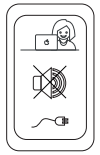
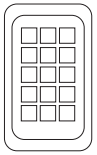
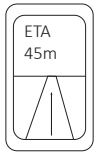
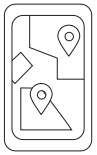
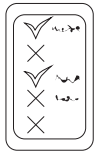
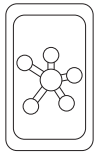
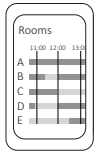





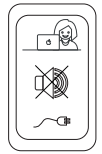
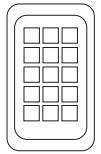
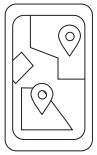
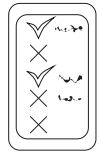


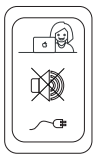
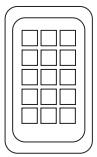
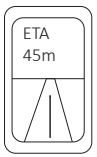




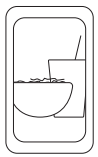
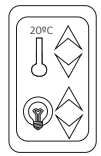



Choosing your place

Making a user journey to illuminate the possibilities of smart tools to support new users of the campus in choosing their workplace

Master thesis

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Preface

Can you imagine a day without any form of technology? It can be great to be 'off-line' for a while but to keep track of the fast pace of contemporary life, the helping hand of technology is a welcoming support. Technology can also be a helping hand in buildings for example, by showing the way to available places or switching on the light when there are people in the room. The great ability of technology is that is can enlarge our knowledge about places. Navigations enables me to go anywhere, I just follow the route presented on the screen of my phone. Information on facilities in the surrounding area is brought to me in a split second. Technology can do anything, it is just about what we want.

The differences between people are enormous. The differentiations between people in the workplace are increasingly valued by offering variations within workplace types. Large buildings have many different places to offer and technology can make people aware of the existence of these places. But what are the boundaries of implementing technology in the built environment? How far do we want to go with technology?

Management is about making connections between people in all layers of the organization. The interference of technology in the built environment is rather new. Although this can scare people away, I rather think it is time to collaborate and embrace the possibilities it offers for the workplace and beyond. Awareness about the possible privacy concerns is very important when exploring these possibilities.

Within the smart campus lab, I had the possibility to look at the campus from a real estate management perspective and focus at the possibilities of smart tools. Driven by the human-centred approach and inspired by alternative way of grasping the desires of the users, I was able to develop and conduct user journeys at several cases. The connections of the smart campus research group and Royal Haskoning DHV were of great value in finding suitable cases.

Acknowledgements
First I would like to thank Alexandra en Ellen for the supervisory support and steering during the full process of my graduation. I could not do it without you and I have very much enjoyed our time together. Bart, from the smart campus research team and Pepijn, from Royal Haskoning DHV, you have delivered a tremendous amount of information to me on different cases, thank you both for providing me with all this knowledge, the connections to cases and the reflections on my work. I would like to thank Huib for your outside view and special tasks as a delegate of the Board of Examiners. Special thanks go to Aksel for replacing Ellen during the final presentation. Without one hesitation, you were happy to stand in during such a special moment for me. Finally, I would like to thank my closest friends for supporting me during this project. Both inspirational conversations as well as some understanding when things get rough, you were there.

I am looking forward presenting my work on Friday the 13th

Summary

Smart tools at campuses

Finding preferences of new users by drawing the customer journey

Abstract

Purpose: The purpose of this research is to research the potential of smart tools in the increasingly dynamic used campus workplace from a user perspective, to provide the campus manager with information on both the smart tool product and the smart tool implementation process.

Methodology: The currently used smart tools are explored by filling out a standardized form. The in-depth case studies are conducted following the user journey approach. By drawing a timeline of a day and mapping the different events with associated feelings, an in-depth view of the users' day can be captured.

Findings: The findings show 9 different smart tools functions. Within these groups, smart tools differ in terms of level of accuracy and combination of provided functions. The user journeys present the diversity in smart tool requests that users can have, which is strongly related to the provided workplace. Based on the findings, implications for the campus manager are summarized in an ambition framework, which presents four strategies to approach a smart tool project.

Practical implications: The findings from this research are based on the campus manager perspective and therefore provide implications for the campus manager.

Originality: The paper provides insights in several smart tool projects. As still many smart tool projects are not considered to be successful after implementation, information is needed to guide campus manager throughout this process.

Key words: Smart tools, User preferences, Campus workplace, User journey.

Introduction

People are increasingly using the workplace in a dynamic way. A combination of different workplace typologies, which are all based on another activity and are used in a flexible way, shape the work environment. In search for personalisation options and because the large availability of different workplaces, variation within workplace types is preferred. The implementation of smart tools in the workplace can provide real-time information to users about several workplace facilities, to take away long moments of searching for a place, which is one of the downsides of a flexible used workplace. Although the general benefits of smart tools are recognized by campus managers, still much ambiguity about the benefits is present when the actual smart tool functions are planned to be implemented. Following Cisco (2017), 60 percent of the smart tool projects does not survive the proof of concept phase but organisations do learn a lot from conducting a smart tool project to perform a more successful project in the future. Obtaining information on the bottlenecks users experience during their workday and information on the functionalities of smart tools is needed to provide the campus manager with the right equipment to make smart tools at the workplace work. To focus this research, the campus workplace is chosen, as the campus is a physical place with different types of workplaces which are shared among many knowledge workers (Jaitli & Hua, 2013). Within this user group, the focus will be on people who are no longer than 6 months connected to the organisation, as people use additional information sources, like a map, when they are unfamiliar with a place (Tan & Wu, 2016). This gives an extra potential for smart tools.

The aim of this research is to gather a deeper understanding of the problems new users encounter during their day at the campus workplace and to connect these problems to specific functions of smart tools. By showing the connection between workplace related problem and smart tool, insight is given on how the work place experience can be optimized during the

day on campus and what the role of already available tools in this process can be. These findings can help the campus manager in making plans for the exploration or implementation of smart tools in the workplace. The main research question is as follows: *Which functions of smart tools are needed to assist new campus users in choosing an appropriate work place throughout the day and what are the implications for the campus manager of the lessons learnt from these user insights, when exploring the possibilities of smart tools at the campus?* By making a classification of smart tools and composing user journeys with new users of four different organisations a redesigned user journey about the workplace experience can be composed that, show the connection between workplace, smart tools and users. These insights will be compared to provide recommendations for the campus manager, when intending to implement smart tools.

First the main concepts of this research, smart tools, campus workplace and new users, will be explored in the theoretical framework. Thereafter the user journey approach, which is used to gather in-depth user information about the workplace experience, will be explained and the additional method for composing the classification of smart tools will be elaborated upon. The findings section will first elucidate the findings from the smart tool exploration and present a classification of smart tools. Thereafter the similarities and differences four different cases will be briefly presented and the main findings will be summarised. In the conclusion the main research question will be answered whereas in the discussion, a reflection will be given on the findings and recommendations for future research will be given.

Theoretical framework

Workplaces

The workplace is moving towards a place which entails different types of places which are used in a flexible, non-territorial way (Kim, Candido, Thomas, & de Dear, 2016). This dynamic use of the workplace is referred to as an activity-based working environment. Although the good intentions of this concept, not every user is satisfied with this workplace concept. Personal differences in the willingness to switch to another workplace can result in a lower satisfaction (Hoendervanger, De Been, Van Yperen, Mobach, & Albers, 2016). In shared offices, the time related to finding a place, finding colleagues in the building and setting up the workplace after a switch are some of the downsides of this concept (Kim et al., 2016). Besides that, incorporating the preferences of users is important to tailor the office concept to the specific users of the organisation. A high number of variations in the office concept can provide an environment that meets the varying preferences of different users.

The workplace is increasingly used in a more dynamic way, meaning workplace types are expanding, more variations are made within a workplace type and spaces are shared and used for multiple purposes. The role of the campus manager is to balance the different perspectives to provide a good environment for all players. The angle of this research is on the user perspective and the translation of this perspective to the campus manager.

Smart tools

Although the presence of smart tools in the workplace and our daily lives is growing, Cisco (2017) reports that 60 percent of the smart tool projects are not resulting in a successfully implemented smart tool. Therefore more information on the implementation of smart tools in the organisation is needed to provide examples for other cases. In this research, a smart tool is defined as: A smart tool is a service or product to provide (real time) information to its users to improve space usage at the campus. (definition is based on smart tool definition of Valks, Arkesteijn, Den Heijer, and Vande Putte (2016)).

A smart tool is part of a system, it needs data to report to its user. Baumer, von Oelffen, and Keil (2017) distinguishes three stages of functionalities for smart tools that build on each other, being monitoring, controlling and optimizing and operating. In the operating stage, a smart tool is able to fully operate on its own, based on provided data and intelligence. So these smart tools monitor, optimize, control and operate based on the information they gather.

Smart tools in the workplace

Smart tools can smoothen work day experience (Dery, Sebastian, & van der Meulen, 2017). To smoothen the workday, a smart tool need to collect information from users. This can result in users having privacy concerns. New legislation on privacy will be valid at the end of May 2018, which will urge organizations to rethink their privacy policy (Autoriteit Persoonsgegevens, N.D.). Van Zoonen (2016) constructed a framework to map the possible privacy concerns users can have regarding smart technology. This can help the campus manager to predict possible concerns and proactively act on this information. The social practice theory conceptualize the position of smart tools in the workplace, by disassembling the elements that construct the practices needed for working. The different parts of a practice, defined by Shove and Pantzar (2005), are stuff, images and skills. The users, who ‘plays’ with elements from these three parts will perform and, after a while, re-invents a practice based on changes in stuff, images or skills. In this way, activities in the workplace can change by the users who perform them.

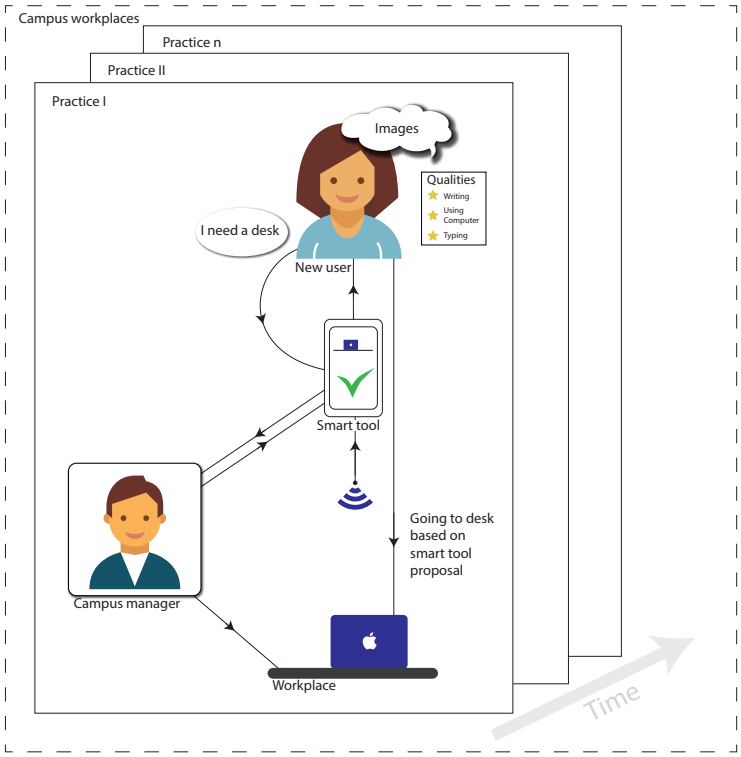

Figure A: Conceptual model

Conceptual model

The conceptual model shows the relations between the theories that are the basis of this research. See Figure A

- System of a smart tool, which gathers real-time data and present it to its user, following the description of (Chen, Mao, & Liu, 2014)
- Social practice theory which makes the role of materials in the workplace explicit (Shove & Pantzar, 2005) and focusses on everyday practices, like the workplace (Hargreaves, 2011).
- Managing role of the campus manager, described by (Den Heijer, 2011).
- Basis of connecting user to building derived from the discipline of real estate management, described by (Nourse & Roulac, 1993).

Research method

In this qualitative research, four different cases will be analysed by composing a user journey. This method is derived from the Customer Journey Analysis (CJA), developed by Halvorsrud, Kvale, and Følstad (2016) and based on the principles of Yin (2009). The CJA combines the visions from both the user, by composing a user journey, and the organization, by composing a planned journey. Comparing these two journeys gives in insight in the possible gap between these views. In this research, this method is extended with composing a redesigned journey, where the actual journey is infused with smart tool functionalities that match the bottlenecks indicated by the new user. These smart tool functions are based on an analysis of a data base of smart tools at organisations which is conducted in collaboration with the campus research team of the TU delft. Valks, Den Heijer, and Arkesteijn (expected 2018) are collecting information on implemented or plans for smart tools at different organisations. The information on the functions smart tools can deliver, are combined in a classification with elucidates the differences among the different systems.

Smart tools

The dataset consist of 31 cases that are reported by the help of a standardized form. The information about the user, which is mapped in these sheets, is used to analyse the different functions smart tools can offer to users. As in some cases the smart tool is not focussing on supporting the user, only 25 cases are used for this analysis. The data is mainly collected by the smart campus research team, with additions from myself, for the publications smart campus tools 2.0 by (Valks et al., expected 2018).

User Journeys, four in-depth cases

In collaboration with Royals Haskoning DHV and the smart campus research team, 2 university campuses and 2 corporate campuses are approached to conduct the in-depth case study by composing a user journey. By connecting the possible smart tool functions, derived from the smart tool analysis, with the workplace related problems users encounter during their day, a redesigned journey for every user could be composed. This journey shows the possible connection between smart tools, the user and its workplace during the day.

Findings

Smart tool analysis

The data set consist of 25 cases, including 13 public organisations and 12 private organisations. Private organisations are slightly ahead when it comes to implementing their smart tool ideas. When analysing the different functions smart tools can offer to their users, 9 different functions can be distinguished. Over sixty percent of the publicly used smart tools are focused on one single function whereas this is only thirty percent at private organisations. Besides that, this function which is offered by public organization is in over 50% of the cases showing real-time availability on one single workplace type, as the private organizations rather show real time availability of different workplace types (>40%) than one single workplace type (25%). Providing this information on an internet site is most popular in the public sector as private organisations rather use screens in their building. The usage of a phone application is almost equal at both organizational types, around 50%.

When zooming in on the nine functions, additional differentiations are found. For example, some of the smart tools require a check-in, by scanning a QR code. When someone is not checked-in, the smart tool does not register the person. Other smart tools use the Wi-Fi for locating a person. Depending on the placement of the Wi-Fi points, this method can be less accurate than alternative sensors. Therefore, a difference in accuracy can be distinguished.

When sorting the smart tools based on the combination of functions the smart tool offers, the differences in complexity become clear. Some smart tools are very accurately doing one thing, others provide additional information, e.g. on the room temperature, and other provide many functions to smoothen the workplace on several aspects.

The classifications made in this part of the research are presented in the full report. These classification are used during the second phase of the research.

Case studies

Following the main concepts of the conceptual model, the findings from the case studies are explained. In addition to this framework, first the differences and similarities between the four cases are presented.

Differences and similarities

The user journeys presented a large variety of problems which users encounter during their day at the workplace. The smart tools that could be implemented to smoothen these problems were therefore also divers and going beyond the workplace itself. The planned journey was in all cases to a certain extend reflecting the user preferences. The two public organisations were planning on implementing less complex smart tools, in contrast to the more complex ideas from the two private organisations which were less specific at the point of reporting. The workplace is strongly related to the smart tool requests of users, as users who have an assigned desk are not searching for a workstation. The user journeys reflected this lack of interest in smart tools which show the availability of desks, but these users showed other focus points for example, requesting information about the meeting room. Besides that, information on the workplace occupancy was requested by the campus manager, as a basis for future workplace strategies.

Users

The request for the function navigation is only present at brand new users or at users who are already longer connected to the campus and are willing enlarge their ‘collection or workplaces’, by going to a new building. Navigation is therefore tightly connected to the unfamiliarity new users have with a place. New users who have an assigned workplace are less interested in navigation. They use their ‘base’ and enlarge their collection of workplaces over time. There is no urge for these users to do this immediately, as they have their own workplace.

Smart tools

Providing static information is in some cases already delivering enough information for users. Therefore a stage zero is add to the stages of Baumer et al. (2017), which is about informing the user and is not really a smart function.

The findings of the smart tool analysis showed a distinction in accuracy and combination of functions. When reviewing the user journeys, many users have different ideas on the combinations or the amount of functions that should be facilitated in the workplace. Most users think it would be helpful to provide an opt-in and opt-out function in the smart tool, to customize the number of provided functions and also to close the digital door for a certain period. This diminished the possible privacy concerns as well for many of the interviewees.

Workplace

Users tend to use only the parts of the campus that they are assigned to. In the Århus case, users were not using the other campus buildings much, as it was a 10 minute walk, which most of the interviewees considered to be too far away.

Campus manager

To be able to implement smart tools, defining the benefits in actual numbers is important. ING was conducting small pilot cases to test and find other parts

of the organisation that was interested in the pilot. In this way, they tested not only if the smart tool worked, but also gained support 'on the floor'. Connecting to the IT and other existing structures on the campus is also important for bringing the smart tool from a piloting phase to a mature phase. On the one hand it is important to freely experiment with smart tool possibilities at the campus to discover what the best solution can be, but on the other hand, finding a connection with existing structures is needed to fulfil requirements later on in the process.

Conclusion

The central research question is: Which functions of smart tools are needed to assist new campus users in choosing an appropriate workplace throughout the day and what are the implications for the campus manager of the lessons learnt from these user insights, when exploring the possibilities of smart tools at the campus? This question leads to a twofold answer, one focussing on a product based answer considering smart tools and one focussing on a process based answer to start a smart tools project.

Smart tools

Nine different functions are distinguished based on the smart tool analysis. The user journeys show a great variety in smart tools users' request. This is, among other things, based on the type of workplace they have. Users who have an assigned work station are less interested in smart tools to find a workplace, but rather want to be facilitated with additional spaces like meeting rooms or spaces for collaboration.

Within the most requested function, show real-time workplace availability, smart tool suppliers differentiate on two variables, being level of accuracy and number of workplace type. This reflects the varying preferences users can have regarding smart tools.

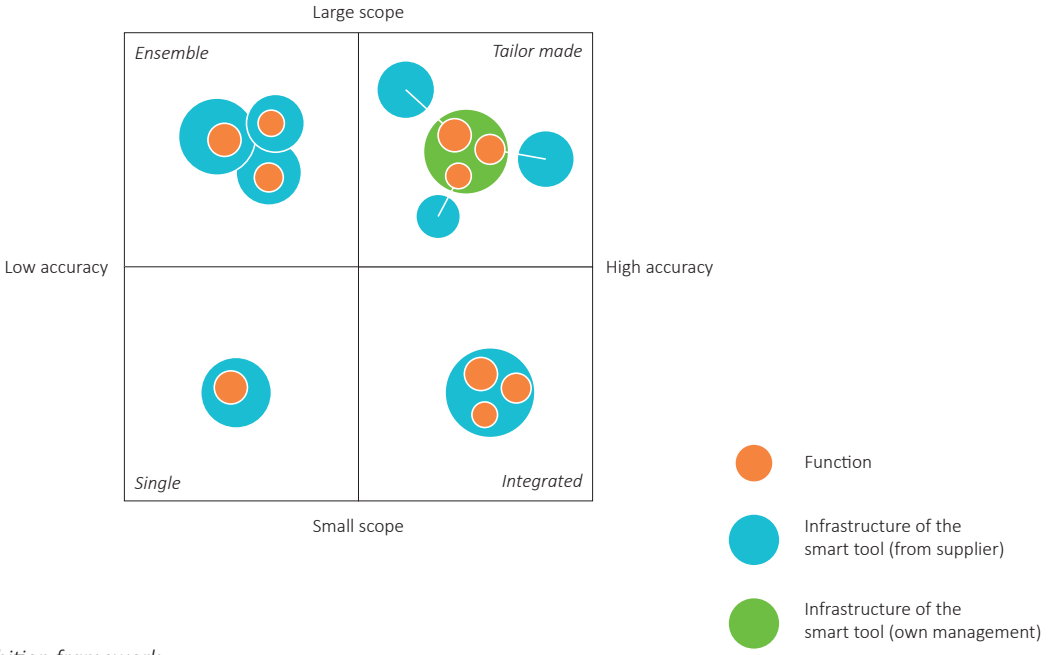

Figure B: Ambition framework.

Users requests, regarding smart tools, do also differentiate in level of smartness. Some users only want some additional information, others would like to be assisted with many activities they perform during the day. Based on this difference, and to respect the privacy concerns people can have towards high sophisticated smart tools, an opt-in and opt-out possibility is preferred when implementing a complex smart tool.

The differentiation of smart tools requests is depending on user preferences, the workplace setting and the organizational point of view. Therefore it is not possible to point at one specific smart tool that is suitable for every user and organisation. Show real-time workplace availability or workplace(s) is a much requested function by users. The differentiation in smart tools reflects the differentiation which is seen among users.

Implementing smart tools

Based on the insights of the smart tool analysis and the user journeys, the ambition framework is constructed. On the bases of differences in scope and accuracy, distinguished by both users and the campus manager, a matching strategy can be selected. This framework is rather to point at a direction for the development of the smart tool project in an organisation, then prescribing what to do. It highlights the differences between the choices. See figure B for Ambition framework.

After retrieving user information on smart tools the following steps can help to manage the process of choosing a smart tool.

- Focus on the benefits of a function
- Explore the possible connections to other domains.
- Test the function in a small project
- Formalize the process to be able to scale the smart tool towards the whole campus

Discussion and recommendations

The main concepts of this research, users and the workplace, smart tools and campus manager, structure this discussion and recommendations part. Also the possibilities of the used research method will be described.

Users and the workplace

The focus on the new user gave insights on the problems they encounter during their day, but still many differences within this group can be distinguished. The focus on the mobility of users, which Leesman (2017) had in their research on the activity based workplace, can be an interesting angle to use when investigating the need for smart tools. Mobility and smart tools are strongly connected, as users who do not use another workplace during the day, do not need to use information to locate this available other place.

Zooming in on the decision-making process of users, when deciding to move or not to move to another workplace, would be interesting to look at in future research. What is the influence of distance and the quality of the workplace? As the quality of the workplace appears to be one of the most important elements in the workplace (Brunia, De Been, & van der Voordt, 2016; Kim et al., 2016), it would be interesting to know more about the reasons for people to switch to another workplace.

Smart tools

Depending on the existing IT structure of the building, connections to this system can be made to provide smart tools with information. Integration can lead to a cost reduction, but can also decrease the flexibility of the smart tools system. Further on it is recommended to focus on other phases of the implementation process of smart tools, as not only selecting the right tool is important but also monitoring and stringing the implementation process, by collecting feedback from users for example (Dery et al., 2017).

Campus manager

The main focus of this research was on the user perspective. Nevertheless, the campus manager needs to incorporate the views of other stakeholders into the smart tool project as well. (see stakeholder scheme by Den Heijer (2011)). Although the potential of smart tools in a broad sense are mostly acknowledge, expressing the specific benefits in numbers can be difficult. The examples, presented by Valks et al. (expected 2018) give already a first step in illuminating these numbers, but further research in defining the exact benefits can help campus managers to get support from other stakeholders.

User journey method

In this research the user journey method is used to illustrate the preferences of users to get insights on what is possible. As indicated by van Boeijen, Daalhuizen, Zijlstra, and van der Schoor (2014) the user journey method can be used throughout the designing process, therefore it would be interesting to research what the effect of using the user journey throughout the process can be.

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Introduction

Technology is becoming more important in our daily lives. Our smart phones have become an assistant, encyclopaedia and brain extension, all packed in that little computer we have with us all day and we can hardly do things without it. It has more power than the best computers years ago and gives us access to an enormously large amount of data.

A nice example of a smart tool which is used at the University of Cambridge is 'Spacefinder'. It's a map which includes information about spaces on and surrounding the campus. This enables the users to find a spot that fits their personal preferences at a certain moment. Or as the university likes to call it

> 'illuminating study spaces at the university of Cambridge and matching them to user need and activity' (cited from Priestner, Marshall, & Human, 2016).

Although it does not provide real time information about the availability of the place, places can be filtered based on personal preferences and insights are given on the possibilities in a certain area. This information is highly valued by its users, especially new users of the campus (Priestner *et al.*, 2016).

Spacefinder shows how easy tools can support user needs at the campus. Actually, it only provides static information about which spaces are around, nothing smart right? So what kind of other tools are out there to support users at their workplace? And maybe even more important, what kind of support are users looking for when being at the campus? The Spacefinder tool was developed on the basis of researching behaviour and experiences, not by asking people what they need. In this way, the tool makers were able to invent something that was really adding to the needs of its future users (Priestner *et al.*, 2016). This alternative way of doing research inspired me to look beyond the conventional methods.

This research is about finding out what kind of smart tools are available and which smart tool functions users can use during their workday. This information could help the real estate manager to implement a smart tool that provide value for its users as well.

Readers guide

This thesis is structures in three sections, first a literature part, then the findings will be presented and finally conclusions and connections will be drawn between the first two parts in the synthesis part.

The literature section starts with exploring the research problem and describing the focus of the research in the problem definition chapter. Then the basic principles of real estate management and the connection to the workplace will be explained in the background chapter. The literature review will introduce the main theories and innovations that are related to the research problem by defining a smart tool and relating it to the workplace. In the theoretical framework part, the conceptual model will be explained and relations between theories are highlighted. This section will be finalized with explaining the research method.

The second section consist of the findings gathered at different organizations. First an overview of functions of existing smart tools, which are used in several organization, will be given where after the in-depth case studies will be listed. These cases illuminate the workplace related problems users encounter during their workdays and a possible integration of smart tools in their days will be illustrated. The smart tools, requested by users, will be compared to the current smart tool vision to see where the deviations are.

In the synthesis section, the findings of the cases and smart tool analysis will be combined to formulate lessons learnt for the campus manager. A conclusion, discussion and recommendation will reflect on the general findings of this research and formulate recommendations for future research.

Problem definition

"We want something with smart!"

This sentence would probably come by if you talk about the workplace with people from the real estate of facilities section of any institution nowadays, at least I've heard it many times during my interviews. The managers see the potential of making the workplace 'smart', but the questions that keep arising are: Where do we start, what do we actually want and, maybe even more important, what do our users want? To explore these questions and define the problem that is the basis of this research, it is important to know more about smart technologies, the contemporary workplace and the effects these two aspects can have on each other reviewed from a real estate management perspective.

The contemporary workplace

Several drivers, like reducing cost and increasing flexibility and productivity are forcing the real estate manager to rethink the workplace (Kleijn, Appel-Meulenbroek, Kemperman, & Hendriks, 2012). Simultaneously the changing workforce drives the workplace change as well. Harris (2016) states that flatter organizations have employees who have more control over their own work and they fulfil their job in different places inside and outside the office such as their home or 'third places', like a bar. Apparently the times of the large number of cubicles and time clocks are over. Both, the facilitators of the workplace and the users themselves are driving the workplace to change it form.

From assigned office to an activity-based work environment

In search for enhancing communication and collaboration, organizations started to experiment with other office concepts then the cellular office (Brunia, De Been, & van der Voordt, 2016). The first step was introduce an open plan office lay-out. Although this was enhancing communication and collaboration and providing flexibility and cost reductions, other problems as a lack of privacy and comfort, arose. The foundations of the activity-based office go back to the '80 with the CoCon-office, which stand for Communication and Concentration (Kleijn *et al.*, 2012). The low occupancy figures of this concept resulted in the idea of sharing these facilities, which is the basis of the activity-based office (Kleijn *et al.*, 2012). The introduction of this concept entails two trends which continue to develop. On the on hand sharing places to increase the effective use of spaces and on the other hand providing different types of spaces that are tailored for a specific activity. Therefore the name activity-based workplace. Although the good intentions of this concepts, just providing some different spaces does not create a great workplace for everyone. Several authors reporting the low satisfaction of activity-based office concepts (Brunia *et al.*, 2016; Hoendervanger, De Been, Van Yperen, Mobach, & Albers, 2016; Kim, Candido, Thomas, & de Dear, 2016; Kleijn *et al.*, 2012). Hoendervanger *et al.* (2016) emphasizes on the willingness from users to switch to another workplace type when starting a new activity. The choice to switch can also be the result of a collective decision, when a group decides to go to a meeting room, or can be scheduled in advance. Kim *et al.* (2016) concludes that the 'non-territorial aspect' of these office concepts, which diminish the possibility for users to personalize their workplace, can be compensated by providing a high quality environment. Besides that, they emphasize on the finding that the possibility to choose a workplace yourself provides a certain amount of control over the workplace. Nevertheless, other findings are less positive an contribute to the low satisfaction of non-territorial offices, like the absence of sufficient desk places, difficulties with finding colleagues, wasting time with finding a place and 'setting-up' the workplace and the lack of personalizing options.

But not only the type of activities influence the workplace type, also personal preferences (Kleijn *et al.*, 2012), culture, well-being and happiness of employees do (van Meel, Martens, & van Ree, 2010). Putting these personal values in the centre of designing the new office is essential to make the workplace actually work (Memelink & Voogd, 2017). There is no such thing as a

'one size fits all' solution for the workplace, individual preferences should be incorporated to provide a working environment that accommodates different 'types' of people (Hoendervanger *et al.*, 2016). Although the ever changing character of personal preferences, which makes it hard to tailor a workplace to one specific person, creating a great range of variable workplaces to meet the different preferences is advised (Kleijn *et al.*, 2012). Harris (2016) combines the workplace changes with the needs of the contemporary office user and states:

> 'It means managing the workplace as a service and support to workers who demand a high level of service, amenity and experience.'

Thus, the workplace is moving towards a place which entails different types of places which are used in a flexible, non-territorial way. This dynamic use of the workplace is referred to as an activity-based working environment. Although the good intentions of managers by implementing this office concept, not every user is satisfied with this workplace concept. Personal differences in the willingness to switch to another workplace can result in a lower satisfaction but also the time related to finding a place and finding colleagues in the building is an explanation for lower office satisfaction rates. Besides that, incorporating the preferences of users is important to tailor the office concept to the specific users of the organization. A high number of variations in the office concept can provide an environment that meets the varying preferences of different users.

Smart tools

> "My telephone has become the extension of my brain"

That was a description derived from an interviewee, when talking about her phone. This can be seen as an example of the use of technology in the workplace. Technology in the workplace expanded significantly in the twenty-first century and shifts how people can perform their job (Holland & Bardoel, 2016). In this report the focus within technologies will be on smart tools. The word 'smart' indicates the connections the tool or device will establish to provide information to its users. The number of connected devices, or smart tools as I will call them throughout this report, is expected to continue its growth (Chen, Mao, & Liu, 2014). Cisco (2013) estimated that in 2013 still 99,4% of the physical devices were unconnected, resulting in 10 billion smart tools at that time, which was expected to go up to 50 billion by 2020. Reduced costs, increased productivity and an increased customer experience are general benefits that can be accomplished by the new connections between tools (Cisco, 2013). In 2017 Cisco (2017) reported that at the end of 2016, 14.9 billion tools were connected. Although the estimations of Gartner (2017a) are pointing at lower numbers, they also report a growth in smart tools. Their estimations show a growth of 30% between 2016 and 2017. Despite this growth, a study of Cisco (2017) shows that 60% of the projects with smart tool initiatives do not survive the 'proof of concept' phase. So organizations are still experiencing difficulties with piloting and implementing smart tools in their organization. Among the surveyed companies, 61% believes that the possibilities of these technologies are barely revealed (Cisco, 2017). So we are just at the beginning of seeing the potential of smart tools within our lives and businesses.

