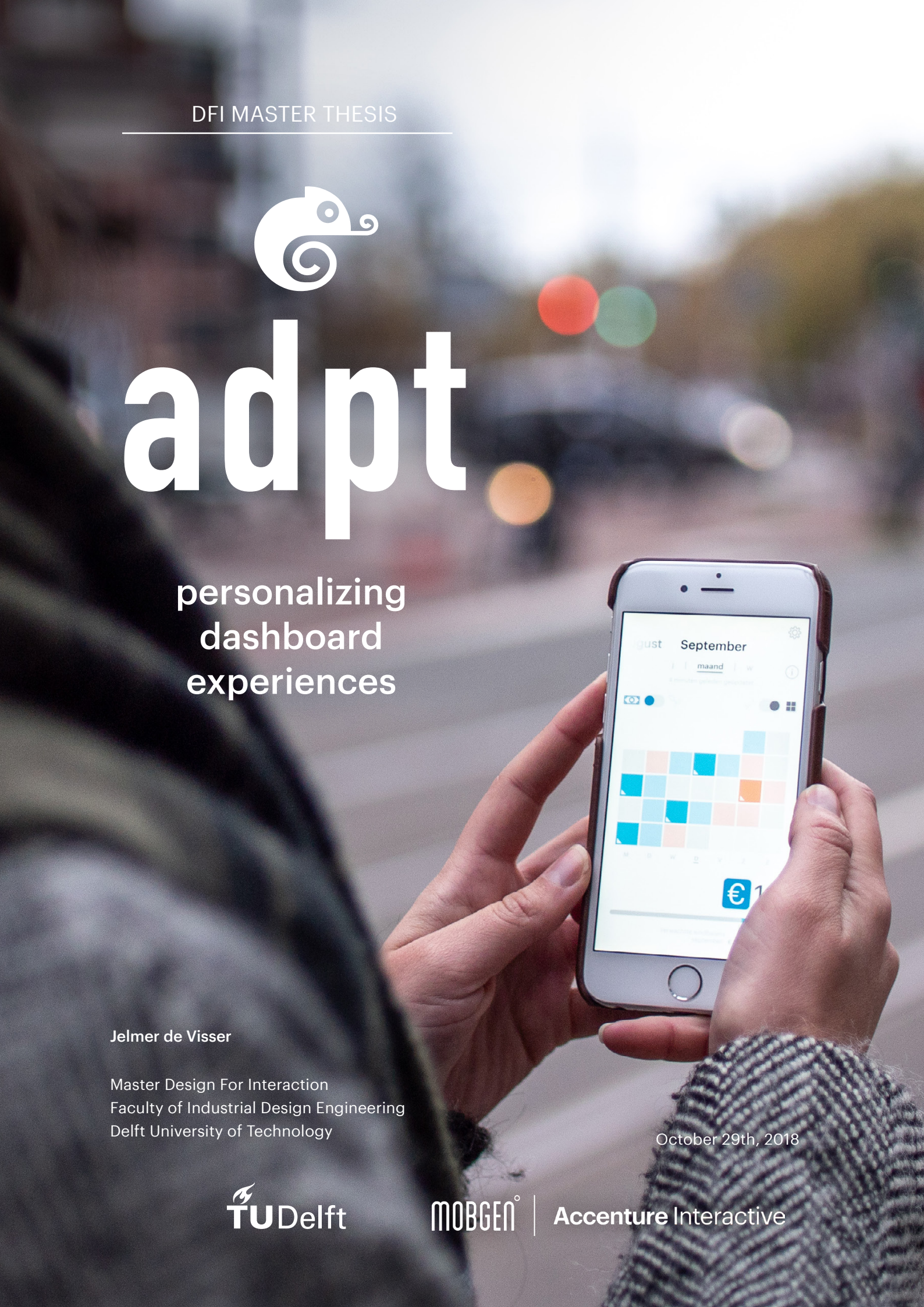
DFI MASTER THESIS

adpt

personalizing dashboard experiences



Jelmer de Visser

Master Design For Interaction
Faculty of Industrial Design Engineering
Delft University of Technology

October 29th, 2018

TU Delft MOBGEN | Accenture Interactive

DFI master thesis
October 29th 2018

Graduate student
Jelmer de Visser

Client
Mobgen | Accenture Interactive

Supervisory team
Prof. dr. Keyson, D. (chair)
Ir. van Dommelen, S. (mentor)
Mueller, N. (company supervisor)
Durieux, K. (company supervisor)


September
23 kg CO2e

Executive summary

In the digital domain, personalization has strong benefits in store. It can be used to reduce user interface complexity through filtering information and simplifying navigation. It can also be used to increase brand loyalty by showing understanding and acceptance for the individual customer.

As a digital innovation agency, Mobgen | Accenture Interactive (M|AI), is a client to this project. The company envisions that the future of brands is about experience. Personalization, with the advantages mentioned above, is given a key position in many of M|AI's partnerships with clients.

Dutch utility company Nuon, an example of such a client, is a player in the highly competitive energy market. In this market the brand loyalty potential of personalization is attractive. Also, the company faces disruption of its main coal- and natural gas-driven business model. Personalizing (household) energy portfolio management is a key part in the transition to a renewable-energy-based business model.

Together M|AI and Nuon are developing a personal energy assistant that is aimed at stimulating the experience of awareness and a sense of control.

The general objective of this project was to demonstrate a new application of personalization in service design. Specifically, the goal was to stimulate a personalized service experience for the energy efficiency service by increasing the effectiveness of the communication to users.

Energy awareness

The project was executed in a future energy context, where individual consumers are likely to be energy producers as well. This future suggests an increasingly central role of the personal energy portfolio in daily life, because there is a larger potential to influence (or control) the balance of the portfolio.

In order to be able to manage the personal energy portfolio (PEP) (that is, to have a sense of control) an energy prosumer needs the ability to track the portfolio's developments (that is, to experience awareness). This expected dependency is the reason for selecting the user's experience of awareness over his PEP as a focal point for this personalized communication project.

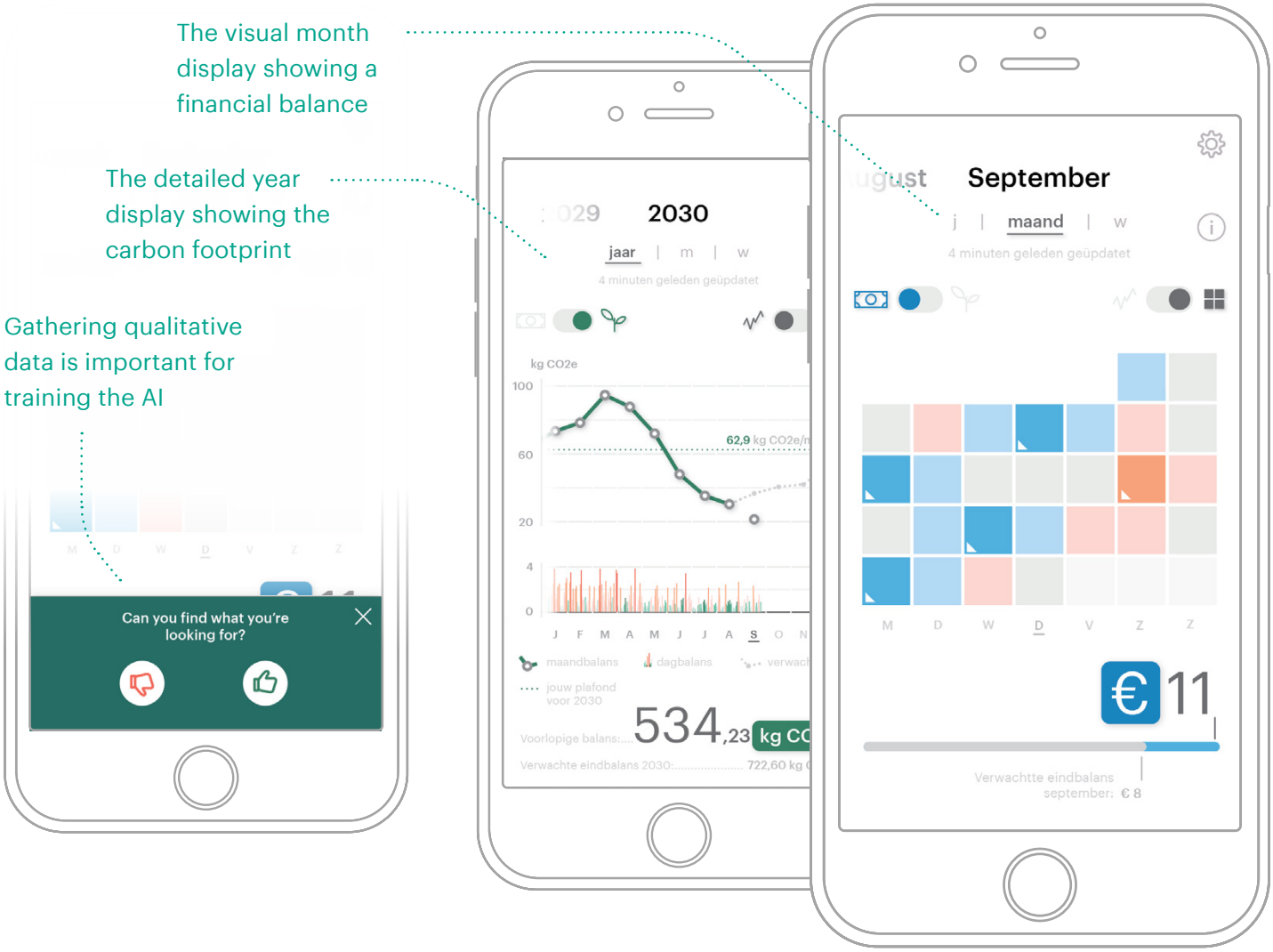
Adaptive user interface

In this project, personalizing service communication was addressed within the paradigm of adaptable user interfaces (AUI). UI adaptability research combined with practice-oriented design and a mindset segmentation tool from the digital innovation industry were used to arrive at a set of personalization guidelines

In summary, the guidelines state that AUI's should support (1) the differences in interests and capabilities between users, (2) interests and capabilities evolving over time and (3) the effect of different contexts of use on the user's interests and capabilities.

The guidelines illustrate the complexity of user variability. This complexity meant that finding validated occurrences of user variability did not fit the size of this graduation project. Therefore, the perceived energy management interests and capabilities of five Nuon user test participants were used to arrive at two different user segments. These user segments, called Frank and Sarah, were then used as the representation of user variability in the design process.

From a benchmark analysis it became clear that current energy management systems (EMS) are mostly focussed on presenting the user's energy data. Additionally, some of the larger players try to gather users' interests to be able to offer tailored energy saving suggestions or products. None of them, however, makes a clear attempt to accommodate the differences in interests and capabilities in the EMS UI.



Adpt

The goal for the design process was to develop a personalized communication system that would be able to offer the user a display variation that would fit his interests and capabilities of that moment.

Four iterative design cycles resulted in the concept of 'Adpt' (pronounce 'adapt'): a proposition for an AI-based personalized energy portfolio management dashboard that increases the user's awareness and control over his personal energy portfolio.

The dashboard design consists of different displays, featuring different time scales, levels of detail and units of measurement. These displays are intended to serve differences in display preferences among users due to the variety of interests and capabilities.

The user's display preferences are analysed by studying his in-app behaviour data in relation to the days of the week. Different days of the week, in this case, represent different contexts of use. Personalization takes place by suggesting specific default displays for specific days of the week.

In this way, Adpt would emphasize relevant information and simplify navigation in one action. It can therefore be regarded as a next generation quick-access personalization solution. But, instead of offering the user his most-used dashboard display as a hyperlink on his dashboard home screen (as a traditional quick-access feature would do), Adpt turns the most-used display into a home screen itself.

A chatbot-based assistant has the role to aid users in managing their PEPMS

This message is about suggesting a new default screen for certain days of the week

Validation

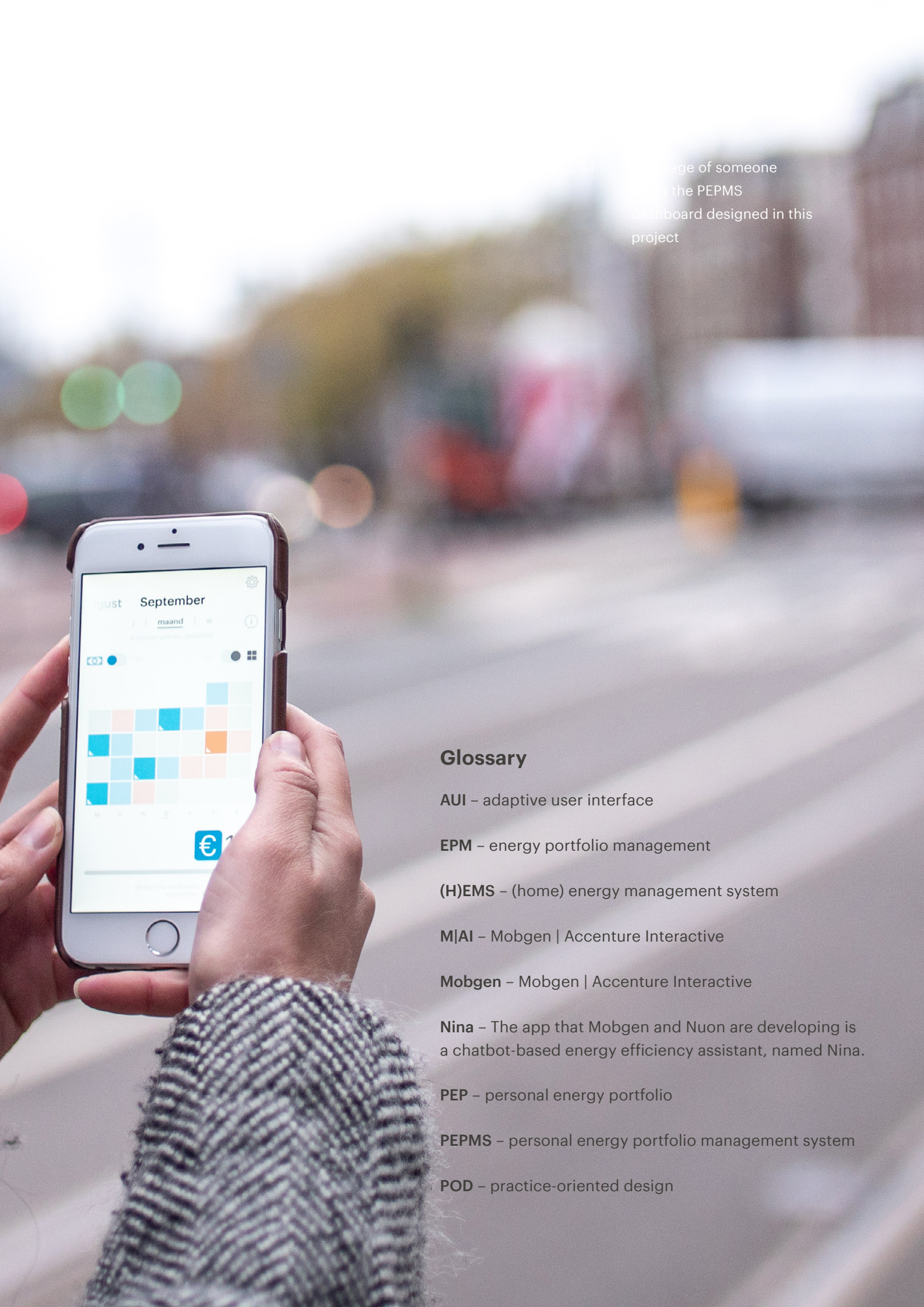
A qualitative assessment with six participants (28 – 53 years old) was used to assess the relevance of the three communication variables of the dashboard in meeting user's different interests and capabilities. Also, the possible contexts of using the PEPMS were explored. The qualitative assessment provided the following key insights:

- Due to differences of interests and capabilities, users are expected to perform different practices with their PEPMS (that is, different ways of using the dashboard)
- Distinguishing between visual and detailed displays can help to support the different interests embedded in the practices and the different capabilities embedded in different users.
- Practices with the PEPMS seem to be initiated by certain triggers, some of which are measurable. Performance of some of practices could thus be identified digitally.

These results confirm the opportunity for an AI-based personalized communication system. An AI could be trained using the measurable practice triggers, a record of the user's PEPMS behaviour and user feedback on the appropriateness of the available displays. This could result in a profile of each user that indicates the preferred PEPMS displays for each PEPMS practice.

By combining AUI theory, a POD perspective and the mindset framework a new application of personalization in service design was demonstrated in this project. Through the design of 'Adpt' and the user test that was performed the relevance for an Adpt-like system was confirmed. Unfortunately, the (personalized) experience was not assessed. Lastly, as a bycatch, the project resulted in the identificaiton of a few opportunities for interaction design in the energy sector.

Content



age of someone
the PEPMS
dashboard designed in this
project

Glossary

AUI – adaptive user interface

EPM – energy portfolio management

(H)EMS – (home) energy management system

M|AI – Mobgen | Accenture Interactive

Mobgen – Mobgen | Accenture Interactive

Nina – The app that Mobgen and Nuon are developing is a chatbot-based energy efficiency assistant, named Nina.

PEP – personal energy portfolio

PEPMS – personal energy portfolio management system

POD – practice-oriented design

Introduction

This document is the master thesis of Jelmer de Visser as part of the master Design for Interaction at the faculty of Industrial Design Engineering of Delft University of Technology. Mobgen | Accenture Interactive is client to this project.

The objective of the project was to demonstrate a new application of personalization in service design. More specifically the project was focussed on increasing a personalized service experience of an energy portfolio management service by increasing the effectiveness of communication to users.

In the project a personalization system was developed in combination with a PEPMS tracking dashboard. In this thesis the context, theoretical background and design approach are described that led to the design of the personalization system and dashboard.

The thesis consists of five parts. In Part I the context of the project is provided by introducing 'personalization', Mobgen | Accenture Interactive and Nuon (a client of M|AI). Part I is concluded with the project goal and approach.

This project is part of the AUI paradigm. In Part II two arguments are built related to that paradigm. Firstly, the energy context is described more in detail and a description is given on differences in user's communication preferences in the energy context due to different interests and capabilities. Secondly, through three theoretical frameworks the argument is made that communication preferences are different for different contexts of use and evolve in time. Part II is concluded with a set of system requirements that the ideal personalization system should adhere to.

Part III contains a benchmark analysis, in which the two arguments made in Part II are studied among existing energy management system providers.

In Part IV the objectives, approach and proceedings of the design process are described. It is done in a fair amount of detail in order to uncover the thoughts and decisions that were made in this relatively complex and iterative design process. The backbone of Part IV are the four design cycles that were completed.

Finally, Part V is concerned with the presentation of the final concept 'Adpt': the AI-based personalization system and the PEPMS tracking dashboard it leans on. The user test plan and results are discussed and in the last chapter the general outcomes of the projects are discussed.

Part I.

The value of personalization to business

Throughout this part of the report I elaborate on the origin of the phenomenon ‘personalization’, it’s benefits for user experience and the relevance it currently has to businesses. The latter is an important contributor for this project to exist in the first place. My collaboration with M|AI and (indirectly) Nuon is based on the potential benefits of personalization. Therefore, Part I includes their perspective and vision on the matter and I conclude with the goals for this project.

1. Personalization: background and benefits

'Personalization' is a frequently used word in this report. Understanding its origin and its effects on user experience is helpful to put the phenomenon in perspective.

The first large scale application of personalization of consumer products took place in the car industry of the late 1980's. The phenomenon was called 'mass customization' (MC), referring to products being customized to the customer's needs against costs close to those of mass production (Pine, 1993).

MC had two advantages. Firstly, it meant better meeting the customers wishes. Secondly, MC lead to a much broader diversity of products, making it more difficult for customers to compare products amongst competitors. Therefore MC was regarded as an effective method for differentiation and building customer loyalty in highly competitive markets (Da Silveira, Borenstein, & Fogliatto, 2001; Riemer & Totz, 2003).

MC industries make use of **explicit** customer requirements to choose between a few customization options of a product. 'Mass personalization' (MP) industries, originated during the uprise of e-commerce in the early 2000's, on the contrary, manufactures for the wishes of each individual customer (Kumar, 2007). MP makes use of **implicit** data (e.g. purchasing history) to attempt to reveal latent consumer needs that can be used to tailor the design of or service around a product (Zhou, Ji, & Jiao, 2013). Conceivably, digital products and services have a major advantage over purely physical products when it comes to the application of MP (Kumar, 2007).

These days, personalization of a service includes (1) filtering of or emphasis on certain information, (2) granting or denying access to certain domains and (3) simplification of certain processes based on user data that is 'remembered' by the system (Schade, 2016). Terms like 'quick access' (see Fig. 1.2) and 'suggestions for you' (see Fig. 1.1) are highly common examples of how personalization comes to the surface. So besides stimulating brand loyalty, personalization is an effective tool for reducing the information load of users (Bright, 2008).

This is supported by a large scale Google research (2016) indicating that 62% of mobile phone users prefers the system to store personal preferences to make future activities easier. Also, 58% of mobile phone users would like the system to specialize in a small number of features that he/she uses frequently. Lastly, Bright (2008) argues that

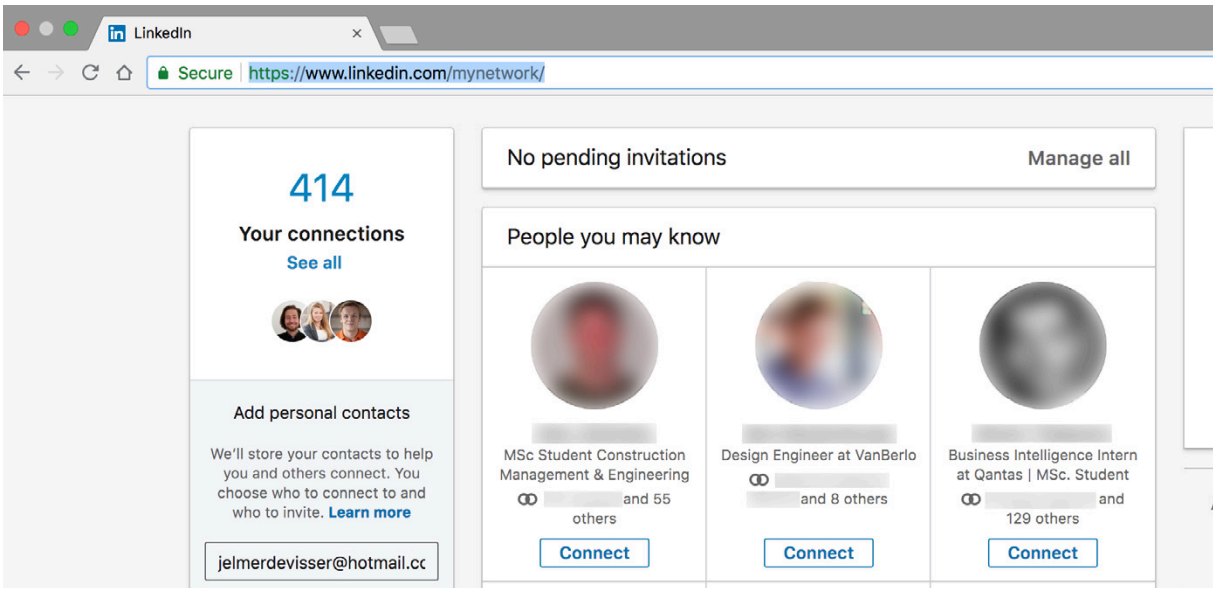


Fig. 1.1 The LinkedIn feature 'People you may know' is one of the many personalization expressions on social media

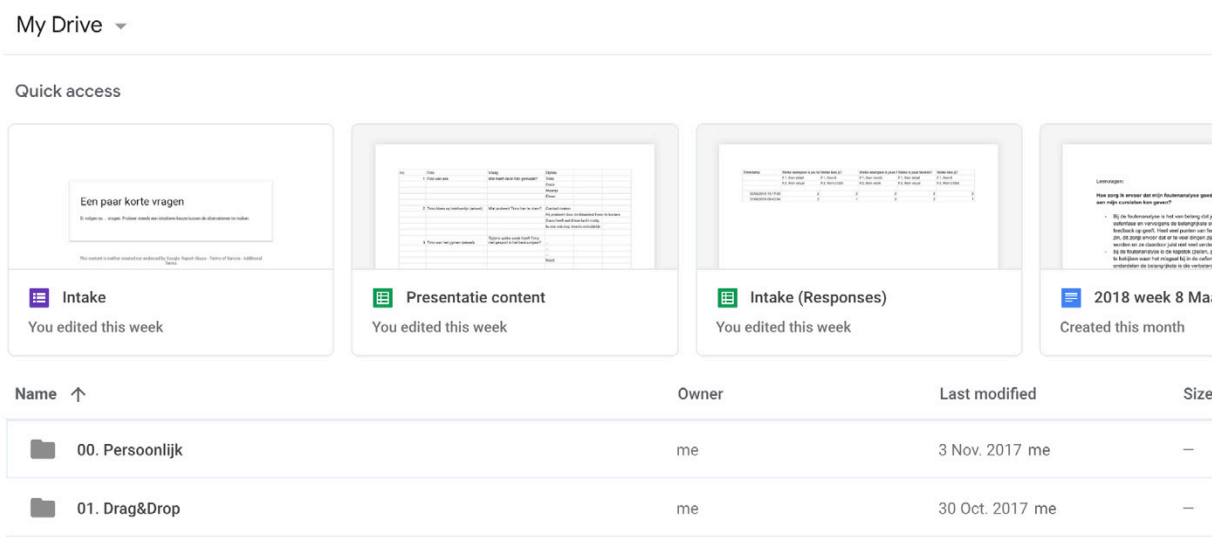


Fig. 1.2 The 'Quick Accesss' option at my personal Google Drive page

being conscious of this personalization process is an important contributor of a pleasant service experience.

The benefits of personalization discussed in this chapter demonstrate part of the added value of personalization to businesses. They return in the project goal as presented in Chapter 4.

Personalization in this project

Derived from the definition of Schade (2016), in this project a system for personalized communication refers to:

A system that emphasizes certain information and simplifies certain processes based on quantitative and qualitative data about the individual user

2. Value for Mobgen | Accenture Interactive

Mobgen is a 9-year-old digital innovation agency currently employing 250 digital specialists in total in their Dutch headquarters and two Spanish offices. Since the acquisition of Mobgen by Accenture Interactive the digital design services of the company have become increasingly integral. From that moment onwards the company was named Mobgen | Accenture Interactive ('M|AI' in short). In the agency's own words M|AI offers 'interactive and digital transformation consulting and integrated, end-to-end, interactive solution delivery'. So, M|AI takes clients from first phases of strategy and service design all the way to app of web deployment, maintenance and improvement through analytics.

Personalization

As the company believes that the future of brands is experience, personalization of service experiences is one of many important focus points of the company. It is of the agencies interest to get to know the relevant dimensions of personalization and to be able to apply that knowledge in various projects, especially those in which clients rely heavily on personalization for building customer loyalty.

The holy grail would be to have as many persona's as having users, meaning that every single user is served with a service that fits his or her unique needs. It's a phenomenon that chief creative officer Nick Mueller likes to call 'milking the spider', referring to the precision of responding to individual users' needs.

Collaboration

While originally discussing smart (that is: personalized) notifications as a main topic, the collaboration with M|AI was eventually built upon another goal. Since a few years M|AI is engaged in a partnership with Nuon, one of the largest Dutch utility providers. The partnership is aimed at developing a new digital customer experience for Nuon and, as Chapter 3 demonstrates, personalization plays an important role in this new digital environment.

