer the project and start developing the concept for market launch.

Case study 3: reflection

This third case study clearly illustrates design inclusion in UXR. Where the second case study had design-inclusive UXR characteristics in the evaluative activities only, this project executes design activities (*envision*, *enable*) as an inherent part of UXR. Ultimately, it even starts to merge the *identify* and *evaluate* activities. In contrast to the second case study, which used a prototype to evaluate the design service flow, this case uses custom created explorative means to identify newly relevant user experience factors. This way the team could directly bring these alive in the design concept, which could then be evaluated with participants.

To be able to do so, the project team was composed of a richer set of disciplines (design, UXR, hardware and software development, data science and psychology expertise) that worked closely and continuously together (one team, one location). Instead of assigning different activities to different disciplines with project sub-goals, the team had a common goal of *identifying*, *envisioning*, *enabling* and *evaluating* user experiences of a personalized system. As decisions made by one discipline could influence the other disciplines, the team had to closely work together and constantly stay aligned. For example, one technical decision about databases could limit data visualization possibilities, means for insight gathering and thus the exploration of “insights” to be send back to the parents. The team ensured a dialogue of decisions through short daily meetings.

Level of insights gained in UX

The method through which the UX insights have been gathered in the third case study can be compared with the second case study. Also, UX insights were gained by enabling ‘real’ experiences in context over a longer period. Again, by combining qualitative methods with data gathering, insights were not limited to experiences only, but encompassed behavioral patterns too.

New in this case study is the collection of user experiences of multiple users in the same context. This allowed for interesting in-family comparison of behavior and experiences (i.e., we recognized different bottle feeding preparation types due to different believes of ‘a good’ bottle

temperature). Furthermore, the first part of this case study was characterized by the collection of UX insights of the currently existing situation that was not yet influenced by design interventions. Seeing data and hearing about experiences of these often unexpected, ‘real’ situations fueled many design ideas for the experiment after.

During the first experiment of this case study we collected data for three weeks and presented these in the evaluation interview. There we noticed that participants found it hard to recall details of user experiences that happened in the past. Therefore, the toolkit of the second experiment ensured that we could continuously question and prompt for user experience insights through remote access to the data and remote questioning. Recognizing changes in experiential and behavioral data of gradual design adjustments was a positive effect of this feature.

Level to which UX design has iteratively advanced

The process of this case study is characterized by almost a total overlap of four types of activities and integrates design, UXR and development. Originally, like illustrated in case study one, these activities were separately executed by design and UXR disciplines. Now these come together in an iterative process (figure 4). The dialogue between these disciplines in different activities increased significantly through the data-intensive approach used in this case study. Not only to remotely collect UXR insights, but also to explore UX design and development through remote interventions. This explorative freedom to continuously ask questions, change designs and understand effects, reduced the time of exploration present in the more linear processes.

Level to which UX design of personalized system is scalable

The result (prototype) of the toolkit with high flexible qualities, for quick adjustments and evaluation, was not yet a marketable system. It has automated and integrated its core functionalities, like feeding detection, but it misses algorithms to send personalized data-based insights to the families. Though, this case study differs from the second case study’s ‘human back-end’ that coached pregnant women through data and personal encounters (like getting to know the participant through the introduction session). In this case the information pool of the ‘human back-end’ was limited to the bottle-feeding data. Thus, choices for sending “insights” were merely made through data insights and did not derive from empathy for the participants. After the study, we sat together with the ‘human back-end’ and unraveled the logic that occurred in sending out the “insights”. That logic is now used as inspiration for building the “insights”-algorithm. So, the gradual steps of design, UXR and development have minimized the next steps to a scalable and meaningful personalized system. The result of the project is not a marketable system but clearly outlines which technical challenges were skipped and development is required.

To live up to the specific demand of industry to deliver UX design that is scalable and can be brought to market, we recognize that design-inclusive UXR was not enough. The case study benefited from hardware, software and data science involvement. Involving these competences in design projects is not new. However, these disciplines were not involved to create a ‘working-prototype’ of a design concept, like traditionally would happen. Instead they build a toolkit by which the design concept, and technologies affiliated, could iteratively advance. This required a new mindset for these disciplines of not building a rigid and solid system but rather a flexible system that could grow, according UX insights.

DISCUSSION

We presented three case studies, executed in industry, that all aimed to design personalized systems in the domain of Family Care. These projects evolved around very personal topics that were challenged by high complexity, context dependency and conflicting perspectives [18].

The case studies from design industry shows a trend of implementing more design-inclusive UXR characteristics that were earlier defined in academic communities [26]. The first case study showed no design-inclusive UXR characteristics and fully separated design and UXR activities. The second study took advantage of design-inclusive UXR in the evaluation phase of the project but not in the earlier phases. The third case study builds on design-inclusive characteristics from the start and continues the integration of design and UXR over the project.