In his book The future of work, Morgan (2014) sees technology as one of the five trends that will shape the future of work. Morgan (2014) agrees on the finding of Cisco (2017) that the possibilities of interconnected tools is barely revealed, as only some companies are jet experimenting with it. Nevertheless Morgan (2014) states that these smart tools have

> 'the potential to make our lives and workplaces easier and more streamlined… '.

He directly links the potential of smart tools in smoothening the workplace but also emphasizes the lack of knowledge on how this would actually work in the field. The study on smart tools at universities by Valks, Arkesteijn, Den Heijer, and Vande Putte (2016) shows that different Dutch universities have already implemented several smart tools to use their spaces in a more effective way and that the tools are further developed or new projects are started to explore the possibilities of smart tools even further.

All in all it can be stated that smart tools have a certain potential in streamlining the workplace. The number of smart tools is growing and there is still much unknown about the implementation and actual functioning of smart tools at the workplace. Several organizations are experimenting with the possibilities of smart tools.

The role of the campus manager

The development of technology results in changing functional desires from workplace users and the organization itself (De Been, De Bruyne, Pullen, Gerritse, & Thoolen, 2016). People use different types of technology in their personal life, think about the train application on your smart phone and small laptop that has a battery up to 8 hours. Organizations need therefore to respond to these preferences and learn how to cope with technological innovations. Technology enables people to work 'anyplace, anytime' which gives a bigger variance in workdays among people and make them become more critical about the actual place (Hoendervanger, van der Voordt, & Wijnja, 2017). Involving the end user is essential to make workplace work (Brunia *et al.*, 2016). In the transition towards the new digital workplace, it is important to match the tools with the individual preferences and needs of its users (De Been *et al.*, 2016). Therefore the campus manager should collect views from users to shape the workplace in a user focussed way.

Several researchers focus on the importance of this connection within different disciplines of the

organization, so integrating the ideas of Human Resource Management (HRM) and Information and Communication Technology (ICT) with the ideas for the workplace coming from Corporate Real Estate (CRE) and Facility Management (FM) (De Been *et al.*, 2016; Haynes, Nunnington, & Eccles, 2017; Hoendervanger *et al.*, 2017; Kloet, Kooyman, & Wallinga, 2017). Hoendervanger *et al.* (2017) envision the manager of the workplace as a connecter who connects different interests and has a human centred approach.

The campus manager is expected to integrate technologies into the workplace, as people are used to these functionalities in their daily live as well. Incorporating user preferences, regarding both the workplace itself and the possible smart tools, is essential to create a productive workplace. This leads to the following problem statement for this research.

Problem statement

People use the workplace in an increasingly dynamic way. Different places are used to perform working activities and the places are shared among a group of users. Varying in workplace type is important to meet the preferences of different users within the organization. One of the downsides of this activity-based workplace concept is the difficulty to find colleagues and workplaces. The growing technology sector is developing variety of innovations to provide the user with information on the location of available places and colleagues. Although the potential of smart tools is seen by the management of organizations, often projects on smart tools are not successfully implemented or even stopped during the pilot phase. Incorporating the preferences and needs of the users and obtaining knowledge on new innovations are important to give the campus manager the necessary information to make smart tools at the workplace work.

Research focus

This research will be conducted from a user perspective, to give insights for the campus manager. The workplace and the user are both very broad terms. Therefore this research is focussed on a specific workplace environment and user respectively, the campus workplace and the new user. The section below will give a further introduction on this research focus.

The knowledge worker

Following Drucker (1999) the knowledge workers and their productivity is the most valuable asset of the twenty-first century. The knowledge worker does not produce something at the assembly line, but instead of actually 'doing' something, knowledge workers 'think' for living. All jobs have parts of knowledge work in their day, but there is a difference in the amount of knowledge work someone performs Mawson (2015). Figure 1 shows the spectrum of knowledge work.

Following Duffy (2008), the workplace will play an important role in providing

> 'a range of intelligent and responsive services' in the 'world of technologically enhanced, knowledge based work'.

The principles of activity-based working, which is the idea of providing different workplace types, are based on the changes in knowledge work, which is becoming more autonomous and interactive (Hoendervanger *et al.*, 2016). So, knowledge work consist of multiple activities that require different workplace types. It is expected that knowledge intensive work continues to grow in the coming years (De Been *et al.*, 2016). As this research focusses on the workplace, the knowledge worker is its main user.

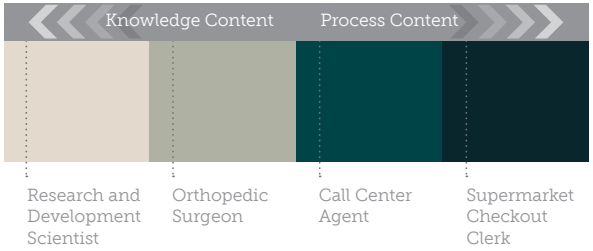


Figure 1: The spectrum of knowledge work, derived from (Mawson, 2015)

The campus

On the campus, many knowledge intensive organizations are situated (Buck Consultants International, 2014). The great variety of workplace types is another characteristic of the campus (Den Heijer, 2011; Neuman, 2013) Jaitli and Hua (2013) describe the characteristics of a physical corporate campus as a group of buildings which use the same support functions and offer a variety of amenities on site. So, there is a variety of workplaces on the campus and support facilities are shared among the different organizations of the campus. Besides that, spaces of the campus are increasingly used in a dynamic way, as spaces are used for different purposes (TU Delft, 2016). Researchers make more use of the computer to conduct research, but highly specific spaces are still needed as well (TU Delft, 2016). Therefore sharing facilities can help to use the workplaces effectively.

Unfamiliarity with a specific place makes people more dependent on external information sources like, brochures, the internet, recommendations from friends and travel guidebooks (Tan & Wu, 2016). In the case of the space finder tool of Cambridge, it is found that the tool is most used in the months when new students arrive at the campus (Priestner *et al.*, 2016). Therefore it can be stated that new users of a place use information from different external sources to gather

knowledge about a place.

The large campus with its dynamic space use needs to support their knowledge workers in practising their job. The hypothesis is that this ensemble of buildings and collection of different knowledge fields can have a big advantage by incorporating smart tools in their work processes, especially the new workers who have a higher need for information in general due to the unfamiliarity with the place.

Combining the research problem and research focus gives the following research aim.

Research aim

The aim of this research is to gather a deeper understanding of the problems new users encounter during their day at the workplace and to connect these problems to specific functions of smart tools.
By showing the connection between workplace related problem and smart tool, insight is given on how the work place experience can be optimized during the day on campus and what the role of already available tools in this process can be. These findings can help the campus manager in making plans for the exploration or implementation of smart tools in the workplace.

Research questions

To fulfil this research aim, the following main research question will be central in this thesis:

Which functions of smart tools are needed to assist new campus users in choosing an appropriate work place throughout the day and what are the implications for the campus manager of the lessons learnt from these user insights, when exploring the possibilities of smart tools at the campus?

Descriptive questions
- What are smart tools?
- What is the relation between smart tools and the workplace?
- What are the characteristics of new users?
- What are the characteristics of the campus workplace?

Sub research questions
Part I
- What kind of smart tools are currently used at the workplace on campuses to assist users in choosing an appropriate workplace and what are the functions of these tools?

Part II
- What problems of new campus users can be identified, regarding space use?
- Which physical functions of the workplace and functions of smart tools are incorporated in the campus vision?
- In what way are the problems identified by new users aligned to the options delivered by currently available smart tools and are these smart tools already incorporated in the campus vision?

Synthesis
- What lessons can be learnt from the comparison between the case findings and the smart tool classifications to provide guidance for the campus manager during the exploration of smart tool possibilities at the campus.

Research method

For the two analyses of this research, two different research methods will be used. The first part is about exploring different smart tools, which are used in several organizations. This exploration will be made in collaboration with the smart tool research team. A basic information sheet will be filled, based on interviews with professionals. This provides a data base of information on several aspects of the smart tool, like user information, sensors and benefits.

In the second in-depth part, the user journey method will be used to map the workplace related problems of users and to see the cause-effects relations of implementing smart tool functions in the day. Reflecting these insights to a planned journey shows the gap between user and organization.

Although this user journey method is not a common way to conduct qualitative research, both Nenonen, Rasila, Junnonen, and Kärnä (2008) and Samson, Granath, and Alger (2017) have explored this method within the built environment and concluded that the approach was applicable in this environment.

Relevance

Societal relevance

The technological development has much potential to enhance innovation, productivity, efficiency and customer experience in all kinds of different domains like healthcare, energy and the built environment (Cisco, 2013). Den Heijer, Arkesteijn, and Valks (2017) points at the potential of smart tools on the university campus by indicating on the potential of increasing efficiency and effective space use. This increase of efficiency and effectiveness leads to a more sustainable approach to space use (Den Heijer *et al.*, 2017). Nevertheless, a research of Cisco (2017) shows that only 26% of the projects which involve smart tools are considered a success and 60% of these projects are not continued after the proof of concept stage. Cisco (2017) indicates as one of the main findings is that learning from failures helps to accelerate other projects. So despite the broadly shared consensus about the possible benefits of smart tools, many projects are not considered a success after completion, if the project even reaches the completion phase. Insights in other projects can help to initiate new projects on the implementation of smart tools to reach the sketched potentials. This can lead to more effective and efficient space use which contributes to a sustainable operation.

Introducing smart tools in the workplace leads simultaneously to opportunities and challenges (De Been *et al.*, 2016). One of the challenges is the guidance of people through this process of implementing new smart tools at the workplace and matching the tools to the needs of the users (De Been *et al.*, 2016). The list of smart tool functionalities, which is one of the deliverables of this research, can help the campus manager to focus the search for smart tools. The in-depth cases show relationships between activities, smart tools and the physical workplace and give an insight in the sequence of activities a user will go through during a workday. Although the cases in this research will not be generalizable to every single campus, it can give ideas on how to conduct a study on user preferences and give insight in what kind of functions are available in the market.

Scientific relevance

It is recommended to conduct further qualitative research to understand the influence of different office spaces on perceived productivity (Harris, 2016). Hoendervanger *et al.* (2016) explicitly state the influence locational factors can have on the satisfaction of workplace users. Therefore it is important to gather additional information on organizational culture and the satisfaction with the interior design to identify what influences satisfaction. To gather this information, Hoendervanger *et al.* (2016) advices to use alternative methods for data collection.

The method that will be used to explore four cases in depth, is the user journey method. Following Nenonen *et al.* (2008) the user journey method provides data about the processes and user experiences in the work environment and point at the ability to uncover small details that effect the workplace experience. Combining this user journey with a planned journey, which embodies the vision of the organization and is advised by Halvorsrud, Kvale, and Følstad (2016), and making a personal profile which states additional information of the interviewee, which is advised by Hoendervanger *et al.* (2016), it is expected to provide information about this gap of knowledge.

On a bigger scale, Morgan (2014) emphasizes the little knowledge there is about the working and implementation of the internet of things but nevertheless stresses the opportunities it has for the workplace. Insight in the connection between smart tools and the workplace can elucidate the potential of smart tools in the workplace. On the one hand, the in depth cases can provide the connection between smart tools and user preferences or requests and on the other hand, the overview of smart tool functions provides example cases to use as a reference when starting a process on implementing smart tools in the organization. This research aims to fill this gap of knowledge.

Background

In this chapter an introduction on Corporate Real Estate Management (CREM) will be given, which is the starting point of this research. The contemporary workplace trends will be explored in this chapter and a typology of workplaces will be given to illustrate the diversity. Then the focus will be on the campus manager, as the facilitator of the workplace, and there will be elaborated important aspects for the campus manager to facilitate the user with a suitable workplace.

Corporate Real Estate Management

The function of real estate has shifted from being an operating cost to being one of the resources of the organization.

> 'The perception of real estate has shifted irrefutably from being merely an operating necessity to a strategic resource integral to business strategy and board-level decision making' cited from Haynes, Nunnington, *et al.*(2017).

Two decades ago, this link between real estate and organization was not existing in many organizations, let alone seeing it as an added value (Nourse & Roulac, 1993). In their article, Nourse and Roulac (1993) emphasize on the importance of the link between real estate decisions and the organizations' overall objectives. Nowadays both industry and scholars recognize that corporate real estate management (CREM) is not only a method to reduce costs but also a way to add value to the organization (Petrulaitiene, Rytkönen, Nenonen, & Jylhä, 2017). Haynes and Nunnington (2010) see corporate real estate as one of the resources of the organization,

> "that need the same amount of attention with regards to planning and monitoring. It should therefore be fully integrated with the corporate planning process" (cited from Haynes and Nunnington (2010, p. 174).

In general terms, this matching of business and real estate is typical for corporate and public real estate management and referred to as aligning the supply of real estate to the demand of the organization (De Jonge *et al.*, 2009). Following Hardy *et al.* (2008), this 'recognized' approach of aligning demand and supply, can have some pitfalls as well. One of them is the single focus on the existing building stock and organizational requirements. Using the approach in a more holistic way by focusing on future possibilities and organizational needs on the demand side and by incorporating the supporting technologies of the working environment on the supply side, these pitfalls can be prevented (Hardy *et al.*, 2008). This future focus within the profession of CREM is also emphasized by Haynes, Nunnington, *et al.* (2017). They argue that a proactive attitude is crucial to keep up with the constant changes. No one can look into the future and tell what these changes will be and how they will work out, but there are certain trends which can be distinguished. Morgan (2014) lists the following 5 trends which will 'shape the future of work'; 1) new behaviours, 2) Technologies, 3) the millennial workforce, 4) Mobility and 5) globalization. A more extensive study on trends is made by Haynes, Nunnington, *et al.* (2017) who conclude that the trends

> 'workplace transformation and ICT and real estate are a common theme across all the professions'.

CREM is about connecting buildings with the people who use it. This connection is not only seen as a necessity: because we need a place to work, but as an extra resource to support the people using it and creating a better work environment. A proactive approach, with a future focus, is needed to anticipate on and create the future work environment. Therefore it is about adapting the workplace to the current and future changes.

Workplace trends

Variation and diversity in people and place

> "In the post-industrial era of consumption and the rise of the service sector, workspaces for many people are diverse and not bounded at all by traditional separation of spheres of production, consumption and reproduction." (cited from Dale and Burrell (2008, p. 2))

A citation from an organization theory perspective on the workplaces en its differences. A domain which

> "deals with the mutual influences of the physical environment and human behaviour" (cited from Mobach (2010, p. 159).

A connection which is made as well in the real estate management domain.

In a collage of photos of civil servants all over the world, Banning (2008) grasped the different appearances local citizens will experience when entering the office. Besides the beauty of these pictures, they also show the differences in culture, rituals and symbols between people all over the world. Van Meel (2015) gives in his book an overview of the contemporary workplace by showing 10 different typologies. Just like Dale and Burrell (2008), Van Meel (2015) notifies the changes in the office. Due to technological innovations, people value offices in a different way, but the physical office is not gone yet, he argues. Duffy (2008) agrees on this notion, and goes a step further by stating that the value of the workplace will even increase. Although this does not result in an increase of rented square meters, but is about number of the intelligent and responsive services that workplace users get. Harris (2015) sees the physical workplace as a 'hub' to bring colleagues together for networking and collaborating, but also to attract and retain the employees of the company itself. Workplaces differ in from city to city, just like the photo collection of Banning (2008) indicates, but Van Meel (2015) connects these workplace differences also to the different preferences of users. A consultant has other preferences than a researcher or an entrepreneur and also these typologies of professions will have a lot of variations within the group itself (Van Meel, 2015). There is no one-size fits all approach for workplace fit-out (Hoendervanger *et al.*, 2016). Different workspaces are needed for different types of work and within this group of people who do the same kind of work, there are still many differences among them. So not only a diversity in types of spaces is needed to support the user, also a variety within these typologies is needed to accommodate the different preferences users can have regarding the workplace.

This trend of increased diversification is illustrated by Harris (2015), see Figure 2, and shows a decrease of the amount of office space and an introduction of non-office spaces. When focussing on the places in the office, van Meel *et al.* (2010) provides the following categorization:

- Work spaces; spaces for desk related activities like reading, writing, calling and PC work.
- Meeting spaces; spaces typically designed for meeting groups of different sizes.
- Support spaces; spaces that support various work processes

When reviewing the illustration derived from Harris (2015) the categories show similarities with those of van Meel *et al.* (2010). Other authors are also pointing at the introduction of non-office spaces to the range of possible work places of knowledge workers. Di Marino and Lapintie (2015) review libraries as one of the public, semi-public and home places that workers use and Ng (2016) reviews the conditions that these public spaces need to fulfil to be an effective workplace of mobile workers. Both Di Marino and Lapintie (2015); Ng (2016) refer to Oldenburg (1989, 2001) for the term 'third places' to capture the meaning of these non-office spaces. This category of third places will be added to the list of van Meel *et al.* (2010) to give a more complete of the different types of places knowledge workers can use for working.

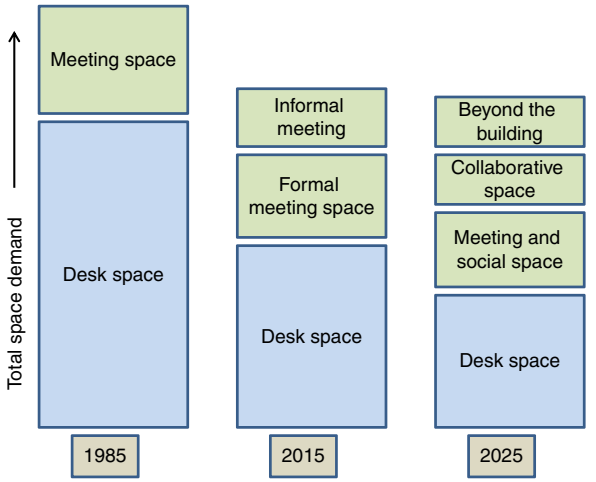


Figure 2: Derived from (Harris, 2015): The changing palette of work settings.

Besides the diversification of space type, there is also an increased variation in how these places are designed and how the ensemble of spaces forms a specific type of office. These office types are categorized in another publication of Van Meel (2015) where 9 office typologies are presented which all have a unique mix of spaces. Also the third places are incorporated in this categorization. Although this is not an extensive scientific study but more a loose categorization, it shows the different tastes and preferences have within different organizational settings and cultural backgrounds. Figure 3 is made to illustrate this two sided diversification of the workplace and provides a conceptualisation of the workplace.

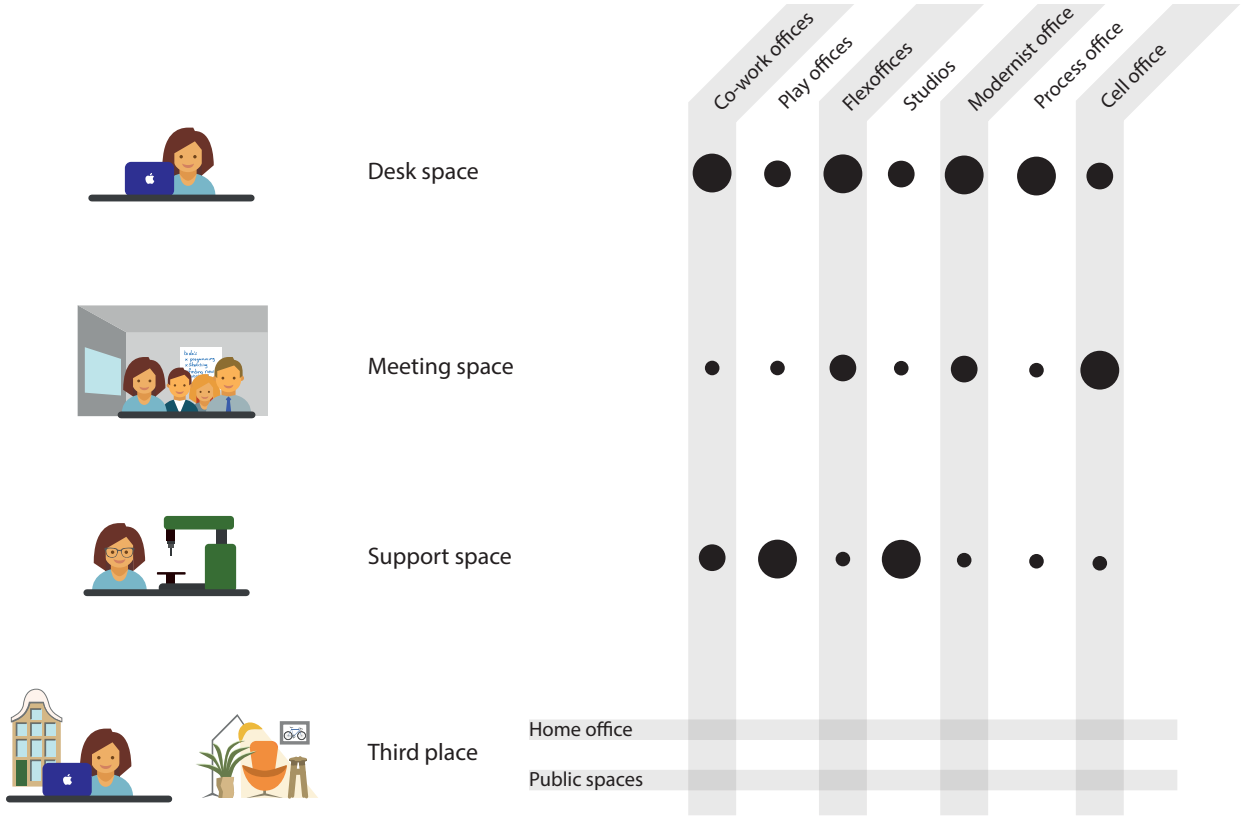


Figure 3: Interpretation of different workplaces in two dimensions, based on (Harris, 2015; Van Meel, 2015; van Meel et al., 2010)

The workplace is no longer only referring to a desk in an office. Therefore Kleijn *et al.* (2012) refer to all these different places as facilities. In this report the term workplace will be used to refer to all places that can be used for work, whereas work consist of different activities that require different spaces. This is similar to the notion of Hampton (2014) who sees the workplace as a concept that refers to 'work environments both within and outside of the company's portfolio'. To be able to make a clear distinction between this overarching term workplace and the term work spaces, defined by van Meel *et al.* (2010), the word work spaces will be changed in the terminology of Harris (2015) and therefore called 'desk space'.

Effective use of space

Creating different places for different activities sounds interesting, but to make such a workplace feasible, sharing these places is a requisite. As mentioned in the problem statement, the idea for sharing workplaces started simultaneously with the first ideas of enlarging the typology of workplaces, driven by the low occupancy rates of the workplaces (Kleijn *et al.*, 2012). This economic reason is still the main drive for organizations to introduce the concept of non-territorial workplaces, which means not assigning a workplace to one person (Kim *et al.*, 2016). Not everyone likes to share workplaces, looking around for ages to find a workplace and installing your personal belongings, like family pictures and your favourite coffee cup, much have been said about the shared

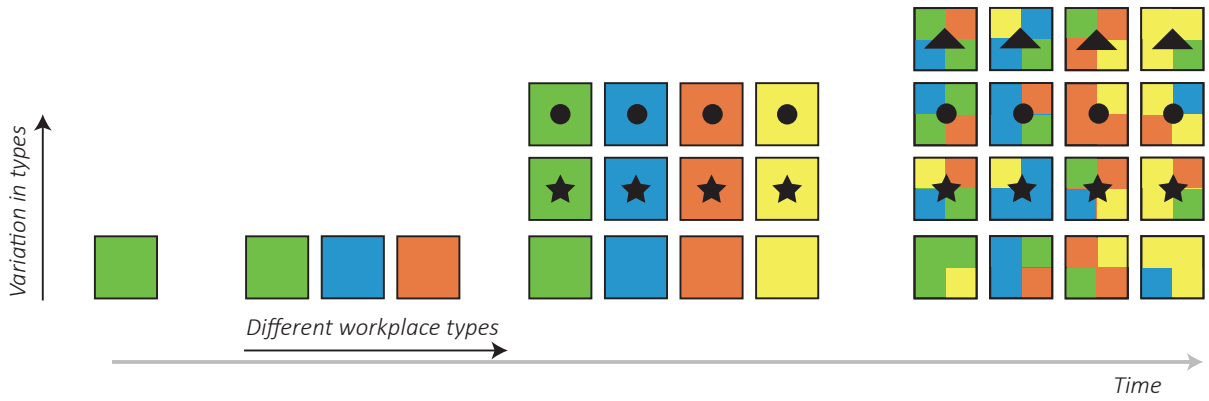


Figure 4: Dynamic space use, own illustration

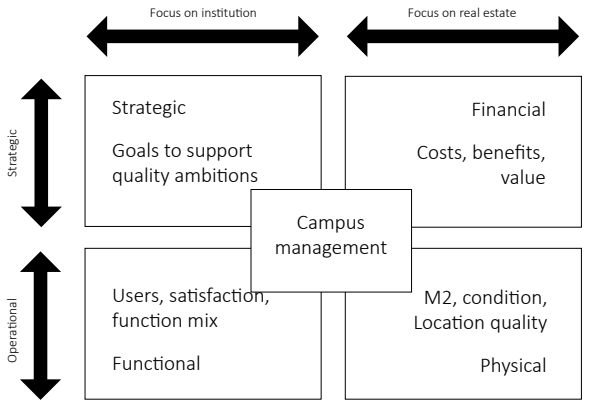


Figure 5: CREM perspectives on managing the university campus. Derived from (Den Heijer, 2011)

workplace in popular media (see for these newspaper articles, Niemantsverdriet and Kranenburg (2017) and Bouma (2016)). Remarkably, Kim *et al.* (2016) found that sharing a workplace does not necessarily leads to lower user evaluations of the workplace. Users of a non-territorial workplace have higher expectations regarding the spatial factors of the workplace,

> "such as the office layout allowing easiness of interaction with colleagues, the ability to adjust/ personalise workspace, and the amount of storage space provided" (Kim *et al.*, 2016).

In this sense, the quality of the work environment should be good enough to overcome the negative influences that sharing a workplace can have. Haynes, Suckley, and Nunnington (2017) mention the office lay out as well as one of the most important factors for perceived productivity and therefore recommend to provide a variation of physical place. Nevertheless, users of a shared workplace are still experience some downsides of this workplace type like, an insufficient number of workplaces, difficulties in finding colleagues and available workplaces and the lack of personalizing options (Kim *et al.*, 2016). The ability to choose a workplace balances the lack of personalization of the workplace itself, in this way, users can choose where they want to work which provides some kind of personalization (Kim *et al.*, 2016). So, sharing workplaces comes with certain conditions for the physical workplace to make the sharing workplace work.

The workplace is becoming a network of places that are tailored to one specific activity. Sharing the different workplace types among different users increases the occupancy figures. Variations within workplace types provides multiple options users can choose from, which provides a form of personalization within the non-territorial workplace. Therefore the workplace is used in a more dynamic way, by different users, for different purposes or activities in different ambiances. See Figure 4 on page 10 for an illustration of the increased dynamic used of space.

The campus manager

The campus manager is the person to provide a suitable workplace for its users, but has to deal with other stakeholders as well. Within the university campus setting, Den Heijer (2011) distinguishes four different stakeholder quadrants namely; strategic, financial, functional and physical. It is the job of the campus manager to integrate these four perspectives and balance them to deliver a good solution for all stakeholders. Figure 2 shows the four perspectives.

As stated in the problems statement chapter, users become more critical about the workplace (Hoendervanger *et al.*, 2017) and to provide a 'working' workplace, involving the ideas of the user is essential (Brunia *et al.*, 2016; Dery, Sebastian, & van der Meulen, 2017). This increased user focus within the workplace, and the need to scope this research, led to the focus on the functional quarter, as described by Den Heijer (2011), which is about the users, user satisfaction and the functional mix of the campus. This information will form an input for the campus manager to develop, implement and operate the new workplace. The other three quadrants are important as well, but not the primary focus of this research. In the discussion section of this research the functional quarter will be related to the other quadrants.

To provide a 'high performance' workplace, different domains within the organization should collaborate (Harris & Cooke, 2014; Haynes, Nunnington, *et al.*, 2017). Although Harris and Cooke (2014) also include finance and procurement, the most often seen connection is made between CREM, Human resource management and ICT. In the workplace, enhancing productivity is an important condition and the mobile way of working leads to the incorporation of digital devices. Incorporating the experts on these fields, the Human resource manager (HRM) and Information and communication technology (ICT) department helps to look at the workplace in an integrated way. In their research De Been *et al.* (2016) used an integrated approach to give recommendations for the future workplace, incorporating views of CREM, FM, HRM and ICT. Also Haynes, Nunnington, *et al.* (2017) put emphasis on the connection between CREM, ICT and HRM. It can be challenging to bring these domains together, as they all have their own distinctive ways of working (Haynes, Nunnington, *et al.*, 2017). Haynes, Nunnington, *et al.* (2017) make a distinction between using IT to monitor the building performances, by installing a building management system (BMS), and using IT and HRM insights to balance the physical and virtual workplace and facilitate interaction (Haynes, Nunnington, *et al.*, 2017). This last angle is the focus of this research, as this can be placed in the functional quarter of the multi stakeholder framework by Den Heijer (2011). The connection of user focused technology with the BMS will be elaborated upon in the discussion of this research.

Conclusion

The discipline of CREM is moving from providing a product towards providing a service. Satisfying the user becomes more important and to accomplish this, the involvement of users within the design and implementation process of the new office becomes larger. The experience of the user plays a central role in the new workplace concepts. Integration between the domains of CREM, HRM and ICT is important to place the user in the centre of new workplace developments.

The workplace is increasingly used in a more dynamic way, meaning workplace types are expanding, more variations are made within a workplace type and spaces are shared and used for multiple purposes. See Figure 4 on page 10. The role of the campus manager is to balance the different perspectives to provide a good environment for all players. The angle of this research is on the user perspective and the translation of this perspective to the campus manager.

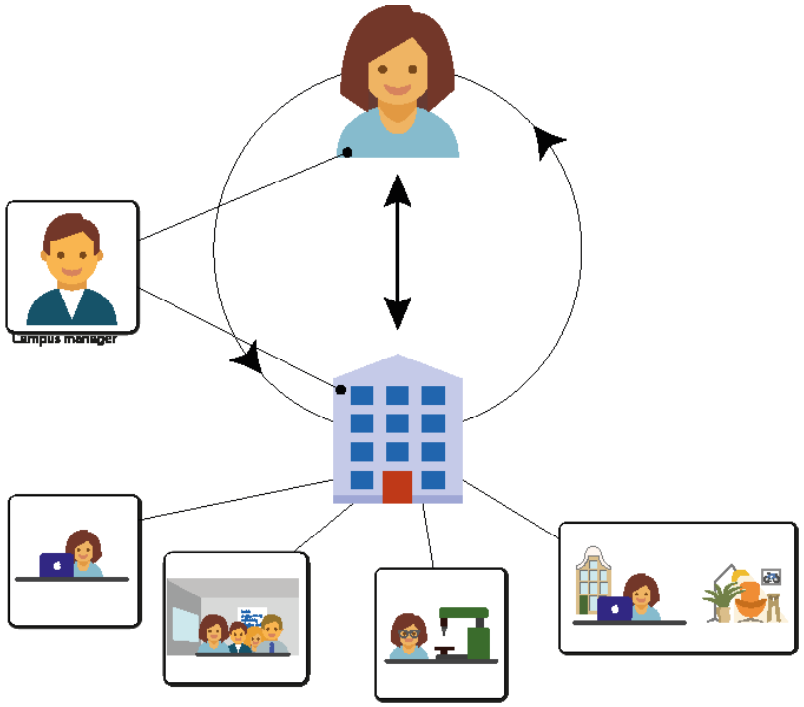


Figure 6: Daily connection between building and users, overseeing function of the campus manager and the user based changes to the building. The diversity of the workplaces is explained as well. Own illustration, combining conclusions from this paragraph.