MOBGEN | Accenture Interactive

The service that M|AI and Nuon are developing, more elaborately discussed in Chapter 5, of Nuon is

Fig. 2.1 a. Impression of the office space and atmosphere at Mobgen headquarters

aimed at providing Nuon customers with (1) the experience of awareness and (2) a sense of control over their personal energy portfolio. Throughout the course of this project M|AI emphasized the importance of awareness and control over the specific use case of energy portfolio management. The energy use case provided an important scope to the design process, but at multiple points in the report I reflect more broadly on the implications for awareness and control in general.

Semantics

In literature (for example the work of Van Dam (2013)) the type of system that Nuon and M|AI are developing is called a Home Energy Management System (HEMS). Nuon wishes to in the future extend the service beyond the boundaries of the home, which suggests to drop the 'H' of HEMS. Additionally, with the rise of energy production and sharing, energy consumers will increasingly be managing a portfolio of energy streams. And lastly, in this report a personalized system is developed. So when discussing a future EMS in this report, I will be using the terms like 'energy portfolio management', 'personal energy portfolio management system' or 'PEPMS'.

3. Value for Nuon

CONFIDENTIAL

CONFIDENTIAL

CONFIDENTIAL

Conclusion

Nuon is a player in the highly competitive energy market. In this market the brand loyalty potential of personalization is attractive. Also, the company faces disruption of its main coal- and natural gas-driven business model. Personalizing (household) energy portfolio management is a key part in the transition to a renewable-energy-based business model.

4. Project objective

On this page the project goal is described. On the following pages my personal motivations for this project and the project structure are described.

Towards a personalized service experience

Clearly, personalization has a large potential for user and business. Chapter 1 descries that successful personalization (1) maximizes the efficiency of the information load on the user and (2) gives the user the experience that the service provider is recognizing him/her as an individual, building trust in and loyalty to that brand. And Chapter 2 and 3 support the wide industry demand for more insights in how to apply personalization in (product-)service design.

It has led to the following project goal:

To develop a solution that stimulates a personalized service experience for the energy efficiency service by increasing the effectiveness of the communication to users.

Three remarks remain regarding this goal. Firstly, it was important to formulate a measurable project goal. Therefore, stimulating personalization was defined as 'stimulating a personalized service experience'.

Secondly, an important hypothesis in the early stage of this project was that users are different in their communication preferences – that is: the way a system communicates with the user. Additionally, 'stimulating a personalized service experience' needed further scoping. Therefore, the project was aimed at exploring people's differences when it comes to communication preferences and utilize those to increase effectiveness of that communication, leading eventually to a more personalized experience.

Third and last, 'effectiveness' in 'the effectiveness of the communication to users' gained more meaning. As state in Chapter 2 the service being developed by Nuon and Mobgen is one that is meant to provide users with the experience of awareness on and a sense of control over, in this case, an energy portfolio. Over the course of the project creating 'awareness' received most attention for reasons explained in Chapter 5. So in this project an effective interface would be one that is able to provide the user with a sense of awareness.

Value for me as a designer

Besides M|AI and Nuon another stakeholder sees great potential in personalization, specifically in the domain of energy management: that's me. Two aspects of this design challenge strongly motivate me.

Firstly, in my direct environment I see many people that do not always seem to decide themselves when pick-up their smartphone. The engage themselves with cleverly designed services countless times a day, but not always do I get the feeling that they consciously choose to do so.

I'd like to support users to ask themselves the questions: When do I want to be engaged with a service? And in what way? And when do I specifically NOT want to be engaged with any or a specific service? Brands fighting for the user's time and attention on an increasingly competitive market, stimulate their designers to create addictive digital products that don't always seem to leave room for those questions.

I believe that personalization can be used to help users and designers to identify the different ways in which people WANT to be engaged and to develop the digital tools that can support people to achieve that. Through this project I aimed to gain experience in applying personalization in service design in order to be able to contribute to support users in making their own decisions.

Secondly, the energy transition is a strongly necessary transformation of the energy sector. It influences the way we perceive and engage with energy. And, as becomes clear for example in chapter 5, an active role is expected from every single energy consumer. Society should be mobilized to support the needed transition. But people should be granted the freedom to engage with the transition in a way that fits their personal style. So as a designer, I believe that recognizing people's differences might help to accelerate the energy transition.

Fig. 4.1 Image from Pexel.com

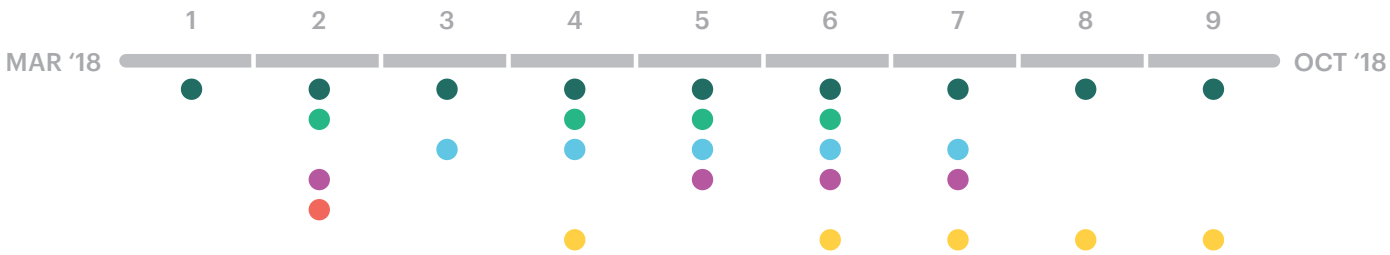


Fig. 4.2 An overview of the activity types throughout the project

Project structure

This graduation project consists of nine consecutive sprints of approximately three weeks. Each sprint started with the formulation of several goals and sometimes definition of hypotheses. And when an answer was found or a dead-end was reached I defined an approach for the next sprint, regularly in discussion with members of the supervisory team.

A reflection on the process proved that it occurred in a very explorative and therefore messy fashion. So, describing on the exact content of each of the sprints would seem a bit too elaborate. An image of the sketch made during the reflection can be found in Appendix 3.

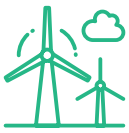
Instead, I summarized the different types of activities, listed on the next page. The activities as part of this project were mainly aimed at exploring differences between people. I performed the activities in a non-linear fashion, and most activities returned multiple times. Their occurrence in the project is visualized in Fig. 4.2. Note that sprint 8 and 9 comprise the finalization of the project.

Relation to the structure of this report

The explored energy future (b) and how people currently perceive energy differently (c) is described in Part II. This part also gives theoretical basis that supports the assumption that people change over time (d). How existing HEMS treat differences between their users (e) is described in Part III. And Part IV is concerned with the approach and results of the design activities of sprint 6 and 7 (f). Also, in this part a more practical insight is offered into the variables on which PEPMS users might have different preferences (c).

a. define approach and plan process

Scoping, choosing an approach and planning the further process were aimed to keep next steps attainable and efficient. Yet, it sometimes also led to trying to 'overdefine' the future process, reducing efficiency of the process.



b. explore context and interactions

In order to explore the differences between people's communication preference I explore the future of energy.

c. explore differences (between people) in that context

In order to get a feeling for peoples interests and abilities in the context of energy portfolio management I explored how people reflect on energy from their current perspective as an energy user.

d. explore how differences behave over time

The insights obtained throughout the project strongly suggested that communication preferences change over time. This activity aimed to explore how.

e. study the way current HEMS treat differences

In order to get a clear image of the existing solutions I explored the way that the largest HEMS-players (seem to) personalize their communication to users.

f. design and validation of the personalizaiton system

Once the idea of specific differences arose, I explored what system and service design could be used to support different communication preferences.

Part II.

Practice- and theory-based personalization guidelines

This part of the report aims to build two arguments: (1) people have different communication preferences when it comes to energy management and (2) people's preferences change in time. To set the stage for Part II, the future interaction with energy that I assumed for this project are described in Chapter 5. Insights from practice on the differences between people are described in Chapter 6. And a theoretical background on how people are expected to change over time is described in Chapter 7. Part II is concluded with a description of different types of user variability in Chapter 8.

5. Awareness & control

Back to the world of renewable energy! The reason for studying the future of energy was to provide a somewhat future-proof and sensible context to this design process. The objective of this chapter is to explain what future energy scenario that was used and how to look at it from a broader awareness-control perspective.

Method

The vision on future energy interactions is established based on the Vice talk of Jeremy Rifkin, a visit to the All Energy Day conference 2018, study of Vandebron & Powerpeers, and the future vision of Nuon

In the energy transition two developments meet each other. One is the transition from a centralized fossil fuel-based energy network to a decentralized renewable energy grid. The other is a transition from the current economy towards a sharing economy, where people exchange products and services peer-to-peer (Rifkin, 2018).

'Jouliette', a virtual energy currency

A solution that clearly exemplifies the vision of the energy sector is blockchain solution 'Jouliette', developed by Alliander and Spectral. With a pilot running at event location 'De Ceuvel' at moment of writing, the virtual currency Jouliette is earned by sharing energy and can be spent by purchasing energy. De Ceuvel consists of several small buildings all equipped with PV cells. The solution is aimed at balancing supply and demand within a local energy network such as De Ceuvel (see Fig. 5.1).

A socio-technical challenge

Behind Jouliette there are two strong technical challenge for the decentralized and green future of energy. Firstly, for example solar energy is only available during the day, while peak consumption mostly occurs in evening. This leads to the iconic 'duck curve', a graph displaying a drop in net load during the day due to availability of solar energy (Burnett, 2016). Secondly, because wind and sun are not always available, providing stability in the energy grid becomes challenging.

Both technical and consumer-centred solutions are being developed for this challenge. An example of a technical

Fig. 5.1 The community map of De Ceuvel displays live energy transactions within the community, hoovering over a building provides more detail

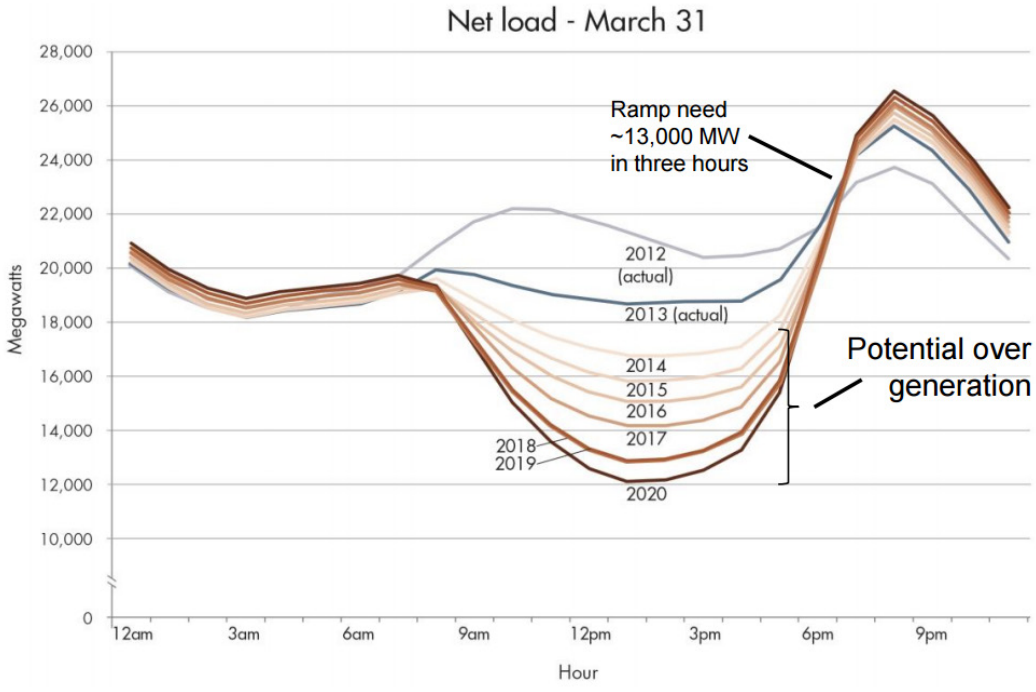


Fig. 5.2 This graph describing the expecte net load on a spring day in california is called 'Duck Curve', it shows the drop in net load due to availability of solar energy

solution is Tendril's 'Orchestrated Energy', a system allows utility companies to 'shave' peak grid loads by remotely accessing the thermostat of a significant number of (smart) homes and pre-heating (or cooling) them prior to a peak (N.A., 2018b). This solution is part of the large landscape of demand side management (DSM) solutions and research (van der Stelt, AlSkaif, & van Sark, 2018).

But literature also suggests an important role for the future energy consumer, also called co-provider or prosumer (combining consumer and producer) (Katzeff & Wangel, 2014). Because of the probably limited amount of energy available in local grids people would have to use energy "at appropriate times and suitable amounts" (Geelen, Reinders, & Keyson, 2013, p. 152). With the Dutch government goals to have two million households off natural gas by 2030 (Straver, 2018), this means that prosumers will have to actively regulate when to heat the home, take a shower or user the stove. In short, the user will have to manage his production and consumption.

Energy sharing, energy trading or social energy

Lastly, the two Dutch companies Vandebron and Powerpeers are examples of new energy sharing service providers. Both match supply of private (for example household rooftop solar energy) or SME energy producers (for example a local farmer with a wind mill) to the demand of private energy consumers. Customers can select their own suppliers. And in case there is no supply from them wind energy from an offshore wind park is added (N.A., 2018d, 2018e).

Additionally, sharing of energy might become a social matter as well. "In the future we might provide our own energy to charity for a lower price or share our energy stats through social media", states Jos Blom, initiator of Jouliette at Alliander, in talk with him at the All Energy Day 2018.

Awareness & control

In conclusion, I defined five distinct energy interactions for the energy future of around 2030. Due to the active role of the consumer as a producer, I refer to this person as a prosumer from this point.

'**Produce**' is a salient interaction, one that does not involve very explicit actions from the prosumer.

'**Use**' refers to the energy consumption of the individual prosumer. Also, with the rise of electric vehicles consumption of electrical energy might extend the walls of the household.

'**Share**' refers to the prosumer sharing own energy surpluses with others and using others' surpluses when having a shortage himself.

'**Understand**' refers to the prosumer understanding how his energy consumption and production develops and why.

'**Manage**' refers to the prosumer setting sharing preferences (such as charity energy donations, price limits, etc.) and planning consumption (such as laundries, heating and cooling, etc.).

The interactions 'understand' and 'manage' seem to be the most active and engaging one's for the prosumer. The interactions also represent more holistic user needs: to experience awareness over what is happening and to feel a sense of control over what is going to happen. Lastly, it seems that a dependency exists between the two interactions. I hypothesize that for feeling control one first needs awareness. And establishing awareness requires a way of communicating information that fits the individual prosumer.

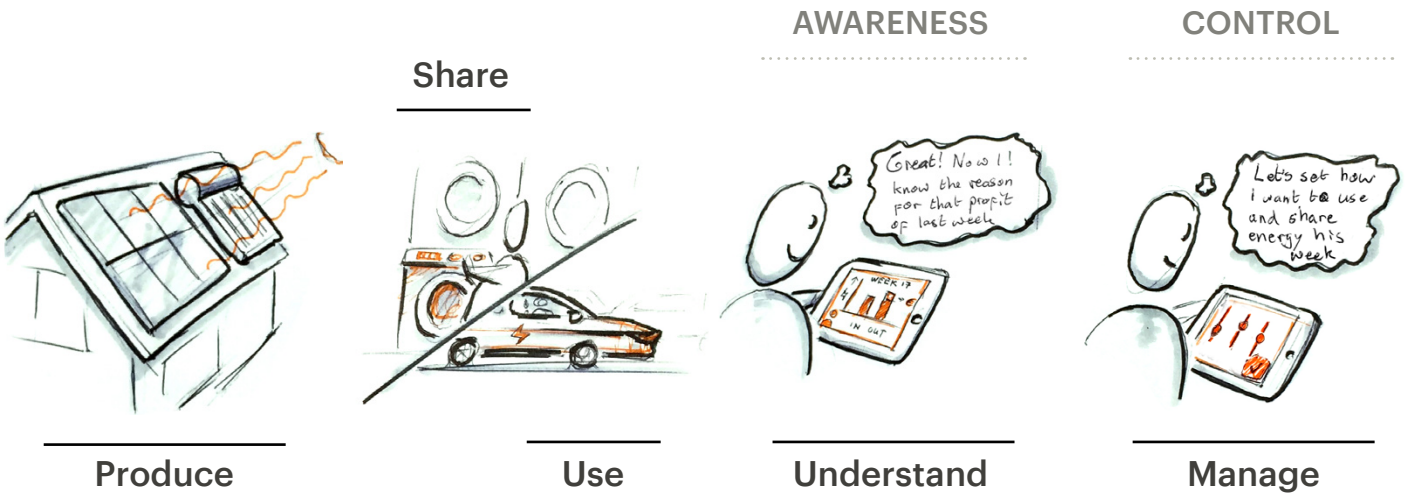


Fig. 5.3 The five main future energy interactions concluded from this studies analysis

6. Energy consumers speaking

Early in the project I took up the role as note taker in a usability and user experience assessment of the Nina app. The test provided insight in the different preferences on how to engage with home energy. With the same objective I performed a set of interviews (see Appendix 7). Due to inconsistency in the interview preparations I discarded the results (see Appendix 9). Nevertheless, the encounters with the participants and the way they spoke about energy remained an inspiration throughout the project.

Yet, in this chapter I only reflect on the approach of the assessment of the Nina app prototype and discuss the results relevant to this project. And lastly, I summarize how I narrowed down the information (including the inspiration from the interviews) to two user segments called 'Frank' and 'Sarah' and I'll describe what role these played throughout the project.

Being note taker in the Nina app user test provided two opportunities. Firstly, it offered an interesting introduction to way M|AI conducts user research. Secondly, it offered an opportunity to get in touch with real energy users and their needs, interests and wishes when it comes to managing their energy.

Thus, for this project the objective for this test was different than the objective of the usability researchers of M|AI itself. Their research goal was: To test the general understanding, navigation and information architecture of the household dashboard, profile, settings, contract details and appliance overview. My research goal was: To record the needs, interests and wishes of energy users for managing their household energy.

It was necessary to conform to the test set-up as prepared for the usability and user experience assessment. The full plan can be found in Appendix 4, the full script in Appendix 5. In this section I will mention the aspects that were of influence for reaching the objective as part of this graduation project.

Study

Research goal: **To generate a first impression on energy users' needs, interests and wishes regarding managing their household energy.**

Research questions:

- What different levels of energy expertise can be found?
- What motivators exist to be engaged in household energy management?
- What different attitudes are there towards sustainability in the context of household energy management?

No.	Gender	Age	Household composition
1	F	40	Together with partner
2	F	34	Husband and children
3	M	50	Wife and children
4	M	31	Together with partner
5	F	25	Lives together with partner, one child on the way

Table 6.1 Participants of the Nina user tests

Method

Participants: recruitment of the participants was done by QSR Selectiebureau, with the criterion that participants should be in charge of the energy matters in their household. Table 6.1 gives an overview of the participants for the Nina user test. Household composition has been added in this table, because in this user test the reflections were on management of household energy usage.

Setting: this test featured an interviewer/ facilitator, note taker and additional observers (see Fig. 6.1).

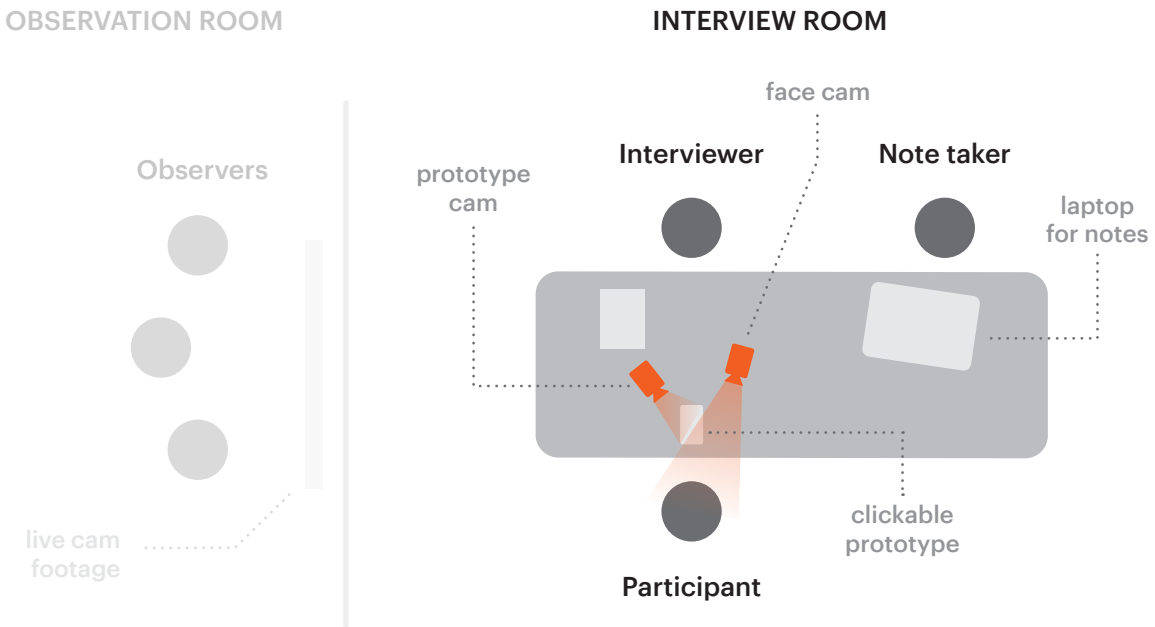


Fig. 6.1 10. Study setting during the Nina user test, the observation room had no influence on the data used for this project

Procedure: the test duration was approximately 45 minutes per participant, it was Dutch spoken and the procedure for the usability test was as follows (see Appendix 5 for the full script):

1) Welcome participant & introduction
2) Brief interview with some general demographic questions
3) Interview with questions related to personal experience of managing energy
4) Participant prioritizes printed dashboard UI elements
5) Participant chooses favourite print of 'My Usage' display
6) Participant executes different small tasks in clickable prototype
7) Participant prioritizes printed profile info elements
8) Debriefing

Data collection methods: notes were taken and video recordings were made from two angles (including audio)

Data analysis: the notes were transferred to an excel sheet and the research question topics were addressed for each of the participants.

Results

In addition to note taking, I aided in analysing the user test results. I used that thorough study of the test notes to answer the questions related to this study as well.

Besides several demographic characteristics, the table on the next page gives an overview of the main interests and motivations per participants. As his way of presenting the results already suggests, the answers to the individual research questions surfaced relatively implicitly and seem interconnected. In the following paragraphs the answers to the research questions are discussed.

Level of expertise

The main interview topic that suggests a level of expertise with energy is the level of detail that participants seemed to be looking for in their engagement with energy. Participant one is highly interested to know consumption details of each appliance, while participant five seems to be much more interested on adoption of habits that save energy. Equally, participant five seems to enjoy diving deep into is wind energy stats and in different units of measurement while participant 2 seems to limit herself to checking the general balance for adjusting her own behaviour.

Motivators & sustainability

The table with results also displays the main topics of interest that the participants expressed. Expectedly, sustainability can also be regarded as a motivator. Therefore, the answers to questions 2 and 3 are discussed together. Each of the participants clearly expressed to have an interest in managing household energy for economic reasons. Participants 1, 4 and 5 showed additional interest in sustainability, participant 4 expressed this the strongest. Participant 1 and 4 were expressed an interest in a technical form of analytics, while participant 5 expressed an interest in non-technical background information about her usage.

Participant	1	2	3	4	5
Age	40	34	50	31	25
Gender	Female	Female	Male	Male	Female
Occupation	Works at TNT	Part-time bookkeeper	Writer		
Children	daughter of 18	three boys: 1, 7, 9	3 children	-	1 upcoming
Household size	2	5	4/5?	2	2 (soon 3)
Interests concerning energy	**sustainability - costs - analytics** - usage of all in-home devices "we have a new house, I'd like to know the consumption of all devices" - Being aware of energy consumption is important, e.g. "how energy is produced, what it costs"	**costs** - "spending as little as possible on energy" - checking if electricity/gas consumption is not too high - strong disinterest in personal energy saving challenges "I have 3 boys (...) I never finish challenges anyways"	**costs** - reducing household energy costs "I have been going to the library to save home energy"	**analytics - costs - sustainability** - price is first - sustainability also if possible - later, when owning a house, "I'd like to have a smart meter and PV on my roof" - likes figures €'s, kWh's, %'s, per week/month/year	**costs - sustainability - analytics** - keen on unnecessary energy consumption for economic reasons "leaving the light on an hour per day will add up on a yearly basis!" - renewable energy if its effortless - rather €'s than kWh's "I don't have a clue what that means"
Interpretation of expertise level (high - moderate - low)	moderate	low	moderate	high	low

Table 6.1 User test summary per participant

Discussion

An elaborate discussion of the results can be found in Appendix 6. The role of the insights of this test in the graduation project was to give direction to the personalization process that was to follow. The test provided the following two take-aways below

The guidelines are relatively high level. Yet, the design process required more tangible users. The development of fictional user segments ‘Frank’ and ‘Sarah’ aimed to provide the required tangibility.

Nina user test take-aways

The test provided the following two guidelines:

- a system that personalizes service communication should be able to offer different levels of information detail and complexity
- a system that personalizes service communication should be able to offer the same information from different perspectives (for example, economic, technical and sustainability perspectives).

Two fictional user segments: ‘Frank’ & ‘Sarah’

The test results suggest that energy consumers with different levels of expertise will eventually demand different levels of information complexity and detail. Also, they suggest that there are differences in the size of the scope through which users would look at their energy portfolio (short- vs long-term).

The Nina user test and the interview gave rise to a new set of assumptions. Some examples:

- level of energy expertise influences the desired scope of looking at energy consumption or production history (yearly, monthly, weekly or daily level)
- energy consumers’ interests determine desired primary unit of measurement (€, kWh, carbon footprint)
- the value of €1 is different among energy consumers, and therefore the way of communicating information about increasing costs should be as well
- people with different ages have different preferences levels of formality in language

The assumptions all contain two elements. Firstly, they contain a hypothesized input variable (such as level of expertise with energy). Secondly, they include a hypothesized output (or personalization) variable. Finding and validating such patterns seemed to have required a data science approach, on which more elaborately is reflected in the recommendations in Chapter 14.

In order to nevertheless allow these assumptions to guide the design project, two inherently opposing energy user segments were defined based on difference that are expected to have an influence on communication preferences. Termed ‘Frank’ and ‘Sarah’ the next four pages contain a persona-based description of them.

A short introduction: Frank is a married IT-specialist of 51, with high energy expertise, focussed on regularity and comfort in living and cares mostly about being financially efficient. Sarah is a 29 years old marketing trainee who lives with two friends, is a relatively novice energy user and is determined to make the world a better place.

Frank de Bruin

"I like to draw my own conclusions on the end-of-year energy bill"

Age: **51 years old**

Occupation: **IT manager**

Mariatial status: **Married**

Household composition:

Dreams

- Financial security for his children
- A carefree old age for him and his wife
- Using home automation to control most home processes from his smartphone

Life priorities

- Family welfare
- Regularity in daily life
- Comfort in living

Satisfaction

"I'm satisfied when I manage to execute the plans I have"

Housing & expenses

Home type: **'50's home in Vianen**

"We bought the house 14 years ago, just before our daughter was born. I don't see us leaving it soon!"

Frank's energy expences: **€ 252,- / month***

Energy mindset

Energy ambition

"Sustainability, fine! I think I'm doing quite OK. It would be nice to go break even on my home energy consumption, especially because it saves me several hundreds of euros a year. But I'll work on this project at my own pace!"