Re-arrangement of activities and roles

We questioned how the separate UXR and design disciplines, existing in our industrial context, needed to rearrange their (*identify, envision, enable* and *evaluate*) activities to cope with the complexity challenges forwarded in designing for personalized systems. The case studies have shown a shift of progressively integrating different activities of the UXR and design process that were earlier executed separately by the either design (*envision, enable*) or UXR (*identify, evaluate*) discipline.

The transition emerged in the quest to setup situated explorations in which insights are gained in ‘real’ and prolonged situations to iteratively advance UX design. Such UXR cannot go without design involvement as user experiences appear in the interaction between user, design and context. Striving for situated explorations, the UXR and design disciplines transitioned from sequential involvement to a continuous multi-disciplinary approach where they worked intensively together. By activities and working as one team at one table, more continuous and less formal knowledge transfers occurred, reducing the chance of losing nuanced user experience in translation to design.

The integration of project activities and competences has not affected the organizational setup of Philips Design, where competence groups are still clearly split. However,

case studies like these have fostered the informal integration of competence groups from bottom-up. Through project experiences and the establishment of virtual horizontal communities, we are keen to advance cross-competence knowledge, methods and approaches.

Categorization of activities

To better understand the user experience components of UXR and design activities in our retrospective analysis, we renamed the four activities of Schön's *reflective practice design process* [20]. Looking back, we notice that Schön's reflective mindset is still embedded in the activities at hand. Namely, with the merge of design and UXR activities, the reflections in the case studies, informing design or UXR decisions, occurred in a blur of activities where reflections from UXR informed design and design reflections informed UXR to gain rich insights (see figure 1, 3 and 4).

Compared to Schön's comprehensive *naming*-activity our focus is more on *identifying* existing user experiences and the opportunities these create. This is different from the approach to clearly formulate a *problem*. Unlike the analytical *framing* activity, the *envision* activity stresses the empathic designerly skills to *envision* how a design prototype can *enable* meaningful user experiences. There is more focus on designing for experiences which can be revealed by the prototype than to make a functional prototype (as described in the Schön's *move* activity) that can only be looked at or solely operated by the design research team. And the *evaluation* activity has much overlap with Schön's description, apart from stressing the value of situated and prolonged experimenting.

Investment of design-inclusive UXR

When reviewing the three case studies one might recognize an increasing trend of lead times and people involved. These design-inclusive UXR projects seem to request a bigger investment to be executed. We affirm that setting up a situated exploration for UXR, design and development increased the preparation time. But once it installed it reduced the time per exploration cycle and ensured iterative explorations of design through user experience insights. Likewise, when we would zoom out and review the innovation process together with the development process (that comes after a business transition) we could argue that these two blur. By taking a feasibility perspective early in the innovation projects we aim to shorten the development track after.

New tools to facilitate design-inclusive UXR

Except from activity rearrangements, changing roles and the involvement of new disciplines, we recognize that UXR methods have changed to cope with the complexity challenges at hand. UXR methods shifted from ad hoc focus groups where participants had to imagine an experience of use, towards prolonged situated explorations of design interventions. Thereby UXR started to combine qualitative user experience insight gathering with data logging about user behavior patterns to iteratively advance UX design.

Another change can be recognized in the use of experience flows and personas. In the first case study the experience flow was described as one journey of one representative persona. In the second case study this converted to multiple persona's and dynamic service flow with associated user experiences. And in the third case study the personas were turned into profiles with data as a fundament to meet personalization scalability.

The three case studies presented here highlight relevant factors of activity integrations but do not give a definite detailed answer to the execution of UXR methods nor what tools are required to facilitate design-inclusive UXR projects in data intensive projects. Therefore, we set out for development of tools that lower the threshold for data-enabled approaches [1] of design-inclusive UXR.

Relevancy of design-inclusive UXR in other fields

Note that the arguments we make for design-inclusive UXR in industry are limited to our experiences within the domain of family care at Philips Design. Although we believe these are relevant for different practices we see a clear need for more cases from other multinationals, SME's and startups. We question the (industrial) UXR community to explore the changing role of UXR and design activities in different product categories and experience domains to build towards a framework for design-inclusive UXR that is both academically rigorous and scalable in practice.

CONCLUSION

The approach adopted in the three industrial case studies at Philips Design progressed from UXR focusing on *identification* and *evaluation* of user experiences to a design-inclusive UXR approach where UXR and design are closely integrated in activities to *identify*, *envision*, *enable* and *evaluate* user experiences. The design-inclusive UXR approach is characterized by having design activities as integral part of research and considers user, context, design and the interaction between those. This is achieved in prolonged situated explorations of design interventions where user experience insights iteratively advance UX design and vice versa.

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