The workplace does not exist, neither does the user. Variations in both workplace type and users are urging the campus manager to provide a diverse workplace, stepping away from a one-size fits all approach.

Figure 6 connects the theory on CREM with the emerging trends in the workplace and positionsd the campus manager within this field.

Literature review

In this chapter a review will be given on the main concepts of this study. The following descriptive questions are structuring this literature review.

Smart tools
- What are smart tools?
- What is the relation between smart tools and the workplace?

Research focus
- What are the characteristics of new users?
- What are the characteristics of the campus workplace?

The definitions and theories found in this literature review will be the basis of the conceptual model, elaborated in the next chapter.

Smart tools

As described in the problem definition, the availability of technology is increasing and the workplace is using these innovations to help users at the workplace. As technology is a rather broad term, this research focusses on a specific type of technology, the smart tool. This section will look into definitions of smart tools and will place smart tools in a greater network of connected concepts.

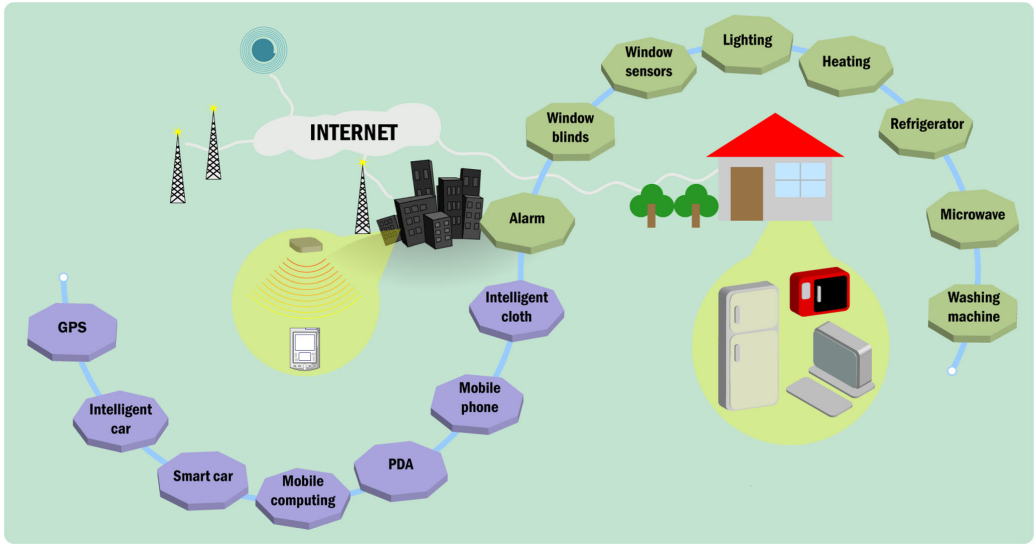


Figure 7: illustration of data acquisition equipment in IoT, derived from (Chen et al., 2014)

Technology types

Morgan (2014) emphasizes on the unknown impact of some technological developments, pointing at the application of Big Data and the Internet of Things, as they are still in their early stages of development and the majority of organizations are not using these technologies jet. The concept 'smart' is often related to the more recent emerging concept of the Internet of Things (IoT) (Atzori, Iera, & Morabito, 2010). The definition from the European commission states: ''Things having identities and virtual personalities operating in smart spaces using intelligent interfaces to connect and communicate within social, environmental, and user contexts" (RFID, 2008). Internet of things strikes the connectedness of smart or less smart objects

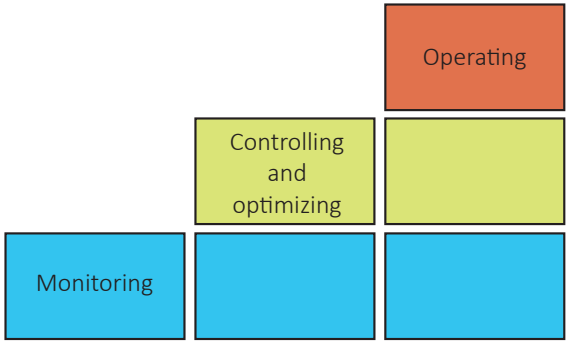


Figure 8: stages of a smart tool, own illustration, based on (Baumer et al., 2017)

within a certain context. This notion is endorsed by Chen *et al.* (2014) who state that within IoT, the data will be acquired by 'data acquisition equipment', which can be a mobile phone, a sensor or another measuring object. Here the connection to Big Data is made as well, whereby Big Data is the derived information from all this data acquisition equipment within the Internet of Things (Chen *et al.*, 2014). See Figure 7 on page 12 for the illustration of data acquisition equipment, derived from Chen *et al.* (2014).

Although several authors indicate that the full potential of the smart tools is far from explored jet (see e.g. Cisco, 2017; Morgan, 2014) , new innovations already arise at the horizon. Gartner (2017b) highlights the possibilities of intelligent applications for user experiences, where sensors first analyse user emotions or intentions and, based on this information, predict the user preferences. One of the examples that is named by Gartner (2017b) is the intelligent application Siri, developed by Apple. Based on enormous amounts of data, these kind of applications are becoming smarter and use this based on your specific question. If you ask Siri to call your partner, 'she' will, based on your phone records, check if she has found the right name of your partner. If you indicate that this is right, Siri will call automatically. Another innovation is the self-driving car. Based on sensors, the car drives semi or fully automatic. So it measures, calculates and acts in a very short timeframe. Baumer, von Oelffen, and Keil (2017) summarise the functions of smart connected products as functions that build on each other, starting with monitoring, controlling and optimizing and name the last step operating.

> 'A fully developed IoT device is capable to enhance itself autonomously, adapt itself to its user's personal needs, and identify and repair gaps autonomously' (cited from Baumer *et al.*, 2017)

This step from reactive smart tools to proactive smart tools shows new possibilities for technology. See Figure 8 for the stages of Baumer *et al.* (2017).

Smart tools definition

This research focusses on the smallest parts of this technology network, the 'data acquisition equipment', defined by Chen *et al.* (2014), which is referred to as smart tools. The term smart tool is retrieved from the research of Valks *et al.* (2016) who conducted a study on the use of smart tools at Dutch universities and the development in smart tools in the market in general. This research resulted in a publication named smart campus tools (Valks *et al.*, 2016) and a new research request from Dutch universities to continue with the research on smart tools by exploring other counties and organizations and evaluate the previous findings collected in the Netherlands (Den Heijer *et al.*, 2017). The definition for smart tools given by Valks *et al.* (2016) is as follows:

> "A smart tool is a service or product to collect (real-time) information to improve space usage at the university campus and guide decision making for the future campus" (translated from the original Dutch text, derived from Valks *et al.* (2016)).

As this research has a slightly different focus than the research of Valks *et al.* (2016), the definition will be adapted to meet the following requirements:

- It should be applicable to all kinds of campuses
- Its prior focus should be on assisting the user instead of guiding future campus decision making

This leads to the following definition for smart tools which will be used in this research: A smart tool is a service or product to provide (real-time) information to its users to improve space usage at the campus.

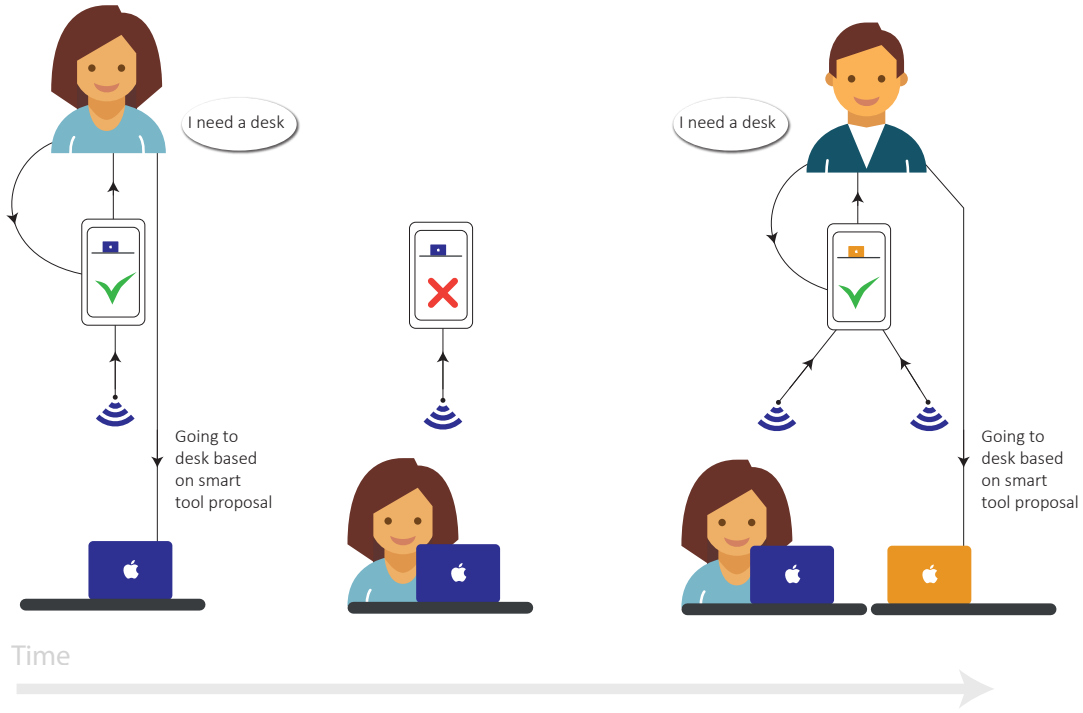


Figure 9: Working of a smart tool. Own illustration.

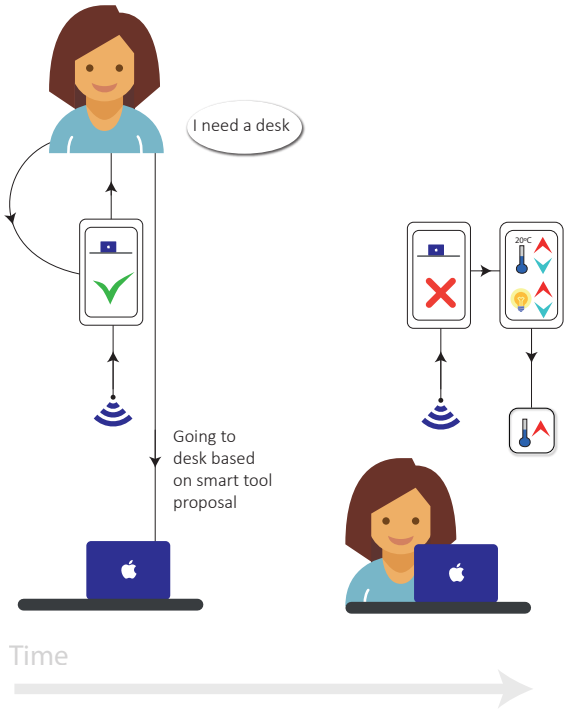


Figure 10: controlling function of a smart tool, own illustration, based on (Baumer et al., 2017)

Based on this illustration of Chen *et al.* (2014) and thesmart tool definition based on the definition of Valks *et al.* (2016) Figure 9 is made to illustrate the system of a smart tool. The illustrated smart tool only performs the first step, defined by Baumer *et al.* (2017), which is monitoring.

The Figure 10 on the right also incorporates the second step that Baumer *et al.* (2017) describes, the step of controlling. The application knows, based on the presence of a person or based on a profile of this specific person, that the temperature should be between 20 and 22 degrees Celsius. By measuring the current temperature, the device decides to raise the temperature. It is also possible to raise the temperature based on the knowledge that this device obtained. For example, by gathering data on the temperature adjustments of several people and applying this knowledge on adjusting the temperature.

Conclusion

The growing presence of technology in our daily life creates opportunities for the workplace. In different ways, smart tools are developed to assist the user in its daily activities. This research focusses on the smart tools in the workplace.

The definition for smart tools that will be used throughout this report is: A smart tool is a service or product to provide (real-time) information to its users to improve space usage at the campus. This definitions is based on the original definition of Valks *et al.* (2016).

Smart tools are part of a network. This network is often called the Internet of Things (IoT) and refers to the interconnectedness of different devices in a network.

Smart tools have different stages of functions they can offer. Figure 10 shows the system of smart tools and presents the first and second stage as defined by Baumer *et al.* (2017). Figure 8 shows the three stages defined by Baumer *et al.* (2017).

Smart tools in the workplace

As the possibilities of smart tools are given in the previous chapter, in this part, the connection to the workplace will be made. Some examples of smart tools will be given to illustrate the possibilities of smart tools in the workplace. Besides the positive effects of smart tools, there are also points for attention. For example privacy concerns that can raise at users when smart tools are being implemented. There can occur privacy concerns by users and workplace users need to adapt to the new features. The last section of this chapter will elucidate these privacy aspects and conceptualize the relation between smart tool and user in day to day settings, as the workplace is.

Technology at the workplace

The availability and use of technology at work has expanded over the last period (Holland & Bardoel, 2016). According to Duffy (2008), the changes in the work environment caused by the advances of information technology have a similar impact on daily life as the changes caused by the Industrial Revolution. Although this is just a metaphor, Duffy (2008) sees much opportunities to support the

> 'increasingly sophisticated, mobile and technologically aware users'

during working and living. Harris (2015) introduces technology as the enabler of flexible and agile working.

> "What seems clear is that technology enablement is unlikely to result in large swathes of the workforce opting to work from home. It is more likely that technology will be used to allow organizations and workers to enhance agility and connectivity while providing choice and flexibility to work in a variety of settings, within the office, at home and in "third places"." (cited from Harris, 2015).

This in in line with the notion of Duffy (2008) that the physical place becomes more important in

> 'the world of technologically enhanced, knowledge-based work'.

Ward (2016) distinguishes three crucial elements to keep businesses healthy; People, Place and Performance. Ward (2016) emphasizes on the different preferences users can have towards their working environment and introduces technology as the connecter for organizations to develop effective places. Therefore she places technology in the heart of three core elements place, people and performance.

Towards a smart workplace

Some authors are already mentioning the smart workplace (Kloet *et al.*, 2017) or digital workplace (Dery *et al.*, 2017). The digital workplace is defined as:

> "the physical, cultural and digital arrangements that simplify working life in complex, dynamic and often unstructured working environments." (cited from Dery *et al.*, 2017).

They make a distinction between systems for employee experience and employee wellbeing. Whereas the employee experience is focussing on smoothening the day to day experience at work and the employee wellbeing systems are focussing on delivering a nice climate and so on (Dery *et al.*, 2017). In this research, the focus is on smoothening the day to day experience, therefore the connections between the activities users perform during the day are important to capture in the research.

A recurring subject, when talking about the contemporary workplace, is the importance of involving the user in defining the new workplace. Kloet *et al.* (2017) introduces people-based work environments, instead of activity-based work environments, to emphasise the importance of the having a personalised user focus in delivering new workplace. Also Dery *et al.* (2017) focusses on the importance of retrieving feedback from users, also during the operating phase of the workplace, to take away the 'speedbumps' that are in the way of a smooth workplace experience.

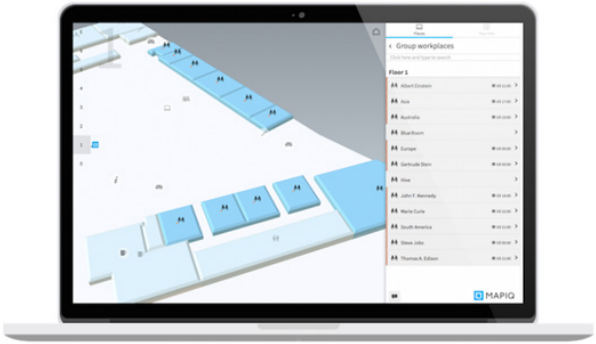


Figure 11: A map to book rooms, MAPIQ, retrieved from: https://www.mapiq.net/nl/kenmerken/3d-kaart

Examples of smart tools

To provide an idea on what smart tools can actually do, below some examples are listed. It is not intended to provide an extensive overview of possible tools, but just give an idea on the functions smart tools can bring into the work environment.

To start with the research of Valks *et al.* (2016) it points out that most Dutch universities are busy developing and implementing smart tools to serve several goals for example, appointing free working spaces for students and a self-booking system for employees (Valks *et al.*, 2016). Efficient space use and supporting the user (student) was in most cases the main reason to start with the implementation or pilot of smart tools.

One of the tools frequently used at Dutch universities is MAPIQ. Figure 11 shows the TU delft library and provides the ability to book a room and see which one is available.

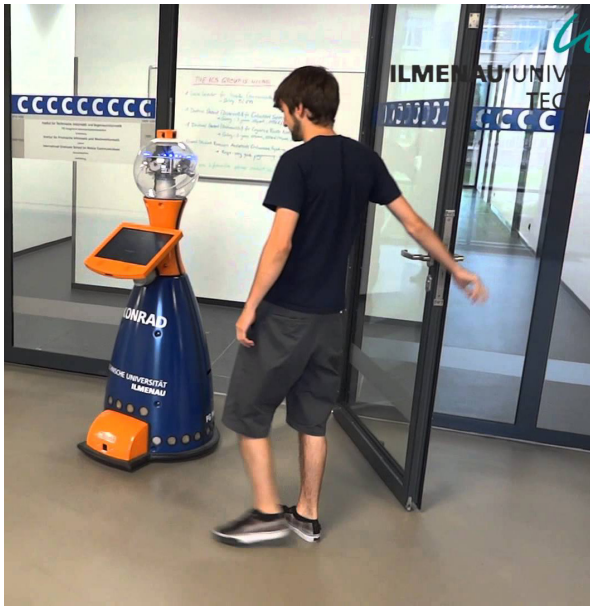


Figure 12: A robot to show visitors the way, retrieved from https://i.ytimg.com/vi/1O3L4r6Baog/maxresdefault.jpg

At the Ilmenau University of Technology, a robot for visitors was developed (Stricker *et al.*, 2012). The robot guides visitors to specific persons in the building and can give them a tour. See Figure 12.

Privacy guarantees

The improvements that smart tools can offer to users and organizations are only possible by first obtaining information from its users. The tool need to retrieve information to be able to perform the defined stages of Baumer *et al.* (2017), monitoring, controlling and optimizing and operating. This can cause concerns for both users and organizations. Users are worried to lose control over their personal information and organizations are worried that something goes wrong with their collected data, caused by own mistakes or a mistake of a third party (The Boston Consulting Group, 2012). This concern of organizations becomes even more accurate as new European legislation will be valid at the end of May 2018 (Autoriteit Persoonsgegevens, N.D.). This legislation increases the responsibility of organizations when it comes to processing personal information. This accountability duty, as it is called, urges organizations to rethink the system of privacy protection and requires them to keep track records on which data is gathered and saved. When the authority requests this information, the organization needs to provide this data. In some cases it is also important to assign an 'information protection agent' at the organization (Autoriteit Persoonsgegevens, N.D.). As this research is mainly focussing on the perspective of the user, the legislation will not be explained in further detail. More information on the legislation and the effects it can have on organizations, can be found on the website of the Dutch Data Protection Authority (Autoriteit Persoonsgegevens, N.D.).

The concerns that individuals can have regarding smart tools are further specified by Van Zoonen (2016) as she focusses on how smart city technologies can cause privacy concerns among the city inhabitants. Van Zoonen (2016) characterises the smart city as a place where 'ICT-infused in infrastructure enable the extensive monitoring and steering of city maintenance, mobility, air and water quality, energy usage, visitor movements, neighbourhood sentiment, and so on.' Although the smart city has a much larger scale then smart tools in an organization, the principle of using information to monitor and steer is similar. Van Zoonen (2016) identifies two dimension about the types of concerns people can have about their privacy namely the difference in the perceived sensitivity of the information and the variation of purposes for which personal information is used. The dominant purposes that Van Zoonen (2016) found were service and surveillance. Combining these two dimensions in a framework gives the possibility to categorize which type of information would raise privacy concerns. The four categories go from impersonal data for service purposes, which causes the least privacy concerns, to personal data for surveillance purposes which causes the biggest privacy concerns. All three examples indicate a possible movement from the original purpose and data sensitivity to personal data for surveillance purposes, the category with the highest privacy concerns (see findings Van Zoonen (2016).

A framework like this, see Figure 13 for framwork by van Zoonen (2016), can identify the potential weight of privacy concerns that specific technologies and data usage can provoke. Although more empirical research is needed to substantiate the relations prescribed in the framework, Van Zoonen (2016) points at the applicability for operational managers to find out which concerns may occur. These insights can also be valuable in an organizational setting, where it can identify how a smart tool can be perceived by its future users. Awareness of the possible privacy concerns can also be valuable for later phases of the smart tools project.

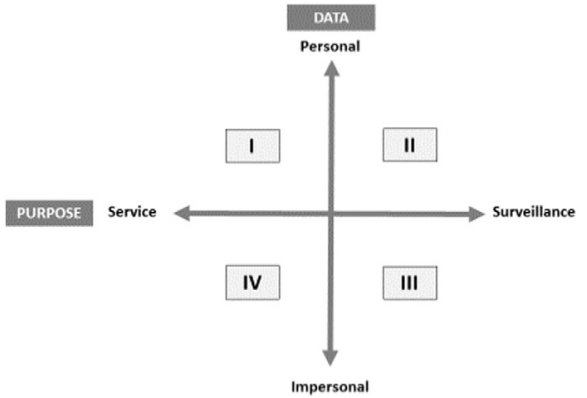


Figure 13: Smart city privacy challenges, derived from Van Zoonen (2016).

Changing the workplace

Corporate real estate management does not only deals with the alignment between organization and building, but also focusses on how to adapt real estate to the organizational change. This proactive attitude towards facilitating the future workplace is emphasized by both Hardy *et al.* (2008) and Haynes, Nunnington, *et al.* (2017), whereas the latter author focusses on the importance to understand the psychological impacts of the workplace and therefore adds the field of environmental psychology to real estate management. Changing the workplace can led to an emotional response, given the attachments an individual can have to a specific workplace (Haynes, Nunnington, *et al.*, 2017). In the literature review by Hayes (2014, p. 1) on different theories on change, it is concluded that change can be seen as

> 'series of interconnected events, decisions and actions' (Hayes, 2014, p. 1).

The leaders of change in an organization are often not achieving the preferred outcome of a change program, but focusing on breaking the ineffective patterns of actions can help to achieve the targeted outcome (Hayes, 2014).

The introduction of smart tools in the workplace is a change in the materials people can use during their day. Based on the advices given by these smart tools, other decisions can be made regarding the place users go to or the sequence activities that will be performed. For example, information on the busyness of the restaurant, can persuade someone to work a little longer at the desk, go to another lunch area or conduct that short phone call which still needed to be made.

Social practice theory

It has been recognized that the surrounding contexts has a major influence on the individual and can override factors like habits, moral norms and affective beliefs (Hargreaves, 2011, p. 81). The ignorance of contextual factors in conventional behavior change theories led to the development of the social practice theory, which shifts away from focusing on the specific person and its decision making moment but rather focuses on the events the person goes through and all the elements that are connected to this sequence of events. Reckwitz (2002, retrieved from Hargreaves (2011)) states that individuals are the carriers of het practices, they perform tasks that the practice requires. Shove and Pantzar (2005) define practices as something that:

> 'involve[s] the active integration of materials [stuff], meanings [images] and forms of competence [skill]'

Making practices more sustainable or efficient, requires to break down the connection between the elements of the current practice and build up connections with new parts to construct a changed practice (Hargreaves, 2011). This idea is similar to the above mentioned statement of Hayes (2014) about breaking ineffective patterns of action to achieve a change.

As this theory focusses on the relations between elements that construct the practice or activity and not on the decisions of the actor itself, this method matches with the introduction of smart tools in the workplace. Whereas the introduction of new smart tools brings new information to the user, who can decide how to use this.

From the social practice theory point of view,

> 'innovations in practice are not simply determined by the generation of new products, images or skills. What really matters is the way in which constituent elements fit together' (cited from Shove & Pantzar, 2005).

When reviewing a smart tool as new 'stuff' that helps to construct a practice, it is not only about the functions of this tool, but also about the connections between the other elements of the practice, being images and skills. Users are not passive but actively participating to reproduce and re-invent the practice (Shove & Pantzar, 2005).

To explain the difference between stuff, images and skills more thoroughly, both Hargreaves (2011) and Shove and Pantzar (2005) illustrate these elements by an example. This is shown in Table 1 below.

Practice	Playing football	Nordic walking
Skills	Dribbling Kicking a ball	'Doing walking'
Images	Rules and aim of the game Appropriate level of emotional engagement	Idea of walking for pleasure or as a leisure activity , not only for transport
Stuff	Ball Goal	Sticks Shoes Path

Table 1: Stuff, Images and Stuff examples

Then reviewing these examples, it becomes clear that the skills and images are embodied in the person who is performing the practice and the stuff are the materials which are needed to perform the practice. In this research this will be conceptualized as follows.

Practice	Writing a memo	
Skills	Typing on computer Knowledge about the subject	Embodied in person
Images	Rules on how memos are made Ideas on where writing should take place	Embodied in person
Stuff	Desk with a computer Preferred place for writing Smart tool (addition	Available in building

Table 2: Stuff, Images and Stuff for a work related practice

The introduction of the smart tool can help to make new connections between stuff, a computer and an available place, taking into account the images and skills of that specific person. Figure 14 illustrates these connections.

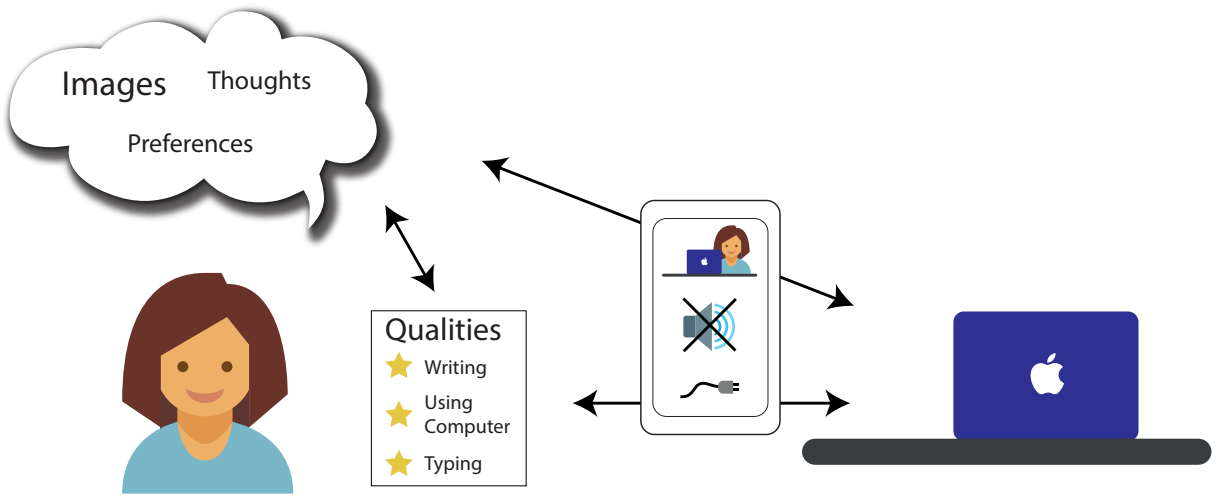
Based on the findings of the single case study of Hargreaves (2011) it is recommended to research environments that facilitate bundles of practices, like homes or the workplace. In this way, also the relations between practices can be reviewed. This will be done in this research.

Conclusion

This section focussed on the possibilities of smart tools in the workplace. Smart tools can enhance the user experience throughout the workday by providing additional information and smoothening the processes. Incorporating the ideas and feedback from users is important to create a good match between smart tools and its (future) users. Privacy is an important topic when it comes to smart tools. New European legislation will be operative starting in May 2018. Although this legislation introduces new measurements to guarantee the privacy of users, concerns by users can still arise. Therefore the framework, developed by Van Zoonen (2016), can give an insight in the perception of privacy issues that smart tools can provoke.

The social practice theory gives a theoretical framework to conceptualize the operation of, and relations between, the different elements that construct a practice. In the workplace several practices are performed to fulfill the obligations of 'working'. The workplace contains bundles of practices to perform the job. Reviewing the workplace makes it possible to review the relations within and between practices. The relations within one practice are shown in Figure 14.

Figure 14: Connections between stuff, images and skills based on social practice theory (Hargreaves, 2011)



Research focus

In this section the focus of the research will be explained, elaborating on the explanation given in the problem description. At first the knowledge worker, as user of the contemporary workplace, will be introduced. Then a link will be made with the campus and a more narrow focus within the knowledge workers group will be defined. This results in definitions that will be used to select the right cases and respondents in a later phase of the research.

The production of knowledge

Knowledge production has become an important asset of organizations and workplaces are the facilitators of these knowledge creation processes (Petrulaitiene *et al.*, 2017). Following the definition of Drucker (1999) knowledge work is "work [that is] requiring highly advanced and thoroughly theoretical knowledge" including jobs like: leaders, designers, researchers and engineers (Mawson, 2015) (see also Figure 1 on page 3). The knowledge worker differs from manufacturing work by not actually making a product, but using the ability to think as most important asset. Due to the increasing autonomous and interactive character of knowledge work, knowledge workers shift more frequently between different activities (Hoendervanger *et al.*, 2016; Petrulaitiene *et al.*, 2017). This is the main driver of the activity-based office concepts which provide a specific workplace for a specific activity.

The campus

The campus is a place where many knowledge intensive organizations are situated. This is one of the characteristics of the contemporary campus following the definition of Buck Consultants International (2014)

1. Physical location with high-end real estate
2. Focus on Reseach and Development or knowledge-intensive activities
3. Anchor tenant (tenant of substantial size)
4. Open and innovative character towards other organizations (e.g. knowledge valorization and company acquisition)

(Buck Consultants International, 2014)

Following the Google Dictionary (N.d.) the word campus comes from the latin word campus which means field and refers to

> 'the grounds of a school, hospital, or other institution'.

The campus was associated with universities, grounded in the American and British campus ideas and transferred to Europe in the '60 of last century (Kooij, 2015). Nowadays the relation between science, education and the market is changed which has also implications for the physical state of the campus (Kooij, 2015). The concept of campuses widens to non-academic fields. This diversification is showed in the overview of 39 technology campuses by Curvelo Magdaniel (2017) who describes the different collaborations on specific technology campuses between universities, the government and the market. Therefore both university campuses and corporate campuses are reviewed in this research.