Level of expertise

- Prefers numbers expressed in both kWh's and €'s
- Is aware of energy-intensive practices within the household
- Is not so much aware of energy-intensive practices in mobility and nutrition
- Is familiar with average energy production numbers
- Understands the concept of a CO_2e, but is not too interestet in it

Behaviour change preferences

Competition:
only with himself

Point of reference:
similar NL households

Reinforcement:
negative**

Do's & Don't's

Frustrations

- Whatsapp notifications of his son's smartphone
- People that have an opinion about his behaviour
- When websites suggest totally irrelevant stuff to him

System must-(not-)have's

- Offer factual information
- Leave conclusions up to Frank
- Have an opinion about Frank's (past) behaviour
- Approach him with new stuff without consent

* Based on **Nibud Energy & Water** figures and municipality tax numbers. The costs include water usage
** Based on Kirman et. al (2010). There's a monster in my kitchen: **using aversive feedback** to motivate behaviour change

*** 'X' refers to expressing energy in terms of liters of water or another **unit that makes the number concrete for the specific user.** 'CO2 f.p.' refers to carbon footprint.

Sarah Wever

"The world has way too many treasures to actually let it go to waste!"

Age: **29 years old**

Occupation: **Marketing trainee**

Mariatial status: **In a relationship**

Household composition: .....

Dreams

- Having a positive impact on the world
- Raising one or two children
- Buying an old house and completely restyling and decorating it to the liking of her and her boyfriend

Life priorities

- Enjoying life every day
- Spontaneity
- Being a nice (girl)friend

Satisfaction

"I am satisfied when I feel I positively contribute to a better world, and when life surprises me."

Housing & expenses

Home type: **monumental upstairs appartment**

"Together with two friends I moved to Leiden centre 1,5 years ago. It's quite expensive, but a really nice location! I think I will be moving in with my boyfriend in one or two years."

Sarah's energy expences: **€ 73,- / month***

Energy mindset

Energy ambition

"I think everyone should make a serious attempt to lower their carbon footprint! I like to learn more about the energy the is needed for my every-day activities and try to lower my consumption. And it might save me just enough money to go on an extra weekend trip, to Paris for example!"

Level of expertise

- Currently prefers numbers expressed in €'s
- Does not understand the concept of CO_2e but would be interested in learning about it
- Is mostly unaware of energy-intensive practices, both in- and out-of-home
- Has limited knowledge on average home energy production figures

Behaviour change preferences

Competition:
with friends

Point of reference:
neighbours and friends

Reinforcement:
positive

Do's & Don't's

Frustrations

- if there is no quality coffee place in the area
- people that don't show ambition or the willingness to learn and grow
- if internet on her smartphone is slow

System must-(not-)have's

- Humour and spontaneity once in a while
- A reward system for her contributions to the environment
- An extensive and detailed consumption overview
- A buggy UX

* Based on **Nibud Energy & Water** figures and municipality tax numbers. The costs include water usage

7. Three human variability theories

This project is aimed at stimulating a personalized service experience. In this chapter two fields of research and one framework from practice are discussed. The three, which all advocate a personalized way of approaching users, all added principles and knowledge to this design project. First, the research field of adaptive user interfaces is discussed. Second, the sociological field of practice-oriented design is explained. And lastly, a Mindset-framework from Fjord (part of Accenture Interactive) is reviewed in the light of this project.

The adaptive user interface (AUI)

An adaptive user interface (AUI) is a system that "adapts its displays and available actions to current goals and abilities of the user by monitoring user status, the system task, and the current situation" (Rothrock, Koubek, Fuchs, Haas, & Salvendy, 2002, p. 50). 'overtime', the concept resulting from this project, can be described as an AUI in the context of energy portfolio management. The insights from this field of research are therefore introduced in this section.

The mobility of user interfaces increased significantly as smartphones gained popularity. It brought about an exponentially increased variation in contexts of use (Yigitbas, Stahl, Sauer, & Engels, 2017). The ultimate goal is termed plasticity, to preserve usability and user experience across different contexts of use (Coutaz, 2010).

A one-size-fits-all approach in UI design is unable to support this context-of-use variability. In stead, multiple UI's are required for the same service. But the design of multiple UI's is problematic as well since (1) at design-time the full context-

of-use variability cannot always be known and (2) because manual development of multiple UI's might be costly (Akiki, Bandara, & Yu, 2014).

An evolving user and a changing context of use

More concretely, this field of research suggests two factors to take into consideration when designing an adaptive user interface. Firstly, users' capabilities and expectations change because each user gains experience over time (Browne, 1990). In the context of energy management this could include the knowledge and understanding about electrical energy as well as the learning curve a user goes through with the energy management service.

Secondly, variability in the context of use can reduce usability and diminish user experience (Akiki et al., 2014). In the definition of Yigitbas et al. (2017) context of use includes the user, the platform of the UI and the environment of use. For this project I'd like to propose to leave out the platform. Context of use would then include: the environment in which the service is used and its consequences on the capabilities and needs of the user. As an example, in the energy management context, this could mean any messages sent to user X on business day at midday should not contain too many details, because the user is occupied with the responsibilities of his job.

Although the example might seem relatively obvious, practice might be much more complicated. Say the message is about a monthly bill that is € 20,- higher than expected. User X might perceive this as a level of urgency that is so high that he desires more detail even at that midday moment in time. The complexity will make successful UI adaption difficult, which might endanger acceptance of the adaption system or the service as a whole. Therefore Akiki et al. (2014) recommends to stimulate awareness and control regarding the adaption process by involving the users in it.

AUI take-aways

AUI theory led to the following take-aways for this project:

- A system that personalizes service communication should attempt to support the evolving capabilities and experiences of the user
- A system that personalizes service communication should attempt to recognize and support use in different contexts of use
- A system that personalizes service communication should allow the user to be aware of and influence the process of adapting the UI
- A system that personalizes service communication should strive to reduce the number of different UI's for the same functionality to reduce costs

Practice-oriented design (POD)

The goal of this project is to increase the personalized experience of an energy portfolio management system (EPMS). The effectiveness of home energy management systems (HEMS) has been studied and discussed abundantly. The critical reflections of Strengers (2011, 2012, 2014) especially pose an interesting perspective on the lacking effectiveness and design of the systems.

Practice-oriented design (POD), she argues, is an interesting paradigm for increasing the effectiveness of HEMS. Several insights from POD have influenced this project. This section introduces POD and discusses the relevant insights.

Strengers (2011) signals that merely providing HEMS and spreading eco-awareness is largely insufficient for provoking eco-friendly behavior. Day-to-day human activities are messy and irrational, and they are culturally, socially, technically or institutionally driven.

Most HEMS seem to be designed for an rational, intelligent and economic fictive user Strengers (2014) refers to as 'Resource Man'. Two problems are addressed. Firstly, expressing human behaviour in terms of kWh, m3 or € is often perceived as too abstract. And secondly, "change is thought to take place via the provision of information (data) and technology" (Strengers, 2014, p. 26).

Strengers thus seems to argue that these energy management systems should as well be designed for non-economical, less intelligent and irrational users. Practice-oriented design could support this process because it admits irrationality of users and recognizes the temporal character of users' behaviours.

Centring the practice rather than user

In her PhD thesis Kuijer (2014) discusses the implications of practice theory for designers. Whereas persuasive design stems from psychology, practice theory is a sociologist perspective on human behaviour. Kuijer cites Reckwitz' (2002) definition of practices:

'a routinized type of behaviour which consists of several elements, interconnected to one other: forms of bodily activities, forms of mental activities, 'things' and their use, a background knowledge in the form of understanding, know-how, states of emotion and motivational knowledge.' (Kuijer, 2014, p. 26)

Additionally, social theory describes practices as a set of three interconnected elements: stuff (materials), skills (competences) and images (meanings), elements that Kuijer adopts from the work of sociologist Elizabeth Shove.

Practice theory does not put humans and their needs central in the design process. It rather takes practices as the

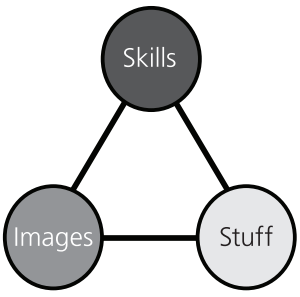


Fig. 7.1 13. The three elements that together comprise elements (Kuijer, 2014, p. 26)

Fig. 7.2 14. A visual representing practices as a central unit of analysis as opposed to individual humans and their needs

unit of behavioural analysis. And it does so because it argues that human needs and desires are shaped by practices people perform and the products they use to perform them. Kuijer again cites Reckwitz (2002) when stating that 'practices, over the course of their career are carried and carried out by a changing group of variously skilled practitioners, while people, over the course of their lives will carry and carry out varying sets of practices. An individual can thus be seen as 'a unique crossing point of practices'. The sketch in Fig. 7.2 attempts to clarify this paradigm.

Although one and a half A4 is hardly enough to give an impression of practice theory, the distinction between 'practice-as-entity' and 'practice-as-performance' is the last part of Kuijers discussion of practice theory I'd like to mention in this section. The main distinction between both is that the more general practice-as-entity survives over time and is more easily recognizable as a practice, while the performance of the practice is slightly different each time. An example of a practice-as-entity is the act of showering, examples of practice-as-performance are then showering to clean, showering to get warm, showering to clean the shower, etc.

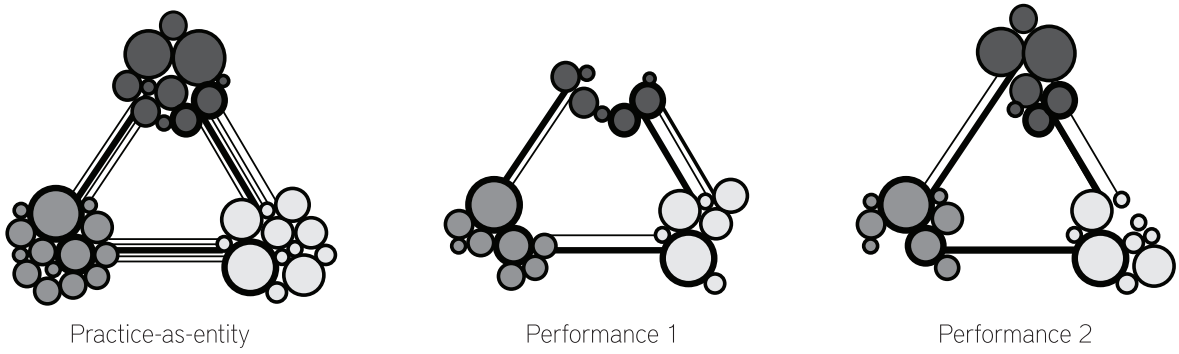


Fig. 7.3 An image that shows that practice-as-performances are parts of the total 'practice-as-entity', the varying thickness of the lines between the elements represent the varying importance of those link (Kuijer, 2014, p. 53)

Conclusion

Practice theory admits the variety and complexity of daily life and thereby becomes a complex theory to utilize in design practice as well. During this project the idea came up to develop practice profiles of users as an input for personalized communication (see Appendix 10). But, "life is full of exceptions which are very difficult to measure and put into a profile", summarized Lenneke Kuijer well in an interview with her (see Appendix 11).

POD take-aways

On basis of the POD-insights of this section, the two following take-aways were concluded:

- A system that personalizes service communication could personalize by supporting different practices-as-performances for the practice-as-entity 'tracking your energy portfolio', for example tracking out of boredom, tracking to beat friends, tracking to set a monthly budget, etc.
- A personalization system should collect qualitative data next to app analytics data. Although it is a very conceptual thought, it might allow to give meaning to people's in-app behaviour, giving a more complete image of their practice(s) in which the service is engaged.

Fjord Mindsets

In this section the Fjord Minset Segmentation framework is described. Based on a lack of trust and interest towards banks that Fjord found amongst millennials, a research project was initiated to find ways in which the financial sector could improve its user-centred performance. The objective was set to provide the right customer, with the right experience, in the right context, a target that aligns well with the objective of this graduation project.

In the study people were asked when, where, how and why they engage with their money. Three parts of the results of this study appeared to be relevant to this project. Firstly, four 'money modes' were identified (see Fig. 7.4).

Secondly, segmentation of users based on demographics is out-dated, because it leads to misalignment with today's users. Rather, companies mush segment users based on their engagement with the company's service, specifically, the mindset that the user has (see Fig. 7.5 on page 48).

Thirdly, users might have different mindsets with the different touchpoints of the service and might switch mindset over time. "It is important to support each of the mindsets in your service and not force a user to be one specific mindset for good", says Gijs Oostendorp, Service Design Lead at Fjord, when discussing the framework at Mobgen. "Also one user might have different mindsets for different functionalities of your service", he adds.

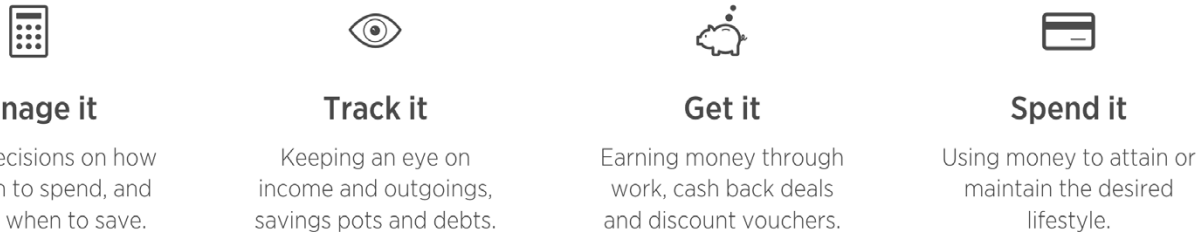


Fig. 7.4 Fjord's 'money modes' representing the four key ways in which people engage with their money

About Fjord

Founded in Sweden in 2001, Fjord is a design and innovation consultancy firm. The rapidly growing firm was acquired by Accenture in 2013 to support its Interactive branch. Currently the company is headquartered in London, employs over 1.000 design, innovation and technology experts and has 27 studios across the globe (N.A., 2018c). The company is globally known for its annual trend release, providing 'a look at what's ahead for the future of business, technology and design' (N.A., 2018a)

Fig. 7.5 The four Fjord Mindset segments placed in a matrix

Energy Modes

In the context of this graduation project, 'money modes' invited to make a comparison with the energy interactions as described in Chapter 5. The two models for describing engagement show an interesting alignment. For that reason, the term 'tracking' was adopted for the energy interaction of 'understanding'.

Frank & Sarah in the matrix

Similarly to the money modes, the money mindsets also suggested similarities to the context of energy portfolio management. The lay-out of the matrix allowed to develop a clearer idea of the mindset corresponding to Sarah and Frank and the role of both segments in this project.

With the definition of Frank and Sarah (in Chapter 6), one could start picturing their position in the matrix and what it would mean for their communication preferences. In the course of this graduation project, plotting Frank and Sarah in the matrix provided a first vision on the design of the personalized communication system. This process was fuelled by the following interpretation:

Frank & Sarah, also defined as user segments, are positioned top left and bottom right in the framework (see Fig. 7.6). Frank, a more experienced energy manager and more conservative in his lifestyle,

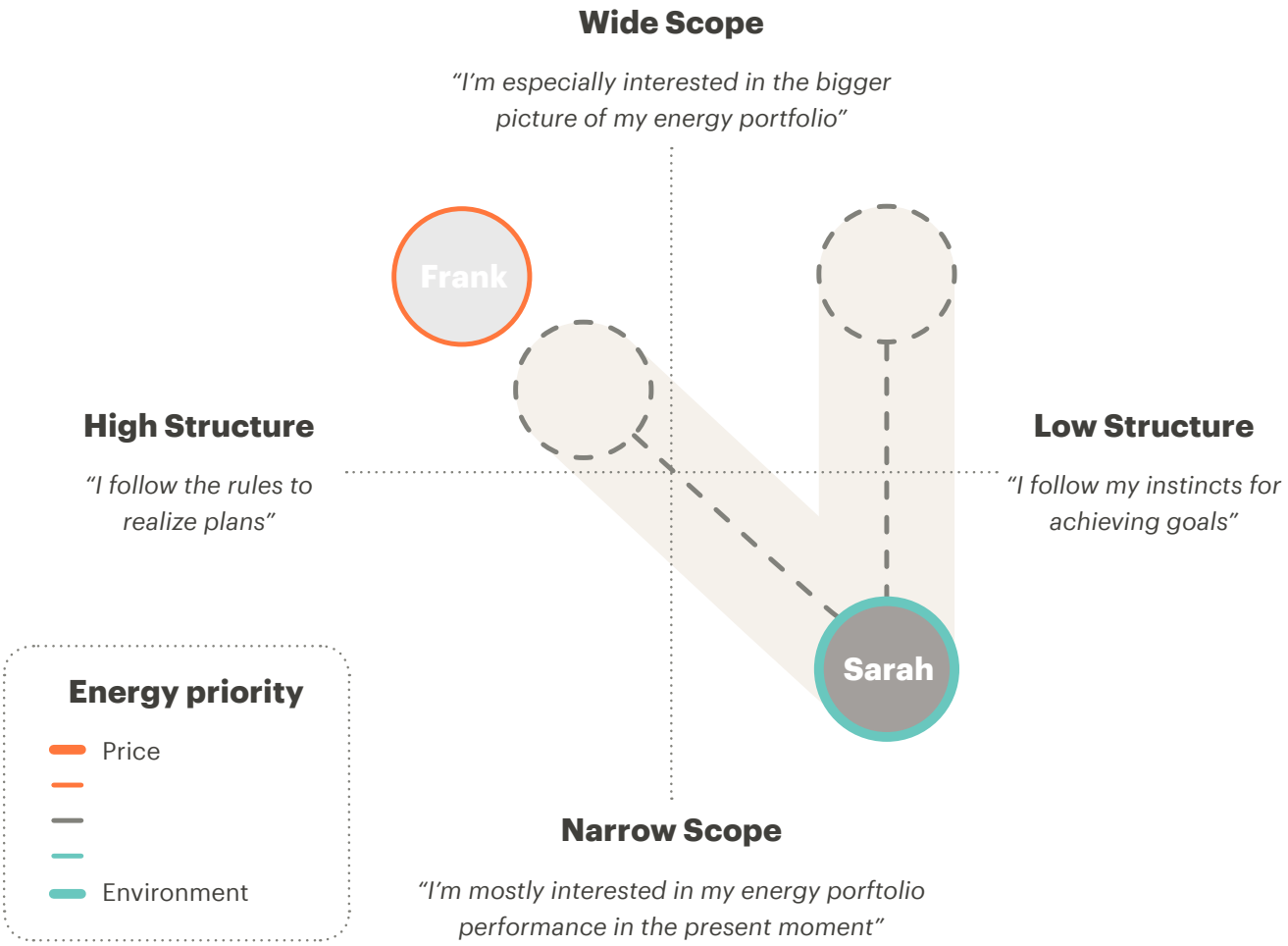


Fig. 7.6 The hypothesized position of user segments Frank and Sarah placed in the Fjord Mindset matrix

likes to look at monthly and annual energy developments in technical language, rather than quick daily updates. Also, he likes the system to be predictable and goal-oriented. Sarah, being a novice energy user and having a more experience-focussed lifestyle, is looking for weekly updates and engagement, social interactions and small surprises by the system. Lastly, I assume Frank to be financially-oriented and Sarah to be environmentally-oriented.

Besides the position of Frank and Sarah in the matrix, Fig. 7.6 embodies two other aspects. Firstly, a wide scope does not mean a sustainable scope. Scope represents time, not impact or geographical scale. This led to the introduction of the energy priority ring. And second, the figure visualizes the hypothesis that a user gaining energy expertise over time might evolve towards a wider scope or higher structure.

Fjord Mindset take-aways

The Fjord Mindset segmentation provided the following take-aways:

- A system that personalizes service communication could use the mindset of the user as a center point
- A system that personalizes service communication should allow individual users to regularly switch between mindsets.

8. System Requirements

The content of Part II of the report contributed to definition of the following system requirements:

Ultimately, a system that personalizes communication should:

- Increase the user's sense of awareness and control over energy portfolio (future interactions)
- Support different capabilities and interests of the user regarding management of their energy portfolio (energy users in practice)
- Support the evolving capabilities and interests of user due to experience gained in management of the energy portfolio (AUI theory)
- Support different contexts of use of the PEPM service and the effects of that context on user's goals and capabilities (AUI theory)
- Minimize the number of unique UIs needed for the PEPMS
- Allow the user to be aware of and influence the process of adapting the UI

Additionally, there was one important project requirement:

- The project goal should be of manageable size

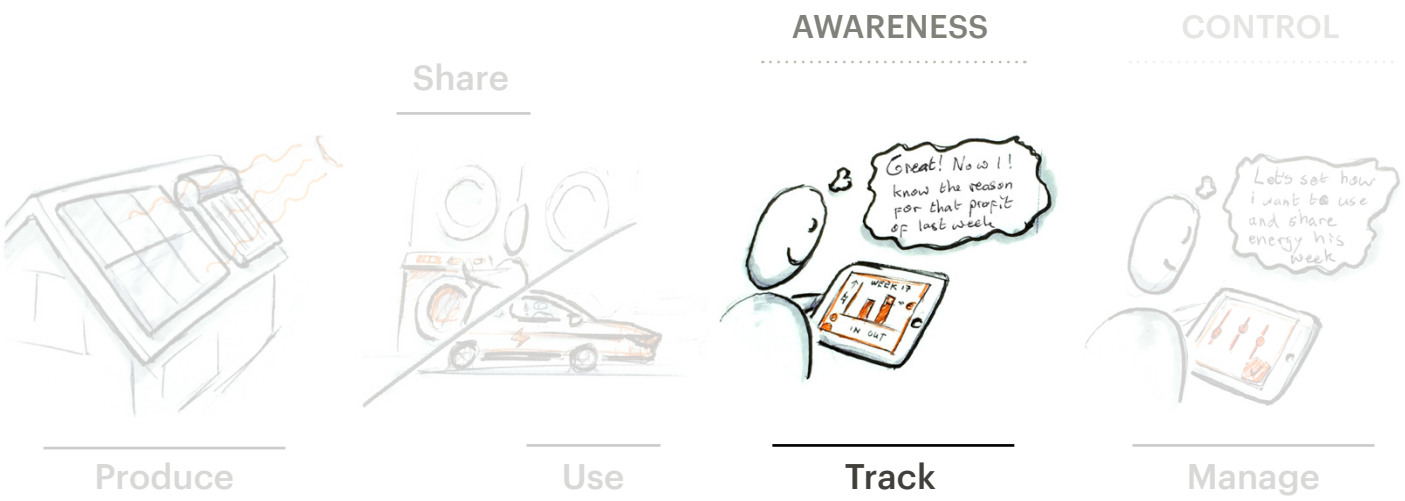


Fig. 8.1 In this project tracking the energy portfolio was chosen as a main interaction

Learning through doing

Over the course of the graduation project it became clear that the personalization system itself would be able to identify how capabilities and interests evolve, what contexts of use exist and how they influence the capabilities and interest of the user.

Therefore, the design process of this project was built upon the assumed segments Frank and Sarah. Throughout the process, other designers and myself also used their educated intuition to envision how these users might evolve and how different contexts of use might influence the user's needs. The approach and intermediate results of that process are discussed in Part IV of the report. Part III firstly reviews the ways in which existing HEMS solutions involve UI adaptability in their service.

Part III.

Benchmarking existing EMS

From Part II it becomes clear that there is a great variety between the interests and capabilities of different users and between different contexts of use of a service. In this part a review is provided of how current EMS providers seem to treat this human variability.

9. Existing Energy Managment Systems

In order to develop a personalization system in a sensible future energy context, understanding the functionalities that current EMS include seemed to be an important basis. Additionally, drawing an image of the existing personalization practices of the EMS allowed to build upon existing solutions. This chapter describes those two elements of the EMS's review: functionalities and personalization practices.

As Bloomberg New Energy Finances overviews during the ECO17 there are several key players in the HEMS market (see Fig. 9.2). These seven companies can be split into two groups. The first group of companies center their product-service around a thermostat and remote climate controlling of the home. They offer their product directly to consumers. The second group of companies has a focus on providing utility companies with customer management and engagement software. They maintain a B2B proposition. The next two pages give an overview of the two groups and the energy interactions that both these product-service systems support.

For both groups, the energy management functionalities and the personalization features of the service are described. As a recap, in this project personalization is about emphasizing or filtering certain information and simplifying certain processes based on quantitative and qualitative data about the individual user (Schade, 2016).

Meanwhile, in the utility industry

The following few fragmants from an Adweek article written by Swant (2018) draw an interesting image of the current attitude of the utility industry:

"To both better help customers understand their energy usage and use it more efficiently in the process, utilities have spent the past few years investing in emerging technologies that can help preemptively meet the evolving needs of consumers—and in the process also help the energy providers themselves.

(...)

Matthew Guarini, an energy analyst at Forrester, said consumers often have very limited and often negative interactions with their utility companies. He said the average person often spends just eight minutes a year interacting with his utility, and usually in frustrating situations such as an incorrect bill or power outage. However, energy companies are beginning to understand the value of brand affinity—Guarini said it's only been recently that they've started referring to customers as "consumers" rather than simply "rate payers."

(...)

Digitally savvy consumers do seem eager for energy companies that are digitally savvy themselves."

Fig. 9.1 Image from Pexel.com

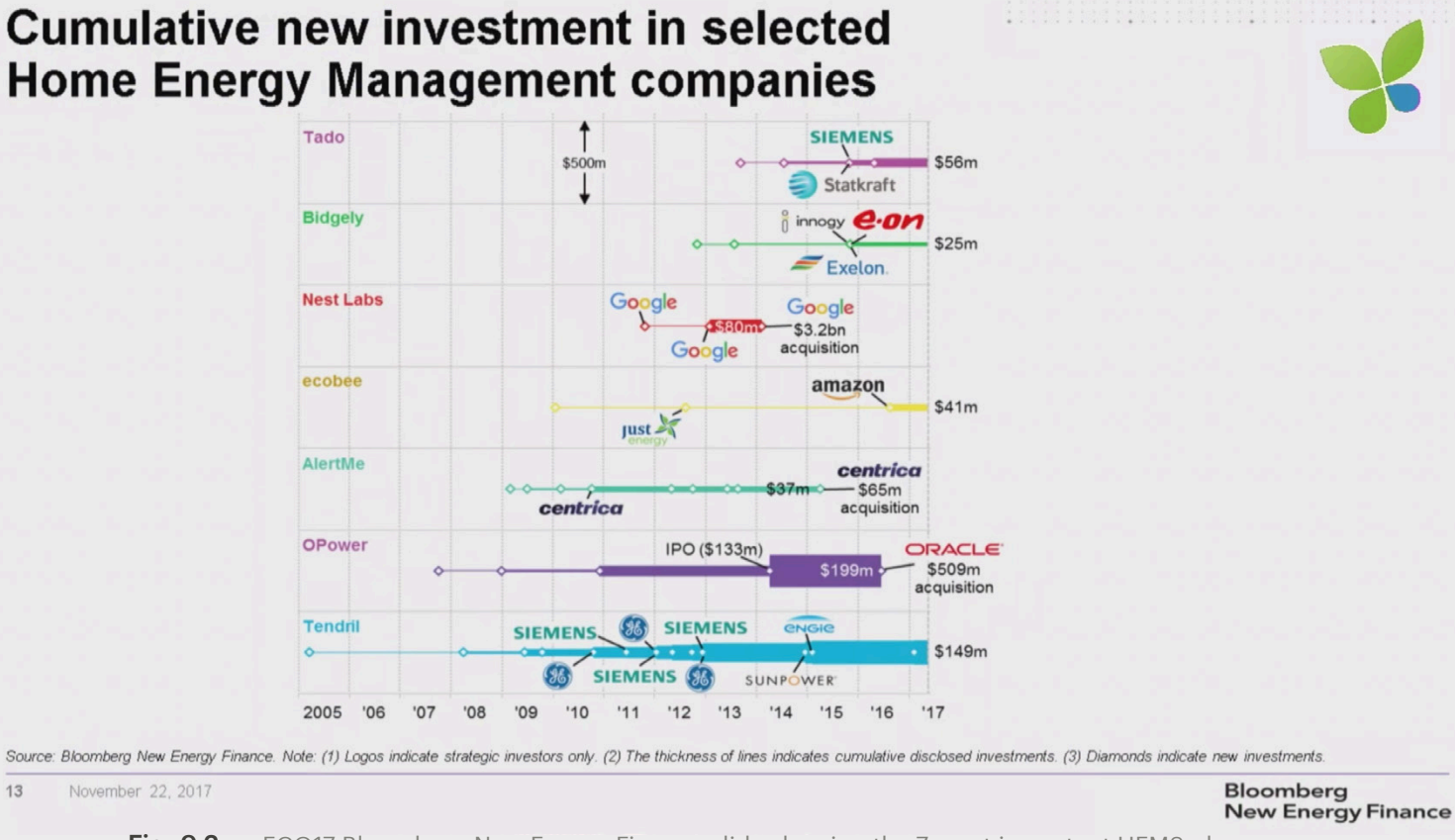
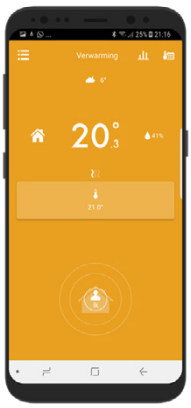
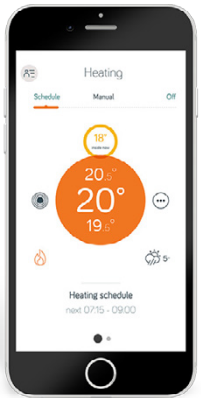
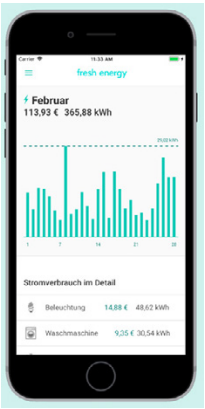


Fig. 9.2 ECO17 Bloomberg New Energy Finance slide showing the 7 most important HEMS players







tado° | nest | ecobee | HIVE | STARTUP fresh energy

They all...