Jaitli and Hua (2013) describe the characteristics of a physical corporate campus as a group of buildings which use the same support functions and offer a variety of amenities on site. Common spaces and amenities are enhancing communication among its users (Jaitli & Hua, 2013). Both Den Heijer (2011); Neuman (2013) list the different space types that can be found on campuses, e.g. academic functions, residential functions, business related functions, retail and leisure and infrastructure. Following TU Delft (2016) the current campus is difficult to define, as the boundaries with the city diminish and the campus buildings are used in a hybrid way. Spaces are used for multiple purposes, but still highly specific spaces are needed to perform experiments and to actually test new ideas (TU Delft, 2016). In increase effective space use, sharing facilities is important at the campus. Researchers are not able to work in the lab and at the desk at the same time (TU Delft, 2016). Another aspect that the research of TU Delft (2016) shows is the increased popularity of being on campus among students, to meet and connect to other students.

So the campus can be defined as a physical place which contains several types of spaces what are used in a hybrid and shared way. Besides that, it is valued as a place to connect to other people. As indicated before, sharing facilities can have downsides as well. The process of locating other colleagues and finding an available workplace are some of the negative aspects of sharing workplaces, found by Kim *et al.* (2016). This dynamic use in connection to the significant size of the campus, creates a potential for the implementation of smart tools.

A specific knowledge worker

Although Hoendervanger *et al.* (2016) focussed on knowledge workers, when studying the switching behaviours and satisfaction in activity-based work environments, still a lot of differentiation within this group was found. Therefore they suggest for future research to incorporate a broader range of variables like situational factors and personal factors to give a better insight in the different preferences. A great variety in preferences from users of activity-based environments is also recorded by Leesman (2017b). Therefore this section will illuminate different ways of grouping workplace users.

Age and gender differences

Several authors point at different preferences of offices users with different ages and genders (Haynes, Suckley, *et al.*, 2017; Hoendervanger *et al.*, 2016; Lyons, Urick, Kuron, & Schweitzer, 2015; Rothe, Lindholm, Hyvönen, & Nenonen, 2012). The age is mostly grouped in terms of generations which is on the one hand a popular way of approaching the age differences but on the other hand a highly criticised way of doing so (Rothe *et al.*, 2012). There is no consensus of the exact periods that define the generations and geographical background and life experience is not taken into consideration (Rothe *et al.*, 2012). Researchers report different outcomes considering a specific group like Haynes, Suckley, *et al.* (2017) who reported no significant difference between men and women. Overgeneralization does not contribute to showing insight in the diversity of users but by investigating age groups, a better understanding can be acquired about intergenerational differences and diversities within a specific age group (Lyons *et al.*, 2015). Therefore in this research no distinction will be made based on gender or age.

Why does size matter?

Have you ever tried to find a book in the library without using the search engine of the library? The size of the book collection makes it hard to know where a book is. Nevertheless signage can help to find a book on the shelves, but imagine that the shelves a dynamically used? So, due to effective shelf usage, the architecture books are moved to the phycology section. This makes it hard to find that specific book that you want to loan. This is where smart tools can step in.

New and temporary users

The application of Cambridge, called Spacefinder, is a tool which shows possible study locations and there specific facilities like Wi-Fi access, size and location. Although it does not measure the availability of places, it provides information on where a specific location is

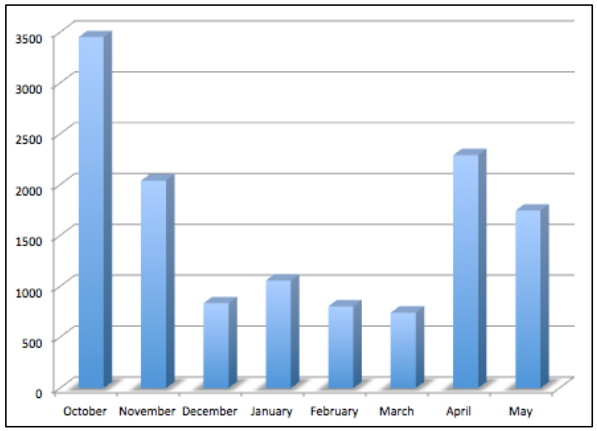


Figure 15: Usage figures of spacefinder per month, retrieved from (Priestner et al., 2016).

to support users in finding a workplace that matches their specific preferences (Priestner *et al.*, 2016). The evaluation of the tool indicated that the tool was most frequently used at the start of each term, in October, January and April (see figure 15) and over 60% of its users were new visitors of the application (Priestner *et al.*, 2016).

The amount of knowledge a user has about a specific place, is defined as familiarity (Jungkyu & Hayato, 2016). It is known that new users are more dependent on external information and users who have visited a place before (Tan & Wu, 2016). Therefore it can be concluded that the static information of the Spacefinder application was valued by new users, but did not give enough new of needed information for users to return to the app during the trimester. They already knew the place and weighted the alternatives without using the application.

Considering the workplace preferences of temporary or contingent users, not much research can be found. The familiarity with the place can be expected to be lower than that of regular user, who are present at the location for a longer period. A research on social capital at the workplace found that "higher employee turnover and an increase in fixed-term employees were associated with higher levels or workplace social capital" (Oksanen *et al.*, 2013). Following Oksanen *et al.* (2013) one of the explanation for this finding can be the high focus on performing within a temporary group of employees and therefore encouraging social cohesion. "Birds of passage don't nest" (cited from Oksanen *et al.* (2013) does not include the social relationships of people in their working environment, there can be even a higher wish to interact with people among temporary workers or these fast changing employees are natural 'connecters'. Thus is can be concluded that users who are only for a limited time stationed in a work environment still prefer to connect to other colleagues.

Towards a user profile for user selection:

The new user of the campus workplace

The activities a knowledge worker has to fulfil require different types of workspaces. There is no such thing as a one size fits all at the office environment, neither in a narrowed user group such as generation Y or the baby boomers. As Hoendervanger *et al.* (2016) recommends, incorporating and explicitly naming personal differences of individual people will help to see relationships between people and can help to compare and explain specific findings. Therefore the sample will exist of knowledge workers and further characteristics of the user will be gathered during the cases to get insight on individual differences.

The familiarity with a place has an influence on the demand for information. Therefore the sample of knowledge workers will be limited to people working or studying at the organization for no longer than half a year. As there is not much information about the development of familiarity during the first months a user is working or studying at an organization, this maximum of half a year is picked as a measurable boundary. By recording the precise time a user is connected with the organization, it can be researched if there is a difference within this group of new users and when the flipping point can be.

Conclusion

In this research focusses on new knowledge workers who work at the campus workplace

The campus is defined as:
A physical place which contains several types of spaces what are used in a hybrid and shared way.

The new knowledge worker is defined as:
Someone who conducts knowledge work, which is

> "work [that is] requiring highly advanced and thoroughly theoretical knowledge" (cited from Drucker (1999)),

and is no longer than 6 months connected to the physical campus.

These definitions and focus will be used to scope the research and select cases and interviewees. This will be explained in the research method chapter.

Theoretical Framework

This chapter will connect the previously described insights from the literature and combines them into a conceptual model. This model will provide the basis structure of the research. Besides that, the different variables will be explained to provide clear boundaries on what will be included and what will be excluded from the research.

Conceptual model

To clarify the different parts of this research, a conceptual model is made, see Figure 16 Following Miles and Huberman (1994) a conceptual model explains the main subjects that will be studied and illustrates the relationships among these subjects.
To clarify this model the different parts will be explained below.

1. System of a smart tool

Based on the following definition, based on the definition of Valks *et al.* (2016) A smart tool is a service or product to provide (real-time) information to its users to improve space usage at the campus. Therefore a smart tool is part of a system which gathers this information, filters it and brings it to the user. This system is described by Chen *et al.* (2014). Following Baumer *et al.* (2017) a smart tools can be used for monitoring, controlling and optimizing and operating.

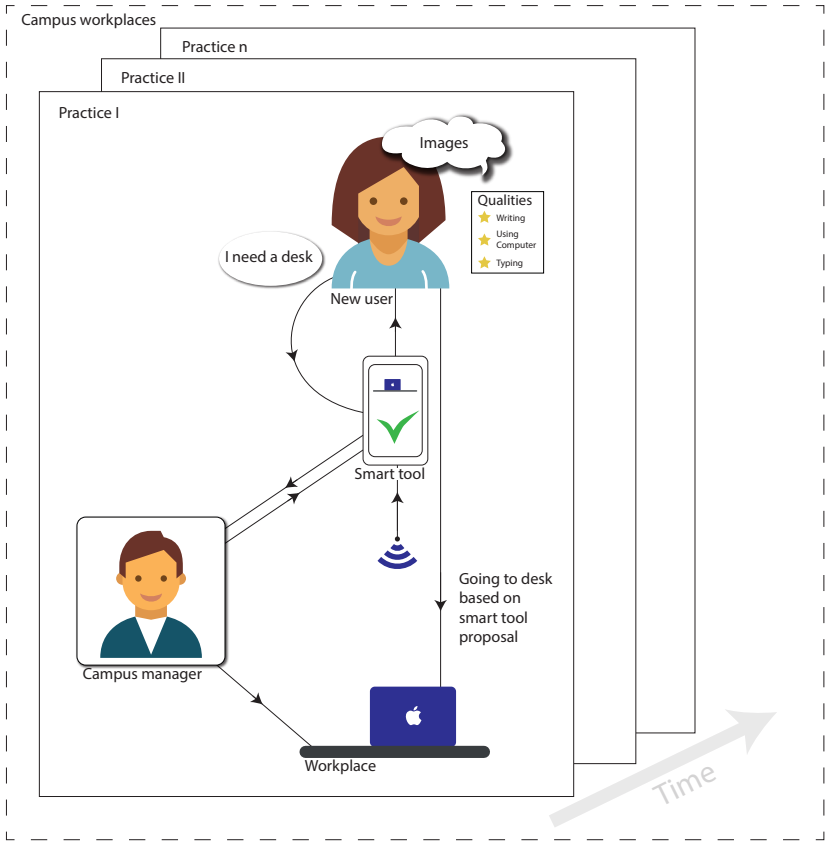


Figure 16: Conceptual framework

Therefore the smart tool in the conceptual model is placed between the new user and the workplace. The (real-time) information that the smart tool provides assists the new user to choose a workplace.

2. Social practice theory

Smart tool as one of the materials to perform a practice

The social practice theory explains that practices, or activities, are composed of stuff, images and skills. Users are actively using components from these three categories to perform and re-invent a practice. By changing elements, practices can change over time.

Users make use of their skills, images and stuff to perform a practice. When smart tools are implemented, they can become part of the element a user uses to perform a practice. This theory focusses mainly on the relations between the elements of the practice and between the practices itself. This focus can give an insight in how smart tools can achieve a behavioural change. For example, going to another workplace because the 'normal' one is occupied and this proposed workplace does even match the preferences of the user to a large extent.

Workplace with a bundle of practices

Especially everyday life settings consist of a bundle of practices, like the workplace or home Hargreaves (2011). The social practice theory, used in a setting were multiple practices are performed, provides the opportunity to review the relations and conflicts between practices as well.

As this research is focussing on the workplace and not on one specific practice, this view on the relation of practices is applicable. In this way the sequence of activities can be adapted to real-time information. For example the extending your travel to avoid the traffic jam and start working from home.

3. Managing role of the campus manager

The campus manager needs to obtain a proactive approach in adapting the workplace to facilitate the preferences of users. Using information, gathered by smart tools can inform the campus manager to adapt the workplace (Dery *et al.*, 2017). The overlooking role of the campus manager is described by Den Heijer (2011) who places the campus manager in a connecting position to balance the values of different stakeholders. The campus manager can adapt the workplace based on, among other things, the information delivered by smart tools.

The angle of this research is on the user perspective. Therefore only the user, and its view towards the workplace, is positioned in this conceptual framework. The other stakeholders are out of scope of this research.

4. Real Estate Management

The foundations of this model, the connection between user (organisation) and workplace (real estate), are based on the principles of real estate management. The link between organization and real estate is made described by Nourse and Roulac (1993).

The balance between both the building and the organization is typical for real estate management. The translation from the user perspective into requirements for the building, which is the aim of this research, is based on this dicipline of real estate management.

Concept	Variable	Type of variable	Indicator
User	Activity	Independent variable	Type of activity to perform work
	Preferences	Dependent variable	Personal preferences of people regarding their workplace
Smart tools	Functions	Dependent variable	Functions which can help the user in achieving its desires
Workplace	Characteristics	Dependent variable	Typologies of workplaces

Table 3: Concept, variable, type and indicator

Concept	Type	
Campus	Internal variable	Corporate campus and university campus
Knowledge worker	Internal variable	Working at the facility from 0 up to 6 months
Time	Constant	
Practice	Constant	
User; Activity	External variable	*Independent variable*
User; Preference	External variable	*Dependent variable*
Smart tools	External variable	*Dependent variable*
Workplace	External variable	*Dependent variable*

Table 4: Overview of concepts

Variables

First of all, a distinction is made between internal variables, which are set to form the boundaries of this research and the external boundaries that will not be influenced. The internal variables are 1) campus and 2) new users. These variables are already defined in the literature review section of this report and placed in the conceptual framework. In the next chapter, the inclusion and exclusion measures considering these two internal variables will be explained.

The concepts, which are shown in the conceptual model, are made explicit by breaking them down into different variables. Bryman (2015) defines variables as 'an attribute on which cases vary'. Between different variables, often a distinction is made between independent and dependent variables whereas the dependent variable is influenced by the independent variable. The workplace is dependent on the activity and preferences of the user, whereas the preferences can also be dependent on the activity. The introduction of a smart tool within the process of finding the appropriate workplace brings in an extra independent variable between the workplace and the user. The smart tool is depending on the kind of activity which the person wants to perform. Also the personal preferences influence the desired functions of the tool. See Table 3 for an overview of this distinction.

Time and practice will be a constant in this research. The practice, meaning the sequence of activities, is working and the time is one day.

Conclusion

This chapter showed the main concepts of the research and the relationships between them. Above Table 4 gives an overview of these concepts. Now the focus is defined, the method for conducting the research and gathering the data can be elaborated upon. The main concepts will be used throughout the report to provide structure. The next chapter presents the relation between this conceptual framework and the research process.

Research method

Research strategy and design

The research strategy of this research is qualitative. Bryman (2015, p. 36) distinguishes a qualitative from a quantitative strategy by putting emphasis on words rather than quantification. Besides that, he mentions that a qualitative approach often entails an inductive approach which is based on theory building instead of theory testing. The order of first selecting cases, than analysing them and simultaneously connecting them to theory is a typical sequence of quantitative research as Bryman (2015, p. 384) explains.

Within a qualitative research strategy, there are different research design that can be chosen. A comparative research design, as described by Bryman (2015, pp. 72 -75), entails studying two, or more, opposed objects using nearly identical methods. Although the campus is chosen as the context of this research, still lots of different types of campuses are available. As indicated before, for this research a comparison will be made between the corporate campus and the university campus. Comparing more cases makes it easier to actually establish circumstances or patterns which improves the theory building capacity (Bryman, 2015, p. 74).

When taking a look at the research aim again, see textbox, this research is mainly about finding the bottlenecks of workplace, which users encounter during their workday, and seeing how the functions of smart tools can change this chain of actions to optimize it. Several ideas on how to analyse and describe these sequences from a user view point have been developed, like service blueprinting and the customer journey (CJ) approach (Halvorsrud *et al.*, 2016). What makes the Customer Journey differ from the service blueprint is the actual view of users that is captured with the CJ, whereas the service blueprint focusses on what the company has in mind for the user (Halvorsrud *et al.*, 2016).

The critical incident technique (CIT) focusses on the negative and positive experiences and collects these 'critical events' (Stauss & Weinlich, 1997). As a reaction on the lack of the full process, the sequential incident technique (SIT) was developed, which also includes neutral experiences and

> 'explicitly takes the process character of service experiences into consideration' (Stauss & Weinlich, 1997).

Nenonen *et al.* (2008), who studies the applicability of these techniques to asses work environments, see much similarities between the SIT and the customer journey technique. Halvorsrud *et al.* (2016) have combined this two-sided view from both user (CJ technique) and organization (service blueprint) into the Customer Journey Analysis (CJA).

To really grasp individual preferences at the workplace, a high level of detail is needed (Hoendervanger *et al.*, 2016). Therefore Hoendervanger *et al.* (2016) recommends alternative methods for data collection, like direct observations or experience sampling. The customer journey is such an alternative method for data collection. Nenonen *et al.* (2008) found that the customer journey method is a process oriented approach which is applicable to investigate usability of a business park. Samson *et al.* (2017) conducted a pilot study whether journey mapping is an effective way to enhance the student experience of the library. They also reflected their findings from users with, as they call it, 'ideal journeys' to find the differences and used these insights to guide decision making on adapting element in their library. There are several ways to compose a customer journey. Whereas van Boeijen, Daalhuizen, Zijlstra, and van der Schoor (2014, p. 53) describes a looser approach which is applicable in multiple stages of the implementation process of a product, Halvorsrud *et al.* (2016); Temkin (2010) put more emphasis on the investigation phase. Temkin (2010) and Halvorsrud *et al.* (2016) both make a distinction between the assumed or planed customer journey and the actual customer journey. The assumed customer journey embodies the vision of the company

on how the journey should look like. The actual journey visualises the real users' demands and the assumed journey can be used as a basis to start the conversation (Temkin, 2010, p. 3). The two journeys, planned and actual, require different sources of information and follow more or less sequentially.

This Customer Journey Analysis method, developed by Halvorsrud *et al.* (2016), illustrates the customer perspective on the delivered service and the organizational vision on how the service should be delivered. In the conceptual model, the campus manager is the person that develops and operates the workplace in collaboration with other stakeholders (see the four stakeholder approach from Den Heijer (2011) Figure 5 on page 10). Illustrating both the view from the campus manager and the user on the workplace, shows the gap that can exist between these two views and helps in focussing on the missing elements. Halvorsrud *et al.* (2016) provides a well-structured approach for the Customer Journey Analysis which will be the basis method for this study. This research is not about delivering services for customers outside the organization, but about facilitating the workplace (service) for its users. Therefore the terminology 'User Journey' will be used throughout this research, referring to the method described by Halvorsrud *et al.* (2016)

Halvorsrud *et al.* (2016) based their extended customer journey method on the insights of Yin (2009) but did not indicated precisely on which method. When reviewing the techniques of Yin (2009), the logic model has much similarities with the customer journey approach. This technique is explained by Yin (2009) as follows:
'The logic model deliberately stipulates a complex chain of events over an extended period of time. The events are staged in repeated cause-effect-cause-effect patterns, whereby a dependent variable (event) at an earlier stage becomes the independent variable (causal event) for the next stage.'

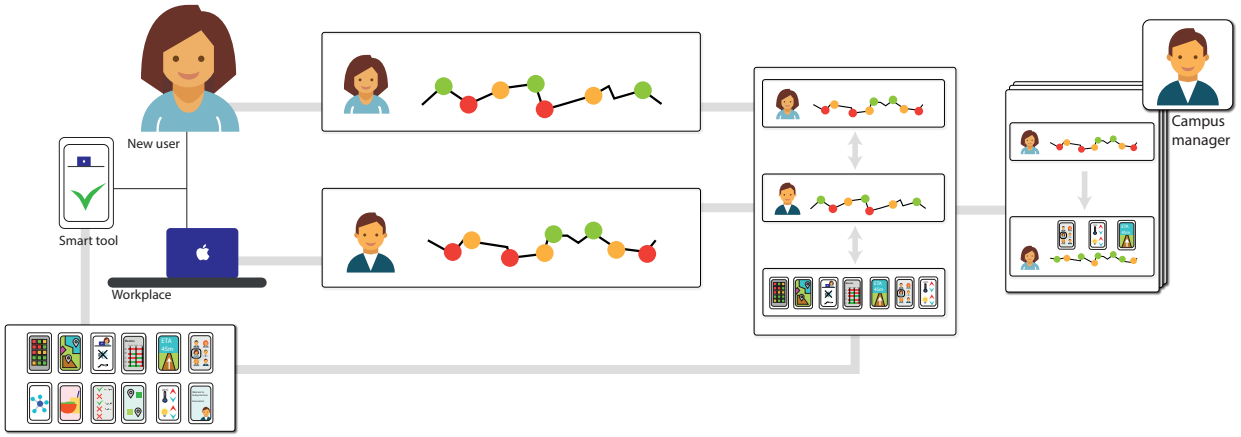


Figure 17: Research process, own illustration

He also emphasized on the matching of theoretically predicted events with empirically observed events (Yin, 2009). In the previous chapter the variables of this research are explained. This cause-effect-cause-effect relationship is made explicitly in the differences between independent and dependent variables. The independent variable, being the user activity, as the first in the row which influences the other variables as user preference (for workplace), User of a smart tool and chosen workplace.

Following the research aim, this research is about 1) grasping the problems users encounter during their day at the workplace and 2) connecting these problems to specific functions of smart tools. The first part can be researched by using the user journey approach as described above. The second step involves on the one hand information on the functions of smart tools and on the other hand a designing step in the user journey, to redesign the user journey by incorporating the matching smart tool functions. Figure 17 shows this process over time.

To be able to connect smart tool functions to the user journey to redesign it, information on these functions needs to be collected. This will be done in collaboration with Bart Valks, who conducts a study on smart tools.A part of his research focusses the functions smart tools offer to users. The user journeys, composed from different cases, are the main focus of the research and the information on smart tools will be used as in input for the case studies.

Unit of analysis
The unit of analysis in this research is the new user, who performs different activities throughout the day. Following the social practice theory, the person is the carrier of the practice, and focus should be on the elements of this practice, stuff, images and skills. The activities and problems the person encounters during the day form the journey which will be analysed and compared to other journeys.

In the smart tool analysis, the unit of analysis is a smart tool which is operating, or planned to be operating, in one single organization.

Generalisation and examples
Most scholars argue that (single) case study research is not or hardly generalizable due to its specific context (Bryman, 2015) but Flyvbjerg (2006) does not agree on this notion. He brings forward 'the force of example' which is underestimated in relation to the overvalued generalization method. The connection to theory can make a research give a more deductive or abductive (combination of inductive and deductive) character. This can also help to find a reasonable explanation (Boeije, 2014). The aim of this research is not to generalise but to get insight in real cases and study the patterns different cases show.

Case selection

Following Bryman (2015) case selection in qualitative research exists of two levels, selecting the context and selecting the participants.

Selecting of the cases will be done by means of purposive sampling. Purposive sampling is a strategic way of selecting cases (Bryman, 2015, p. 418). In line with the concepts of the conceptual model, the following selection criteria are used.

1. The workplace of the organization is situated on a campus. (see campus definition)
2. As this study focusses on smart tools in the workplace, there either should be some kind of smart tools already present at the workplace or a strategy or wish for researching and implementing smart tools should be present at the institution. (see smart tool definition)
3. The organization should be open to approach the study from a user perspective and incorporate the views of users
4. The organizations should be willing and able to give insight in the campus vision and associated vision on smart tools

The selection of new users within the organization will be done by means of criterion sampling as well. The persons need to meet the definition given in the literature review. There is also a snowball effect in this sampling method as the contact person will probably assign several people to conduct the interviews with.

Royal Haskoning DHV and Smart campus research
Based on the above mentioned criteria, cases were explored with the help and based on the contacts of two networks of specialist, Royal Haskoning DHV and the Smart Campus research team of the TU Delft. Because the knowledge of these two networks is complementary, Royal Haskoning has more corporate contacts and the research team more university contacts, both were able to provide a range of possibilities. Based on the above mentioned criteria, cases could be selected. Besides the case studies, also smart tools are mapped in collaboration with the smart tool research team that, conducts a research on smart tools.

Cases and respondents

User journeys
In total four cases are studied, two university campuses and 2 corporate campuses. In each case, several respondents are interviewed and a user journey is made. On the user side, the ambition was to interview four respondents who match the selection criteria. To gather information on the campus and smart tool vision, additional interviews are conducted. The number of respondents per case, to gather the information on the visions, is dependent on the available vision documents and access to end users and may therefore vary among the cases.

Smart tools
The former research of Smart Campus Tools (Valks *et al.*, 2016) and all other TU delft based research about the university campus (Den Heijer, 2011; Den Heijer & Tzovlas, 2014; TU Delft, 2016) provides an enormous amount of information about university campuses in the Netherlands and Europe. Based on the contacts made in previous years and the known ways to contact new people within the university network, a big amount of universities can be contact to derive information on smart tools. By searching on the internet and approaching other private organizations about the implementation of smart tools, also some smart tools at private organizations could be added to the smart tool exploration.

Within the data collection process of the smart campus tools project I have contributed as follows:

- Support in establishing the questions and standardised form (to ensure applicability to this research)
- Assisting in data collection of cases (i.e. Aarhus University, EMC, Carnegie Mellon University)
- Independent data collection of cases (i.e. Tech company 1, Tech company 2, ING, Ahrend, update of Aarhus University)

Measures

The data could have been influenced by the following aspect:

- Available time
  Some of the respondents were very busy. In these cases there was less time to really go in depth and grasp the underlying feelings and thoughts of respondents.
- Level of knowledge on smart tools
  If respondents are familiar with smart tools or even developing these tools within the company, their answers can differ to people who do not have any experience with them
- Familiarity with customer journey approach
  Some organizations are familiar with the customer

journey approach. They will respond more directly to the questions and know the value of giving deeper information. People who are not familiar can react strange if they have to tell about their day, when it starts and what they do.

- Willingness and ability to share information
  The interviewees are expected to talk about fairly personal preferences. This can be difficult. Also organization should be willing to openly talk about their ideas considering smart tools. At this moment there is much development in this area, which can result in organization not being completely open about their ideas because this can be used by other organizations as well.

Data collection and analysis

Due to the two sided data collection, being gathering information on the functions of smart tools and composing user journeys at four organizations, these two processes will be explained separately.

Part I

Explorative study to gather information on smart tools

The data used for this analysis is collected within the Smart campus tools project (Valks, Den Heijer, & Arkesteijn, expected 2018). The data collection is done by filling in a list of questions which is converted to a standardized presentation sheet. This sheet gives an overview of the smart tool by delivering information of different aspects. Figure 18 on page 34 shows an example of the presentation sheet.

By exploring the information, differences in applied functions between private and public organizations will become visible. Also a greater understanding of the possible functions will be made by making a classification of the functions. This information will be used as on input for the second part of this research, the user journeys at four cases.

Part II

Comparative study of different campuses

As Bryman (2015) states, within a comparative design it is important that data collection procedures are similar at all cases. Therefore a step by step approach is listed below, which is tailored to the research aim and based on propositions of others. The basis of this plan is retrieved from Halvorsrud *et al.* (2016) who based their approach on the principles of Yin (2009).

Step by step plan to draw the customer journey

Step 1 Description of the customer type and scoping the journey

Based on the focus of this research on the temporary user, the specific user of the organization will be selected based on the definition. Besides that the journey should be scoped around a specific question, which directly relates to the research question. This will be done during the first conversations with the organization, by conducting semi structured interviews and reviewing vision documents.

Step 2 Composing the planned customer journey, an inside out approach

Composing the assumed customer journey by deriving information about the vision of the organization on supply and the usage of the supply. This will be done by conducting semi structured interviews with persons who are concerned with managing the real estate of the organization and reviewing vision and ambition documents.

Step 3 Making the actual customer journey, an outside in approach

The actual customer journey will be mapped by retrieving user information on finding the appropriate space during the day. There are two ways to acquire this information, depending on what is already available:

a) Conducting semi structured interviews with users and mapping their daily experiences.

b) Using data which is already collected by the organization and compose actual journeys from these source documents. Therefore semi structured interviews can be conducted with the researcher and the gathered data will be analysed.

The number or actual journeys will be limited by the following elements:

- Time
- Available information
- Possibility to interview users

The goal is to construct at least 4 actual customer journeys per case.

Step 4 Analysing and comparing the journeys

By aligning the actual journeys and comparing this to the planned journey, deviations can be distinguished between the different demands, and demand and supply. Yin (2009) describes this analysing technique as the 'logic model'.

> "The use of logic models consists of matching empirically observed events to theoretically predicted events." (cited from Yin, 2009).

The empirically observed events are the actual journeys and the theoretically predicted events are the planned journeys.

Step 5 Synthesis: combining smart tools to the 'gaps' of the journey

As this research reviews the usage of smart tools in the process of aligning demand and supply, this step is added to the more conventional and generic roadmap (Halvorsrud *et al.*, 2016; Temkin, 2010) proposes. The knowledge gained during the phase of mapping smart tools will be combined with the gabs shown in the customer journeys. This results in a list of recommendations on which tools, or parts of tools, can change the user experience.

Step 6 Synthesis: redesigning the customer journey
Connecting the list or recommendations to the customer journey and make a new journey based on the implementation of the smart tool. The role of the tool(s) will be intertwined with the journey to form one new sequence of activities.

The steps to make the customer journey is further explained in the appendix where interview protocols and a time indication is mentioned.

Findings

In this chapter the findings of this study will be presented. This chapter has two parts, the first part shows the exploration of smart tools which are currently used at different organization. The second part elaborates on four different cases and illuminate the organizational views and user perspectives, through composing user journey about the interference of smart tools in the workplace. Each part start with an explanation about the interpretation of the data and illuminates the different steps of the analysis.

Part I Smart tools

Introduction

The sub researchs question which is central in this part is: *What kind of smart tools are currently used at the workplace to assist users in choosing an appropriate workplace and what are the functions of these tools?* In order to answer this question, data of smart tools that are used at public and private organizations are analysed. The aim of this analysis is make a categorisation of functions and smart tools to provide an overview of the possibilities. To come to this categorization, first a more general analysis is made to elaborate on the different functions and find the minor differences between them. In this way the smart tool functions can be matched to the preferences of users derived from their user journey and can be brought together in a newly composed a redesigned journey, which will be done in the second part of this chapter.

Smart tool function
With the term smart tool function, the ability of the smart tool is meant. This can be providing the possibility to adapt the temperature of the room or providing information on the position where a restaurant is and how busy it is at that moment. Depending on the type of information, a way of presenting this information is chosen.

Matching dataset to research question
As described in the research method chapter, the data is gathered in collaboration with the campus research team. The specific focus of this research is how smart tools can assist users. This is in contrast to the focus of the smart campus tools project, which is also focused on the perspective of the campus manager and/ or support staff of the organizations. This can have influences how specific the information is in relation to functions, as describing functions is only a small part of the study done by the smart campus tools project. Therefore, smart tools which do not provide information to users will be excluded from the analysis. Besides that, as the sub question indicates, the focus is on tools which assist users in choosing an appropriate workplace. The data set includes smart tools which fully match this requirement and tools which partly match this requirement. For example one smart tool gives an overview of people within the same field of knowledge. Although the tool does not directly give information on a workplace, the user can decide that, based on this information, it would be valuable to be close to this other person with the same interest. Both of these tools are included.

The following division within the data set is made:
Excluded in analysis
- Smart tools which only provide information to support and management, not to end-users.

Included in analysis
- Smart tools which assist users in choosing an appropriate workplace
- Smart tools which assist users in work related activities

Based on these inclusion and exclusion criteria, 6 of the 31 collected smart tool sheets are excluded from this analysis. This brings the total used sample down to 25 cases. The data on the kind of information the tool provides for management and support is out of the scope of this research. Therefore this part of the dataset is excluded from analysis. The analysis is based on the information which is gathered in the standardized form. See Figure 18 on page 34 for an example.

Limitations
When two different persons are conducting interviews to gather information, there can be some deviation in the exact meaning of certain notions and differences in style. Besides that, the aim of both researches is different which results in a different emphasis when gathering data and conducting interviews. The standardized form helped to be able to gather the right information in the same way. By frequently consulting each other, we have attempted to minimise discrepancies and sharpen future data collection. As mentioned before, the standardized form is established

Figure 18: Presentation sheet with data from smart tool at an organization *(own illustration, following the format composed by the smart campus research project team)*

See appendix for other sheets.

AHR-1 Ahrend Ahrend smart working app

phase: implementation
scale: 120 workplaces, 5 building
duration: start 2016 - present

Project description

The development of the tool started from the original business of Ahrend; (office) furniture. Based on providing extra services to the user, the development started. The development is very demand (user) driven. The problem statement is that users have difficulty to find collegues and suitable workplaces in a large open office. At the same time, users often have empty batteries.

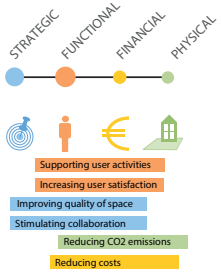
Foreseen developments

The first development is implementing the so called ergonomic passport. This passport is connected to a specific user and remembers the personlized settings for the height of the desk. This will be developed towards the comfort workplace, a decentralised way of heating, cooling and lighting which is integrated in the workplace. The main room temperature will be lowered and the desks will have additional heating and cooling elements integrated. This adapts to the specific user at a specific moment. Besides these new developments, also the existing elements are upgraded.

Impression - map to find available spaces

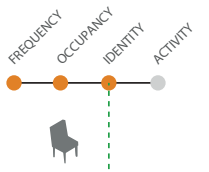
Profile

Why: Objectives



The demand side has priority, so strategic and functional. The supply is a result of the demand oriented approach.

What: Measurement



The identity of persons is measured by making a connection to a personalized application. The table makes a connection with the phone, so no movement is measured. There is an depersonil-sation fucniton

identity is visible for all application users to find each other in the building. Fequency is used for reporting and occupancy for finding an available space.

How: Measurement method

i-beacon + Qi, combined in the PUK

AHR-1 Ahrend Ahrend smart working app

functionalities: Monitoring space use, find a workplace and find a colleguege
space types: Offices, (whole building)

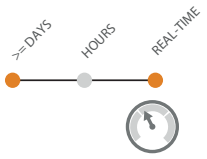
User information (employees)

Users are able to see who is in the building and which working spaces are still available. This is registrated by putting your phone on a certain spot at the desk (called the PUK). If you leave the desk, it will be available after a certain period, based on the wishes of the company. The PUK is measuring activity within a certain distance, upto 1 to 2 meter around the PUK. Only after the phone has been physically on the PUK, the PUK will detect an nearby phone, to prevent the PUK from connecting with every single closeby phone. The user can see available workplaces and meeting rooms and find colleagues.

Management information

The manager is able to review occupancy throughout the whole building. This is visable per specific workplace. The information is connected to a specific workplace and not to a person. The specific person, who used a certain spot, is depersonalised by the system. In this way, it is not possible to monitor where a specific person is sitting during a period longer than one day. Every users gets a new code every day in the data base. This makes it impossible to know who is connected to which number, only at the current day.

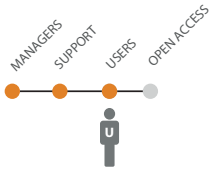
Actuality of the information



The information displayed in the on screens and in the application in floorplans and reports and is (near) real-time.

The data used in reporting goes from real-time to as far back as possible.

Access levels



Only employees have acces to the app. There is a possibility to review the information on a screen so visitors can review the information as well.

Manager can derive report about occupancy. Identity is depersonal-ized.

Benefits

The main aim of the tools is providing a better service to the user and in the end happy and healthy employees. Other benefits as lower energy costs and more users per square meter are connected to the main aim but are an effect of the tool. These latter benefits are also important for the business case. We are measuring the satisfaction rate of employess via questionairres and interviews (before a new working concept and after). Occupancy can be monitored via the online dashboard.

Side notes

There is a 'depersonalisation-button' so users can make themselves unvisable to find. Only the occupancy will be measured than, but no personal information will me made available to other users.

after consultation, to make sure both research aims were covered, meaning the views from both management and end-user. By these measures, the limitations are reduced as much as possible.

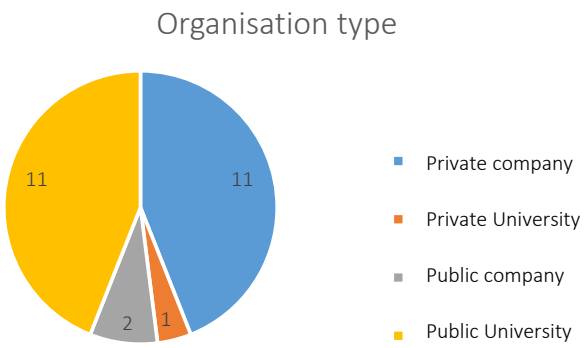
Analysis

Differences between smart tools at public and private organizations

The data collection contains both public and private organizations. The 25 cases are almost equally divided, containing 11 public universities, 11 private organizations,2 public organizations and 1 private university. As there are only 2 public organization and 1 private university, further on the specification of organizational type is made based on their public or private purpose. This division is in line with the four cases that will be analysed in part two of this chapter, as there is also a division made between public and private organizations. See Figure 19.

This division is chosen above the division between organizations and universities becouse the findings of Valks *et al.* (2016) indicate a higher focus on efficiency at market parties in relation to public parties. Based on the fact that there is only 1 private university and 2 public organizations, the influence these two different types on the full data set is limited. It therefore can be concluded that within this data set, most private organizations are in fact private companies and the public organizations mostly consist of public universities.

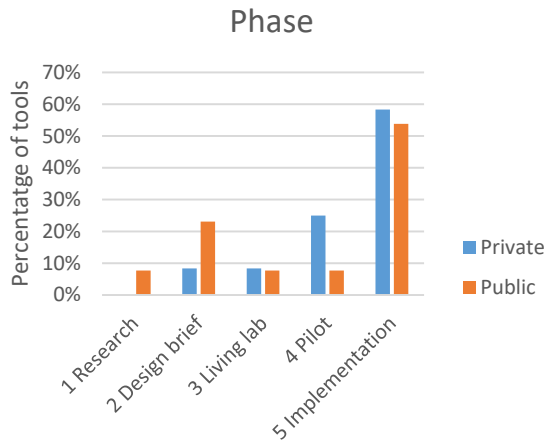
Figure 19: Devision of the data set in organizationa*l type*



Phasing

When looking at the phasing differences, most tools are situated in the implementation phase. Public organizations have more projects in the research and design brief phase. In these phases, the actual tool is not jet chosen but the data of these cases represents the ideas on smart tools which will sooner or later be implemented, based on the findings in the research and design brief phases. See Figure 20.

Figure 20: Present phase of smart tool projects



Functions of smart tools

The different functions tools can provide to users

As the data shows, tools can provide multiple functions to its user. In the data collection, Valks *et al.* (expected 2018) defined different functionalities of tools. These functions are reviewed from both management and user perspective. The function monitoring use of space is not relevant for the end-user in terms of providing a valuable function, it is a function for management and support to get a better insight into the actual use of places. These managerial functions are not the focus of this research, therefore these functions will be excluded from the sample. Besides that, the function 'find a workplace' is identified by 18 out of 25 organizations and therefore the most identified function in the sample. As this exploration focusses explicitly on the functions of smart tools, a further specification of the functions 'find a workplace' is preferred. Table 1 shows the differences in function descriptions between the standardized form and the functions that will be used in this exploration.

Specification of the function finding a workplace

When reviewing the different tools that have the tag 'finding a workplace', a distinction can be made between smart tools which show 1 specific workplace type and tools which show several types. Besides that, almost all these tools have the ability to show real-time information on the availability of the place. Therefore the category of finding a workplace is split into three categories namely:

1. Show real-time workplace availability One workplace type
2. Show real-time workplace availability Different workplace types
3. Show 'thirds places' in neighbourhood

The third category is about showing a larger range of spaces in a larger geographical area. It can be stated

Functions mentioned in standardized form		User Functions	Explanation	Group
Find a workplace	1	Show real time workplace availability One workplace type	Shows if there is an available workplace left. This can be done on workplace level or floor level.	Assist users in choosing an appropriate workplace
	2	Show real time workplace availability Different workplace types	Shows types of workplaces, e.g. concentration spots, meeting rooms and desks.	
	3	Show 'thirds places' in neighbourhood	Shows types of secondary workplaces like a restaurant, café, library of place outside own real estate.	
Room booking	4	Room booking	The ability to claim a space for a specific time.	
Way finder	5	Way finder	Indicates where specific rooms or places are.	
People finder	6	People finder	Indicates where specific people are in the building. Level of detail can differ.	Enhance collaboration and wellbeing
Optimising workplace comfort	7	Adjust temperature and lighting	The possibility to locally adjust the heating and or lighting to your own preferences	
Monitoring space use		*(excluded)*		
Linking systems		*(excluded)*		
-	8	Gives additional information	Provides additional information which can create awareness, opportunities or can inspire	Providing information
-	9	Gives recommendations	Actively gives advices to the user to act.	

Table 5: specification of functions, based on collected data.

that this functionality goes beyond the workplace. A tool can only once get the tag of the category 'show real-time workplace availability' to get the right view on functions.

The functionalities 'monitoring space use' and 'linking systems' are excluded as these functions do not primarily provide valuable information for the user.
Two new functions are introduced: Gives additional information and gives recommendations. Some tools are difficult to 'fit into a specific box' but can add value to a user. Therefore the category 'gives additional information is included. Besides that, some tools already provide information in an active and or personalized way. Following the change from reactive to proactive technology, illustrated by Baumer *et al.* (2017) who point at the different stages of information that build on each other, the category 'gives recommendations' is added to the list of functionalities.

The combination of specified functions, current functions and newly defined functions can be grouped as follows

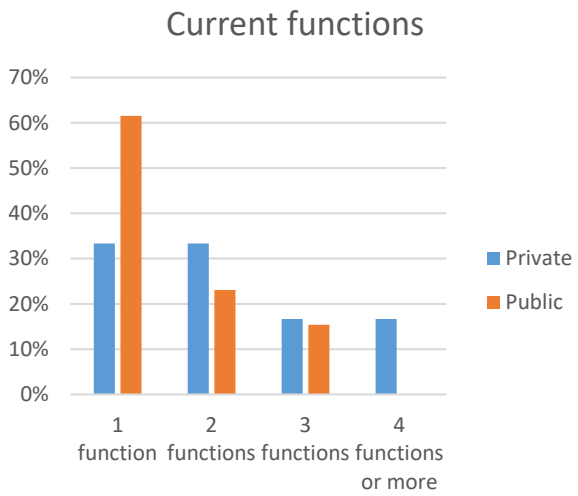
1. 'Assist users in choosing an appropriate workplace' (1-5)
- Directly adding to the central question of this analysis
2. Enhance collaboration (6) and wellbeing (7)
- Indirectly adding to the central question of this analysis. These functions are mostly an addition to the functions from group 1 or more focussed on enhancing the working process.
3. Providing information (8, 9)
- Indirectly adding to the central question of this analysis. These functions provide information on an additional aspects of the workplace.

Number of functions

The most complex tools can be found at private organizations. Over 60% of the found tools at public organizations are single function tools. When reviewing the future developments of tools, the public organizations are planning on developing slightly more functions in the future. The private organizations have already more functions implemented which can be a conclusion for little less focus on developing more functionalities.

The spread of the different functions is illustrated in Figure 23. This graph shows that public organizations are mainly focussed on one specific workplace type and private organizations have, besides the focus on providing information on the availability of workplaces, more additional functions as comfort options or providing extra information (function 7 and 8). None of the public cases has a people finding function in their applications.

Figure 21: Current functions of smart tools



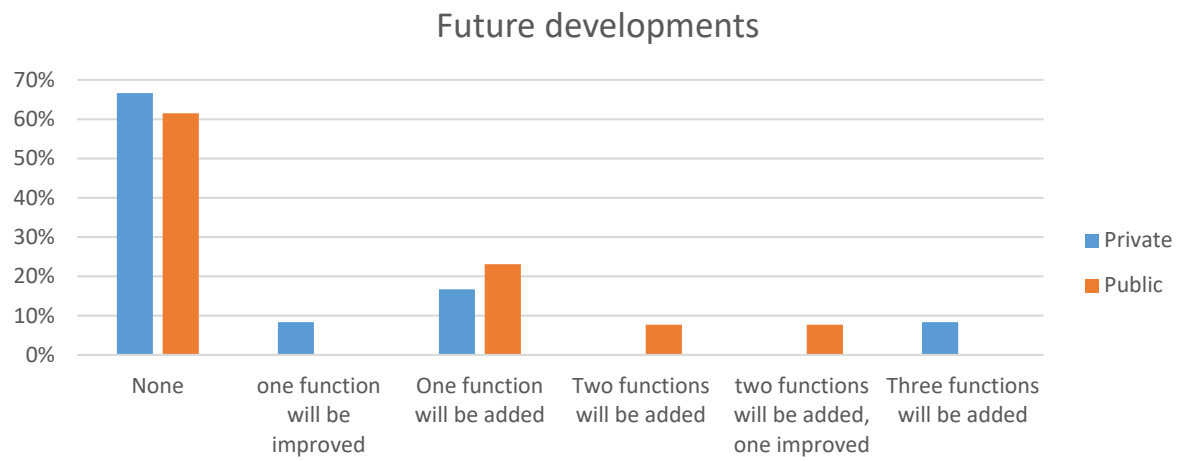
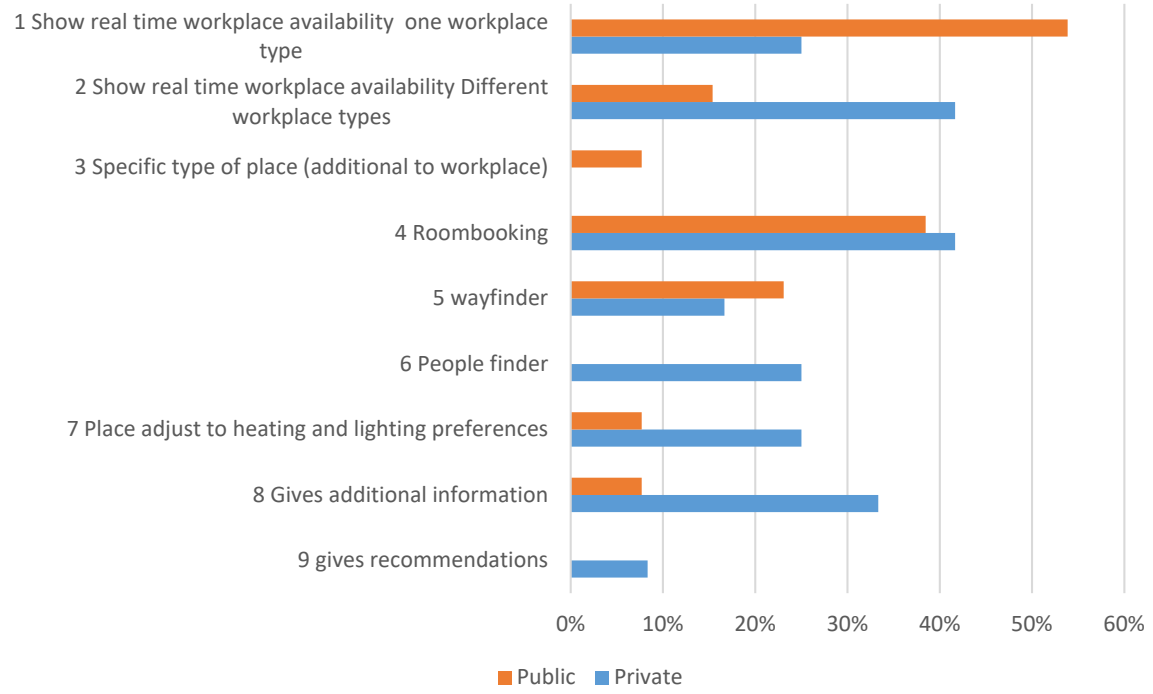


Figure 22: Future developments of smart tools, indicated by interviewees.

Figure 23: Different functions per organizational *type*



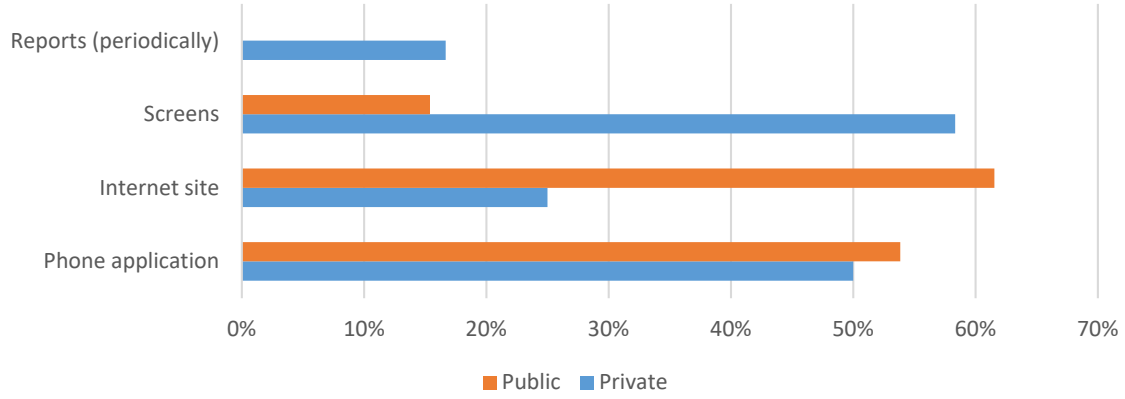


Figure 24: Way of presenting information

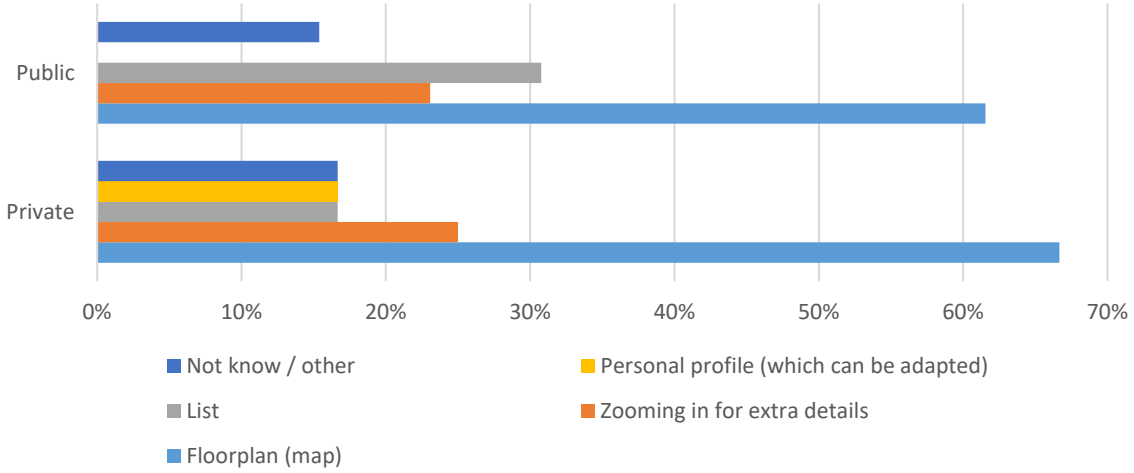


Figure 25: Type of given information

Providing information to the user

Information can be delivered to the user in several ways. It differs through which kind of device the information is provided and how the information is visualized. Among the cases, four different ways of bringing the information to its user has been found.

The phone application does not show big differences between both types of organizations but the screens and internet sites do. Public organizations use the internet site much more often than their private counterparts. Private organizations prefer to use screens.

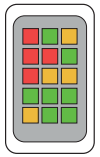
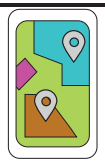
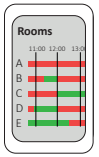
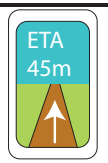
What kind of information is given

The floor plan is the most used way to show information. A list is used in 6 cases. Only three of them are actually providing information on workplace availability (one workplace type). The two smart tools that are already implemented give the information on a building level or floor level, not on specific workplaces. When the information needs to be provided in a very precise way, the floor plan seems to be the best option. A list is in some cases used in addition to this floor plan. Other application provide even more information by giving the option to zoom in on the floor plan. It should be kept in mind that the information presented here illustrates the way how functions were presented in the specific case. It is possible that the supplier also offers different ways of presenting the information.

Towards a classification of smart tools and related functions

Based on the analysed data set, a classification of the different functions is made. A further distinction is made based on the level of accuracy and a deepened explanation is given about the function. One classification is made with the different function categories as its input and the second classification presents the smart tools first to show connections between functions within a specific smart tool. After the sheets, the categories will be elucidated.

Assist users in choosing an appropriate workplace

	Function	*Icon*	*Level of accuracy*	*Function specification*	*Reference cases*	*Smart tool supplier*
1	Show real time workplace availability *One workplace type*		Group of people	From defined zones of a floor the occupancy is shown.	NLG UU ABN	Plekchecker Lone Rooftop Lone Rooftop
				On building level	KL	Blokken in Leuven
			Individual	Based on specific workplace measurement	DTU ING	Smart library (custom)
2	Show real time workplace availability *Different workplace types*		Group of people	Type of workplaces on a floor level, check-in required for desk by QR code	OVG	MapiqPhilips
				Type of workplaces on a floor level	TUD-1 UvA MIC – 1	Mapiq - Blinq systems Mapiq Smart building app
			Individual	Based on the desk the person uses around that moment. Which relates to type of room	AHR	Smart working app
				Based on detecting persons and showing the specific room.	ERI AGF	Flowscape Office 3.0
3	Show 'thirds places' in neighbourhood		-	Showing third workplaces which can me filtered by checking personal workplace preferences	CAM	Spacefinder
4	Room booking		-	Booking a workplace or group room, check-in required for desk by QR code	TUE OVG	Book my space – Planon MapiqPhilips
				Booking a workplace or group room	AGF	Office 3.0
				Booking a group room	TUD-1 UvA ERI	Mapiq - Blinq systems Mapiq Flowscape
				Shortening the process of room booking and accompanied actions	TC	(custom made)
				Releasing meeting rooms if they are booked but not used	ING	(custom made)
5	Way finder		Indoor	Shows where a room or area is on the map	TUD-1 UvA OVG ERI	Mapiq - Blinq systems Mapiq MapiqPhilips Flowscape

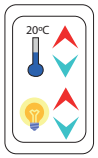
		Function	*Icon*	*Level of accuracy*	*Function specification*	*Reference cases*	*Smart tool supplier*
Enhance collaboration and wellbeing	6	People finder		Desk	Based on desk login, check-in required for desk by QR code	OVG	Mapiq&Philips
					Based on desk login, recognition by application on phone	AHR	Smart working app
				Person	Based on location of the person	AGF	Office 3.0
	7	Adjust temperature and lighting		Group of people	Temperature an lighting on a panel level (couple of desks or 1 room)	OVG	Mapiq&Philips
				Individual	Heating and cooling is provided on the level of an individual person. Follows the person.	AGF	Office 3.0,
					Adaption on temperature and lighting on a desk level	AHR DTU	Smart working app Smart library
Providing information	8	Gives additional information			Showing the impact of meeting room usage to its users	GGL	Meeting room nanny
					Provides information on productivity and the projects other colleagues are working on	MIC-2	Delve/Workplace Analytics
					Provides availability information based on room bookings and logged-in PC's	VU	Study Spot
					Provides information on comfort and noise levels	MIC – 1	Smart building app
	9	Gives recommendations			Proposes times and books rooms based on locations and calendars of different people	TC	(custom made)
					Gives proactive insights to increase productivity	MIC-2	Delve/Workplace Analytics

Figure 26: Classification of functions and differences within functions in relation to an actual smart tools and reference case code

1 function (7 tools)	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*Specific tool function*	*Remarks and opportunities*
	Real time availability 1 type	*Real time availability several type*	*Third places*	*Room booking*	*Way finding*	*People finding*	*Adjust temperature and lighting*	*Gives additional information*	*Gives recommendations*		
Lone rooftop	1									Shows availability of workplaces at floor level	Current infrastructure of Wi-Fi in the building determines accuracy of the information. Uses Wi-Fi infrastructure which is already there.
Plekchecker	1										
Blokken in Leuven	1									Shows availability of workplaces at building level	It is not know where people are in the building. Uses access control which is already there.
Spacefinder			1							Shows location of third places with filtering option	No real-time availability information. Without sensors, provides new information.
Book my space - planon				1						Possibility to book a desk or room	Does not check the presence of people at desks.
Meeting room nanny								1		Showing the impact of meeting room usage to its users	Only periodically shared. Gives insight in actual use of meeting rooms to enlighten people
Study spot								1		Provides availability information based on room bookings and logged-in PC's	Is only partly real time. Uses infrastructure which is already there
2 functions (5 tools)											
Custom (ING)	1			1						Releasing meeting rooms if they are booked but not used. Tool gives real time availability of availability or meeting rooms.	Requires high accuracy to prevent mistakes in releasing rooms. Offers people unused spaces
Smart library	1						1			Provides real-time availability on desk level and gives option to adjust temperature and lighting	Each desk needs a sensor. Ability to personalize the workplace and adjusting comfort settings.
Smart building app		1						1		Shows availability on floor level of different workplace types and provides information on comfort and noise levels	Gives additional data to select right place on temperature and noise.
Custom (TC)				1					1	Shortening the process of room booking by proposes times and books rooms based on locations and calendars of different people	Customised for specific soft and hardware. Smoothens the journey of room booking and meeting organising.

	Real time availability 1 type	*Real time availability several type*	*Third places*	*Room booking*	*Way finding*	*People finding*	*Adjust temperature and lighting*	*Gives additional information*	*Gives recommendations*		
***3 functions** (4 tools)*											
Mapiq		1		1	1					Shows real time availability of different workplace types on a room or area level and provides a room booking option.	Availability is not provided on desk level
Mapiq - Blinq		1		1	1						
Flowscape		1		1	1					Shows real time availability of different workplace types on a room or desk level and provides a room booking option.	Indoor positioning is optional. Privacy is guaranteed
Smart working app		1				1	1			Shows real time availability of different workplace types on desk level, provides people finding function and comfort adjustments	People finder function can be turned off to guarantee privacy. The connection between desk and personal information gives another view on privacy.
Delve / Workplace analytics						1		1	1	Provides information on productivity and the projects other colleagues are working on	Is looking into personal information. Privacy can be an issue. Gives advices on improving productivity and insight in colleagues' projects.
***4 functions** (1 tool)*											
Office 3.0		1		1		1	1			Shows real time availability of different workplace types on desk or room level, provides option to book desks and rooms, provides people finding function and comfort adjustments	Privacy is guaranteed by managing consent by editing the personal profile. The link between comfort preferences to location enables mobility at the office.
***5 functions** (1 tool)*											
Mapiq - Philips		1		1	1	1	1			Shows real time availability of different workplace types on a room or area level and provides a room booking option. Comfort can be adjusted and a people finding option is provided.	Availability is not provided on desk level.

Figure 27: Classification of smart tools related to its different set of functions and the remarks and opportunities of these complete tools.

Classification of functions

Differences within categories
Some tools offer the same functions but provide the information on different levels of detail. For example, they provide information on the level of individual workplaces or on a building level. A very precise measurement of availability can be very helpful when looking for places in a busy place, but the preciseness can also introduce other aspects that should be taken into account, like the privacy guarantee or the infrastructure to provide this information. These deviances between smart tools can steer the final decision for a specific smart tool. Based on the insights provided by the above analysis, a classification is made to specify the variety of options in smart tools, related to a specific function.

Classification of functions
The user journeys, made in the second part of this findings chapter, will highlight the functions of smart tools that can be implemented to optimise the journey. Therefore the first classification will take these functions as its starting point. First a more deepened specification of the function will be given by indicating the level of accuracy of the tool and an additional description of the function of the smart tool. Then this function will be linked to the name of the smart tool and reference case from the data set. Below the different categories will be introduced as a guidance for the table of page 40.

Level of accuracy
When reviewing the specific function of the smart tool, different levels of accuracy can be distinguished. Some smart tools show availability on a room level and some do this on a room level. This difference can have implications for the infrastructure on sensoring that should be in place to achieve a certain amount of accuracy. Other smart tools need a QR code check-in to know that the place is occupied. The purpose of the tool can require a certain level of accuracy. For example, in the ING case there was the requirement to measure the availability in a room with a 100% accuracy. This requirement was set because they did not want to release a booked room when no activity was measured but in fact people were still using it. This can lead to annoyances and damages the reliability of the smart tool. In this specific case, a very accurate measurement method was used to make sure the system would not make any mistakes and cause irritation instead of convenience. Therefore the level of accuracy should match the specific preference from the users and is therefore an important variable. In general terms, it can be assumed that a higher level of accuracy requires a high density of sensors which leads to a cost increase compared to less accurate measurement methods.

Function specification
All the tiny differences between smart tools within a function category are made explicit in the column of ‘function specification. Especially the tools that give additional information are further specified in this column.

Icon
Each function has its own icon. These icons will correspond with the journeys, made in the analysis of part two of this chapter.

Classification of smart tools

Classification of smart tools
Some smart tools have multiple functions. To be able to review the full package a smart tool has to offer, the second classification takes the smart tool as its starting point. In this way, combinations of functions can be matched to a specific smart tool that is used in the field. The limitation in this classification is that the possibilities a smart tool has to offer in total can differ from the information collected for this analysis, because in most cases the end user is consulted for collecting data on smart tools. There is a possibility that the tool has to offer extra functionalities when consulting the developer, but that the end user did not need or want the full range of possibilities. The table on page 43 shows the classification with smart tools as its starting point.

Privacy
Smart tools guarantee the privacy for their users in different ways. It depends on what is actually measured; the presence of a person (frequency and occupancy) or the presence of a specific person (identity) or even the activity of a specific person (activity). The first measurement is not focussing on who this person is, but only measuring if there is someone. 18 Smart tools from the data set are only gathering this kind of information. These smart tools mostly take care the privacy guarantee by not saving of using personal data or anonymising this data immediately. Five smart tools are measuring activity (2) or identity (3). The privacy guarantee of these tools will be explained in the classification table in the remarks and opportunities column. Two smart tools do not measure anything. Therefore privacy is no issue for these smart tools.

As the regulation on privacy will change in the near future, in many cases it is seen that the privacy sensitive functions of the tools are not further developed or implemented before the privacy is guaranteed.