- Offer a thermostat and app
- Which are part of a larger home automation appliance family exept tado°
- Are targeted at households as a whole and on the consumer market
- Personalize based on material property and measurable behaviour
- Feature the following energy interactions:

efficient thermostat scheduling

monthly consumption reports except for HIVE

consumption predictions

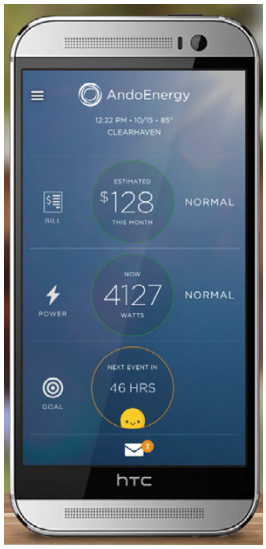
Additionally featured energy interactions

– Detailed home heating with smart radiator valves	– Additional tailored saving tips – Energy saving rewarding system (‘leafs’)	– Detailed home temp. measurement with room sensors	-	– Additional tailored saving tips – Breakdown into appliance consumption

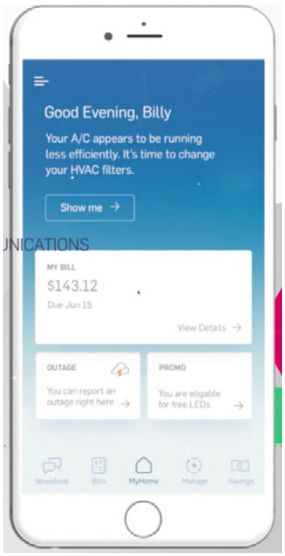
Personalization features

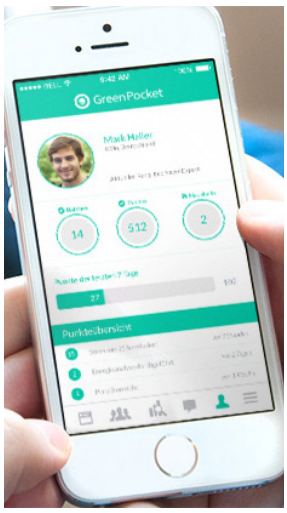
– Personal heating data – Geofencing	– Personal heating data – Geofencing	– Personal heating data – Geofencing – Graphic style UI is customizable	– Personal heating data – Geofencing	– Personal heating data – Geofencing

Services centered around a thermostat



no preview available





bidgely | OPOWER | TENDRIL | NEW PLAYER GreenPocket

They all...

- are suitable to serve both households and SME's
- approach households/SME's as a whole (and not the individuals in them)
- feature the following energy interactions:

all communicated as economic savings

- billing prognoses
- high usage alerts
- tailored saving challenges
- monthly consumption reports

Additionally featured energy interactions

- Breakdown into appliance consumption
- Breakdown into appliance consumption
- 'Social metering': allowing users to share their energy saving achievements

Personalization features

- Personal energy data
- Personal energy saving information
- Personal energy data
- Personal energy saving information
- Personal energy data
- Personalized saving information (based on segmentation through user-initiated 'Energy ID')
- Personal energy data
- Personal energy saving information

Utility customer engagement software

Review

Both groups of EMS's (thermostat services and utility services) show large similarities in terms of energy management functionalities and personalization features. Thermostat services are clearly and understandably more limited in terms of energy management features than the utility services, because thermostat services are limited to home heating.

The personalization features are also surprisingly similar. 'Personal energy data' takes the form of an overview of kWh's or €'s available at different time scales, such as year, month and week scale. And 'personalized energy saving information' almost all combine a comparison with (1) the average neighbour and (2) the most efficient neighbour and the provide tips that match your home time and energy usage patterns. Despite the strong similarities, it can be expected that the complexity and quality of the user segments and the personalization algorithms in practice shows some variation among the EMS's.

Conclusion

The two objectives of this chapter were to (1) provide more detail into the specific functionalities of current (and possibly future) EMS's and (2) to review current personalization solutions.

EMS functionalities

Overall, both groups indicate the three groups of service functionalities as displayed on the next page. The service functionalities described in '2. Personal insight' section align well with the 'track' (or awareness) interaction of the energy interactions as described in Chapter 5. The functionalities of '1. Automation' and '3. Social' energy could be regarded as elements belonging to the 'manage' interaction.

Having this thorough understanding of EMS, it seems that the majority of interactions seems to be dictated by technical issues, such as peak-load shaving and reducing general peak load. What (additional) energy interactions would arise when user-values and interests would be the driving force? Although being a very interesting and possibly necessary question, it did not fit the scope of this project. In this project, the overview was an important source of inspiration for the dashboard used to demonstrate the final concept in Chapter 12.

EMS personalization features

In each of the EMS personal data is the centre of the interface. How is YOUR energy portfolio performing? How are YOU doing compared to (similar) others? What are opportunities for YOU to increase the performance of YOUR portfolio?

Especially on the area of personalization, it is uncertain if all existing features surfaced in this external analysis of EMS. Personalization is not always visible, especially not from UI screenshots. Additionally, Opower for example has been actively hiding any insights in their UX and UI design since acquisition by Oracle.

However, it is still worthwhile to review what was found. With the system requirements as concluded in Chapter 8 in mind, Tendril MyHome and Opower make an important start with personalization, by building user segments that involve the user's main interest. Yet, support of evolving capabilities and interests or of different contexts of use of the PEPM seems absent.

One might cautiously wonder why such large companies are not showing any signs of UI adaptability. Yet, having seen the potential necessity of UI adaptability in Part II of this report, one might also say there is apparently an important opportunity for EMS providers to start including adaptable UI's.

1. Automation

- Users set their heating and cooling preferences, technology does the rest. That is:
  - Utility or thermostat services improve the efficiency of home heating and cooling schedules (e.g. through geofencing and machine learning)
  - Utilities remote-control major home appliances (such as HVAC systems) for 'shaving' grid peak-loads (e.g. pre-heating several homes to spread out a neighbourhood's energy demand peak).

2. Personal insight

- Users have continuous insight in their energy usage history and prognoses, including an itemization of their usage and a comparison with similar (neighbour) homes
- Users have continuous insight in their energy billing history and prognoses
- Users have continuous insight in the energy they production (e.g. through PV cells), where energy surpluses go and what the user earns with that transaction
- Users receive tailored information about possible energy-saving activities that the expected financial implications of them (based on household properties, home type, energy behaviour, etc.)

3. Social energy

- Users are offered opportunities for energy-saving and charity energy-sharing activities, which are part of a reward system. People are able to share the activities and their reward system scores through social media and energy communities.
- Users are supported to develop an 'energy identity' that indicates what their main motivators and values are in the area of energy consumption and production

Part IV.

Design brief and process

In Part I & II of this report several holistic criteria were pitched for a system that personalizes service communication. Also, the conclusion of this part stated a design paradox: data needed for designing a personalized service communication system can best be obtained through a personalized communication system itself. In other words, a system seemed needed for development of that same system. Part III of the report concluded that existing EMS show a vacancy for adaptable UI's as specified in Part II.

This part of the report contains a description of the approach for the design process in Chapter 10. Following in Chapter 11 is an impression of the different stages of the design process and what they added to the final design. This chapter also aims to exemplify the effects of the design paradox mentioned in the preceding paragraph.

10. Objective and approach

At the end of what you would call the 'analysis phase' of this project, a design brief was pitched (see Appendix 13). The goal that was set at that point and the approach that was used since then are summarized in this chapter.

The goal for the design process (received a terminology update and) stated the following:

To design a system that allows an EMS to approach each user through a personalized set of display variations that based on his/her dynamic communication preferences profile.

The design goal was supported with the system overview of Fig. 10.1, acting as a starting point for the design process. It shows a system that assembles a profile of user X that can be used to automatically conclude the preferred display variations for user X in his context of use Y. Qualitative energy portfolio management (EPM) data and quantitative EPM and application analytics data are examples of input for that profile.

The system design was additionally built on a few principles. One principle for this system is that the UI of the PEPMS is largely a single-design interface but contains a few elements that have different display variations. These elements are termed 'communication variables'. This principle stems from the challenge specified in AUI literature to minimize the number of unique UI's.

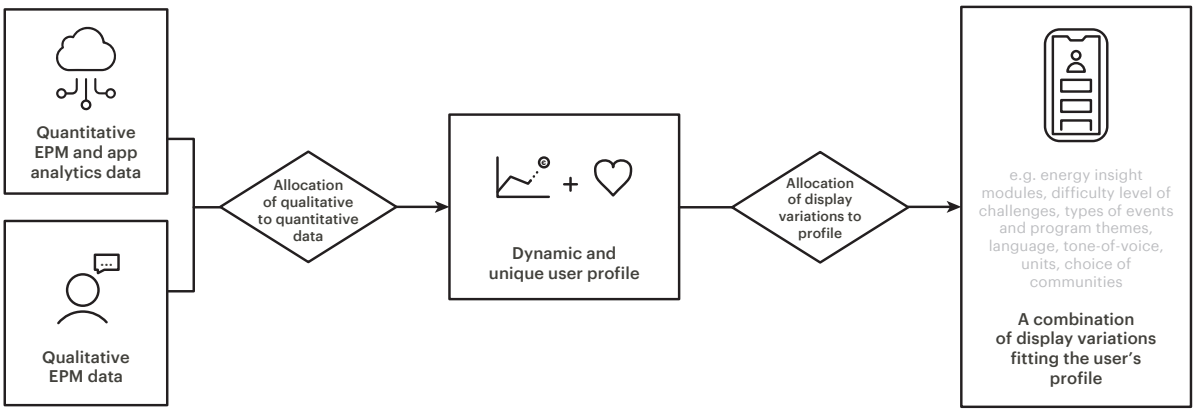


Fig. 10.1 The leading system design during design preparation

Another principle is that a large share of this personalization process runs automatically, without necessarily involving user action. This principle is based on two ideas. Firstly, as opposed to customization (see Chapter 1), personalization makes use of implicit user needs, based on the idea that users are not always able to express what they actually want. Secondly, involvement of the user is believed to stimulate system acceptance by the user. But at the same time, user involvement in the personalization process is also associated with higher costs of interaction (Schade, 2016). Concluding, the process of gathering data and assembling the needed user profile should be able to run as independently as possible. Allowing the involvement of the user to take any form desired by the user.

These principles and other criteria were assembled in a list of criteria, displayed on the next page. The list shows a distinction between must-have's and nice-to-have's, which supposedly explain their meaning quite well. The explorative nature of this graduation project made it difficult to formulate concretely measurable criteria. 'Must-have' therefore refers to that the topic must be addressed by the solution to some extent.

Personalization all the way

In the light of the knowledge presented in Part II one might even hypothesize that users have different preferences for their involvement in the personalization process. Therefore, the UI of a personalization system should afford allow different levels of engagement with the personalization process. Although it poses an interesting thought, the idea has only lightly been considered througout the design process.

Must-have's

- User-system interaction requirements
  - It should be a lightweight interaction for the user
  - It should allow the user to influence how the service communicates to him/her
  - The user should be aware of the fact that he/she has influence on the service's communication
  - It should be clear for the user what he/she could influence and what not
  - The user should have the opportunity to indicate his/her satisfaction about the communication
  - The solution should be operable through basic smartphone features: touch-screen interactions and playing audio and video
- User experience requirements
  - The solution should increase the personalized experience of the service
  - The solution should increase the sense of awareness over the energy portfolio
- System requirements:
  - The solution should be applicable to personal energy portfolio management assistant services
  - The system should support different capabilities of users
  - The system should support different interests of users
  - The system should support evolvement of a user's capabilities and differences over time
  - The system should support the variations of a user's capabilities and differences due to variations in context of use
  - Recording the appropriate data and assembling the user's profile should be minimally dependent on user action
  - The system should minimize the number of unique UI's needed

Nice-to-have's

- The solution should increase the feeling of ownership of the user over the service
- The solution should increase customer loyalty to the service or the brand
- The solution replaces the need for using persona's
- It should be clear if and how the solution could be applied in other (non-energy-related) services
- It should be clear how the concept could be applied to service that are used (mainly) via vocal interfaces

Concluding, the design process was about answering four questions:

1) What communication variables should be personalizeable?
2) What type of input data is needed?
3) How should the personalization system be embedded in the PEPMS tracking dashboard?
4) How should the user be engaged in the personalization system?

Approach

For two reasons the ambition was set to use an agile approach for this project. First, agile development processes are widespread in the mobile development industry, including Mobgen. An agile approach in this project thus would allow me to align with the company's way of working and build skills I will most probably need in the future.

The second reason to choose an agile approach is inherent to the approach itself. A designer using an agile approach has the flexibility to adjust the requirements and design of the final solution throughout the design process (Ratcliffe & McNeill, 2011). This principle proved useful to the complexity of the design project.

The approach initially chosen for this project is show in Fig. 10.2 on page 66. It is adopted from the build-measure-learn cycle of the book 'The Lean Start-Up' by Eric Ries (2011). My expectation with this cycle was regular and explicit testing of hypothesis using paper prototypes, collecting any data needed and designing a new iteration. In practice, the design cycles in the design process of this project contained less explicit testing. Validation rather happened through interaction with other designers, members of the supervisory team or encounters with inspiring other

applications or designs. Also, in contrast to my expectations, some of these validations were not planned, but occurred more by coincidence.

As an addition to the agile mindset in the design process, there was one main approach on how to address design a personalization system, visualized in Fig. 10.3. First, the differences in communication needs of Frank and Sarah were studied, by designing a dashboard interface for them separately. Then, when comparing these two dashboards, similarities and differences arose. The differences were an answer to the first question: what commiunication variables should be personalizeable?

Second, a selection of differences was made, which was the central theme in the following iterative design process. The process was aimed to find out (1) what the general dashboard should look like and how the different display styles should look like, (2) how you could measure a certain preference from the user and (3) how the user should be engaged in the personalization process. In other words, it was about answering the last two questions. This was an iterative process, because the solutions for the challenges strongly influenced eachother.

The four cycles of Chapter 11 have been marked in the overview as well.

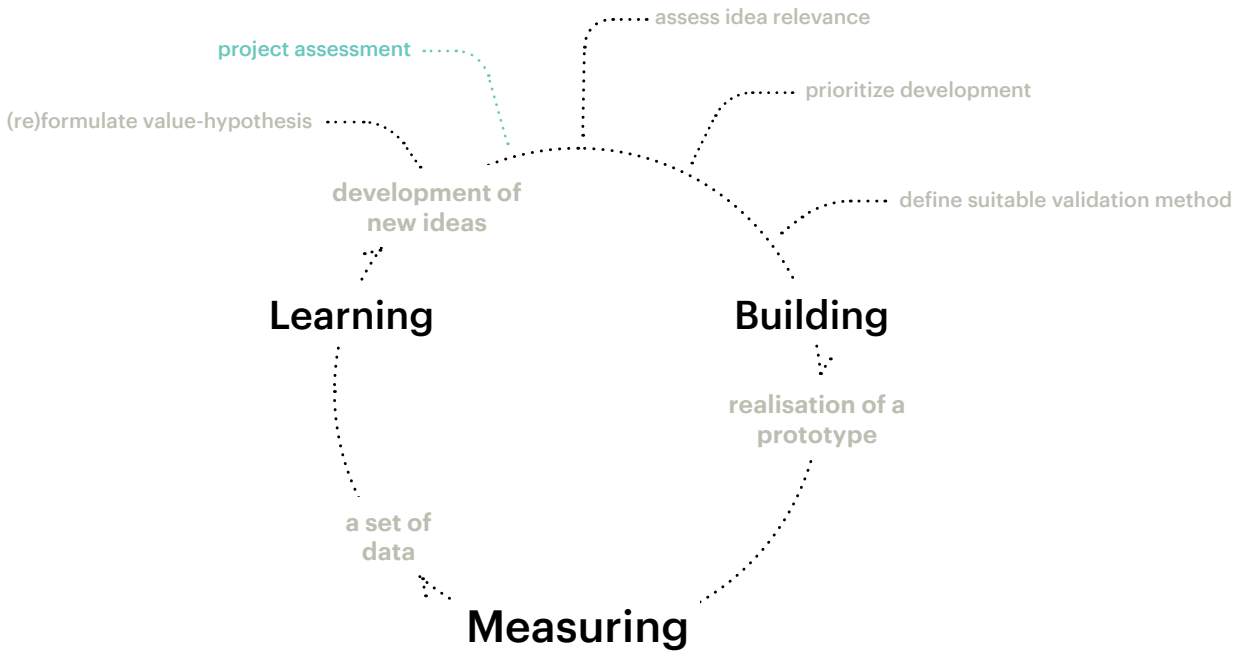
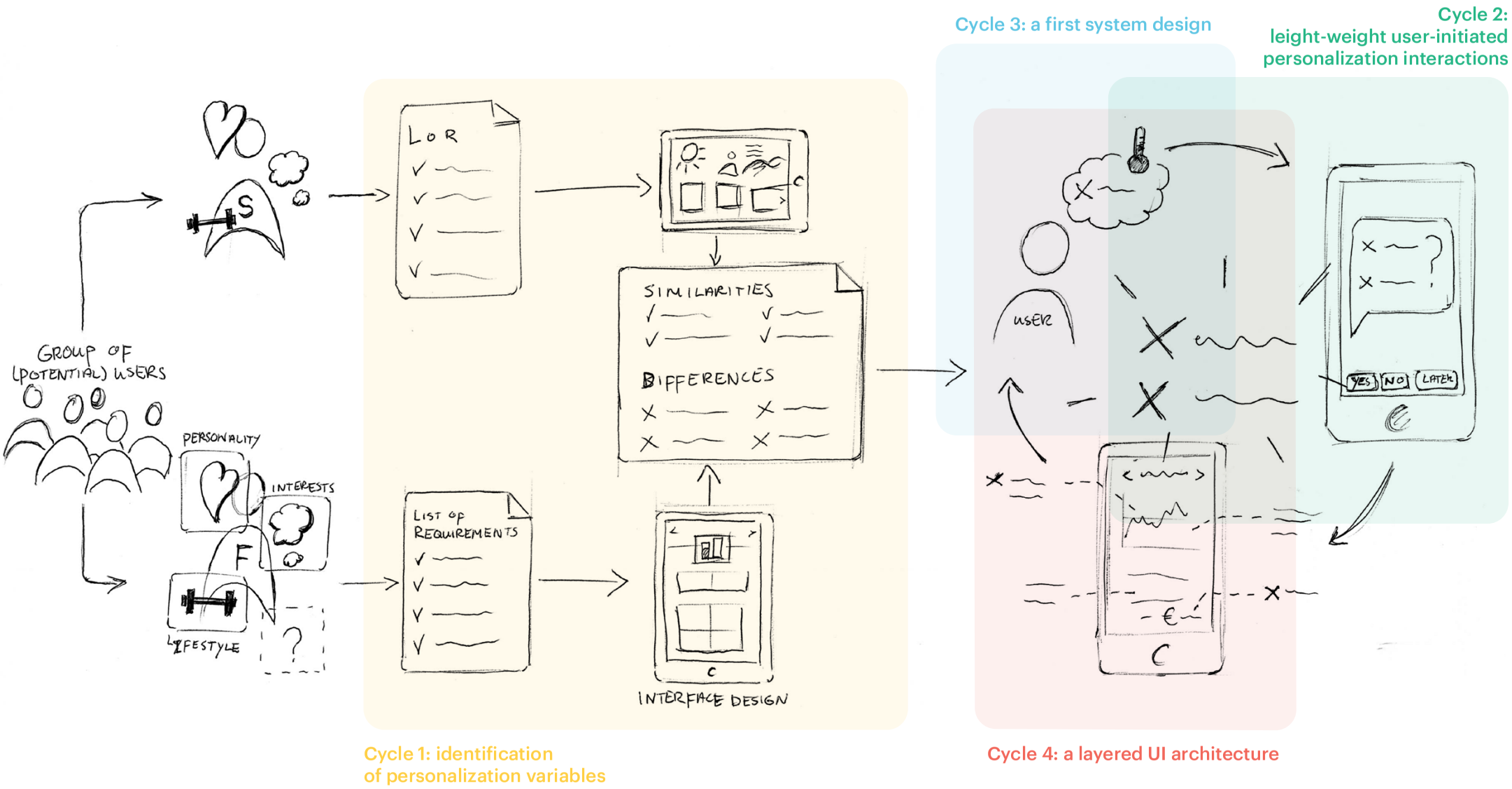


Fig. 10.2 The build-measure-learn cycle planned for this project, adopted from Ries (2011)

Fig. 10.3 The approach for the design process first focussed on revealing concrete communication preference differences and then on how to support these differences



11. A flight through the design process

In this chapter the design cycles are discussed by describing (a) the objectives of the cycle and what question was to be answered, (b) the activities that were done and (c) a description of the results, what was learned from them and the implications for the next cycle. In total four cycles have been completed.

Cycle 1: Identification of personalization variables

Objective

The objective of the first cycle was related to the first question raised in the introduction of this chapter: what communication variables should be personalizeabe? So, the objective was to find relevant personalization variables. The approach to get here was the following:

1) Identify specific needs of Frank and Sarah
2) Design dashboards for them
3) Conclude similarities and differences

Activities

I hosted a 3-hour creative session with 6 Mobgen colleagues that comprised the following procedure (see Appendix 14 for the full procedure).

Part I: introduction to energy future

Part II: splitting up into a Frank and a Sarah group and sensitize through a week-in-the-ilfe-of exercise

Part III: still split up, develop a list of requirements for your characters dashboard through a braindump, clustering activity and filling-in activity.

Part IV: design of an interface that might fit your character through 365-type of exercise and finishing by presenting dashboard to other groups and list similarities and differences

Par V: collectively brainstorm on how to merge the two dashboards and support the differences

Fig. 11.1 The Sarah-group (front) and Frank-group (back) members sharing their individual dashboard ideas during the session

Enso: the facilitator app

The session was facilitated using a fresh Mobgen app called ‘Enso’. It is a tool that supports you to plan and run your design sprints interactively. Using the app you can display full screen descriptions for the next step or show an alarmingly large timer. The app even features an energizer library!

Results & implications

The session delivered some EMS dashboard designs specifically for Frank and Sarah. Although I expected these to be valuable input for the following design cycles, it appeared that under the time pressure of the session and with limited knowledge of the energy future the session participants had not been not fully able to draw complete and sensible designs.

Rather, the result of Part III of the session appeared to be most valuable. The braindump, clustering and filling in the list of requirements delivered a clear picture of their dashboard vision for their character. The two lists of requirements were analysed on differences and similarities. It resulted in a list of personalization variables (see Appendix 15).

A selection of them is shown in FIGURE. As an example, 'units for expressing numbers' indicates that Frank and Sarah have different preferences when it comes to their preferred main unit of measurement. Their specific preferences are described in light grey.

The personalization variables found in this cycle were the input for the next cycle.

Level of detail when reflecting on energy consumption

- Frank: year - month - week, itemized data
- Sarah: month - week - day, one score

Units for expressing numbers

- Frank: kWh, €'s, CO_2e,
- Sarah: Analogies, €'s

Tone of voice

- Frank: straight forward, semi-formal
- Sarah: playfull, optimistic, Informal

Notification style

- Frank: based on regularity, few notifications
- Sarah: based on spontaneity, could be regular notifications
- Both: support changing interests

Nature of energy saving challenges

- Frank: med-high costs (€), low effort, not aimed at behaviour change
- Sarah: low-cost (€), low - high effort, aimed at behaviour change

Cycle 2: Light-weight user-initiated personalization interactions

Objective

The objective of this second cycle was related to the second and fourth questions of the introduction of this chapter. (2) What type of input data is needed? (4) How should the user be engaged in the personalization system?

The envisioned solution was to create an interactive means for users to indicate their preferences. The idea stemmed from the Nest thermostat example: a user keeps setting his desired temperature preference at a time he or she desires and after a while the system starts to recognize a pattern, allowing it to run automatically. The objective for this cycle was: to support the user interactively in selecting the appropriate communication style. In other words, to design light-weight user-initiated personalization interactions.

Activities

The approach for this cycle was to design light-weight interactions for all five personalization variables separately. And then see how they could be combined. To put boundaries to the design process a first tracking dashboard lay-out was assumed (see Fig. 11.2). It features four content cards: a summary on top, an energy consumption overview, a energy production overview and an energy saving challenges section. These were adopted partly from the designs resulting from the session and partly from the interactions as identified in Chapter 5.