Social practice theory
The social practice theory describes the relation between materials, images and skills. Smart tools can be seen as one of the materials that becomes part of working, which consist of a bunch of different practices, like writing. Based on the function classification of smart tools, there are different roles that this smart tool can have in this system to make and re-invent a practice. At first it can directly provide information to obtain

'materials' to exercise the practice, e.g. by showing an available place for writing. Besides this function there are also tools that provide additional information or recommendations and in this way influence the images of practitioners. The Delve / Workplace analytics application is an example of this indirect way of assisting a user. By obtaining information about the work processes of the user, recommendations about optimisations can be given. This may change the way this person thinks about executing a specific activity. This proactive smart tool function is in line with the sketched developments by Gartner (2017b), who indicate that smart tools are becoming increasingly intelligent based on the preferences and habits of its user. To clarify this distinction the illustration Figure 14 on page 18 is adapted to the following Figure 28

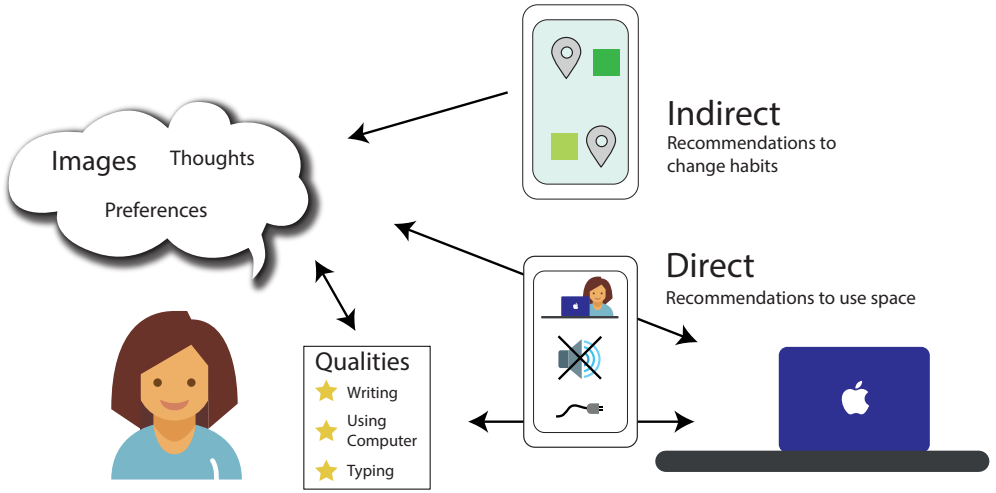


Figure 28: elaboration on relation between stuff, skills and images. Based on social practice theory.

Conclusion

This analysis is made to gather information on the functions of smart tools which are available in the field. This information is needed for the next part of this research to connect the preferences of new campus users to available smart tools and their related functions. The research question central to this analysis is: *What kind of smart tools are currently used at the workplace to assist users in choosing an appropriate workplace and what are the functions of these tools?* To answer this question, 25 cases are analysed which resulted in 18 different smart tools and 9 different definable functions.

Cases

The data set consist of 25 cases, including 13 public organizations and 12 private organizations. Private organizations are slightly ahead when it comes to implementing their smart tool ideas. The division between public and private organizations is made in relation to the second part of this research's analysis, which includes two private and two public organizations.

Functions

When analysing the different functions smart tools can offer to their users, 9 different functions can be distinguished. Over sixty percent of the publicly used smart tools are focused on one single function whereas this is only thirty percent at private organizations. Besides that, this function which is offered by public organization is in over 50% of the cases showing real-time availability on one single workplace type, as the private organizations rather show real-time availability of different workplace types (>40%) than one single workplace type (25%). Providing this information on an internet site is most popular in the public sector as private organizations rather use screens in their building. The usage of a phone application is almost equal at both organizational types, around 50%.

Within the 9 different functions, a further specification can be given based on the level of accuracy and actual function. Some tools measure on a workplace or personal level while others do this on a floor or building level. An overview of the classification of functions is given Figure 26 on page 41

Functions are offered by a specific tool, which in some cases also delivers other functions. These combinations of functions are shown Figure 27 on page 43. Privacy is mostly guaranteed by the tool itself but depends also on what the tool measures. Measuring identity of activity requires a details measurement system which is in most cases also privacy sensitive. The classification shows the privacy constrains that are applicable for the specific smart tool.

At public companies smart tools are mostly more complex on different levels, e.g. more options for personalization and offering more functions from the categories enhancing collaboration and wellbeing and providing additional information. The function 'people finder' is only found by private organizations. The two classifications give an overview on the different functions that are available and on the combinations of functions that are offered by smart tools.

Part II Case studies

Introduction

The second part of the findings chapter provides an in-depth view on smart tools at four organizations. The classifications made in the first part of the finding chapter will be used as an input for this part. The three sub questions that are leading in this chapter are the following:

- What problems of new campus users can be identified, regarding space use?
- Which physical functions of the workplace and functions of smart tools are incorporated in the campus vision?
- In what way are the problems identified by new users aligned to the options delivered by currently available smart tools and are these smart tools already incorporated in the campus vision?

These questions are connected to the analysis steps for the user journey. This connection will be explained below.

The aim of this part is to review smart tools within the workplace and connect this to the workplace related problems users encounter during their day and the vision on the workplace and smart tools. The final product of this part is providing an overview of possible smart tools per case and point at the additional aspects and considerations that can influence the vision on smart tools.

Cases

At four different cases, including two public universities and two private organizations, the same research method is used to compose user journeys. For more information about the research method, review the precious chapter or the interview protocol in the appendix. All of the four cases are located on or planning on building a campus. The following cases are selected:

- Århus Universitet, Denmark
- Technische Universiteit Delft, the Netherlands
- ING, Amsterdam, the Netherlands
- Tech company, the Netherlands

Analysis steps

Per case, several steps will be taken, based on a sub-research question and method. Figure 29 on page 48 shows the sequence of these steps.

Limitations

The proposed focus group for this research was new campus users, defined as knowledge workers who are no longer than 6 months present at the campus. In some cases there were difficulties to get connected with the right people who meet these time bounded requirement. In the limitations section of each case, this issue will be elaborated upon. During the interview period, it is decided to include the information derived from users who are longer than 6 months connected to the organization as the information contributed to the richness of the data set. In the case conclusions, a distinction is made between the data derived from users who meet the focus group requirements and the data derived from users who do not meet the requirements.

In one case, there was no possibility to conduct four interviews with end users. Therefore the other method of composing a user journey is applied, see appendix for interview protocol. The alternative method is described here. Due to the scope of this research, these alternatively composed journeys only contain smart tools that are related to the workplace.

Acknowledgements

The icons of persons and transport ecquipments, used in the user journeys, are based on the examples from ‘freepik’.

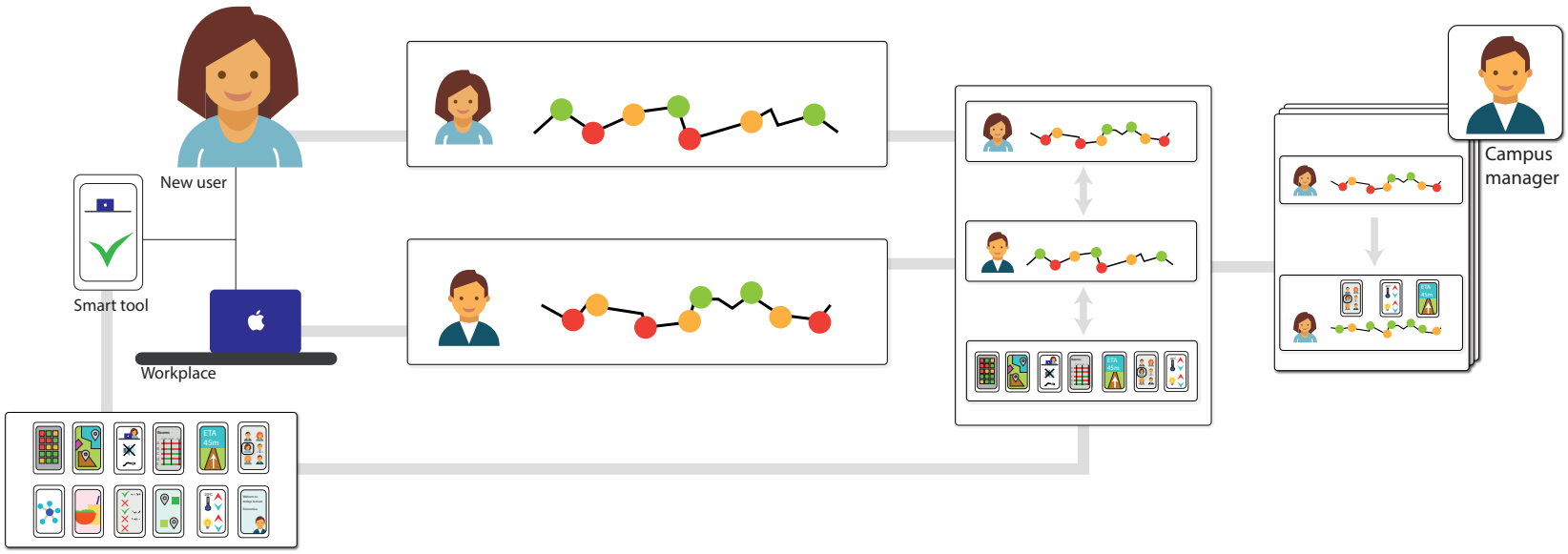


Figure 29: Research process and analysis steps

Analysis steps

Step 1 Planned journey

Sub-research question

Which physical functions of the workplace and functions of smart tools are incorporated in the campus vision?

Method

Making a planned journey. This shows the options in workplace type and smart tool that are able to take based on the vision of the organization.

Step 2 Actual and redesigned journey

Sub-research question

What problems of new campus users can be identified, regarding space use?

Method

Making an actual journey based on an interview with users. This shows the day of one user and highlights the following aspects:

- Activities
- Ideas / thoughts regarding a specific activity
- Mood during different activities
- Type of workplace that is used or preferred.

Besides that, some personal information will be gathered for each interviewee

Analysis

Based on the problems highlighted in the actual journey, the following questions will be answered:

- Are the problems solvable with a smart tool?
  No ✗ Indirect ? Yes ✓
- Is the problem related to the workplace?
  No ✗ Indirect ? Yes ✓

Redesign

Making a redesigned journey where smart tool functions are integrated based on the problems or preferences that are highlighted in the actual journey.

Step 3 Case synthesis and conclusion

Sub-research question

In what way are the problems identified by new users aligned to the options delivered by currently available smart tools and are these smart tools already incorporated in the campus vision?

Method

Matching the incorporated smart tools functions to the planned journey.

Proposed smart tool functions

Bringing all incorporated smart tool functions together and reflecting these functions on the combinations that are available in the market, which is reflected in the classifications from part 1 of the findings chapter.

On the following pages, the user journeys are presented. The picture aside the journey is one of the favorite workplaces of the interviewee.

The journey is split in three different types:

1. the planned journey (organisation)
2. the actual journey (current workplace experience of the user)
3. the redesigned journey (with smart tools infused journey to show (future) relation between activities and smart tools)

Århus Universitet, Denmark

Introduction

Case angle

The university of Arhus is divided into four faculties. The ambition to implement a new smart tool comes from the school of Business and Social Sciences, which is one of the faculties. The central university is aware of the initiatives and gives the faculties the possibility to experiment and implement new things like these smart tools. The case is therefore focused on this faculty of the university.

The user journeys will be made based on the information given by PhD students, MSc students and BSc students from the faculty BSS. Below all interviewees are listed.

Purpose	*function*	*Department*
Contact person and information on smart tools / planned journey	Member of administrative staff	Aarhus School of Business and Social Sciences (BSS) Estates Facilities
IT, smart tool, planned journey	Chef for web	Aarhus IT
Planned journey, events on campus	Head of Aarhus BSS Career & Alumni	Career, BSS and BSS External Relations
Actual Journey	PhD	BSS
Actual Journey	PhD	BSS
Actual Journey	International MSc student	BSS
Actual Journey	International MSc student	BSS
Actual Journey	BSc student	BSS
Actual Journey	BSc student	BSS

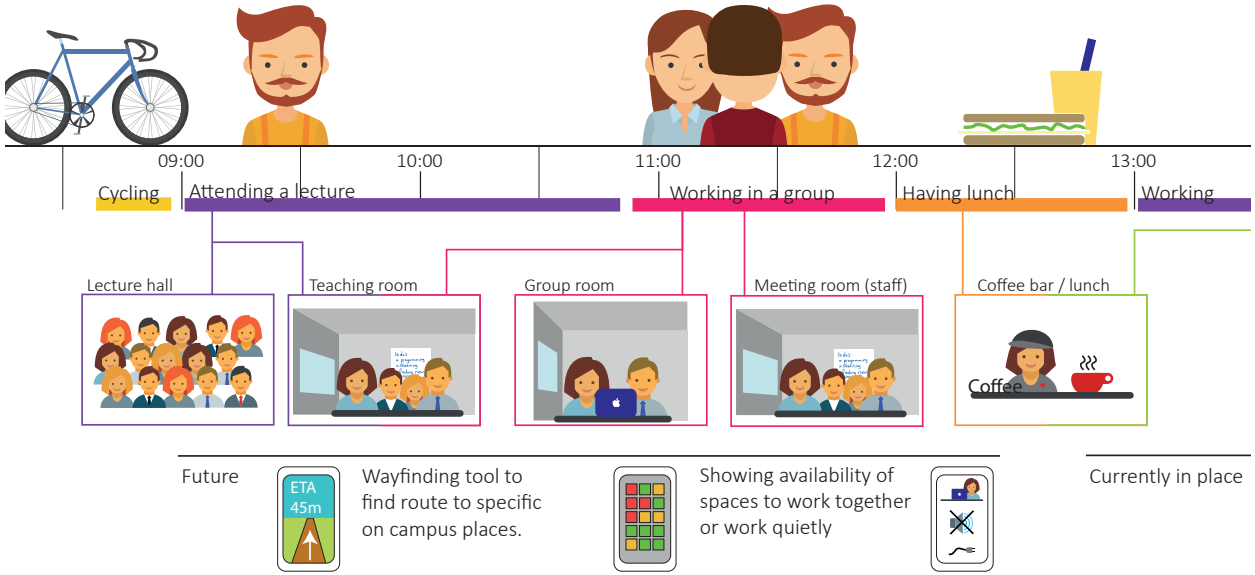
Limitations

The data will only give an insight on how people at BSS experience their day. Besides that, the two BSc students do not meet the criteria for new campus user. The information derived from these participants is shown but a distinction will be made in the case conclusion.

Institution

The university of Århus has 40.000 students and 8.000 fte of employees spread over four different faculties; Arts, Health, Science and Technology and the school of business and social sciences. The main campus is situated in Århus but the university has small dependences spread around the country and three across borders. The focus of the university is on delivering high quality research, providing extra academic activities to talented and motivated students and focusing on international teaching to enhance mobility of talent.

Planned journey



Campus

The campus in Århus has around 70 buildings and houses 35.500 students and 5.900 employees. Employees have their own desk in a private office or share the room with one colleague. PhD students share a room. It is not expected that this will change in the near future. Master students who are writing their thesis can subscribe for a desk for half a year. Depending on the number of subscriptions, the students will be assigned to a specific desk. Other students can book rooms and use the shared spaces for working. Both silence places and normal places are provided.

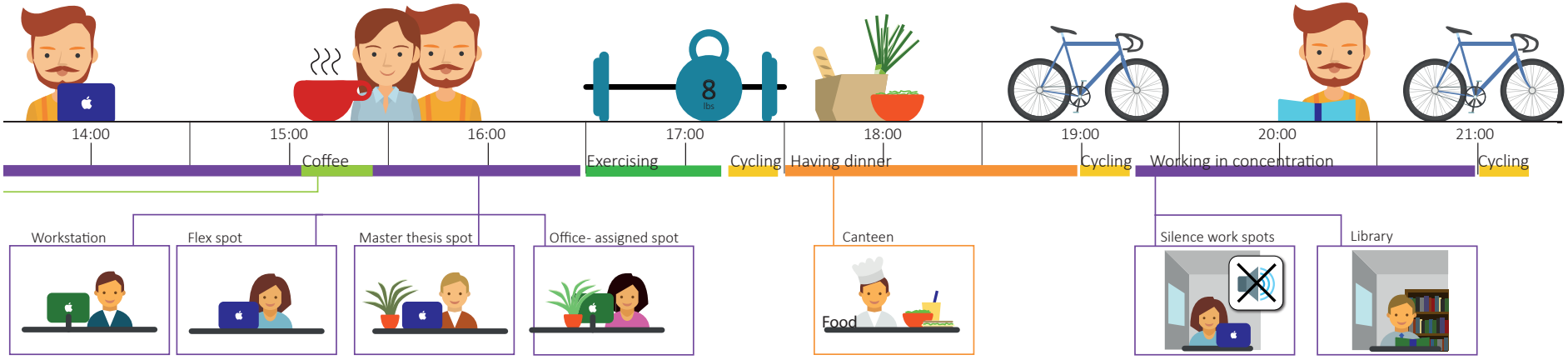
The university just acquired the old university hospital and will move in these buildings around 2020. It is not clear jet which department or faculty will move in.

Smart tools

Current: The university has two tools developed, AU find and room booking for students. AU find enables people to find the location of specific departments and the offices of employees. The tool is based on static information and does not include actual positioning of people. The room booking tool gives students the possibility to book group spaces or vacant lecture rooms. The tool is based on booking information, not on the actual use of space.
Future: The ambition is to expand the above mentioned tools to become smart. Expanding AU Find by incorporating indoor way finding and showing actual availability of different spaces

Users

The average age of the Århus campus population is as follows:
Bachelor students: 24,5 y.
Master students 28,5 y.
Employees: 43,4 Y
Among the student population, around 12% has a non- Danish cultural background. When reviewing the numbers of the last decade, the university shows a growth of students every year. Every half year new students start with courses. This can be for a couple of years but for some months as well. Introduction programs are in place to show them around. For employees the departments should take care of this introduction.



AU find (website)
Gives locations of persons and specific functions on and surrounding the campus

Room booking for students (website)
Vacant rooms are available for students to book for groupwork. Both teaching spaces and special groupwork spaces can be booked.

User journey AU – A

Main workplace related problems
The interviewee finds it difficult to find a room to have a Skype call. Although there are some available rooms around, it is not clear when they will be used. To prevent occupying a room when someone else booked it, he mostly does his Skype calls on the hall way or somewhere hidden in a corner.

- Showing available rooms and indicate when they are booked would help to facilitate this search for space.

As the interviewee makes long days at the faculty, a place to lay down for some minutes would help him to focus afterwards. Nevertheless, he is not sure if this 'activity' is accepted at the department.

- Showing these kind of places on a map would help him to find a place to lay down for a short moment. The cultural aspect is more difficult to solve with a smart tool but if the university shows these kinds of spaces on a map and actively invites people to use the space, this could help to create a culture where taking a little nap on a couch is accepted.

Other workday related problems which can possibly solved with smart tools
There are no other workday related problems shown in the user journey.

Additions
The interviewee is at this department for a very specific goal, collaborating with one other colleague from this department. Therefore he only needs to get in contact with this person and needs a place to work.

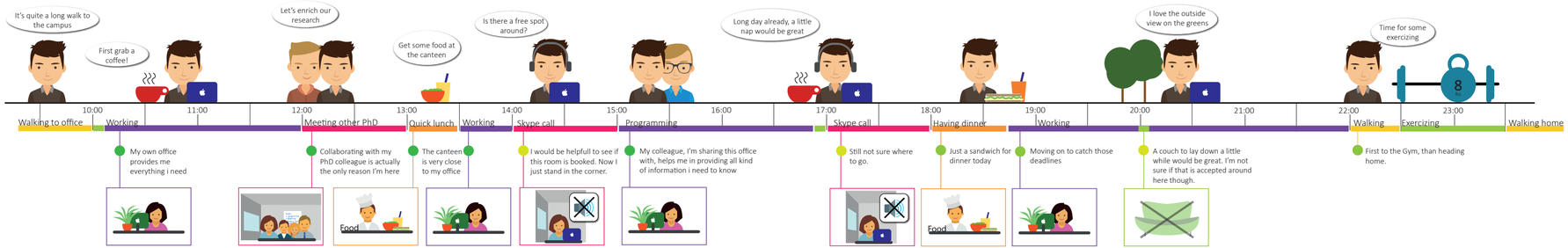
Proposed functions, derived from journey
1. Show real-time availability of one workplace type, meeting rooms.
- Provide information on the period of availability / when the room is booked again.
2. Show the location of different types of workplaces, a place to take a break and lay down.

User journey AU - A

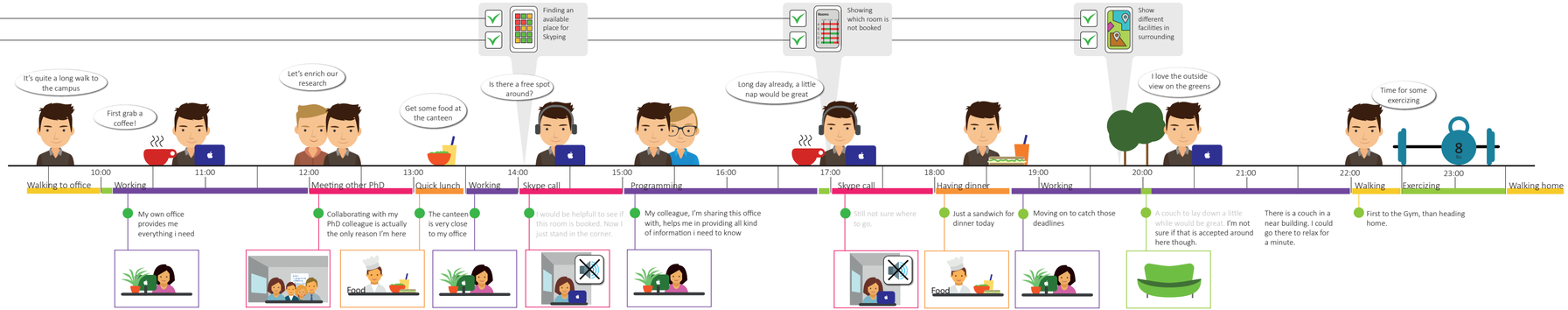
Are problems solvable with a tool?

Is the problem related to the workplace?

Actual journey



Redesigned journey



33 years old
since 2 weeks
Visiting PhD student from Tampere, Finland
Satisfied with job but experiences stressfull moments

Misses places to call or have skype meetings.
A little couch in or close to my room would be great to be able to have a short nap.

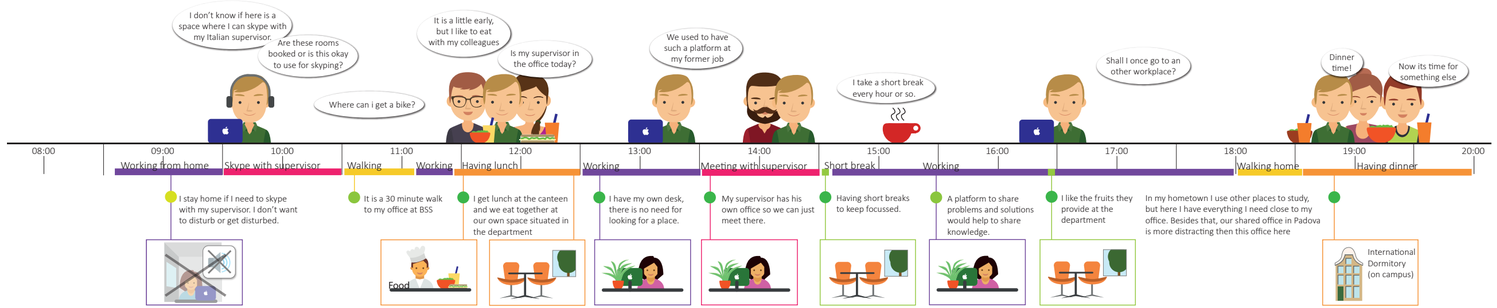
I like the views on the greens and the possibility to go outside immediately.

All facilities i need, for food and coffee are around.

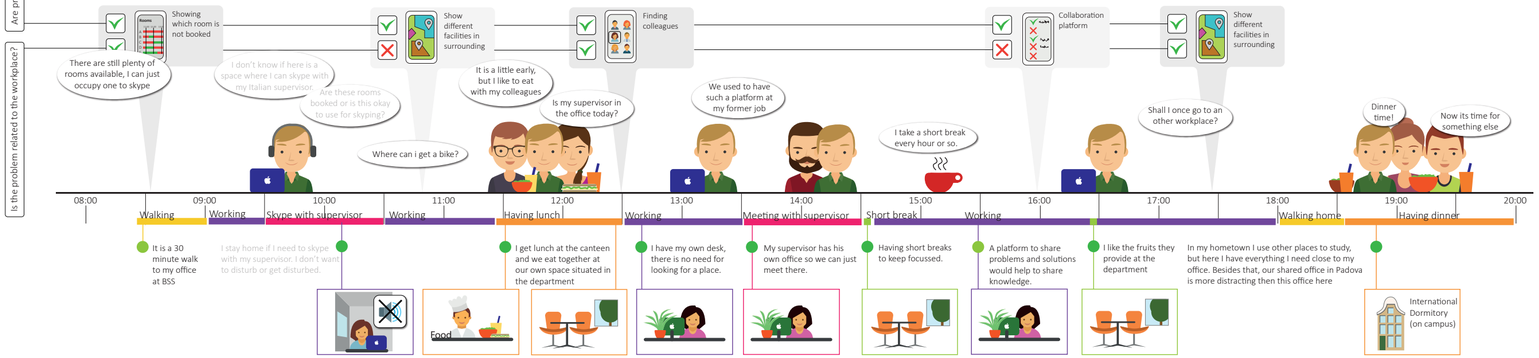
It would be great to see on a Ipad or something to see if a room is booked. Than I can just enter and use it.

A tool which gives information on location of specific facilities or persons, I see the benefit of that, but I don't need it right now, I have the people that I need already around

Actual journey



Redesigned journey



27 years old
since 1 month
Visiting PhD student from Padova, Italy
Satisfied with job

I don't know when places are occupied, so I do the skype calls with my supervisor at home.

There is some good coffee and free fruits at the department

Know who is in the office. (real time presence)

Room availability, to see if a room is available for the upcoming hour.

Match on knowledge, interest and problems to learn from each other.

User journey AU – B

Main workplace related problems

Just like the other PhD interviewee, this interviewee also needs to Skype regularly with one of his supervisors. As he does not know which room he can use and when it will be used by other people, he stays home to conduct these calls.

- Showing available rooms and indicate when they are booked would help to facilitate this search for space and gives him the possibility to do his calls at his workplace.

To prevent looking, he would be interested to see who is in the building.

- A people finder on a building level could provide this information.

In his hometown university, he often visits the library to work as his shared office is sometimes distracting him. In Århus he only shares his office with one or two other PhD students, which is less distracting. Nevertheless he would be interested to sometimes use another place to work.

- Providing an overview of the different workplaces at the university can help him to find another workplace to get inspired.

Other workday related problems which can possibly solved with smart tools

Most people in Århus use the bike to go to the university. This interviewee would be interested to know how to get a bike for a temporary period. This would solve much time when getting to the department.

- Showing different facilities on campus could help to find a bike rental.

At his hometown university, a collaboration platform is in place to help each other with common problems. Many people have the same problems and by sharing these on a forum, people can help each other with their research.

- A forum like this could maybe become part of the department intranet pages.

Proposed functions, derived from journey

1. Show real-time availability of one workplace type, meeting rooms.
- Provide information on the period of availability / when the room is booked again.
2. Show the location of different types of workplaces, to find another workplace.
- This function can be extended by showing other facilities on and surrounding the campus, like a bike rental shop.
3. Collaboration platform for exchange of information and problems.

User journey AU – C

Main workplace related problems
There are no workplace related problems

Other workday related problems which can possibly solved with smart tools
The interviewee mentions that there is not much information shared among the students.

- A collaboration platform could solve this issue.
- There is not much of a sharing culture. An collaborating platform would not change this culture directly.

The different event on campus are very much scattered around different channels. If this could be streamlined into one application, that would be very interesting.

- This function could be added to the existing application.

Additions
As the interviewee indicates, the introduction program helped him to find places at the beginning of his courses at Århus. Therefore it he is aware of different spaces around campus. This can be enlarged by providing these spaces on an application, but is not necessary, when looking at his journey.

Proposed functions, derived from journey

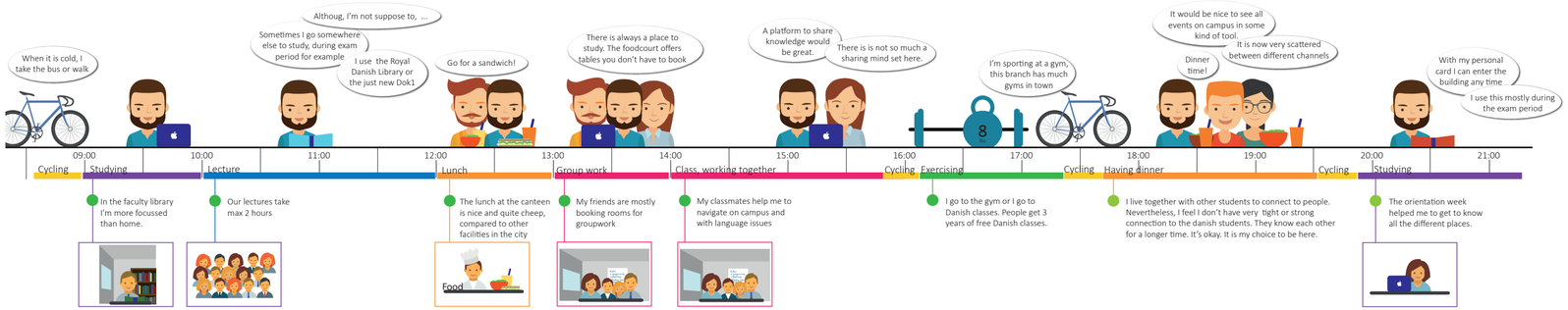
1. Collaboration platform for exchange of information and problems.
2. An extension of an application to show all events on campus

User journey AU - C

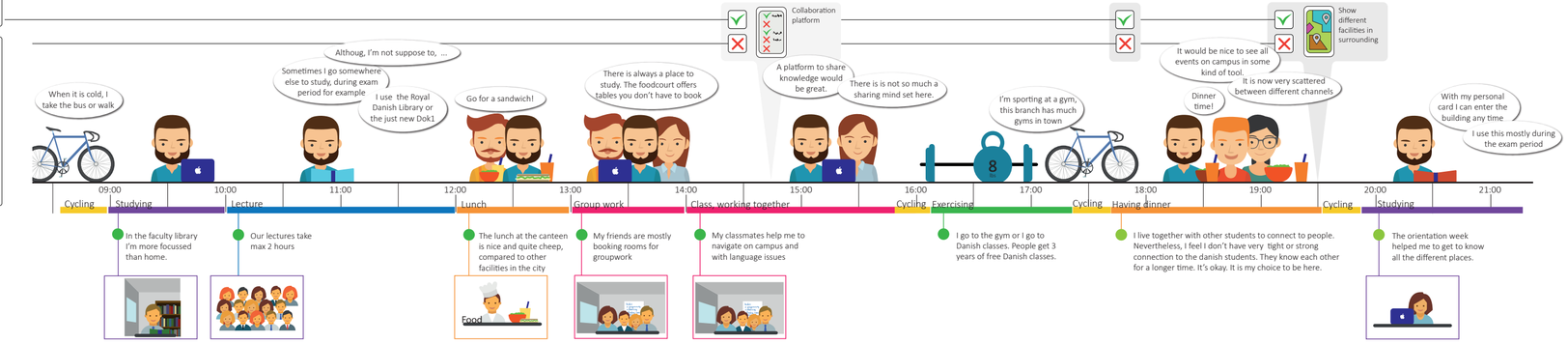
Are problems solvable with a tool?

Is the problem related to the workplace?

Actual journey



Redesigned journey



29 years old
since 5 month
Master student BSS
Satisfied with university

Actually, there is not really something that sets me up.

I specifically choose this university, as it is one of the best in the world and I wanted to learn Danish. I really like it to be here, it is a considered choice.

AU find is great, but I have a problem with my phone so I cannot use it. I used it during my first days at the campus

Extending this application with the events on campus would be great. Information on events is now very scattered between different channels

A tool for sharing summaries and other knowledge for courses would be great.

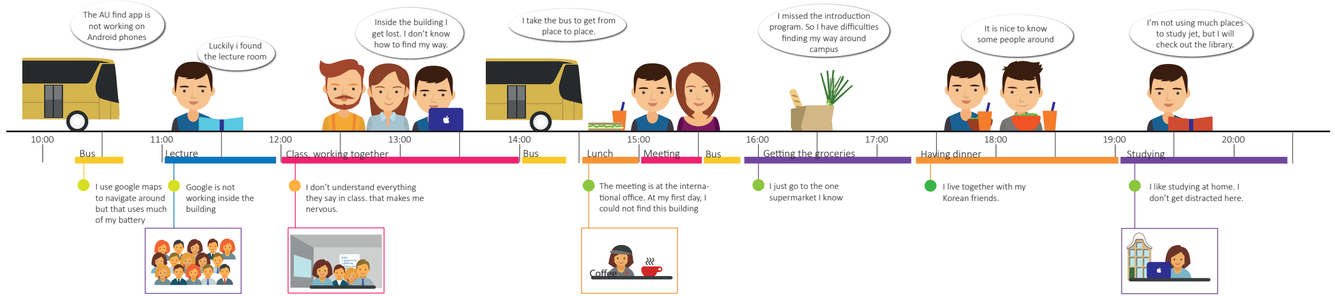
It would be interesting to see on a camera how busy the library is, but I almost find a place.

User journey AU - D

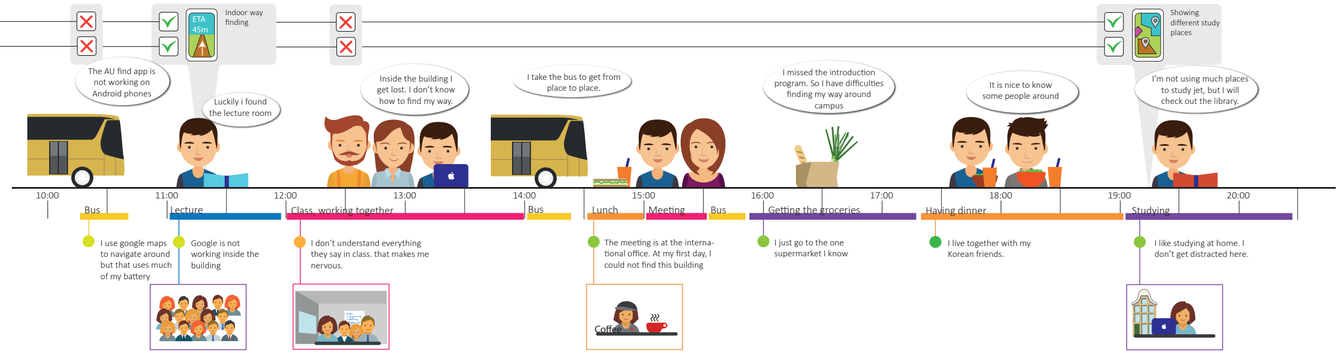
Are problems solvable with a tool?

Is the problem related to the workplace?

Actual journey



Redesigned journey



23 years old
since 1 week
Exchange student BSS
Satisfied with university

I find it hard to understand the people, as my English skills are not that high already. This makes me nervous. Navigating inside the buildings is difficult as well.

I specifically choose this university, to learn more on the nordic culture. I wanted to come to Norway, Finland or Denmark.

AU find is great, but I cannot use it becouse i don't have an Iphone. I use Google maps. There is no indoor
navigating tool. Now it is hard to find my way indoors

User journey AU – D

Main workplace related problems
As it is his first week, this interviewee has troubles getting to the right room.

- An indoor navigating tool would help him to find the right room.

Other workday related problems which can possibly solved with smart tools
At this moment he does not need to find other places to study. Later on he would like to discover the spaces in the library

- A tool that shows different places on campus would help him to find different spots.

Additions
The interviewee did not understand the English language completely which gave him a nervous feeling during his first time in Denmark.

Proposed functions, derived from journey

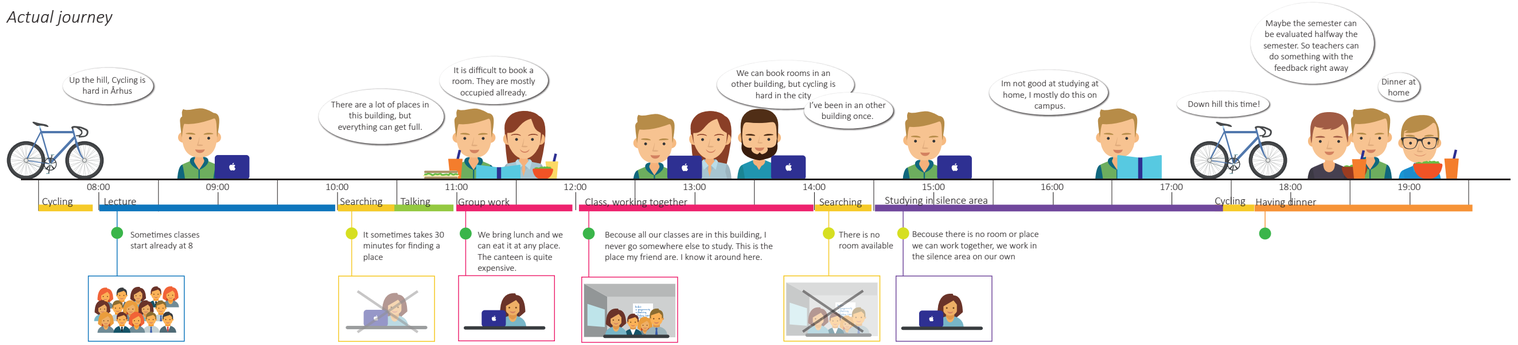
1. An indoor navigating tool to find rooms.
2. A map that shows different workplaces on campus.

User journey AU - E

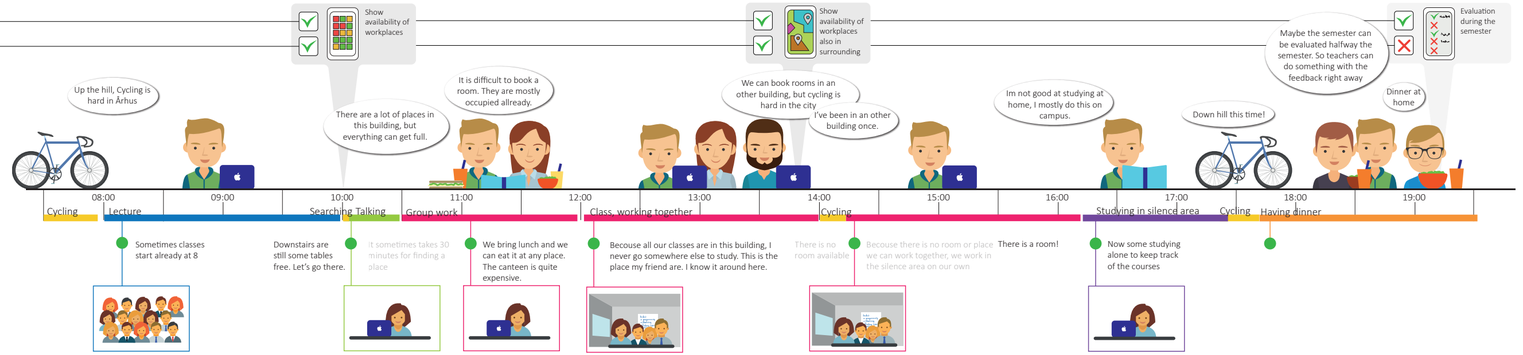
Are problems solvable with a tool?

Is the problem related to the workplace?

Actual journey



Redesigned journey



24 years old
since 1,5 years
Bachelor student BSS
Satisfied with university

It is sometimes difficult to find a available spot in the building.

In the beginning I really had to adap to studying again. But now I'm very happy to be here.

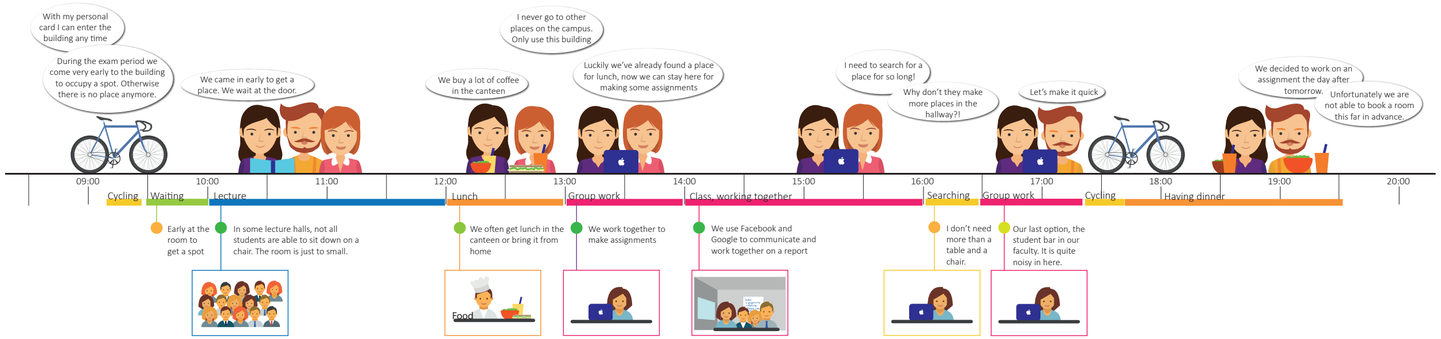
The roombooking tool works but between 12 and 2 there is never a place available.

A tool for availability would be very helpfull. But not by hanging cameras into the spaces. The privacy should been taken care of.

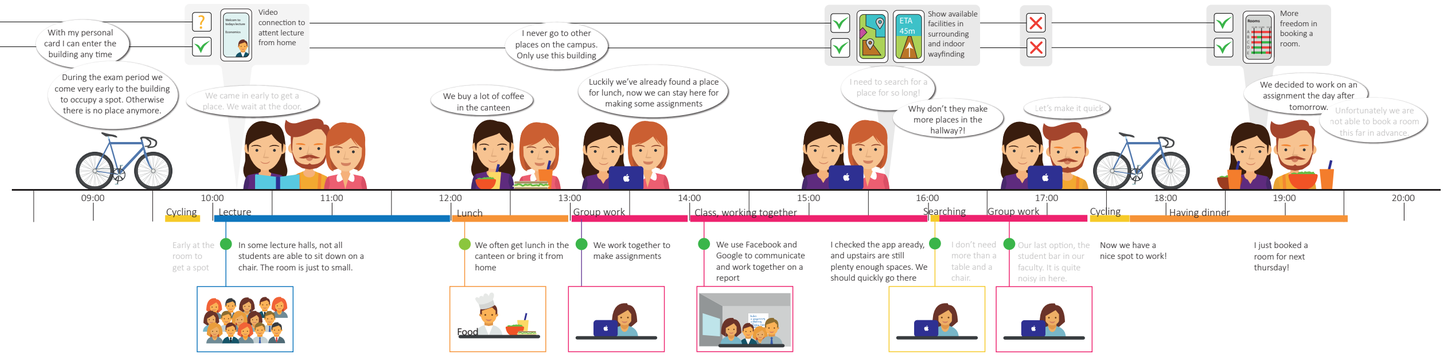
Are problems solvable with a tool?

Is the problem related to the workplace?

Actual journey



Redesigned journey



25 years old
since 1,5 year
Bachelor student BSS
Satisfied with university

It is difficult to find a study place. I use a lot of time to look for a place. Adding places in the hallway would help. The lecture rooms are sometimes to small.

I choose this university becouse it was close. I like the university! It is nice to have access to the building any time. Although, during exams, you should be early to get a place.

I use AU find to look for specific buildings. Inside the building I mostly got lost if I don't know the place.

Knowing the availability of places at other parts of the campus would maybe help. But I rather have more places in this building.

The room booking tool is nice but I want to be able to book a room more in advance. That is not possible now.

User journey AU – E

(does not match requirements on new campus user)

Main workplace related problems
Some of the lecture rooms are too small to provide a place for all the students. Therefore this interviewee tries to be at the room very early to make sure she is able to obtain a spot.

- A way to keep the pressure of lecture rooms could be to record the lecture. In this way students can watch the lectures from home. This can release some of the pressure on the lecture rooms.

Looking for a space to study takes up much of her study time.

- Providing her with a smart tool that shows the availability of workplaces would help her to find a spot more easily.

The room booking tool only makes it possible to book a room one day ahead. This makes it difficult to plan collaboration sessions more days in advance.

- Enlarging the possibilities for room booking could solve this.
- There is also a possibility that people will book rooms in advance without using it, if they are able to book more days in advance.

Other workday related problems which can possibly solved with smart tools
There are no other workday related problems shown in the user journey.

Additions
The student bar is used in day time for studying. Because the higher noise levels in this place, this interviewee only uses this space if there is no other place to be found.

Proposed functions, derived from journey
1. Show real-time workplace availability.
2. Enlarging room booking possibilities.
3. Video connection to attend the lecture from home.

Case synthesis

The main workplace related problems are identified in the user journey. The redesigned journey shows the possible smart tool functions that can be introduced in the journey to take these problems away or at least to diminish the impact. The verify if these introduced smart tool functions are in line with the vision of the campus and in what way similar functions are incorporated at other organizations, this synthesis is made. The main question is: In what way are the problems identified by new users aligned to the options delivered by currently available smart tools and are these smart tools already incorporated in the campus vision?

Case findings

The interviewed students and PhD students of the Business school and Social Sciences faculty (BSS) of Århus University are very much connected to their own cluster of buildings, which is situated slightly off campus. It is approximately a 6 minute bike ride or 15 minute walk to the main part of the campus. Only one student sometimes visited other facilities on campus, like the library.

- Showing the availability of other places on campus could persuade users to go to other buildings for studying or group work.
- Besides its value for new campus users, Indoor navigation could be of great value for the people who explore new buildings.

The PhD students had no need to search for another place as they have their own desk in a shared office.

AU find, the tools that is currently in place, was mentioned as helpful by almost every interviewed user. Some people were less satisfied as the application did not work on their type of phone. The RE department of BSS is the initiator of providing the availability and indoor way finding tool. Due to the decentralized

Function	Number of requests	Additional explanation	Incorporated in Planned journey
Showing the different spaces on campus	3 (1)	Preferably connected to the availability of that place.	Partly future
Availability	2 (2)	This differs between PhD students, who would like to see how long a certain room is still available and students who are just looking for an available spot.	Partly future
Indoor wayfinding	1	This function is also helpful for people who are already for a longer period on campus but have not been to a specific building before.	Future
Show events	1	An extension to the current application which streamlines the different events on campus	- *
Find a colleague	1	Only on the level of in the building or not. Students were not looking for such a function	-
Collaboration platform	2	To post problems and share information on different topics	-
Room booking	(1)	The room booking tool now has its limitations. This can be broadened.	-
Video connection of lecture	(1) (indirect)	Could solve the problem of not being able to fit in the classroom	- **

* Providing information an a faculty level or based on buildings, when there is a special event for example, would be something the career department would be happy to have.
** the central IT department is busy developing tools to support learning. Recording lectures is something that is happening already at some lectures.
The numbers in brackets show the preferences of the two interviewees that do not match the criteria for new campus users.

Table 6: Overview of functions preferred by users

position they are able to pilot this tool quite fast. On the other hand, when not the full campus is incorporated, it is not clear if the full potential of the function is met.

- Testing a tool like this can be of great value for the new buildings which will be occupied around 2020. One of the aims for the campus 2.0, as the university calls this new part of the campus, is to become a flexible study environment with many places for study. This tools can enlighten users about the possibilities the new building has to offer.

The IT department of Århus is looking at the study journey. Recording lectures is something which is increasingly implemented. As the journey of interviewee E shows, these changes from the IT perspective have implications for the RE department as well. Maybe people start studying in facilities closer to their homes if they do not have to come to class anymore. Knowledge about the facilities in that area would be helpful to facilitate this change.

There is a difference between people who are just started at the university and people who are already there for a longer period. Navigation is something brand new people would like to have, based on the journey of person D. He missed the introduction and due to the language difficulty, he finds it very hard to keep up. It also looks like the students who are longer present at the campus are slightly more critical on their workplace.

Proposed smart tools functions

Based on the overview of functions preferred by users, listed in Table 6 on page 62 the folloring smart tool functions are proposed for this case.

Functions connected to planned journey
The planned smart tool is matching the demands of the users.

- Providing indoor way finding would help new users to navigate and enables current users to enlarge the number of spaces they use in other (unknown) buildings

Providing availability of place can be the trigger for people to visit another building for a certain activity. This function would add value to all user of the campus who do not have their own workplace.

Additional functions
Following the user journeys, these planned functions could be extended with the following functions.

- Providing an overview of different spaces. E.g. a place to relax for employees, a place to work in groups and facilities like a bike rental.
- This function could be extended by providing information on temporary events on campus and to third places of campus

Providing information on when places are used. Especially the meeting rooms.

Smart tool example
Mapiq or flowscape would be a tool that meets the wishes of the interviewees. This will not cover the people finding request, but the combination of Mapiq and Philips shows that a people finding option is possible. The functionality of mapiq and flowscape also cover the already planned functions. There is a difference in level of accuracy between Mapiq and flowscape, as mapiq measures on a room or group level and flowscape on an individual desk level. The information derived from the journey does not indicate a need for measurement on individual desk level, therefore both smart tool providers could be considered. Besides that, it would be interesting to give an overview of the different buildings on campus to show facilities in the surrounding or maybe indicate the presence of an event that day. Spacefinder, but also the current AU find application, provides a map with information on a building level. Linking the information from mapiq or flowscape to these buildings would provide a sophisticated smart tool that combines the different user wishes at different levels of accuracy.

Conclusion

The functionalities found by making user journeys are partly in line with the future developments of smart tools on the campus of Århus. Providing information on the availability of places would help users in finding a suitable spot and can trigger users to go to other buildings to study. Indoor navigation would only be interesting for brand new people or for all campus users when they are exploring a new building on campus. The combination, indoor navigating and showing availability of workplaces can enlarge the options users have on campus. The willingness to go to a different building depends on the difficulty to find a spot in the current building, person F was sometimes looking for half an hour to find a spot. By showing the distance to the nearest spot, in another building, and the number of available places, he stated that he was willing to go somewhere else if it took him less than half an hour. These two functionalities together can enlarge the possibilities users can go to en therefore reduce the pressure on a particular building.

The workplace concept, e.g. if users have their own desk or not, is very important to determine the function of a smart tool. PhD students, person A and B, did not need to know information on the availability of other spots as they had their own desk. They only needed to know it there was another room available for a skype meeting, to not disturb their colleague PhD student in the same room. As they had their own desk and other supporting facilities, like a place to get coffee and relax, their preferences were very much different from the students, person C – F.

Technische Universiteit Delft, The Netherlands

Introduction

Case angle

The department of campus development and education and student affairs are working together to provide educational spaces for students. They also look at the possibility of implementing smart tools at the campus. The focus in this case is on bachelor and master students. PhD students mostly have their own workplace, located at the research group. Other academic staff has equal or more personally assigned space. As there are more buildings than intended interviewees, in collaboration with the two contact persons is decided to take someone from the new and old Applied Sciences building, someone from the designing faculties (Architecture or Industrial design) and someone from another faculty. In this way the differences in study activities will be reflected as much as possible and the new faculty building is also reflected in the results.

Purpose	*function*	*Department*
Contact person, Smart tools, planned journey	Policy maker real estate development / Researcher smart campus tools	Campus and real estate / Real Estate management
Contact person, Smart tools, planned journey	Coordinator educational spaces	Education and Student affairs
Planned journey,	-	Education and Student affairs
Actual Journey	International MSc Student	Urbanism, Architecture
Actual Journey	BSc Student	Applied Physics, Applied Sciences
Actual Journey	MSc Student	… , Applied Sciences South
Actual Journey	International MSc student	… , Electric Engineering
Actual Journey	International MSc student	Architecture, Architecture

Limitations

Only one respondent per building does not give a rich data set on a building level. Nevertheless, the scope of this research is bigger than the single building level namely, the campus. To reflect the diversity of the campus population, the above listed people are chosen. There are big differences in type of activities and required spaces for those activities between the courses. Besides that, there is a difference between 'normal' weeks with lectures and projects and 'exam' weeks. During exam weeks students do not have lectures and study in different places to prepare for the exams or to finish their projects. To reflect both weeks in the journey, in some cases, the activities from both weeks are reflected in the journey. The journey reflects a representative day, not one specific day, to contain as much as different activities and problems.

Planned Journey

On the next page the planed journey of the TU Delft is shown. The illustration shows all the different places that are available on the campus and illustrates the different ideas on smart tools.

Institution

Delft University of Technology is located in the western part of the Netherlands. With 8 different faculties in spreading from architecture to aerospace engineering, it is the biggest university of technology in the Netherlands.

Size: 1.610.000 m2, 21.651 students
World coverage: 1 country
Core business: Education, University
Main vision: “Delft University of Technology contributes to solving global challenges by educating new generations of socially responsible engineers and expanding the frontiers of the engineering sciences.”

Campus

The campus is located close to the historic centre of Delft. Most faculties require large laboratories or workplaces that need large buildings. Renewing current buildings in a sustainable way and improving the utilisation of existing spaces is something the TU is planning to do. In general the aim is to reduce the amount of square meters to reduce costs on real estate. A green campus will be created to provide a pleasant study, work and recreational environment. Due to the focus of this case, this is focussed on the workplace strategy for students. Each student gets 0,9 education spot and 0,25 study spot. In total makes this 5.000 study spots. During the exam period, another 3.000 temporary study places are realised.
The following functions are realised on campus: Canteen, coffee bar, Library, Café, Lecture halls, offices, laboratory, study spaces, practicum spaces and sport facilities.

Future campus plans
Two new buildings will be realised on campus for 4000 extra students. Some old buildings will be demolished or renovated. The vision is to create flexible buildings which are dependent on each other. This means not every faculty gets its own canteen but canteens are shared amongst multiple buildings.

Smart tools

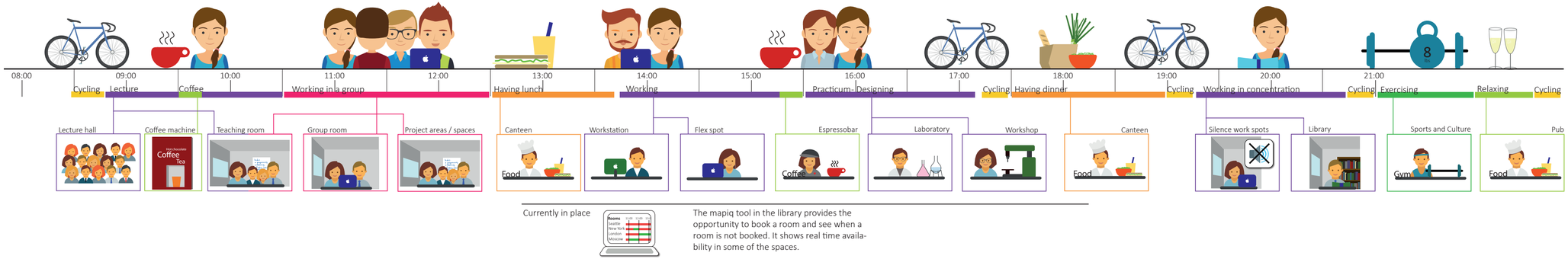
Mapiq is currently working in the library. Users can book rooms and see where different workplaces are situated in the building. For some spaces the availability of places is shown. Besides that, a pilot with lone rooftop has been done in the Industrial Design faculty and mechanical engineering faculty. This system will measure how the educational spaces are used in these two buildings.

The goal is to measure the occupancy of educational spaces. If they are not used, they can be made available for studying. It would be interesting to show how many people are in the room, so people know if they can join there to study. It is not about reserving spaces. A distinction will be made between silence rooms and ‘talkable’ rooms. The goal is to display the information of the specific room on a digital sign at the entrance of the room and in an application. A website is seen as a first step which is easier to get running then an application.

The first step is to get the management information. Later this information will be made available to users. The time span to finish these ideas is about three years.

Users

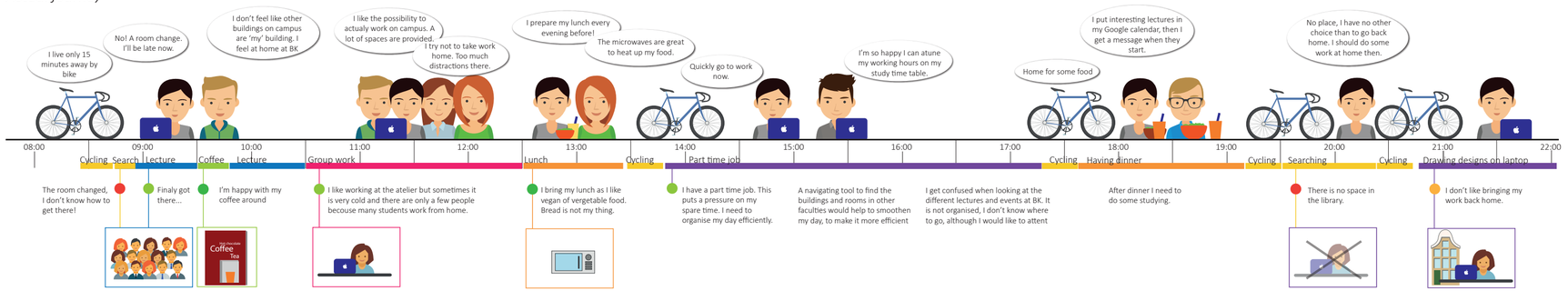
The average age of the student population is not given, but given the length of the study (5 y.) and the age most people start with a course, the average age should be around 20 – 23 year.
The average age of employees is :40,5 y. 19% of the students are international students and 53% of the staff is international. 56% of all BSc students pass for their BSc degree within four years. 35% of all BSc + MSc students pass for their MSc degree within seven years. The student population shows a growth from 13.253 students in 2005 to 21.651 students in 2016. It is difficult to tell if this trend will continue.



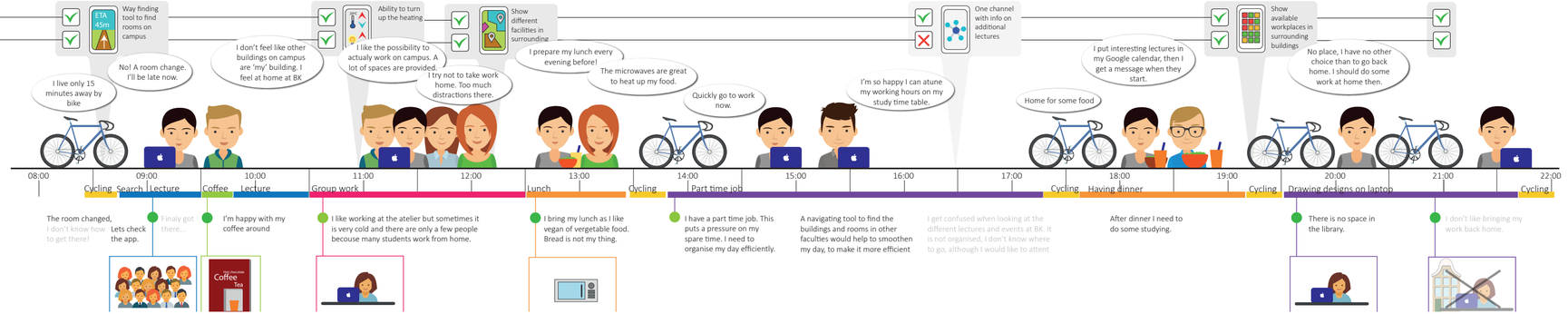
Are problems solvable with a tool?

Is the problem related to the workplace?

Actual journey



Redesigned journey



25 years old
since 6 months
Master student Urbanism
Faculty of Architecture
Satisfied with university

When the lecture room changes, because I'm always lost then. Also the information on additional lectures is very structured. It is very much on different channels.

The facilities on campus are nice. There are so many spaces!

A tool to navigate towards and inside buildings. So I won't be late after a room change.

A tool that shows the different workplaces at the campus would be great. Availability of these places and additional information on temperature would be even better!

User journey TU – A

Main workplace related problems
A room change results into a search on campus to the new lecture room on another faculty, which means that she would arrive to late in class.

- Outdoor way finding on campus.

The room temperature at the BK atelier spaces is not always high enough.

- Ability to adapt the room temperature

Finding a space in the library can be difficult at busy days. Providing information on availability or the locations of alternative spaces would be welcome. As she does not want to work from home, the possibility to work at the campus is important

- Real-time availability of workplaces

Other workday related problems which can possibly solved with smart tools
Due to the part time job, time management is important.
Streamlined information is preferred to avoid losing time on searching information on different channels. An example are all the additional lectures that are offered in the faculty, but it is hard to keep track of all these activities.

Additions
The microwave is an important machine to heat up her lunch.
If she studies in another building than the faculty of architecture, where she knows the way, this could be something to add on an indoor way finding or other map that shows facilities in the surrounding.

Proposed functions, derived from journey

1. Way finding tool to find lecture rooms on campus
2. Ability to turn on the heating
3. Show different facilities on and around campus
4. Show real-time availability of workplaces in surrounding buildings
5. Combine different information flows, e.g. of additional lectures.

User journey TU- B

Main workplace related problems
It can be busy in the library. Normally this interviewee goes early to the library to occupy a workplace, but this is not always possible. During exam periods, finding a spot can be challenging.

- Providing information on available spots in other places would be helpful. It should also indicate how many people are watching these available spots, so you can make an indication on the likability that the space is still available when you arrive.

Other workday related problems which can possibly solved with smart tools
There are no other workday related problems shown in the user journey.

Additions
The furniture in 'the cone' are sometimes cracking when somebody walks by. This cannot be solved with smart tools.

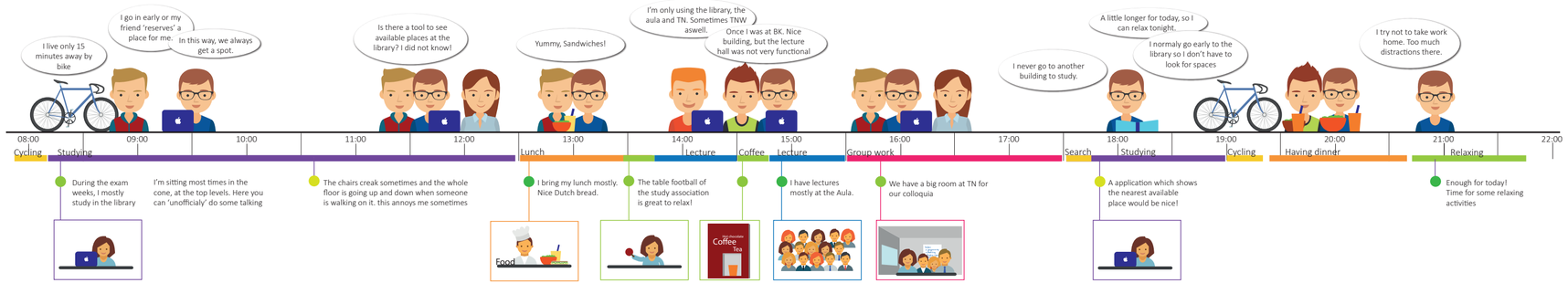
Proposed functions, derived from journey
1. Show real-time availability of workplaces in the surrounding.