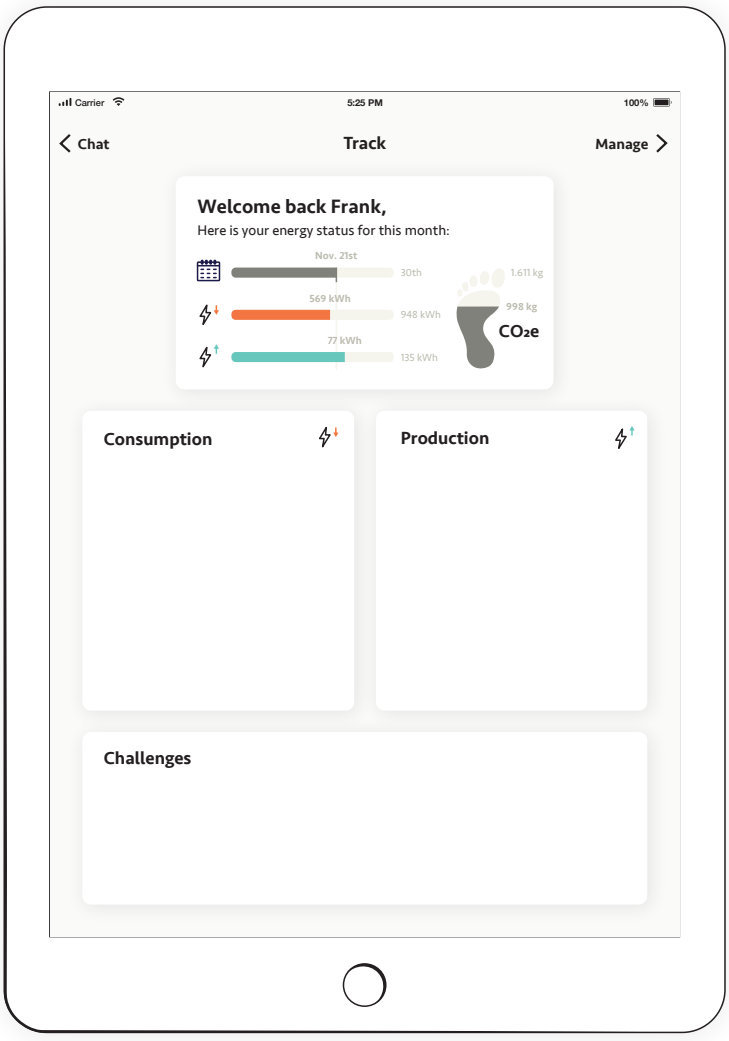


Fig. 11.2 The tracking dashboard design boundaries in design cycle 2

Results & implications

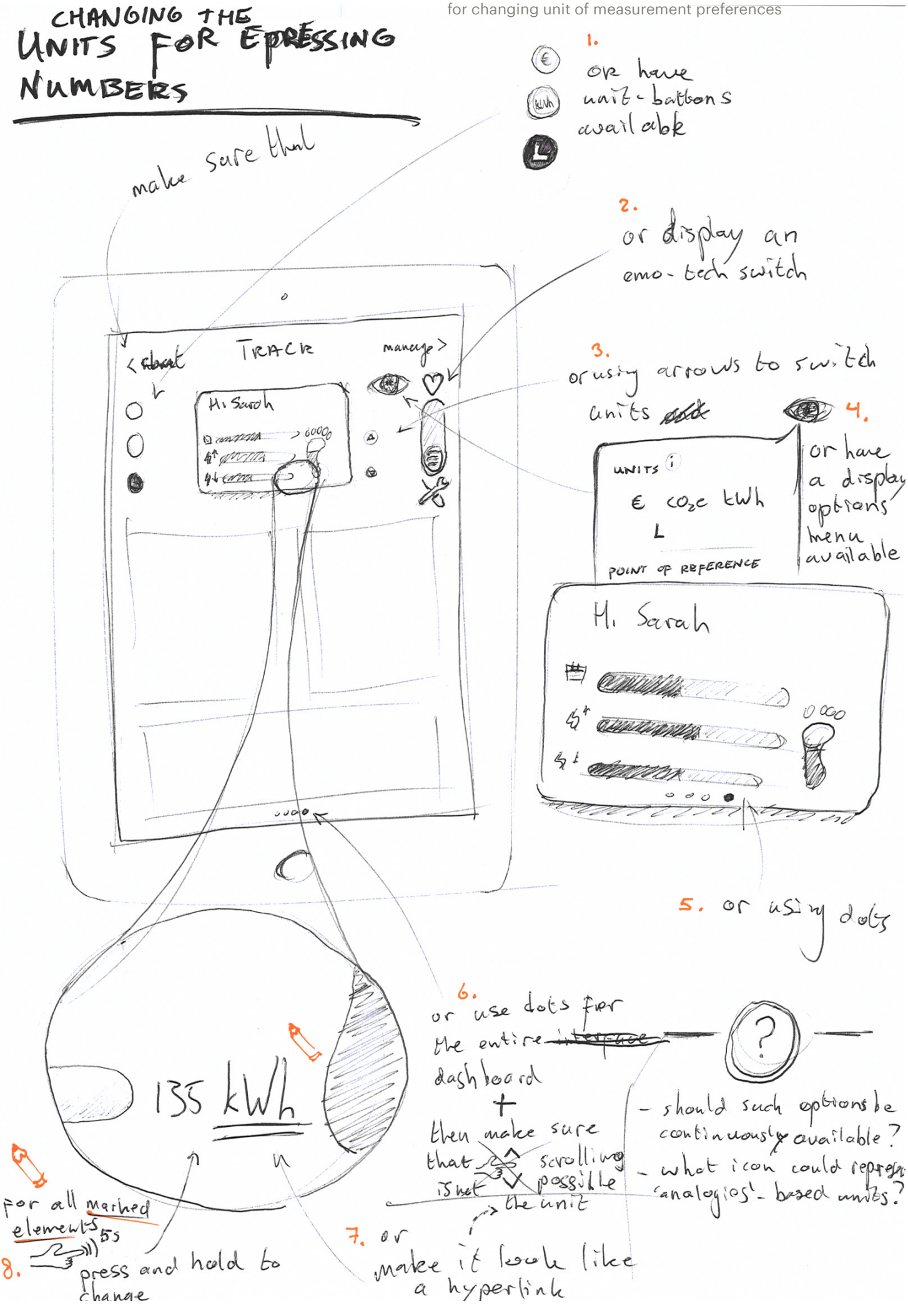
Fig. 11.3 gives the example sketches of the light-weight interaction designs for changing the units in which numbers are expressed.

In discussion with two Mobgen colleagues the designs were discussed. Although user-initiated personalization interactions could deliver valuable personalization data and insights, the designs produced in this cycle seem to have too high interaction costs. And while it was termed 'personalization interactions', the button- and setting-menu based designs of this cycle actually concern 'customization interactions'. It expects the user to be aware of his preferences.

Possibly, a user such as Frank, who desires to draw his own conclusions on his own time in his own way, might know very well what is display and communication preferences are. But a use such as Sarah, who likes easily digestible information and to be taken by the hand in the tracking environment, might not be fully conscious of her preferences. A system with these designs would only deliver data of Frank-type of users, because Sarah-type of users might not use the customization features. So, the system should rather gather implicit communication and display preference data.

Concluding, the design process should be aimed at developing an interface that uncovers implicit user display preferences. Also, the next cycles should draw an image of how that system gathers and utilizes that implicit preference data. Lastly, feedback from the supervisory team was gathered that the current interface boundaries (Fig. 11.2) seemed to be lacking the most interesting part of the energy future: energy trading. Involving this might make the dashboard more engaging, making it easier to test future solutions.

Fig. 11.3 Light-weight user-initiated personalization interactions for changing unit of measurement preferences



Cycle 3: A first system design

Objective

This cycle had two objectives. The first one was to specify a system design for the personalization system. This objective was related to answering design question 3: How should the personalization system be embedded in the PEPMS tracking dashboard?

The second objective was also related to question 3. It was about developing a better idea of what the PEPMS tracking dashboard should look like in the first place. The intention was to more clearly involving energy sharing, energy trading and social energy elements in it, and thereby make it more future-proof and more engaging. This choice was also based on the assumption that managing the energy portfolio is much more engaging than tracking it, which meant is was worthwhile to explore the interactions related to energy sharing.

Activities

In order to meet the first objective, the tone of voice personalization variable and one top-of-mind solution were used to draw a first image of the personalization system design.

In order to meet the second objective, three activities were done:

1) A brief study of peer-to-peer energy services Vandebron and Powerpeers was performed
2) An attempt to distinguish the elements of energy sharing that would be engaging to Frank and Sarah
3) A service feature overview was developed containing all knowledge at that point of features that should be available in a PEPMS tracking dashboard

When I got stuck in step 3, a Mobgen colleague introduced me to the approach she uses to design interfaces. First, list any elements that come up. Second, put them in a possibly logical architecture of main elements and sub elements. Third, circle and cluster elements that together would comprise one feature of the dashboard (which would become content cards). Fourth, select the content cards you want to design first (see result on the next page).

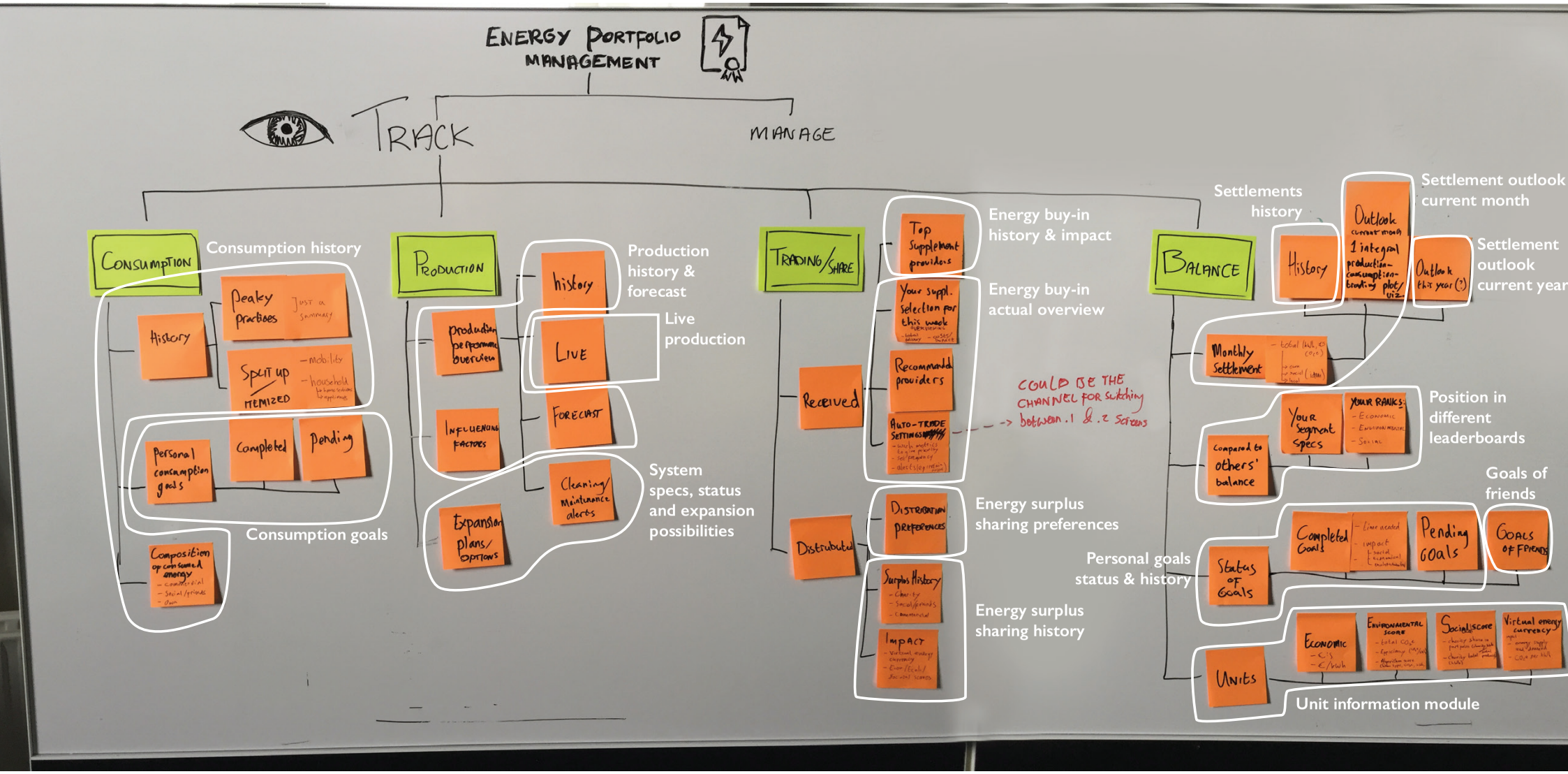


Fig. 11.4 An overview of the possible features and architecture of a PEPMS tracking dashboard

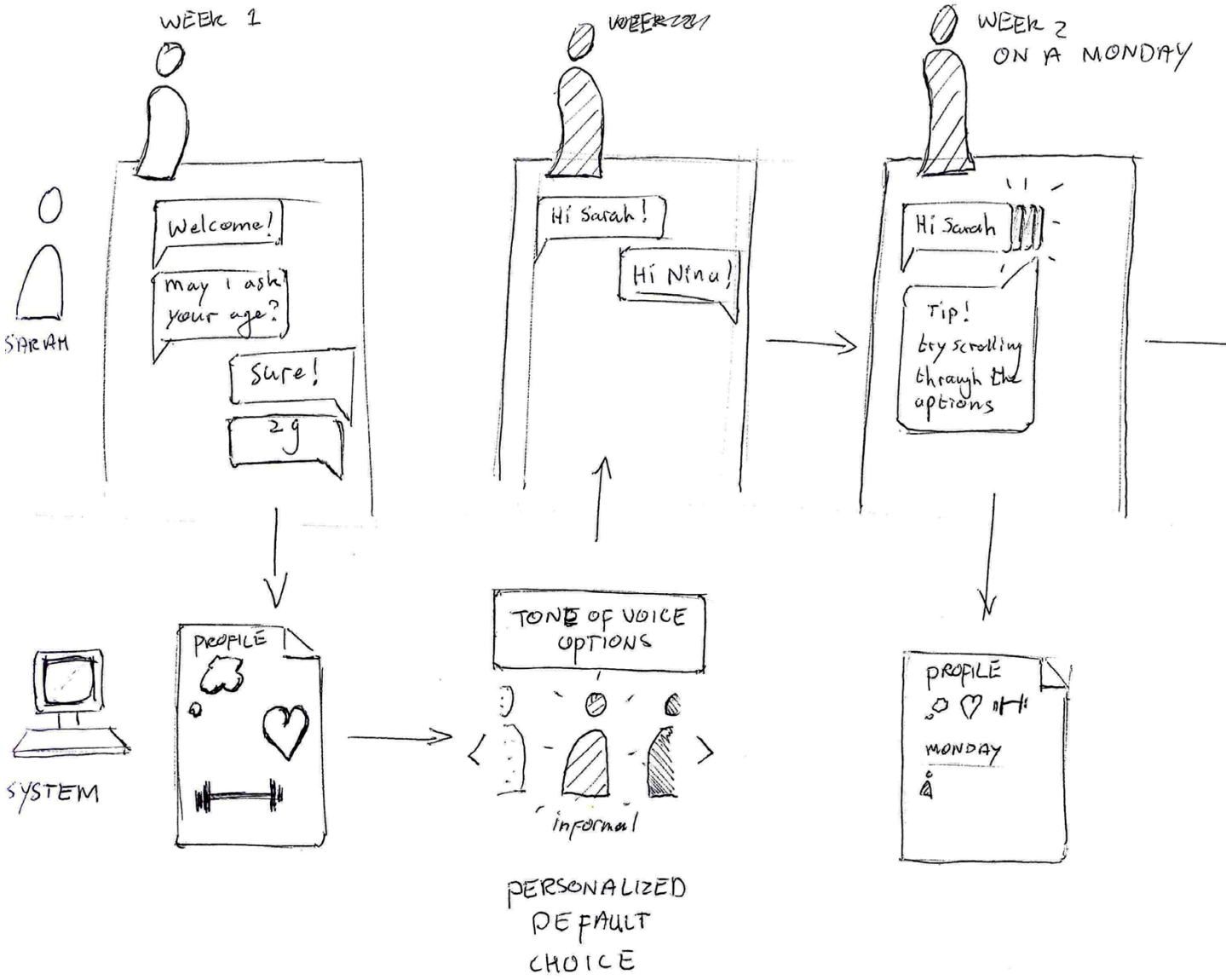


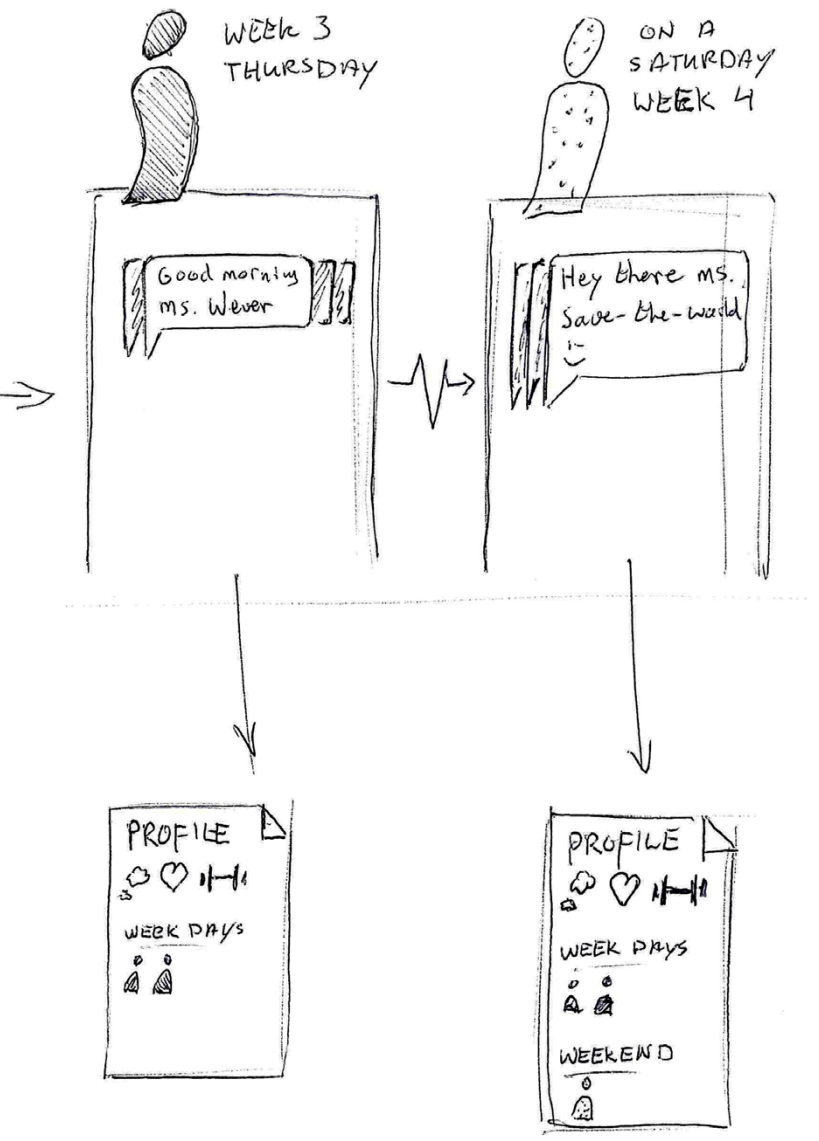
Fig. 11.5 A design of the personalized communication system showing how a tone-of-voice preference over time is build up

Results & implications

Fig. 11.5 shows the system design as intended for the personalized communication system, in this case specifically describing tone of voice personalization. And Fig. 11.6 shows the solution that could be used to record tone of voice preferences of a user.

Week by week the system assembles a profile of a user's tone of voice preference. Sarah, in this case an example, might select an informal tone of voice on week days and then a cosy tone of voice in the weekend. Saved in Sarah's system profile, those choice become the new default tone of voice for the specific moments in the week. The user does not need to be able to express a personal preference. He or she merely needs to select the display option that feels best at that moment in time.

In the light of the design process, this sketch proved to be an effective first visual of the system principle functionalities. Yet, tone of voice was concluded to be



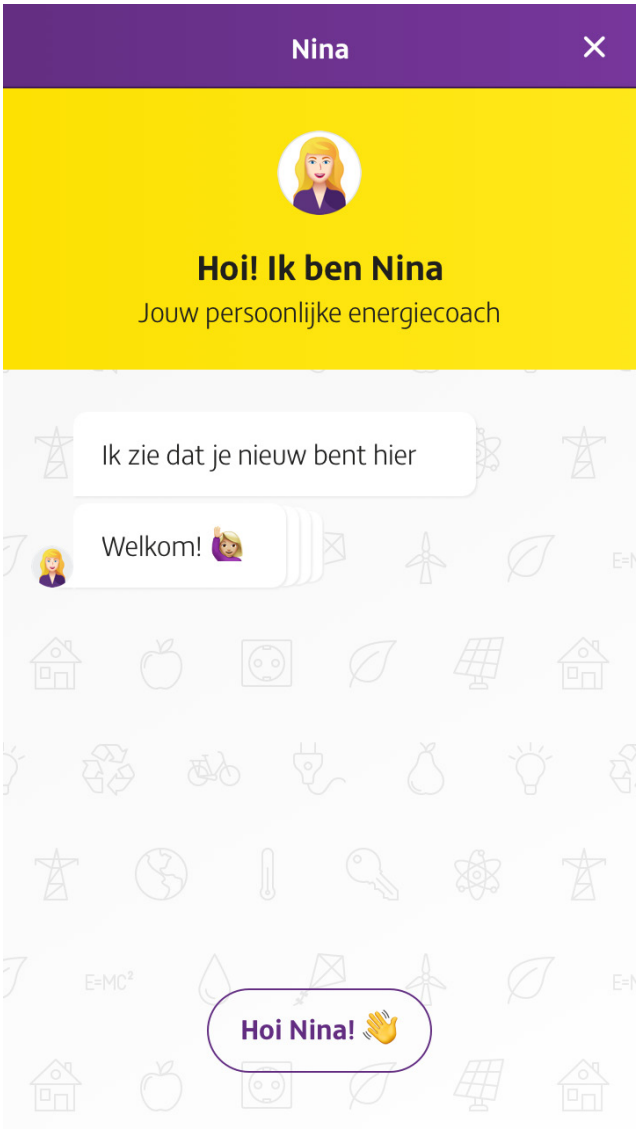


Fig. 11.6 A top-of-mind solution for recording tone-of-voice preferences, the user can swipe between alternative welcome messages with a different tone

a very complex personalization variable. Proposing several varieties in tone of voice for the entire chat-bot library is quite a venture and thus needs much more elaborate considerations, and probably too much for the remainder of this project. Therefore in a next cycle the system design had to be adapted to a different (set of) communication variable(s).

Regarding the second objective of this cycle, an overview of relevant PEPMS tracking dashboard elements and architecture of Fig. 11.4 on page 75 were concluded. The approach suggested by a Mobgen colleague proved effective in this stage, because it was an efficient way of assembling, structuring and visualizing the knowledge available at that moment in time.

The aim to identify engaging energy interactions for Frank and Sarah was relatively unfruitful. Appendix 16 shows the results of a braindump on this topic. At one point I started trying to apply Strava principles to the energy domain. Although it delivered interesting ideas, it proved to be a complex domain, one requiring a graduation project on its own. I realized there was too much emphasis on the energy domain of this project and the personalization domain was receiving too less attention. The main principle derived from this step was the insight that people might feel engaged when there is something to win (by being engaged) or loose (by not being engaged).

Concluding, the remainder of the design process was to be based on the features as identified in the PEPMS tracking dashboard overview. Also, the system design developed in this cycle was to be adopted for personalization of other communication variables than tone of voice.

Cycle 4: A layered UI architecture

Objective

Looking at the duration of the project at this point, there was a necessity to let things come together. Therefore, the objective of this cycle were relatively ambitious:

- to suggest a PEPMS tracking dashboard design for this project
- to adapt the system design to other personalization variables
- to develop an idea of how the user would be engaged in the personalization process

The objectives covered all four design questions as raised in the introduction of this chapter.

Activities

In this cycle the choice was made to use a specific part of the PEPMS tracking dashboard. The previous cycle delivered the insight that having something to win or lose might stimulate engagement.

Therefore the PEPMS tracking dashboard in this project was decided to feature the balance in your energy trading portfolio. This could either mean a financial balance or a ecological balance. In the future, the price of the kilowatts you buy and sell and the number of kilowatts you produce might change constantly. The balance can therefore be different every day. A clear tracking dashboard thereby would imply that if you pay attention, you might be able to gain from it (ecologically or economically).

Also, in this cycle a choice was made to continue with a specific selection of personalization variables. This was namely expected to reduce the complexity of implementing the personalization system in the PEPMS tracking dashboard. The following three variables were chosen: 1. time scale (year, month, week), 2. level of detail (visual and simple, technical and detailed), 3. unit of measurement (Euro's, carbon footprint).

The cycle's main activity was sketching PEPMS tracking dashboard screens containing the chosen elements, and finding relevant display styles for Frank and Sarah in it.

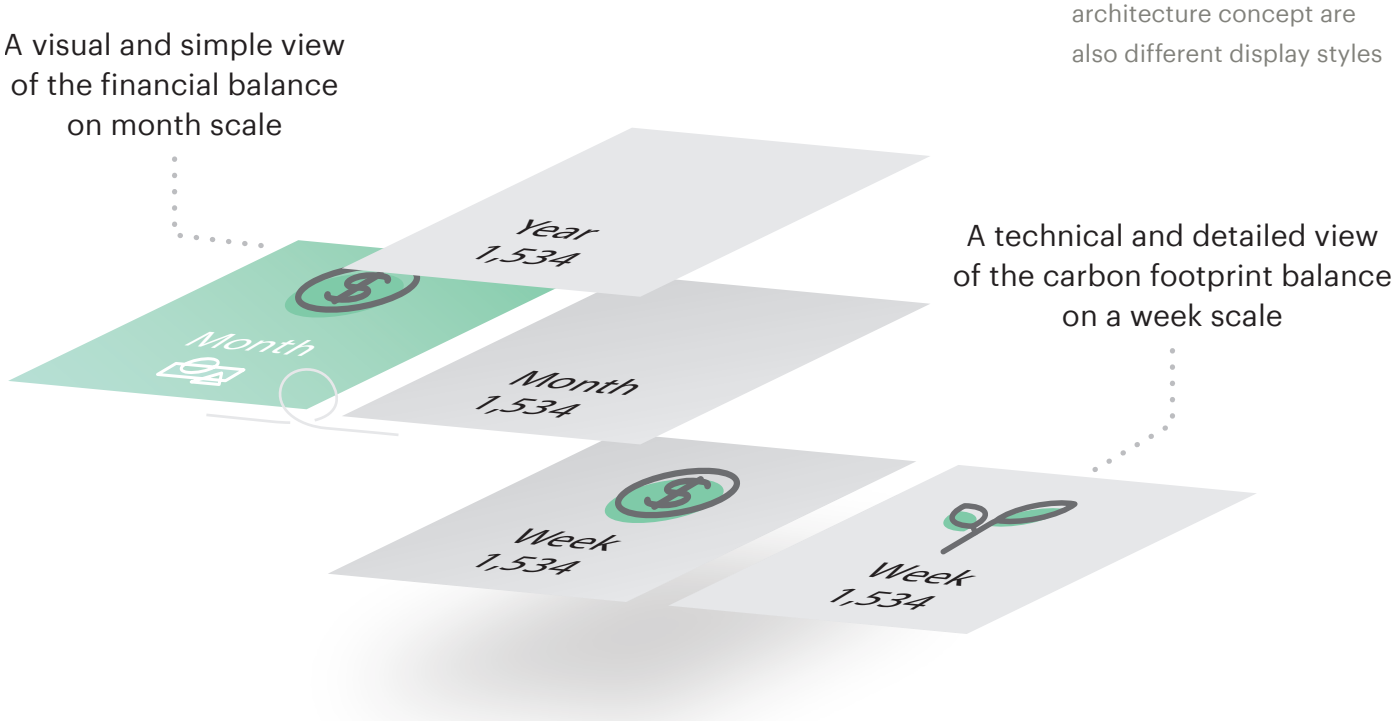
Results & implications

Cycle 4 delivered an integral solution for a personalized communication system embedded in a PEPMS tracking dashboard (see Appendix 17 for a chronical overview of the session results). As a main development a layered dashboard architecture was designed that both allows personalized communication as well as that it offers a complete dashboard overview.

As displayed in Fig. 11.7 the dashboard would be layered into three different time scale levels (variable 1). One side of each layer (grey) would be a technical and detailed display of the balance on that specific time scale and the other side of each layer (green) offers a visual and simple display (variable 2). Lastly, each of these (six) displays of balance could be either expressed in a financial balance or an ecological balance (variable 3).

Personalization would take place by automatically navigating the user to a

Fig. 11.7 The layers of this UI architecture concept are also different display styles



Personalization takes place by defining a user's default screen. The prefered default screen might vary per day of the week and might develop over time.

preferred point of entry in the dashboard interface. This is important and interesting, because this means that there are is only one UI needed and not multiple unique UI's for the same usability. The system merely alters the default screen of the user based on his behaviour in the app, which is assumed to represent his interests and capabilities.

Additionally, in this cycle several first screen designs were developed for the PEPMS tracking dashboard with the layered architecture as specified above. Visual and simple display versus technical and detailed display was the main challenge of this design process. First, the specific content was written up for each. Second, designs were drafted to represent both display versions. Third, an architecture was designed to switch from one to the other. Switching between different time scales and different units of measurement were then added. Appendix 17 provides an impression of these sketches. The final sketches were turned into a first clickable prototype of the PEPMS to test the interaction with the usability (see Fig. 11.8).

Not yet answered in this cycle was the question on how specifically the user would engage with this personalization system. Due to time constraints in the process, that interaction was designed once: in the final design process. Some alternative designs were weighted in the weeks before the user test of Adpt, see Appendix 19.

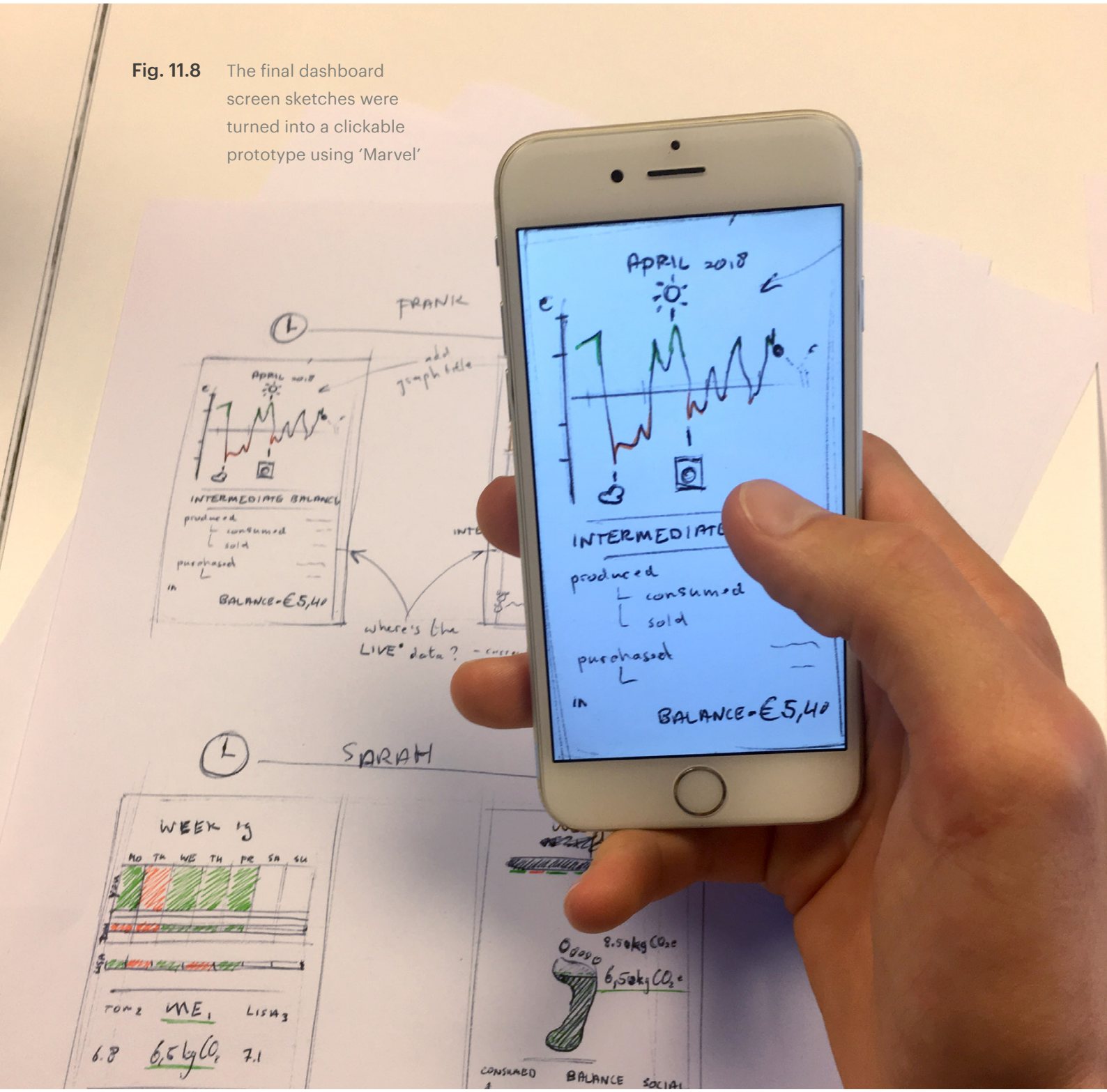


Fig. 11.8 The final dashboard screen sketches were turned into a clickable prototype using 'Marvel'

Conclusion

The design questions raised in the beginning of this chapter were:

1) What communication variables should be personalizeable?
2) What type of input data is needed?
3) How should the personalization system be embedded in the PEPMS tracking dashboard?
4) How should the user be engaged in the personalization system?

1. Personalization variables

In cycle 1 an overview of possible personalization variables was generated. Over the course of the design process three variables were selected (time scale, unit of measurement and level of detail).

Importantly, since the variables were generated based on (educated) assumptions, they do not represent validated needs of PEPMS users. Rather, the variables offered an interesting and concrete starting point for the process of designing a personalized communication system for a PEPMS tracking dashboard. The implications of this for the validation are discussed in Chapter 13.

2. Input data

In the current design, two sources of information are required. First, in the onboarding process of the user, general demographics data or another in-take interaction is used to determine a general default page. Second, over periods of weeks the user's in-app behaviour is utilized to supplement and update the profile.

In-app behaviour data is assumed to represent the user's interests at different moments in time. Practice should provide insight in the extent to which in-app behaviour data indeed contains that information.

Besides that, in time other forms of input data could be used as well as it might improve the system's ability to support even more contexts of use. Imagine for example that the smartphone's accelerometer data could be use to detect if someone is walking. The system could then decide to show a simple and visual screen first, because that display style is easier to comprehend while looking at a moving screen.

3. Embedded in the PEPMS

On the question how to embed the personalization concept in the PEPMS tracking dashboard, the layered information architecture concept provided an answer. In reflection, the personalization system shaped the architecture of the PEPMS, a hierarchy that surprized me. Could we say the PEPMS tracking dashboard became an overlay of the personalization system?

On a more critical note, the personalization system is intended to personalize navigation through the app. Yet, with the current PEPMS tracking dashboard design, that same personalization process is equivalent to maximum two clicks. This makes validation of the personalization system concept difficult, which is discussed in more detail in Chapter 13.

4. User involvement

In the four cycles of the design process only the usability of the PEPMS tracking dashboard was briefly tested. Time constraints limited the time available for designing how the user would be involved in the personalization process.

Some alternatives have been weighed during the preparations of the final concept. These are attached in Appendix 18.

The importance of designing this involvement right, is related to the mental model that the user develops of the service. A mental model is ‘the model of what a user (thinks he) knows about the architecture of the app’ (Nielsen, 2010). Changing the default screen or point of entry of the user over time might have implications for the user’s mental model. The way the user is involved in the personalization process is expected to have a large influence on that.

The concept of involving the user is described in Chapter 12, which presents the concept ‘Adpt’.

Part V.

Final design: ‘Adpt’

‘Adpt’ (pronounce ‘adapt’) is a personalization system that uses a user’s in-app behaviour data to serve each user the right user experience at the right moment in time, a process in which the user is actively involved. Its design, use flow are intended user experience introduced in this chapter. Adpt has been designed and demonstrated using a PEPMS tracking dashboard. With different information display styles integrated its UI-architecture, this dashboard plays an important role in the personalization system.

The first chapter describes the PEPMS tracking dashboard and the design and use flow of Adpt. The second chapter in this part discusses the evaluation of Adpt. Part V is finalized with a general discussion of the project results.

Fig. 11.9 An image of someone using the PEPMS dashboard designed in this project

12. ‘Adpt’

More info?

Looking for some more info on the future vision and the balance concept? Go to https://vimeo.com/297059262 to view the 5-minute movie that was used to explain this scenario to user test participants.

As stated, Adpt is a personalization system embedded in a personal energy portfolio management tracking dashboard. The design of this dashboard includes several different display styles, which form the leading personalization variables for the personalization system. First, the design of the dashboard is discussed, followed by a description of the use flow of the personalization system.

The PEPMS tracking dashboard

The role of the dashboard in this project was to support the design and demonstration of a personalization system. This section starts with a description of the type of information available in the PEPMS tracking dashboard designed for this project. Next, the different information display styles are described, including their relation to Adpt.

Energy source	GWP (gCO2e/kWh)
Coal	820
Biomass	230
PV (rooftop)	48
Wind (offshore)	12

Table 12.1 The global warming potential of different renewable energy sources (IPCC, 2014)

Market forces for the individual prosumer

The dashboard assumes an energy prosumer who has several solar cells placed on his home roof. There is insufficient storage capacity and his peak consumptions take place in the morning and evening. As a result, most of the solar energy is sold during the day and energy supplements are being purchased from other energy sources in the grid in the morning and evening.

On a large scale this buying and selling of energy leads to a constantly changing balance of supply and demand, resulting in a variable energy price. So, the financial balance of the prosumers energy portfolio can change on a daily basis.

Additionally, for his energy supplements the prosumer can choose between different providers that have different renewable energy sources. Different renewable energy sources have different environmental impact, expressed in carbon footprints (see Table 12.1). The availability of, for example, solar and wind energy is obviously subject to weather conditions. As a result, the footprint of the prosumer’s energy consumption might change on a daily basis as well.

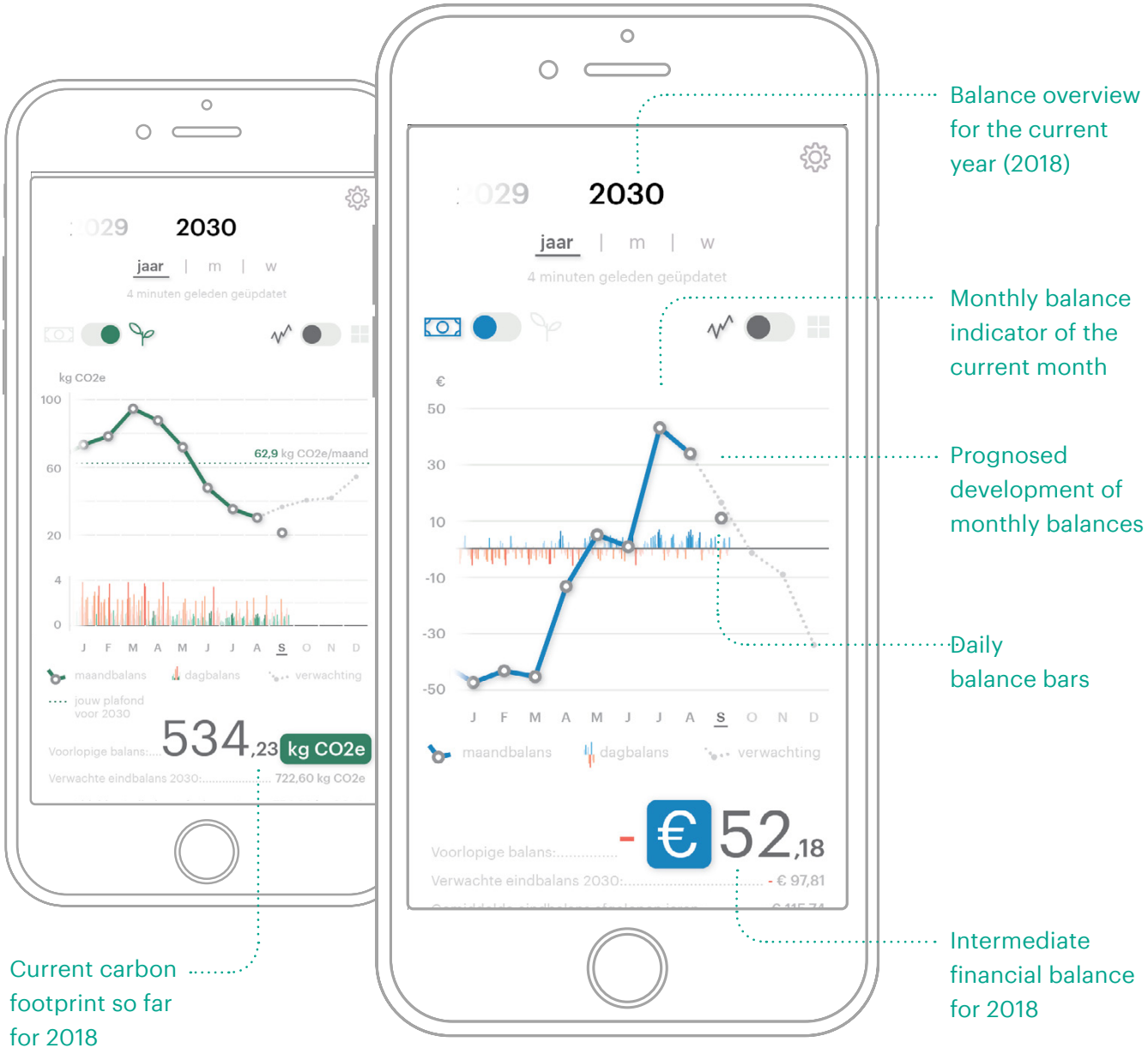
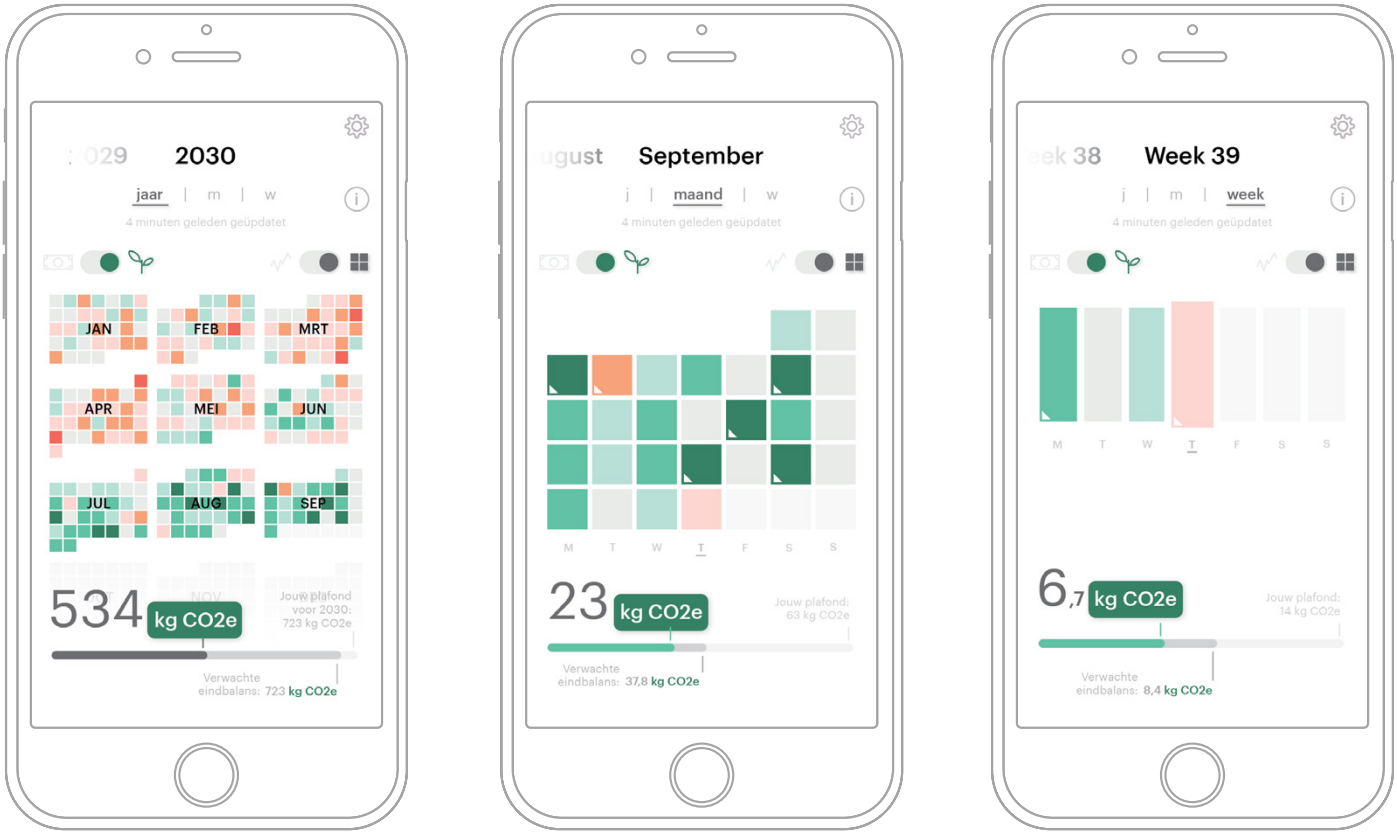


Fig. 12.1 The PEPMS tracking dashboard design used in this project (in Dutch)

It is important to note that that the numbers shown in this PEPMS tracking dashboard are only indications of real balance numbers. A higher fidelity was not needed for design and demonstration of a personalization system. Also, the calculation of global warming potential (GWP) or CO2-equivalent is extremely difficult. And drawing a realistic image of the behaviour of the future energy market fell outside of the scope of this project.

These financial and carbon footprint balances are, nevertheless, the main topics of the PEPMS tracking dashboard designed for this project. Theoretically, the prosumer can influence these balances by (1) changing his production capacity, (2) changing his energy storage capacity), (3) changing the magnitude and/or timing of his consumption and (4) his selection of energy sources. In this dashboard the actionability is limited to selection of energy sources.

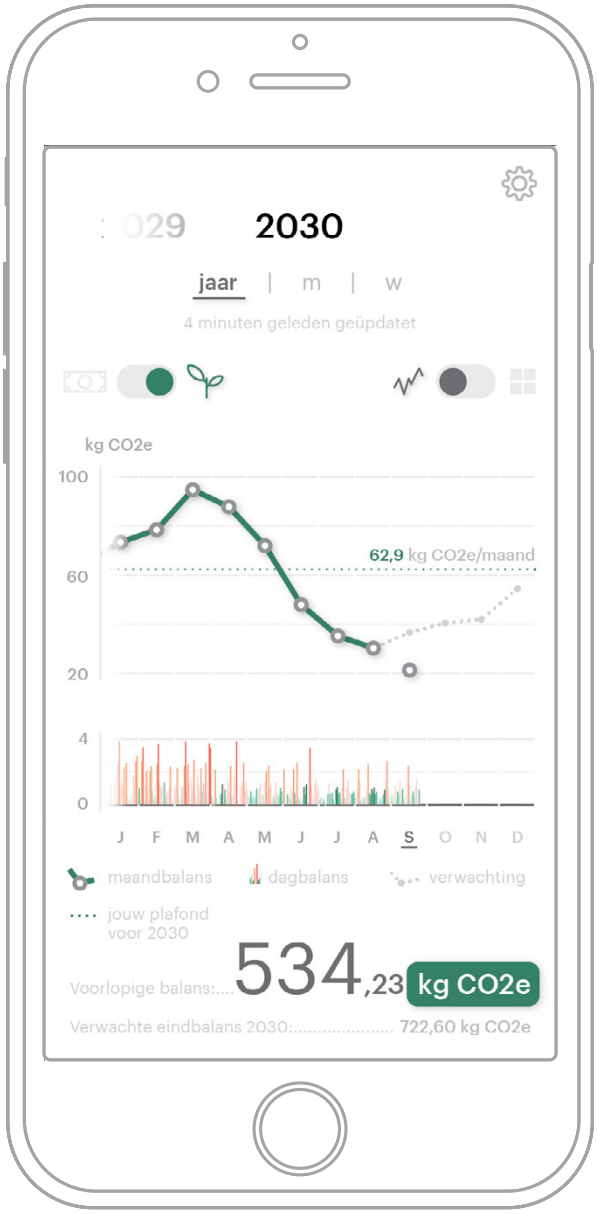
year | m | w

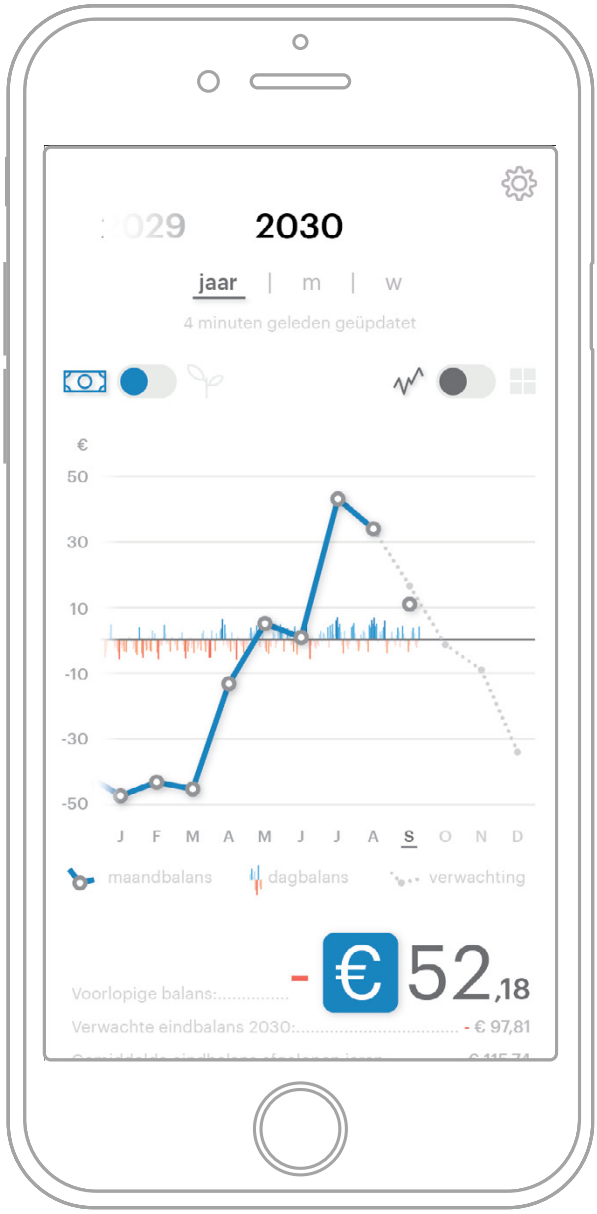


Time scale

Time scale refers to the amount of time that is displayed. In the PEPMS tracking dashboard, three time scales are available: year, month and week. From a personalization perspective, a smaller time scale (for example week scale) is assumed to align well with a more narrow scope and a larger scale (for example month scale) with a larger scope.

534,23 kg CO2e



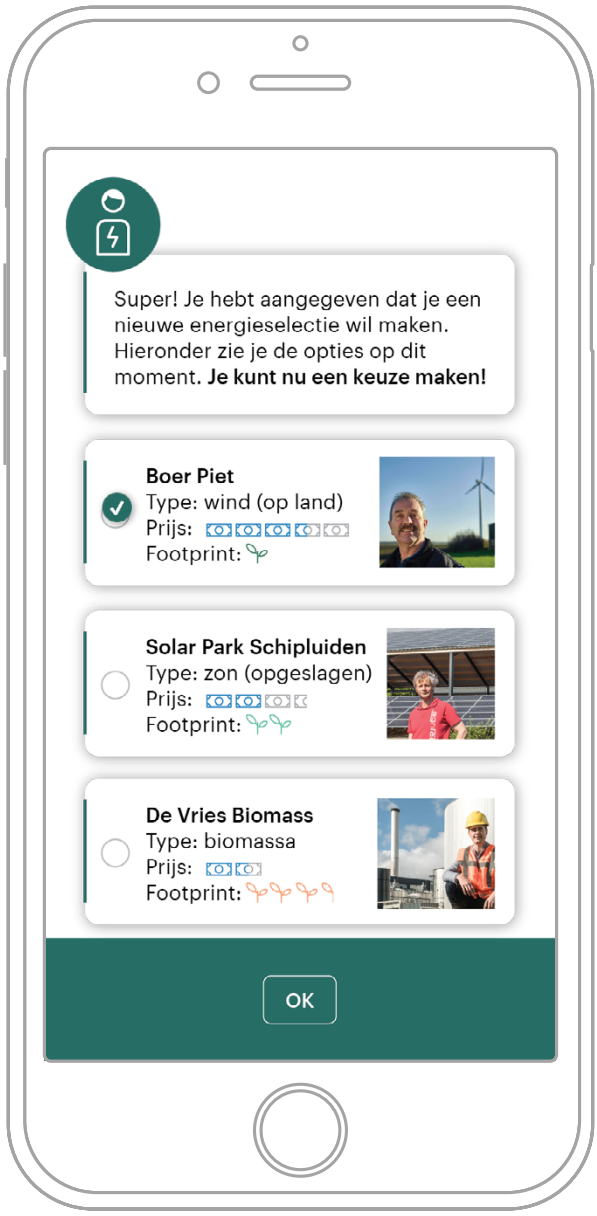


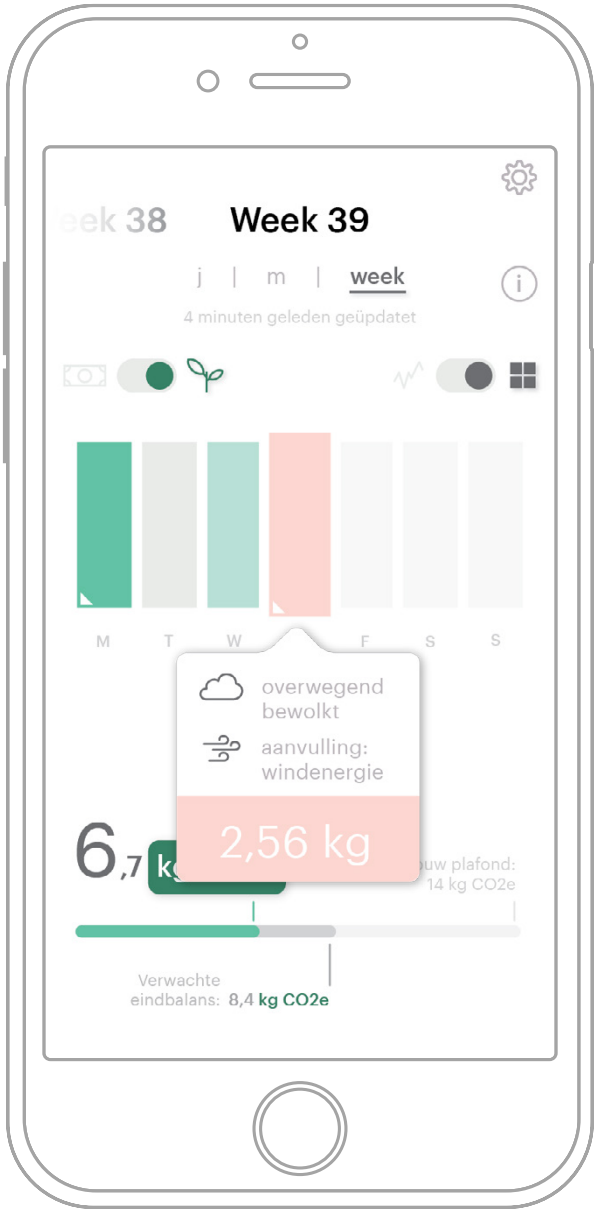
Unit of measurement

Unit of measurement refers to unit in which the balance is expressed. In practice, one could distinguish a large number of units, such as €'s, kWh's, gCO2e, social scores. In the current dashboard design, this is limited to a financial balance (expressed in euros, coloured blue) and a carbon footprint or environmental balance (expressed in grams of CO2e, coloured green). From a personalization perspective, value's and interests related to energy determine the preferred unit of measurement. And these interests might change each day.

Level of detail

Level of detail can be seen as a combination of two different elements. First, it represents the level of visuality (that is, the balance between images and text/numbers). Second, it represents the level of detail available in the displayed information. Conceivably, this communication variable affords many different display styles. Yet, the dashboard is limited to two different styles: visual with low detail, and less visual with higher detail. From a personalization perspective, higher levels of user energy expertise are expected to prefer a higher level of detail. Also, users in a contexts of use that offers them limited time are expected to prefer a less detailed display of information.





Supporting the energy source choice

The dashboard features an assistant that supports the prosumer in managing his portfolio. In the current design, one of its roles is to provide a selection of energy sources to choose from. The prosumer can prepare himself for this choice by studying the information pop-ups available for days with a peaky balance. In a real-life scenario, the number of source options and the amount of available information to prepare the choice would be larger. But in the current design they have been limited.

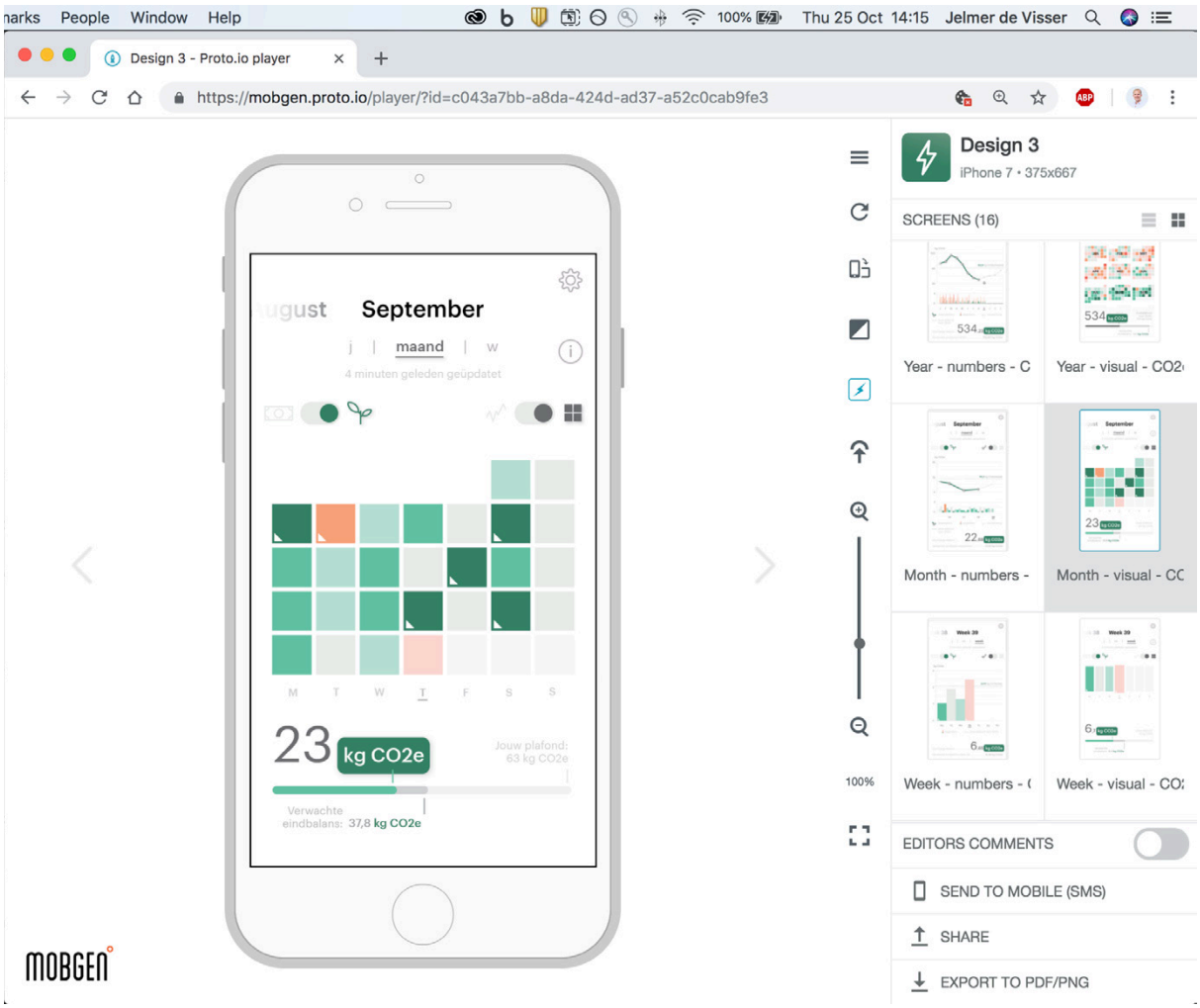


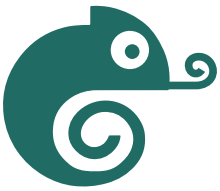
Fig. 12.2 The clickable prototype was made using Proto.io, a web-based prototype application that also features a smartphone app to test prototypes

Interaction

The layered architecture discussed in cycle 4 of the design process, also has been translated into interactions. In the dashboard, prototyped using the online tool 'proto.io', switching from visual to detailed displays make the interface flip. These display styles namely were presented as being two sides of the same layer.

Also, navigation between different time scales is made clear through 'zooming-in and -out' type of screen transitions. This is meant to resemble zooming into time (towards a smaller time scale) or zooming out (towards a larger time scale).

Switching between €'s and CO2e happens through a fading transition. In cycle 4 the unit layers were displayed next to each other. But sliding the screen left or right, led to a false navigational experience.



AI-based personalization

With Adpt I propose a personalization system that increases an energy prosumers awareness of his PEPMS by personalizing in-app navigation. With changing contexts of use and evolving experience of the user, the primary dashboard display of interest is expected to be under constant development as well. Through an AI, Adpt continuously maintains a profile of the in-app behaviour of the user to have an up-to-date image of the user's current interests. With that profile it can change the user's point of entry in the app (that is, the default screen), and it can even set different points of entry for different moments in time (that is, different time slots in a week). The user is involved in every change of his point of entry and can edit the point-of-entry settings, at all times, as well as view and destroy the recorded data.

Thereby, Adpt is a next generation quick-access personalization solution. Instead of offering the user his most-used dashboard display as a hyperlink on his dashboard home screen, Adpt turns the most-used display into a home screen itself. Changes in context of use are integrated by maintaining living user profile of different default displays demanded in different contexts of use.

On the following pages the use flow is described.

Onboarding

1. First use

Upon first use the user is offered different sets of images and is asked to select a favourite. Based on concepts like VisualDNA, this process is used to develop an image of the user's character traits. It should result in setting a first general default display for the user. During the first visit the user is then directly welcomed to his general default display.

After a few weeks

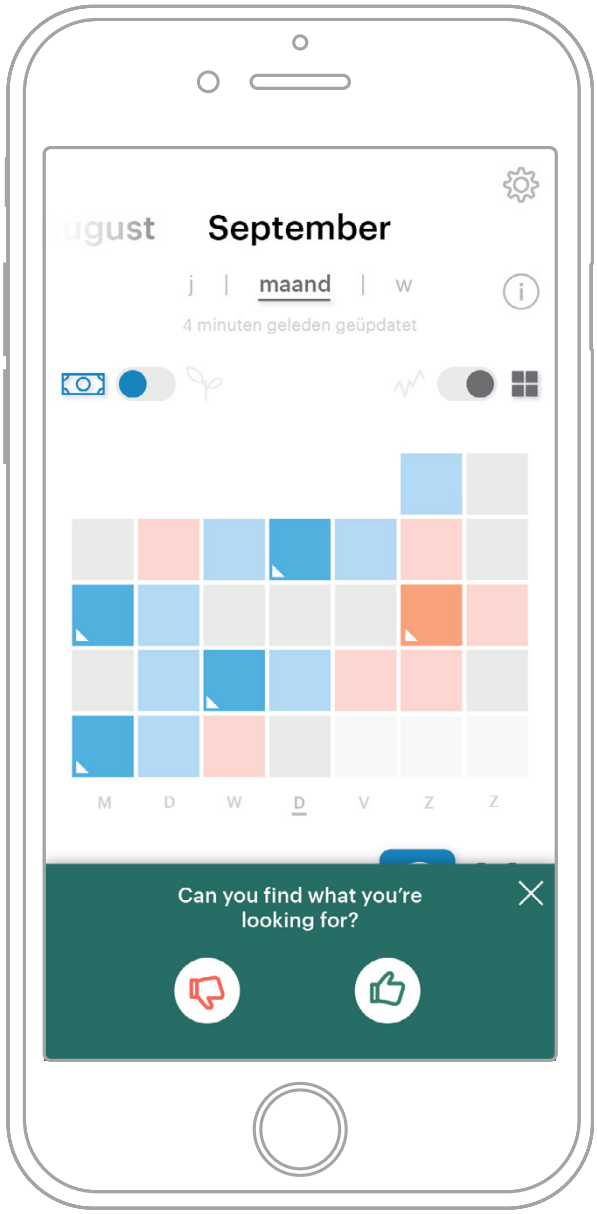
2. Default display suggestion

After sufficient in-app behaviour data is gathered and clear usage patterns arise, specific default screens are suggested. For certain days in the week the user has apparently visited one specific page most often. Days of the week, in this case, aim to represent different contexts of use. Expectedly, a higher 'resolution' is needed in real life as one day could easily contain different contexts of use and not every Thursday will always result in the same contexts of use.

Upon opening the app, the assistant approaches the user with this default display suggestion. The system proposes a time-bound default display setting: for the days in blue it suggests to set the screen above as default.

Two responses are available in the chatbot interface. Choosing ‘yes’ leads to a confirmation message (left screen above). Choosing ‘no’ leads to a new question (right screen above). This is to check whether the timing of the suggestion is off or if the suggestion is not appreciated at all.

The latter screen then also offers a GDPR related response ‘What behaviour data did you use for this suggestion?’. It is a first small step in making Adpt GDPR-compliant. The general data protection regulation namely specifies data owners have the right to view their personal data that is stored (EUGDPR, 2018). Several earlier design iterations of these suggestion screens can be found in Appendix 18 and Appendix 19.



After deployment of first default screens

3. Integrated validation

The fact that for user X display Y is the most visited page on Wednesdays, Fridays and Saturdays, does not immediately mean that he enjoys having that screen as a default screen for these days. This fifth interaction is intended to assess appreciation of the dynamic default screen. In case the user dislikes it or presses the question mark, a few optional follow-up questions are offered as well as an opportunity for providing feedback.

From a personalization perspective, the data generated by this tool could help to automatically improve the performance of the algorithm used for (1) finding behaviour patterns and (2) improving the translation from these behaviour patterns into suggested default display setting patterns.

Adpt and the chameleon

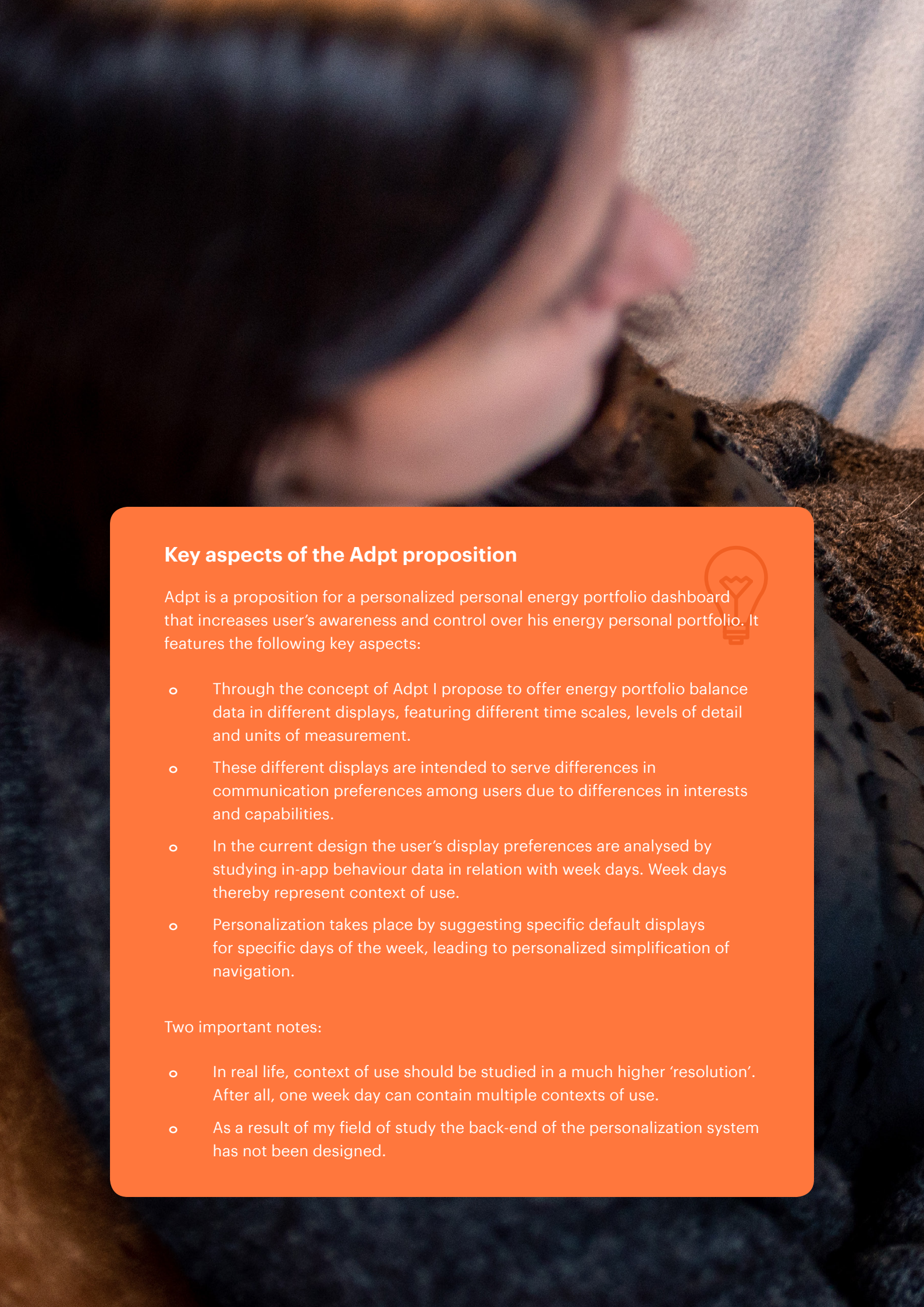
Many chameleon species are famous for their ability to change skin colour. The ability is among others used to blend in with the lizard's environment. This property of chameleons appeared as a fitting analogy for the personalization principle of Adpt: the dashboard has a different (default) display style depending on who is using and the context in which it is being used.

Depends on user

4. User-initiated default adjustment

To provide the user with control over the default settings, the default display setting menu allows the user to view and change the default display settings. The menu shows the default display for each day of the week, specifying the time scale, level of detail and unit of measurement. The days that have not been assigned a specific default display remain on the general default.

Also, this page provides a hyperlink to the user data overview that is also demanded by the European GDPR as the right to access (EUGDPR, 2018).



Key aspects of the Adpt proposition

Adpt is a proposition for a personalized personal energy portfolio dashboard that increases user's awareness and control over his energy personal portfolio. It features the following key aspects:

- Through the concept of Adpt I propose to offer energy portfolio balance data in different displays, featuring different time scales, levels of detail and units of measurement.
- These different displays are intended to serve differences in communication preferences among users due to differences in interests and capabilities.
- In the current design the user's display preferences are analysed by studying in-app behaviour data in relation with week days. Week days thereby represent context of use.
- Personalization takes place by suggesting specific default displays for specific days of the week, leading to personalized simplification of navigation.

Two important notes:

- In real life, context of use should be studied in a much higher 'resolution'. After all, one week day can contain multiple contexts of use.
- As a result of my field of study the back-end of the personalization system has not been designed.

Fig. 12.3 An image of someone using the PEPMS dashboard designed in this project

13. Validation of Adpt

Through the concept of Adpt I propose to offer energy portfolio balance data in different displays featuring different time scales, levels of detail and units of measurement. These different displays are intended to support differences in communication preferences among users due to their differences in interests and capabilities. Therefore, the first objective of the user test was to assess the relevance of these three communication variables in meeting the different interests and capabilities of users.

Secondly, in line with AUI theory, I propose that interests and capabilities change throughout different contexts of use. In the design process of this project this was always acknowledged, but never actively studied. So, the second objective of the user test was to explore the various contexts in which users would expect to be using the dashboard and what consequences users expect each context to have on their display preference.

Lastly, through the concept of Adpt I propose a personalization system that simplifies navigation for and provides personalized information to users based on their in-app behaviour. The third objective of the user test therefore was to evaluate the acceptance and desirability of this personalization system.

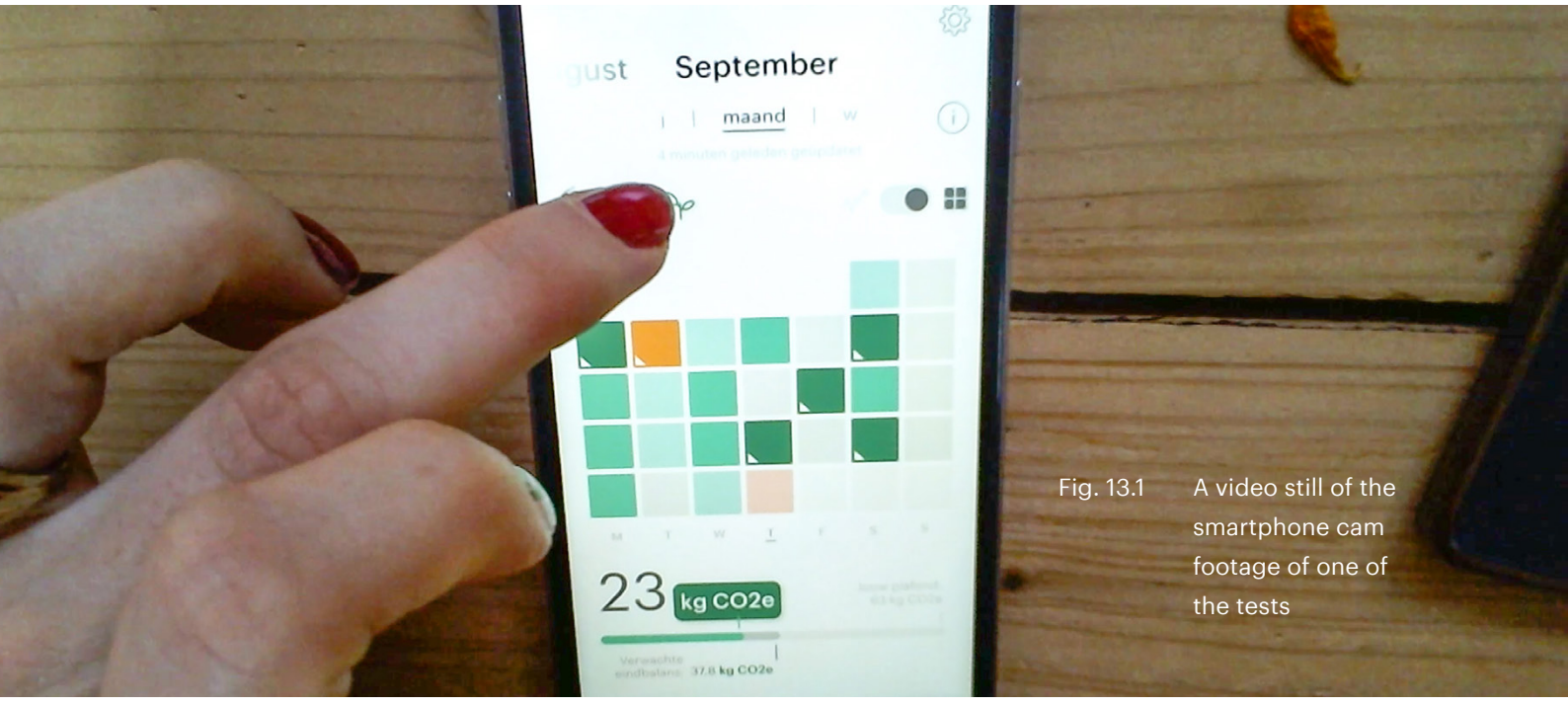


Fig. 13.1 A video still of the smartphone cam footage of one of the tests

Study

In the PEPMS dashboard that was developed in this project the influence of the user is limited to choosing an energy source. Consequently, energy source selection became the context in which the relevance of the communication variables was to be assessed. The objectives of the validation resulted in the following **research questions:**

1) Within the three communication variables what information display preferences do people have when it comes to supporting their energy source selection?
2) Apart from the three communication variables what information display preferences do people have when it comes to supporting their energy source selection?
3) To what extent are the three communication variables sufficient in supporting people's energy source selection?
4) To what extent are people satisfied with the current information display variations as designs of the communication variables?
5) In what contexts and frequency would people expect to be using this platform?
6) What influence do people expect the different contexts of use to have on the information display variation they prefer?
7) To what extent would people be interested in simplified navigation and personalized suggestions by the platform's assistant based on their behaviour in the platform?

Hypotheses

There are a few hypotheses on the relevance of the relevance for different interests and capabilities and different contexts of use:

- Users with a more long-term vision on energy will prefer a month or year time scale and users with a more short-term vision on energy will prefer a month or week time scale
- Users with relatively high energy expertise will prefer the detailed information display, novice energy users the visual information display
- Users with limited available time (possibly due to context of use) will prefer the visual information display
- Aesthetical preference between visual and detail might also play a role for having a certain preference than the level of detail of both options

Method

Participants

For this qualitative user test six participants with the following characteristics were scouted: 28 – 53 years old, mixed gender, Dutch, mid-high socio-economic status, mid-high experience with home energy, mid-high level of experience with smartphone and apps.

Participants were scouted in what you could call the second ring of acquaintances: people that I know but haven't met in several months and have no knowledge about the content of my user test.

An overview of the participants scouted for this user test is found inTable 13.1. Each of the participants is described through his gender, age, profession and role in that profession, which was recorded through a pre-test online form. The remaining descriptives are based on the participants' responses and attitudes in the user test.

Setting

In Fig. 13.2 the set-up of the user test is displayed. A fellow Design for Interaction student aided in the user test by hosting it. I took up the role as technical facilitator and note taker. This had three advantages. Firstly, my bias as owner of this project could not steer the responses of the participants. Secondly, hosting and (technically) facilitating the user test could be done simultaneously. Thirdly, it was possible to take notes during the test, making data analysis less time-consuming.

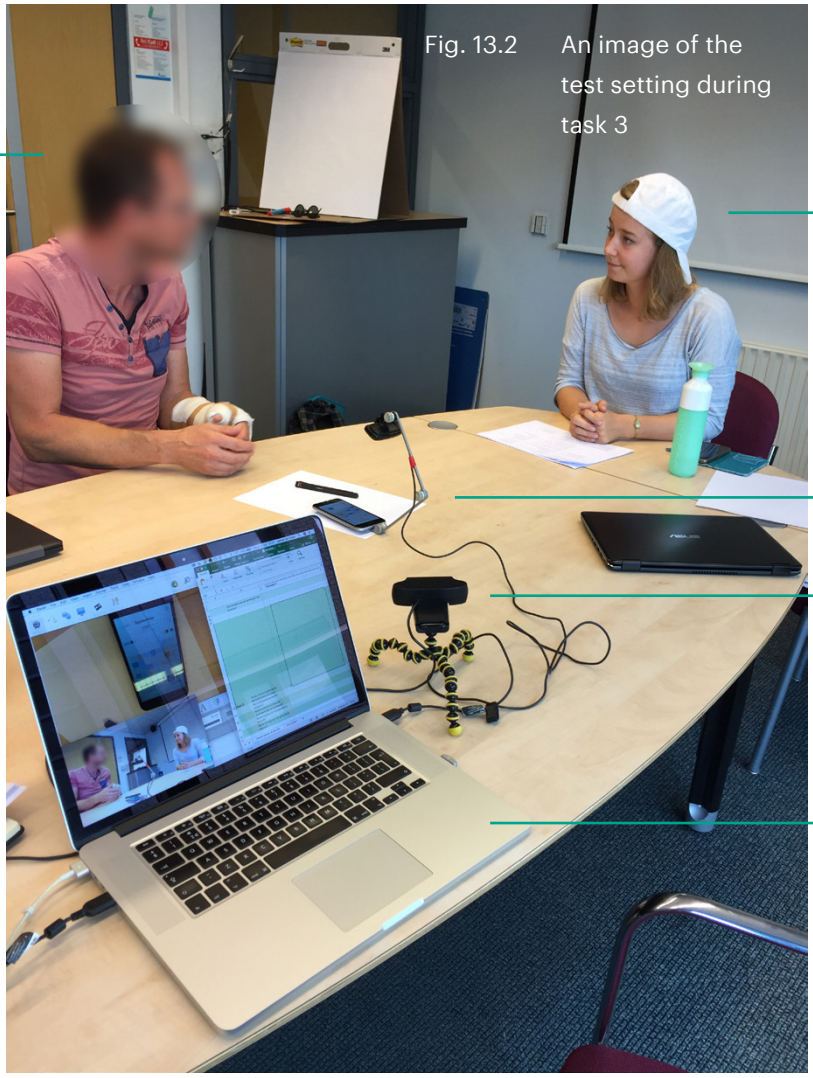


Fig. 13.2 An image of the test setting during task 3

No.	Gender	Age	Profession	Characteristics	Quote
1	m	53	**Army officer**, consultant in the training department	affluent, tech gadget lover, and low structure	"For me this [dashboard] would be the perfect toy, just every day!"
2	f	31	Dentist's **receptionist**	caring for others that need help, economic, limited cognition	"I want to know what it means for me, you know, what I will earn with it"
3	m	51	**Network operator**, involved in a university's network maintenance	tech gadget lover, economic, high structure	"I said to him 'Do you want German or Chinese panels?', I have Germans, because the Chinese already do a lot"
4	m	48	**Network consultant,** involved in innovation of a university's network	sustainability oriented,affluent, high structure	"I took floor heating because in the future we'll probably be able to hook it up to a heat pump"
5	f	28	**PhD candidate** at the cardiology department of a hospital	affluent, determined, high structure, low effort	"I'd ask myself 'Am I staying within my carbon or financial budget? Yes? Then I can take a longer shower"
6	f	29	**Consultant** in building and construction industry	leaves energy to her boyfriend, pragmatic, low effort, affluent	"Just give me a notification when there is something to improve (...) I would like to set the parameters myself!"

Table 13.1 An overview of the six participants that were scouted for the validation of Adpt, the characteristics were concluded from their responses and attitude in the user test

Procedure

The main challenge for this user test was to secure a consistent test environment for all participants while allowing each participant to follow his personal interest and instinct while interacting with the dashboard or reflecting on it.

The solution was found in the formulation of open-ended tasks. In other words, the tasks did not challenge participants to identify a specific number, value or display. Rather, they were aimed at stimulating the participant to make reflections on and give descriptions of the dashboard (content) that would be interesting and important for himself. Yet, constrained to the context of choosing an energy source.

The debriefing was then aimed at extending beyond the context of choosing an energy source and explore what other situations the user would expect to be using this dashboard for.

Apart from that exploration, participants will be asked to fill in a system usability scale (SUS) questionnaire first. The result can be used to signal a low perceived ease-of-use, which affects general system satisfaction (Sauro, 2011). As a result, a low system satisfaction might also influence the extent to which the participant has a personalized experience. Thus, assessing the general system satisfaction is important for putting the personalized experience level into perspective.

A few set-up iterations were considered before arriving at this one, which are briefly described in Appendix 19. An overview of the procedure that was used is displayed in the scheme on the right. The script, added as Appendix 20, provides more detail about the procedure.

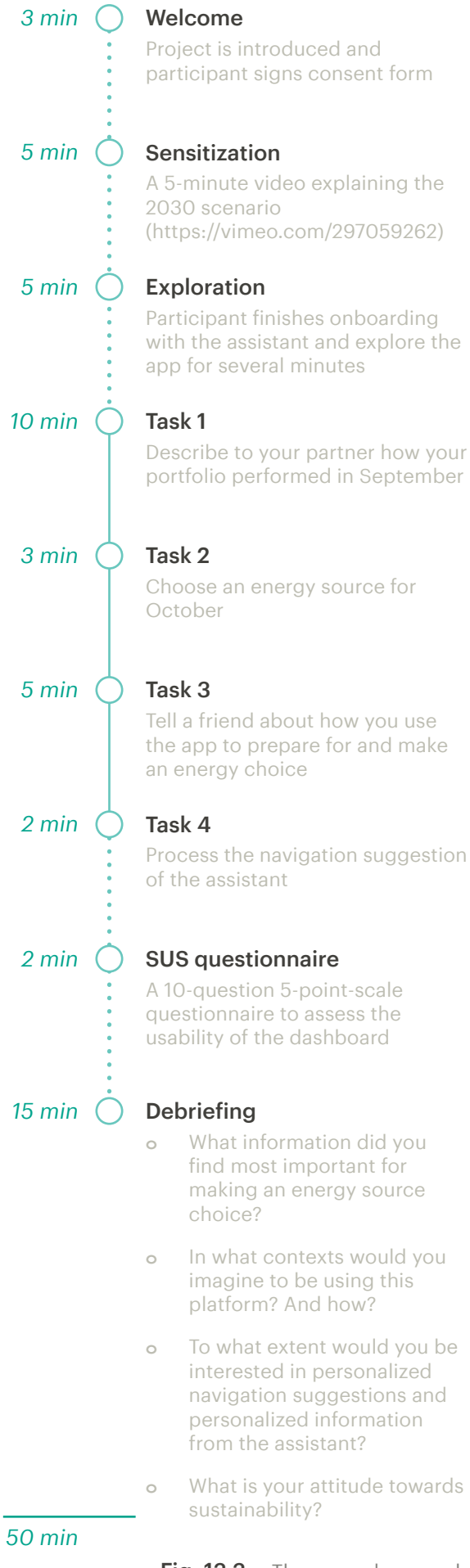


Fig. 13.3 The procedure used for this user test

Data analysis

For this user test, also displayed in the scheme below, a basic pre-test questionnaire was sent out to participants, two video recordings were made of each session, notes were made during the sessions and a SUS questionnaire was filled in.

The pre-test questionnaire was sent out to record demographic data about the participants. In addition to basic questions such as age and occupation, participants were asked a few smartphone-related questions (to be able to filter out novice smartphone users) and were asked a few questions about how they manage their bank account. The latter was aimed at obtaining an impression on the position of the participant in the Fjord money mindset matrix presented in chapter 7.

Data analysis took place as follows. First the notes were supplemented on several points using the video recordings. Responses or behaviours by the participants related to the research questions were highlighted. Then these highlights were summarized for each of the research questions, which lead to an answer to the research question.

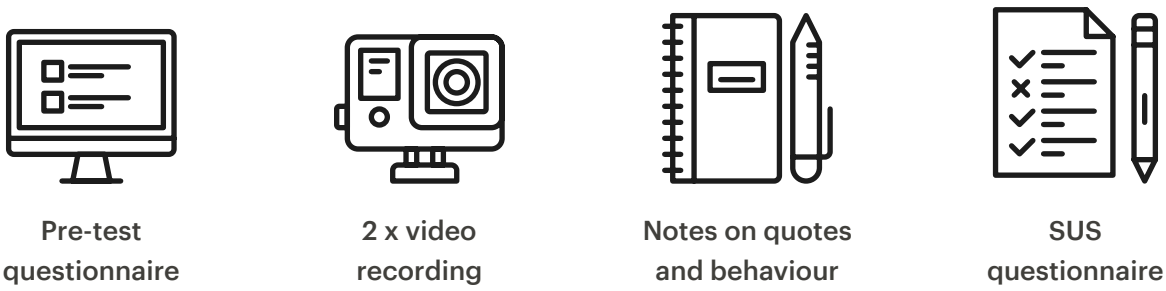


Fig. 13.4 The types of data recorded in this user test

Results

In the following sections the results of the user test will be described. The research questions have been used as a structure. The summarized research notes are attached in Appendix 21.

1. Within the three communication variables what information display preferences do people have when it comes to supporting their energy source selection?

From the three time scale options, the month scale was used in the majority of interactions, probably largely due to the month-based context of the test. Participants with an interest in efficient interactions and low detail preferred visual displays (p5, 6). Participants that enjoyed detail (p1, 3) or seemed to feel confidence from seeing detail (p2) preferred the graph display. The carbon footprint and financial displays were used with equal intensity. This was probably because within the short duration of the test participants had an interest in exploration rather than that their primary interest (in € or kgCO2e) was leading.

"With the tiles it is not really clear how much that would exactly be for me", p2 about the visual display

"It's a handy overview with those colours, you quickly understand it", p6 about the visual display.

2. Apart from the three communication variables what information display preferences do people have when it comes to supporting their energy source selection?

The participants desired additional sources of information: weather predictions (p1, 4, 5) and returns on your solar cell investment (p6). And the participants desired additional display of the existing information: a display of footprint with an analogy (p2, 3, 6) or a reference (p1, 5), consumption per home appliance (p2, 3), an archive of chosen energy sources (p5) and an integral carbon footprint and financial view (p4).

"Looking back at the weather (...) of last month, does not really make sense of course. It is no guarantee for the future", p4

"How much CO2 I save, I don't care. It doesn't mean anything to me. Expressed in trees it would be different", p3

3. To what extent are the three communication variables sufficient in supporting people's energy source selection?

The answer to question 2 already gives a partial answer to this question: the participants indicated that they would need additional information sources and additional information displays to actually make the choice for a new energy source.

In addition, participants 2 and 3 did not fully understand the meaning of two balances (€ and CO2e) displayed in the interface. Yet, it is unclear whether the underlying concepts of carbon footprint and financial balance were unclear or that the display of information was unclear. The reflections of the other four participants on September showed correct understanding of the balances in the dashboard.

"So this is the average of the CO2 energy that you can produce, and I'm under the average now. I think I could produce more", p2 after studying the dashboard

"The lowest carbon footprints seem to be associated with wind energy, as well as the lowest costs", p5 after studying the dashboard.

4. To what extent are people satisfied with the current information display variations as designs of the communication variables?

In this question 'satisfied' was intended as 'usability of the UI design'. Although by some perceived as too low in detail, participants indicated that the visual information display and colour labels were intuitive. Interestingly, two of the three participants that had preferred a detailed display (p1, 2, 3) two participants (p2, 3) did not understand its content fully. Supposedly, prior experiences with graphs shaped the participants attitude towards this display type. The remaining three participants experienced the graph display as too info-heavy (for a first acquaintance). Lastly, some text was perceived to be too small.

The lowest SUS score was 70. The average 82. This is higher than the bottom line of 68. Very positive scores. Yet, participants were asked to imagine a scenario (2030, two times role playing). So, it is likely that the participants' SUS responses are formed by the sensitization, tasks and role-playing as much as by the interface itself.

5. In what contexts and frequency would people expect to be using this platform?

6. What influence do people expect the different contexts of use to have on the information display variation they prefer?

As their answers seemed intertwined, questions 5 and 6 are answered in one go. Answering them first raised a new question. What does context of use mean? Environment of use? Purpose of use? Trigger for using it? Upon formulating the research question 'context' was intended as 'situation', unaware that such a term still leaves room for interpretation.

You could say that context of use contains the following elements: what part of the service does the user use, why, where, when and with whom. This could also be described as a 'practice': a specific way of using the service. The results delivered a list of practices the participants expect to be performing with the platform.

Unfortunately, participants were not explicitly asked for the 'when' for the practice(s) they formulated. And even if they were explicitly asked it is difficult to say whether it is a question that participants would have been able to answer.

The results suggest the following practices, they can be grouped into three categories:

Portfolio performance optimization

- Running improvement projects: set out periodical goals and strategies and evaluate them in detail on a monthly (or longer) basis to improve portfolio performance. [p1, p5] *"What if I would drag [in the interface] showering to the afternoon, what would happen then?"*, p5
- Quick and thorough: choosing a new energy source based on an integral CO2-€ detailed information display to make a well-grounded choice and be done with it [p4]
- Least-effort portfolio management: let the system send notifications whenever there is something to gain clearly but with low detail, so it won't be necessary to open the dashboard yourself [p6] *"Just give me a notification when there is something to improve"*, p6
- Assisted financial efficiency: let the system help you to improve financial efficiency of your portfolio clearly but with low detail on a weekly or monthly basis to save as much money as possible [p2] *"You want to know what it'll do for you, what you'll earn with it (...) A recommendation on what you would benefit from most"*, p2

For fun

- Daily fun checking: checking live performance of the portfolio in detail on a daily basis (especially in the first period of usage) for entertainment reasons [p1, p3, p4] *"This would be the perfect toy for me, just every day!"*, p1
- Sharing performance: sharing the successes of your portfolio or lessons you learned with friends on a monthly basis, detail depends on audience, to get recognition or to teach others about it [p1, p3] *"Last week a friend came to me asking what I'd recommend"*, p3

Managing behaviour

- Portfolio budgeting: to estimate the expected fixed costs in low detail on a monthly basis to be able to picture the remaining budget and plan how to spend that [p5, p6] *"Honestly, I'd first check how much money there is left, before I'd decide to do something for the environment"*, p6
- Budget checking: Based on the defined CO2 and € budgets check the status in low detail on a weekly basis to plan consumption behaviour [p5] *"Am I staying within my footprint and euro's budget? (...) OK, I can take a longer shower"*, p5

Context-specific interests

The 'when', the trigger that makes one perform a practice, can also be seen as a context-specific interest: if [when] then I would like to [why]. Despite the missing measurement, a few context-specific interests were found among the responses:

"When a lot of wind is expected to come up", participant 3 would like to make an appropriate energy source choice. *"Maybe on an exceptional day, I'd check it"*, p2. *"Sometimes when we had a nice day, I'm curious to what my panels did"*, p3. So possibly, certain weather conditions or forecasts could trigger certain interests.

"This is an app, that is just private", states p2 to indicate only to be making new energy considerations at home. *"No, I won't be checking this app in the café, haha"*, p4 indicated for the same purpose. So possibly, certain locations are stronger related to interests in energy management than others.

"Just like with all the other apps. You sit down in the evening and check facebook, news app, and this one. At least that's what I do", p4. This indicates a strong habit. So possibly, certain times of the day are stronger related to interests in energy management than others.

"When the bill is a setback (...) What did we do wrong?", p5 indicated on the question when expecting to be using the dashboard. So possibly, certain financial results can trigger certain interests.

"October is always a relatively expensive month, I always celebrate two birthdays, my boyfriend's and mine. So maybe money is a bit more important now", p6. So possibly, certain periods of the year are related to specific priorities that could affect PEPM.

7. To what extent would people be interested in simplified navigation and personalized suggestions by the platform's assistant based on their behaviour in the platform?

The responses gave the impression that it was difficult to see the benefit of the personalized navigation suggestion. Nevertheless, five of the six participants indicated to 'be fine' with the suggestion as part of task 4 of the test and pressed OK. Probably, this is because they believe the system to base it on an intelligent judgement.

"It is information about me, I want to have that as clear as possible", p4

"The data will be recorded anyway, so let it use it then!", p1.

Participant 5 was not interested: *"Right now I am using the financial screen most, but I would like to be more engaged with sustainability"*

All participants were interested in filtering of energy sources by the system, of which three expressed the condition that the other options should be available as well (p1, 4, 6) and that they would like to be able to alter the filter parameters (p1, 4, 5).

Fig. 13.5 Video stills from the six user tests

Discussion

Because interests and capabilities are divers even for a single user, no concrete interests and capabilities were recorded in the design process. Rather, several communication variables were assumed to be relevant for supporting different interests and capabilities. Three of these were selected and their assumed application was specified in the 'Hypotheses' section. As a result, the user test was an exploration of interests and capabilities as much it was an assessment of the relevance of the three communication variables in meeting them.

In correspondence with the order of the user test objectives, first the knowledge gained about the communication variables is discussed. Then, the knowledge gained about interests and capabilities is discussed. Lastly, the acceptance and desirability of personalization in general is discussed.

Objective 1: to assess the relevance of these three communication variables in meeting the different interests and capabilities of users

Relevance of the communication variables

The time-scale preferred by participants of the test seemed mostly related to the time-scale of the assignment. It gives the impression that the preference in time-scale is also for an important part task-related.

In line with the hypotheses, the preference for level of detail seemed be related to the level of expertise with energy and time the user would have available. Additionally, high detail was also regarded as something entertaining and as something that could provide confidence. Lastly, in this user test available time seemed to be determined by the interest of the user in the topic.

Only a few clear preferences for unit of measurement surfaced in the user test, probably due to the imaginative atmosphere of the user test. Undoubtedly, the design of the carbon footprint in the current dashboard was too abstract (in 2018!). This might have played role as well.

The fact that participants showed different preferences towards the detailed and visual displays suggests that this is a relevant communication variable in the design of personalized energy management-related dashboards.

Objective 2: to explore the various contexts in which users would expect to be using the dashboard and what consequences users expect it to have on their display preference

The implications of different contexts of use

The 'Results' section provides an overview of different ways of using the dashboard that were suggested by the participants. Because this is a qualitative user test, this list of 'practices' is not conclusive on the possible future ways that participants will be interacting with their energy management portfolio.

Instead, the list of practices and the list of context-specific interests indicate the origin of user's display preferences. Looking at the results, it seems that users perform a certain practice after having received a trigger. Also, this practice contains a momentary interest, a certain objective for that moment (to be assured about X, to show Y to someone, to fix Z, to be entertained etc.). And as a consequence, there will be a preferred display.

In the basis, not all users perform all possible practices. Their character, their long-term interests and their capabilities determine the set of practices they perform. Also, what passes for a relevant trigger is determined by the long-term interests.

This hierarchy of factors that form users' display preferences might reduce the complexity of human variability when designing personalized dashboards. Add to that the context-specific interests as opportunities for identifying the triggers.

Objective 3: to evaluate the acceptance and desirability of this personalization system

Acceptance and desirability of personalized systems

The disinterest of remaining regarding the personalized default display suggestion is an important signal. It means that it is apparently worthwhile to explicitly discuss such personalization activities with the user. The results of this user test, however, are inconclusive on to what extent other personalization activities should be consulted with the user.

In this test, participants in general indicated to accept a system that intends to help the user with managing his PEP in return for the user's personal (in-app) behavioural data, be it with a few conditions regarding transparency. Interestingly, this acceptance occurred even though the exact benefit was not completely clear. Apparently, there is a certain confidence or trust towards the intelligence and reasonability of such systems.

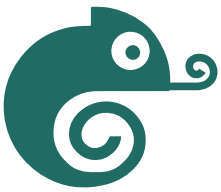
The combined context- and user-based personalization suggested in this project requires detailed user data of in-app but possibly even general smartphone behaviour. Therefore, acceptance as is a must-have, because without the user data there will be no personalization. The acceptance of the designs and personalization propositions in this user test are thus a positive sign.

14. Project discussion

The general objective of this project was to demonstrate a new application of personalization in service design. The goal of this project was specified as: to stimulate a personalized service experience by increasing the effectiveness of the communication to users. This goal was pursued in a context of personalized energy management in 2030, a period when home energy production is ubiquitous. Effectiveness of communication was specified as to increase the experience of awareness and control over the personal energy portfolio.

The design goal was to design a system that allows a PEPMS to approach each user through a personalized set of display variations that is based on the user's dynamic communication preferences profile. An iterative learning-by-doing-based design process was conducted.

In this chapter the implications, limitations and recommendations of this project are described.



AUI + POD + Fjord mindsets

Unique to this project is the proposition to combine AUI theory with the POD perspective and the concreteness of the Fjord money mindsets. Looking at the general objective of this project, the Adpt proposition can be regarded as a new application of personalization in service design.

The four design cycles of this project demonstrate the complexity of this combination of theoretical frameworks. They did not prescribe a clear (qualitative) design approach. In reflection, I believe that arriving at a few mindsets for describing the users of an (info-heavy or dashboard-based) service might help to more efficiently exploit the potential that seems to be stored in the combination of AUI and POD.

Energy in 2030

On the go, quite some insight was gained on the future of engagement with energy, probably driven by a growing personal interest in the energy transition. In the upcoming decennium decentralized, private renewable energy production will grow to be ubiquitous. Bringing about valuable opportunities.

Research showed that monitoring and reducing energy consumption creates only temporal engagement. However, interactions related to energy sharing and energy trading offer a whole new and potentially much more engaging involvement with energy.

Energy sharing and trading will create a context in which there is something to gain or lose every day. This will make it possible for users to have different levels of engagement. For example, the 'geek' can check it every day, the 'lazy' can leave optimization up to an automated system, the 'experiencer' can look for stories behind profit or loss.

Diving deeper into the design of these interactions allows businesses to boost customer engagement and loyalty and could enable sustainability-oriented organizations to much more effectively support sustainable behaviour by the average energy prosumer. So, particularly to the energy sector I would recommend designers to combine AUI, POD and the Fjord mindsets framework to develop personalized awareness and control for users.

An opportunity confirmed

In the design process it was proposed to meet different interests and capabilities of users by providing several display variations of the same information. 'Adpt' was developed to demonstrate this principle: personalization system embedded in a PEPMS dashboard.

Using the PEPMS and personalization system designed in this project a user test was conducted. It delivered the following results:

- Due to differences of interests and capabilities, users are expected to perform different practices with their PEPMS
- Distinguishing between visual and detailed displays can help to support the different interests embedded in the practices and the different capabilities embedded in different users.
- Practices with the PEPMS seem to be initiated by certain triggers, some of which are measurable. Performance of some of practices could thus be identified digitally.

These results confirm the opportunity for an AI-based personalized communication system. And through that conclusion the relevance of the concept behind the design goal, presented in Chapter 10, is confirmed as well. An AI could be trained using the measurable practice triggers, a record of the user's PEPMS behaviour and user feedback on the appropriateness of the available displays (in terms of design and available information). This could result in a profile of each user that indicates the preferred PEPMS displays for the practices he/she performs with the PEPMS.

Undelivered

Within the available time it was not possible to develop part of the personalized system and test its effects on the level of personalized experience of the PEPMS by the user.

No design was made of the interactions and interfaces that allow the user to view the behaviour data that is used by the personalized communication system (due to the EU GDPR). Expectedly, this could constitute an entire project on itself.

The Adpt proposition also contains analysis of user personality and character traits through a VisualDNA-type of questionnaire. This segmentation was not further developed or tested.

Recommendations to M|AI

Build it! Obviously, this project created an itch on the fact that the actual system could not be built and tested. Before pursuing practice- and capability-oriented service design, I'd recommend testing a low-key version of the system proposed through Adpt. With personalization playing a key role in the experience-based future that M|AI envisions, such a validation is key in determining the added value of an Adpt-like system in that future.

More holistically, it is recommended to acknowledge different interests, capabilities and corresponding display preferences in the service design process, specifically for dashboard-based services, because they are info-heavy. This is relevant because (1) users have different capabilities towards viewing data and (2) info-heavy services seem to afford many practices to be performed with them. Based on the results of this project, the most practical framework would be to focus on different interests embedded in practices and capabilities embedded in users. In other words: focus on practices and capabilities.

If the decision is made to embed practices and capabilities in the service design process, a few recommendations can be made. The following guidelines could help a team to best prepare for training an AI for the purpose of creating a personalized communication system:

- Qualitative research could be used to get an idea of the variety of practices that users would perform with the service (to be designed).
- In contrast to traditional qualitative research, it is recommended to perform research not only as a snapshot but also over time to accommodate the variable nature of users' interests.
- Focus in these preparations should lay on identifying different expected practices and their 'when', 'why' and 'what'. And it should be used to draw an image of the capability diversity that exists among users.
- Then take a moment to explore how to explore how the various practices and various capabilities could be supported through a minimal number of unique UI's

Recap on 'practices'

You could say that context of use contains the following elements: what part of the service does the user use, why, where, when and with whom. This could also be described as a 'practice': a specific way of using the service. The most important parameters:

- When: the trigger that initiates that practice (if ... then ...)
- Why: the momentary interest(s) for performing that practice (to be assured about X, to show Y to someone, to fix Z, to be entertained etc.)
- What: the part of the service relevant for that interest (desired information and desired display style of that information)

Additionally, each user will have certain capabilities and long-term interests, leading to the performance of only a specific set of practices slowly evolving over time.

Recommendations to the AUI paradigm

To the paradigm of AUI I would recommend to further explore how practice-oriented design (POD) could be made applicable. The interview with Lenneke Kuijer, who did her PhD on POD in interaction design, admitted that is a relatively abstract paradigm.
The results of this project indeed show the complexity that is hidden in human variability. But it also shows that POD seems to be an effective paradigm for pursuing adaptive user interfaces in.

Additionally, core of the Adpt proposition is to explicitly discuss new default displays with the user. Yet, some practice triggers might be very salient and difficult to explain to the user. So it seems that research is required to the required level of transparency for personalization systems (a form of adaptive interfaces). For what measures of personalization will you consult the user and for what measures of personalization will you avoid bothering the user?

15. References

Adomavicius, G., & Tuzhilin, A. (2005). Personalization technologies: a process-oriented perspective. *Communications of the ACM, 48*(10), 83-90.

Akiki, P. A., Bandara, A. K., & Yu, Y. (2014). Adaptive model-driven user interface development systems. *ACM Computing Surveys (CSUR), 47*(1), 9.

Bright, L. F. (2008). *Consumer control and customization in online environments: An investigation into the psychology of consumer choice and its impact on media enjoyment, attitude and behavioral intention*: The University of Texas at Austin.

Browne, D. (1990). *Adaptive user interfaces*: Elsevier.

Burnett, M. (2016). Energy Storage and the California 'Duck Curve'.

Coutaz, J. (2010). *User interface plasticity: Model driven engineering to the limit!* Paper presented at the Proceedings of the 2nd ACM SIGCHI symposium on Engineering interactive computing systems.

Da Silveira, G., Borenstein, D., & Fogliatto, F. S. (2001). Mass customization: Literature review and research directions. *International journal of production economics, 72*(1), 1-13.

EUGDPR. (2018). GDPR Key Changes. Retrieved from EU General Data Protection Regulation (GDPR) website: https://www.eugdpr.org/key-changes.html

Geelen, D., Reinders, A., & Keyson, D. (2013). Empowering the end-user in smart grids: Recommendations for the design of products and services. *Energy Policy, 61*, 151-161.

Google. (2016). Mobile app marketing trends and mobile landscape. Retrieved May 14th 2018, from Google

Kalyanaraman, S., & Sundar, S. S. (2006). The psychological appeal of personalized content in web portals: Does customization affect attitudes and behavior? *Journal of Communication, 56*(1), 110-132.

Katzeff, C., & Wangel, J. (2014). Social practices, households, and design in the smart grid *ICT innovations for sustainability* (pp. 351-365): Springer.

Kuijer, S. (2014). Implications of social practice theory for sustainable design.

Kumar, A. (2007). From mass customization to mass personalization: a strategic transformation. *International Journal of Flexible Manufacturing Systems, 19*(4), 533.

N.A. (2018a). 2018 Fjord Trends. Retrieved from https://trends.fjordnet.com/?/

N.A. (2018b). Demand Management. Retrieved from https://www.tendrilinc.com/solutions/solutions-for-utilities-and-retailers/orchestrated-energy

N.A. (2018c). Fjord on LinkedIn. Retrieved from https://www.linkedin.com/company/fjord_2/?originalSubdomain=nl

N.A. (2018d). Powerpeers. Retrieved from https://www.powerpeers.nl/

N.A. (2018e). Vandebron. Retrieved from https://vandebron.nl/

Nielsen, J. (2010). Mental Models. Retrieved from https://www.nngroup.com/articles/mental-models/

Pierrakos, D., Paliouras, G., Papatheodorou, C., & Spyropoulos, C. D. (2003). Web usage mining as a tool for personalization: A survey. *User modeling and user-adapted interaction, 13*(4), 311-372.

Pine, B. J. (1993). Making mass customization happen: strategies for the new competitive realities. *Planning Review, 21*(5), 23-24.

Ratcliffe, L., & McNeill, M. (2011). *Agile experience design: A digital designer's guide to agile, lean, and continuous*: New Riders.

Riemer, K., & Totz, C. (2003). The many faces of personalization *The Customer Centric Enterprise* (pp. 35-50): Springer.

Ries, E. (2011). *The lean startup: How today's entrepreneurs use continuous innovation to create radically successful businesses*: Crown Books.

Rifkin, J. (Writer). (2018). The Third Industrial Revolution: A Radical New Sharing Economy, *Vice*: Impact.

Rothrock, L., Koubek, R., Fuchs, F., Haas, M., & Salvendy, G. (2002). Review and reappraisal of adaptive interfaces: toward biologically inspired paradigms. *Theoretical issues in ergonomics science, 3*(1), 47-84.

Sauro, J. (2011). Measuring Usability with the System Usability Scale (SUS). Retrieved from https://measuringu.com/sus/

Schade, A. (2016). Customization vs. Personalization in the User Experience.

Straver, F. (2018). Twee miljoen huizen moeten voor 2030 van het aardgas af. *Trouw*. Retrieved from https://www.trouw.nl/groen/twee-miljoen-huizen-moeten-voor-2030-van-het-aardgas-af~a0bd9c22/

Strengers, Y. (2011). *Designing eco-feedback systems for everyday life*. Paper presented at the Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, Vancouver, BC, Canada.

Strengers, Y. (2012). Peak electricity demand and social practice theories: Reframing the role of change agents in the energy sector. *Energy Policy, 44*, 226-234.

Strengers, Y. (2014). Smart energy in everyday life: are you designing for resource man? *interactions, 21*(4), 24-31. doi:10.1145/2621931

Swant, M. (2018). Smart Technologies and Digital Assistants Are Helping Utilities Engage With Their Customers. Retrieved from https://www.adweek.com/digital/how-smart-devices-and-digital-assistants-help-utilities-engage-with-customers/

Van Dam, S. (2013). *Smart energy management for households*: TU Delft.

van der Stelt, S., AlSkaif, T., & van Sark, W. (2018). Techno-economic analysis of household and community energy storage for residential prosumers with smart appliances. *Applied Energy, 209*, 266-276.

Yigitbas, E., Stahl, H., Sauer, S., & Engels, G. (2017). *Self-adaptive UIs: integrated model-driven development of UIs and their adaptations*. Paper presented at the European Conference on Modelling Foundations and Applications.

Zhou, F., Ji, Y., & Jiao, R. J. (2013). Affective and cognitive design for mass personalization: status and prospect. *Journal of Intelligent Manufacturing, 24*(5), 1047-1069.

DfI master thesis
Delft University of Technology
October 29th 2018

Graduate student
Jelmer de Visser

Contact
[M] +31 (0)6 25 32 31 35
[E] jelmerjelledevisser@gmail.com
[L] www.linkedin.com/in/jelmerdevisser

personalizing
dashboard
experiences