User journey TU - B

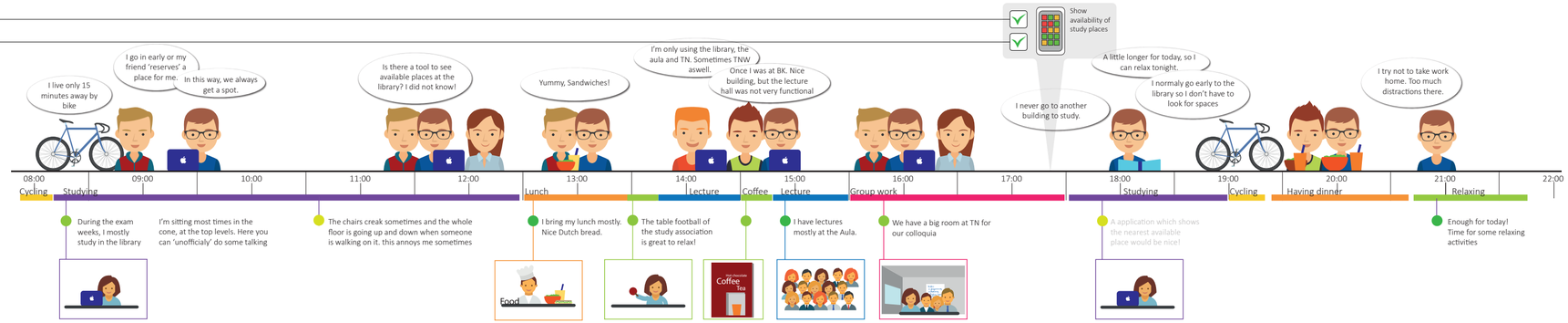
Are problems solvable with a tool?

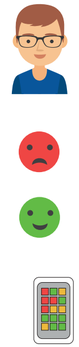
Is the problem related to the workplace?

Actual journey



Redesigned journey





18 years old
since 6 months
Bachelor student Applied Physics
Faculty of Applied Physics
Satisfied with university

When facilities are not working properly, like a creaking chair or disfunctional lecture room.

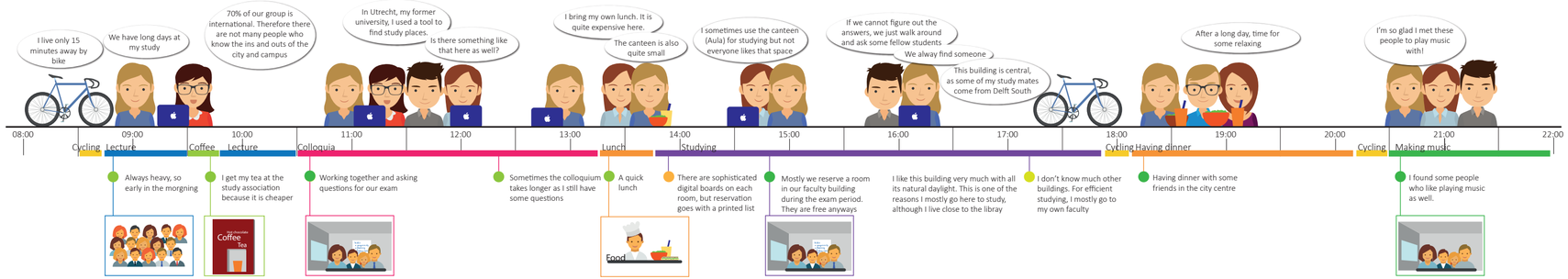
I like the different facilities and the football table at the study association!

A tool that shows the availability of places would be great. It should also indicate how many people are looking for those empty spots, so you can make an estimation if they are still available when you arrive.

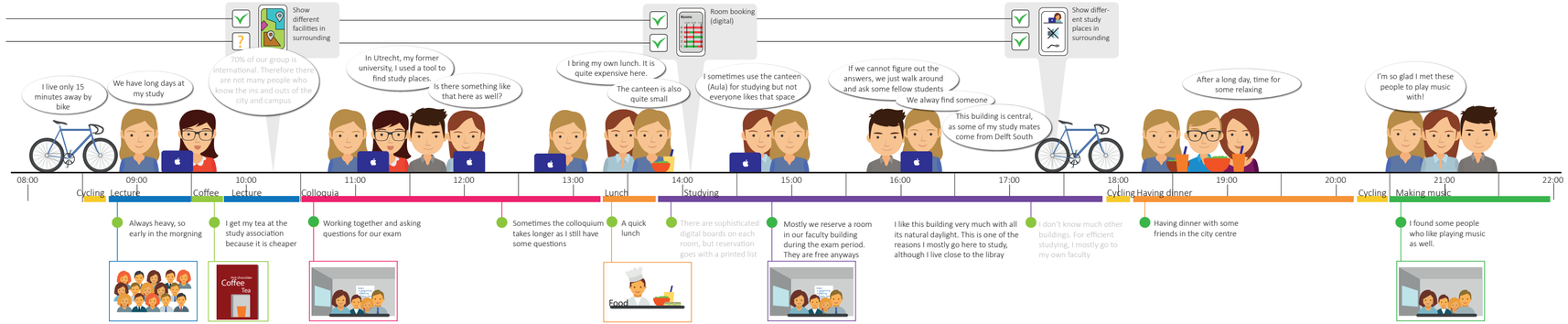
Are problems solvable with a tool?

Is the problem related to the workplace?

Actual journey



Redesigned journey



24 years old
since 6 months
Master student Applied Sciences
Faculty of Applied Sciences (TNW zuid)
Satisfied with university but misses some social relationships in the city

The sophisticated screens at all the rooms are great, but if I want to book a room, I need to go through a incomplete hardcopy list at a the service desk.

The TNW zuid building is very nice, much natural light.

A tool that shows the availability of studyplaces would be great. Now I just go to the places I know.

People finding tools can be helpfull but, I want to be able to 'close the digital door' when I want to. I don't necessarily need such an application.

User journey TU- C

Main workplace related problems
On each room hangs a digital panel but if this interviewee wants to book a room, this should be done by going through the list of room reservations and reserving a space at the service desk one day in advance. Although she likes the possibility to book a room, this analog way of room booking does not match the digital tools on the rooms.

- Digitalizing the room booking process and integrating this with the digital signage on the room would take this ‘frustration’ away.

She hardly goes to other buildings for studying, as she does not know how to navigate in these buildings and does not know what these buildings have to offer.

- Showing the different study places of buildings and, additionally, show their real-time availability as well will enlarge the options users have, when looking for a workspace.

Other workday related problems which can possibly solved with smart tools
This interviewee does not have much knowledge about the options the campus has to offer. A tool with information about facilities and maybe even some events would help to increase this knowledge about the campus facilities.

Proposed functions, derived from journey

1. Show different types of workplaces on campus (and their real-time availability)
2. Integrate digital room booking process with digital signage
3. Show facilities of the campus and campus surrounding

User journey TU- D

Main workplace related problems
During the exam period, this interviewee has sometimes troubles with finding an available workplace in the library. Because he starts his day very early, he'll find a spot, but later on it becomes crowded.

- Showing real-time availability of surrounding workplaces could help to release the pressure of the workplaces.

He often books project rooms in the library to work together with his study mates. He is not aware of the possibility to book these kind of spaces in other buildings.

- Showing the different types of workspaces on campus would help to provide a nearby project room. The pressure on the project rooms in the library can be lowered in this way.

Other workday related problems which can possibly solved with smart tools
There are no other workday related problems shown in the user journey.

Additions
Information on the availability of workplaces should preferably be provided by an application instead of a webpage. Taking out your laptop to find a suitable space is not preferred by this interviewee.

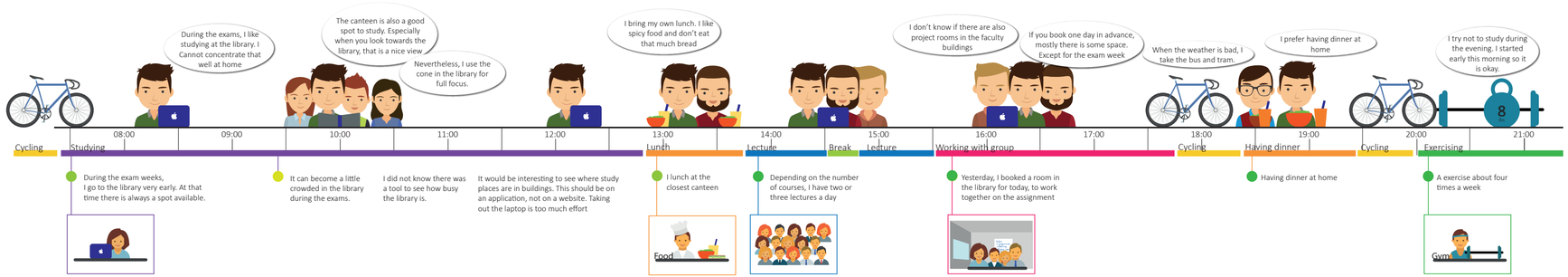
Proposed functions, derived from journey
1. Show real-time availability of study places
2. Show different types of study places, like project rooms. Preferably also give the availability of these spaces.

User journey TU - D

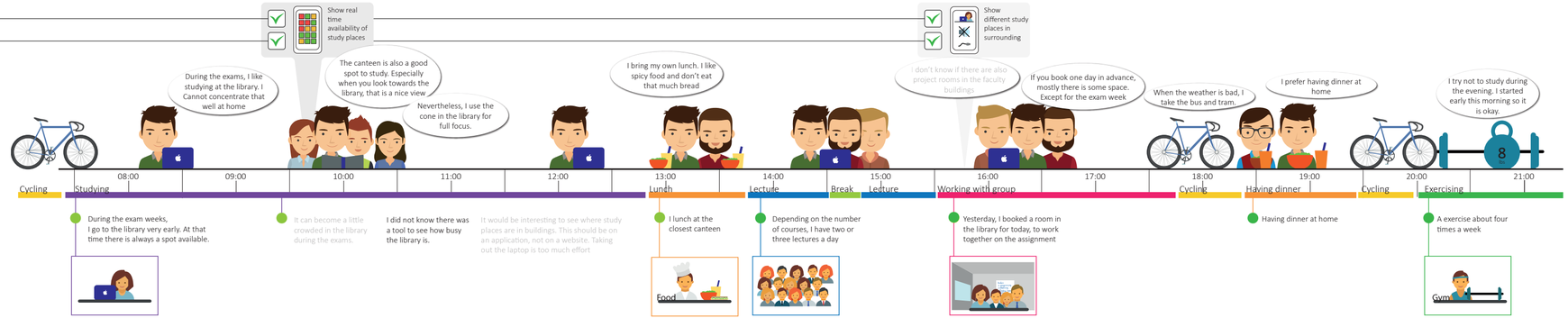
Are problems solvable with a tool?

Is the problem related to the workplace?

Actual journey



Redesigned journey



22 years old
since 6 months
Master student Electrical Engineering
Faculty of Electrical Engineering(EWI)
Satisfied with university

Does not like the Dutch weather. Especially when it rains and is stormy

The university and faculty in general. A tool that shows the availability of studyplaces would be great. Now I just go to the library to study.

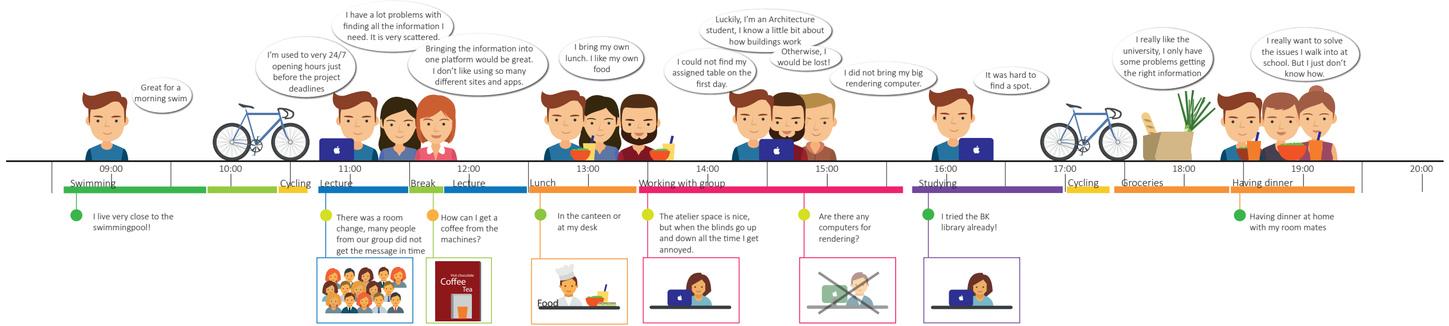
The information should be provided in a application, not on a website, as an app is more convenient

User journey TU - E

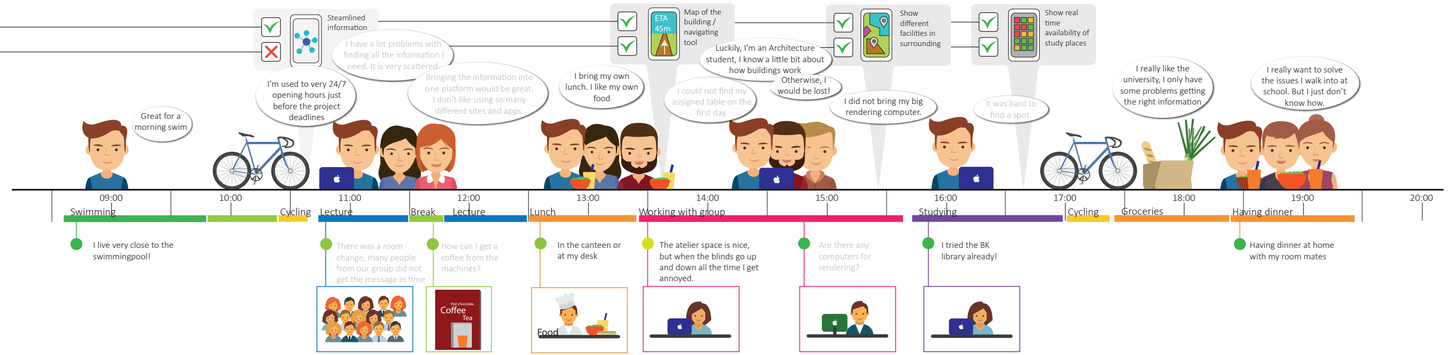
Are problems solvable with a tool?

Is the problem related to the workplace?

Actual journey



Redesigned journey



23 years old
since 11 days
Master student Architecture
Faculty of Architecture
Satisfied with university

The scattered information streams make it hard to find the right information. Many things are not connected, like my campus card and the coffee machine.

The university and faculty in general.

A tool that shows the availability of studyplaces would be great. It was hard to find a spot at the library

User journey TU- E

Main workplace related problems

The faculty building can be quite complicated as this interviewee was not able to find his project table the first day.

- Providing an indoor way finding application could resolve this issue.

He did not find any PC's for rendering on campus. Only one room with computers he found, but it was not clear for him if he was allowed to use these computers.

- Showing the different study places at the campus would solve this issue.

It was hard to find an available library spot.

- Providing real-time information on the availability of workplaces can help to find a free spot.

Other workday related problems which can possibly solved with smart tools

For brand new users, making sure the information on a room change is difficult as not all email accounts are already working properly or other starting problem occur. Streamlining information and providing on information platform can help to assist users and new users to access all needed information.

Proposed functions, derived from journey

1. Indoor navigation tool
2. Show different workplaces in the buildings on campus.
3. Show real time availability of study spaces
4. Streamline information, centralizing information.


25 APRIL 2018
2.

Synthesis

The main workplace related problems are identified in the user journey. The redesigned journey shows the possible smart tool functions that can be introduced in the journey to take these problems away or at least to diminish the impact. The verify if these introduced smart tool functions are in line with the vision of the campus and in what way similar functions are incorporated at other organizations, this synthesis is made. The main question is: In what way are the problems identified by new users aligned to the options delivered by currently available smart tools and are these smart tools already incorporated in the campus vision?

Case findings

All interviewed users put emphasis on the difference between a 'normal' week during the semester and an exam week. Activities are different during the exam week and the week before this week. Studying in a silenced area or working hard to finish the project are the only activities during those weeks. Most interviewees use the central library during this period. Although the university provides extra temporarily study places, the interviewees find it hard to find a study place during these weeks. Most interviewees prefer a place on campus as they are less distracted on campus compared to their homes.

Although every faculty building has possibilities to buy lunch, the majority of the interviewees are using microwaves to heat up their own lunch or bring something else.

The mapiq smart tool that functions in the library for room booking and finding study places, is not commonly known among the interviewees. One interviewee uses the tool for booking rooms in the library but was not aware of the information on availability. One other interviewee did not know how to find the smart tool and the other students were not aware of the tool or did not mention it during the interview.

Most interviewees use their own faculty building during the normal weeks and use the library during the exam period. Other buildings are sometimes visited to attend lectures, but the interviewees do not actively use these buildings for studying or group work. All interviewees use the library (4) or expect to use it (1). The presence of silence workplaces and other places that force people to work are mentioned as the reason to visit the library. Also the longer opening hours are the reason for some people to go there. Other study facilities, like the fellow ship, are not mentioned. Only one interviewee (TU-C) mentioned the fellowship after a direct question of the interviewer.

One interviewee (TU-C) was surprised on the analog way of room booking in relation to the digital signage on the room. Two other interviewees had difficulties with understanding the different information channels at the campus and were looking for a more centralized or streamlined medium where they could find all the information they needed.

Proposed smart tools functions

Based on the overview of functions preferred by users, listed in Table 7 on page 77 the folloring smart tool functions are proposed for this case.

Functions connected to planned journey

The planned smart tool is partly in line with the preferences of users.

- Showing available places in educational spaces will help to reduce the pressure on 'known' work places like those of the library and workplaces in the own faculty building.
- The distinction between silence rooms and areas where talking is allowed is preferred. Many users want to work together at some time. A silence room is not suitable for collaboration.
- The digital signage on the rooms will indicate the possibility to use the room or not. A reservation option for students for educational spaces is not intended.
- Way finding can be a result of the way information is displayed, e.g. when a map is used to show available spaces, this can also be used to provide information on where a faculty is. If a further zoomed in level will be made, also indoor navigating options are possible to implement. It is not clear jet how the information will be displayed, therefore it is too early to say that navigation is incorporated in the foreseen smart tool, but a possibility to incorporate the function is present.

Additional functions

Following the interviewed users, these planned functions could be extended with the following functions:

- Extend the display of different spaces, e.g. computer rooms, workshop places, coffee machines, shops and so on. Providing real-time availability of these spaces would be an additional function but not necessary. Providing information on what is around and if you are able to use it would help to show all the options the campus has to its possible users. 4 out of 5 interviewees are interested or do not know if project spaces are present at all buildings. 1 interviewee was interested in information on additional facilities like a lunchroom or café.
- A reservation option for small meeting rooms is already in place at the library, but in other buildings there is no clear vision on the possibility

Function	Number of requests	Additional explanation	Incorporated in Planned journey
Show real-time availability of study places	4	Indicate where work places are and if they are available (real-time)	Yes
Show different workplaces in surrounding (real-time)	4	Indicate where different workplaces are, like meeting rooms and silence areas and additionally show real-time availability	Partly, so far only 2 types of workplaces are incorporated
Show facilities on and surrounding the campus	1	Indicate different facilities on campus like lunch places and events	-
Wayfinding	1 (indoor) 1 (outdoor)	Show how to get to places on campus.	Indirect incorporated in plans
Integrate digital signage with digital room booking	1	Integrate digital signage with digital room booking instead of an analog room booking process at the service desk	Partly, reservation is excluded
Adapt comfort level	1	Possibility to adapt room temperature	-
Combine and streamline information flows	2	Bring together different information streams on basis information and manuals but also additional lectures and event in the faculty	(out of scope)

Table 7: Overview of functions preferred by users

for room booking by students. It is not clear if students actually want to book a room or just want to use a small project room for discussion some times. If the latter is true, showing availability of free spaces would already help users to find the space they would like to use.

- The interviewees mostly want to use rooms to not disturb other students around them and be able to discuss and have silence as well.
- Changing the temperature of the space, as one interviewee was feeling cold whole day. There are systems to adapt the individual workplace temperature but maybe providing information on temperature in different places can already help users to find a place that suit his or her wishes.

Smart tool example

Flowscape and Mapiq both combine the three functions of 1) showing real-time availability of several workplace types, 2) Room booking and 3) wayfinding. As the room booking function is not something that is preferred by the management, lone rooftop, plekchecker or the smart building app provide information on availability of workplaces on different levels of accuracy. The smart building app provides information on a desk level and can make a distinction between different types of places as lone rooftop and plekchecker provide information on a floor or area level with less information on the availability of different types of places. Depending on the ambition level and preferred accuracy of information, the above mentioned tools can be chosen. Contact directly with the smart tool provider of plekchecker or lone rooftop can also illuminate the more advance possibilities these smart tools have to offer. The preferences of the interviewed users lay between the options of flowscape and mapiq on the one hand and plekchecker and lone rooftop on the other hand.

Conclusion

The preferred smart tool functions following the user journeys are partly in line with the ideas on smart tools of the TU delft. The users show an interest in information on different types of workplaces. Following the functions that can be implemented in the journeys, two types of smart tool providers can be distinguished, on the one hand the more sophisticated mapiq or flowscape that provide a room booking function, wayfinding function and show different types of spaces and on the other hand plekchecker and lone rooftop which provide information on availability on workplaces on a floor level. Interestingly, with both mapiq and lone rooftop, a project is already implemented at respectively the library and two faculty buildings (see appendix).

ING, Amsterdam, The Netherlands

Introduction

Case angle
The contact person is from the facility services department. From this angle the smart developments at ING are initiated. Through conducting pilot studies with smart tools, different ideas are tested based on predefined users journeys.
To conduct this case study, the following people are interviewed.

Limitations
The interviewed persons to compose a user journey with are all very aware with smart tooling as they are involved in developing the IoT platform at ING. This can affect the findings as this may not represent the broadness of the ING employee.

Purpose	*function*	*Department*
Contact person and information on IoT platform / planned journey	Principal Product Manager	Facility Management
Map smart tool	(unknown)	Facility Management / Innovation Program
Actual Journey	Project Lead FABLAB innovation	Facility Management / Innovation Program
Actual Journey	Sr. Consultant	Facility Management / Programma & Project management
Actual Journey	Internet of Things platform	Facility Management / Innovation Program
Actual Journey	Internet of Things platform	Facility Management / Innovation Program
Planned journey, workplace concept	Consultant Workplacemanagement	Facility Management

Planned Journey
On the next page the planed journey of ING is shown. The illustration shows all the different places that are available on the (new) campus and illustrates the different ideas on smart tools.

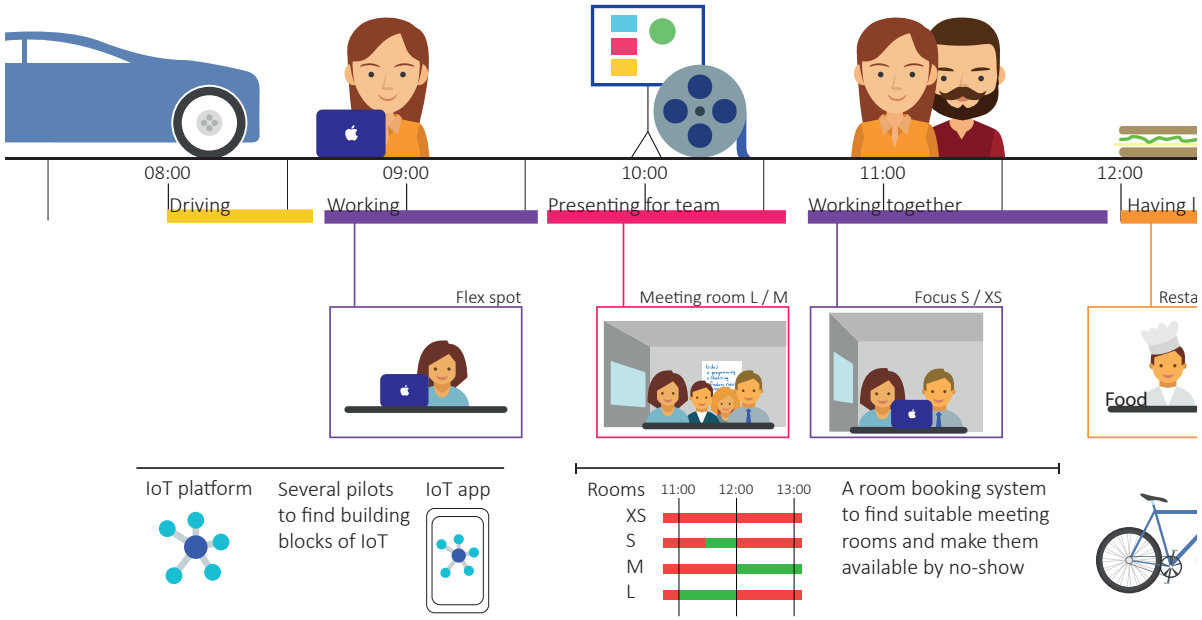
The orange workplace concept consists of a flexible workplace and meeting rooms in four different sizes, XS, S, M and L. In addition to this workplace concept, a canteen, library very large meeting rooms and informal collaboration spaces are realized.

Institution

ING is a private company in the banking sector. The discipline of banking is changing, ING is therefore increasingly focussing on digital services. “ING has become an internet company in the banking sector”, as one of the interviewees indicated. People are no longer visiting a local bank to arrange new loans or mortgages online.

Size: 51.000 employees
World coverage: 40 countries
Core business: Banking
Main vision: Empowering people to stay a step ahead in life and in business.

At this moment a new campus will be build, near the current offices of ING. This building will become the new Head Quarters of ING. The current HQ will be refurbished.



Campus

The campus location is situated in Amsterdam South East and is composed out of 8 buildings close to each other. Around 11.000 people are working for ING in this area. The general real estate vision is: Inspiring work environment, Simulating collaboration, spontaneous encounter, open and transparent and attractive for top-talent. When focusing on the workplace strategy, there is an aim to stick as much as possible to the 'orange workplace', a standardized workplace concept of ING. This concept can be used in a flexible way by offering different workplaces from hot-desking to different sizes of meeting rooms. Flexibe places are clustered in groups of 100, that belong to one section. The starting point is 15 sq m per workplace and a flex ratio of 0.8.

The campus is located in a livable area in the Schopping centre and event location 'Amsterdamse Poort' with various restaurants, bars, shops and event centres.

Smart tools

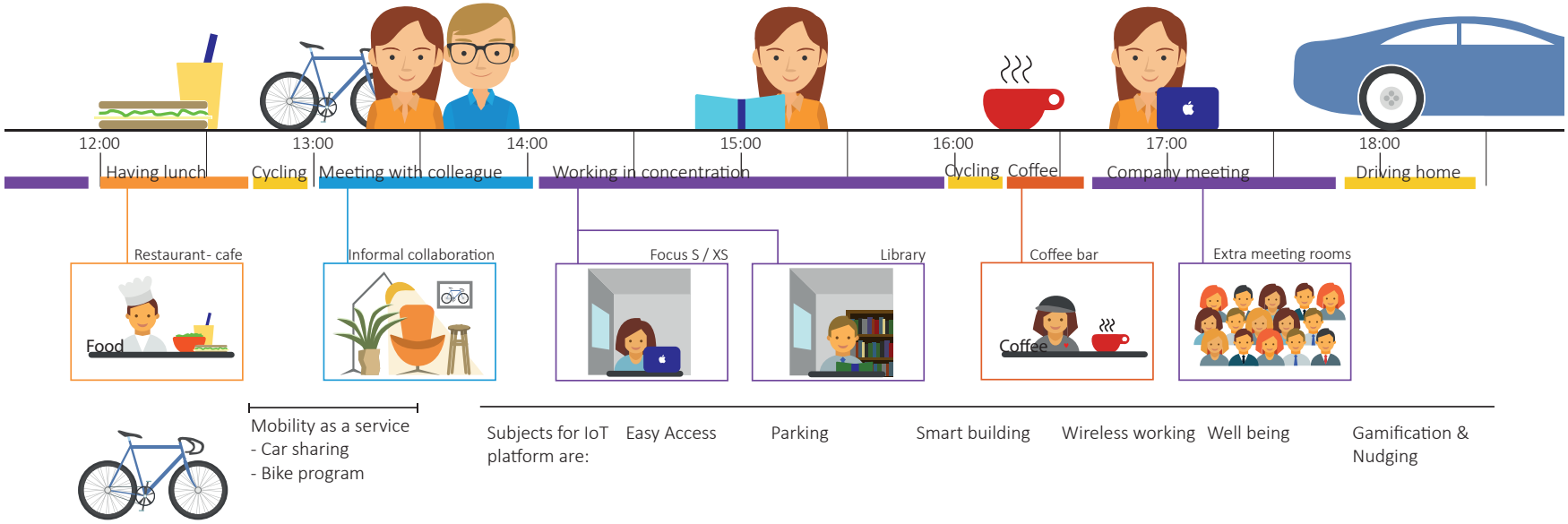
Current:
A lot of pilot projects are started to work towards an Internet of Things (IoT) platform and test smart tools as part of this network. For example, a shared cycle plan and a pilot on releasing non-occupied but reserved meeting rooms is now being tested.

Future:
The ambition is to develop an Internet of Things network which connects several devices. The focus points of the smart ambition are: Easy Access, Parking, Smart building, Wireless working, Wellbeing and Gamification & Nudging. Besides the user focus, information about occupancy will be used to steer processes and future decisions. This platform should be scalable and adaptable to be implemented at all ING workplaces and become more connected during its life.

Users

Currently ING is diminishing its size, although it was expected to lower the number of employees even faster. The better economic climate in the Netherlands and the amount of work it costs to changes processes lowered the speed of the expected decrease.

The focus towards IT requires attracting people with other knowledge. This results in a higher influx of international employees, mainly from Eastern Europe and India.



User journey ING – A

Main workplace related problems

- When there are no places available, workplace comfort will be diminished when working to long on a ‘short term’ workplace.
- It would be helpful to show the availability of workplaces in surrounded places
- She is not sure if it is allowed to use the ‘break out room’, socially speaking.
- Maybe an informational application can show the new features of the buildings and can promote a healthy and playful office life.
- She walks to another building to find a concentration spot.
- Providing a smart tool which shows the nearest concentration places would spare some time.
- Working from home can indicate that the workplace is not sufficiently supporting her work life. Nevertheless, it can also be a choice to work sometimes from home.
- A smart tool that shows different places can help to show users different options at the workplace.

Other workday related problems which can possibly solved with smart tools

- Sending a reminder to get some lunch would help her to stay healthy and full of energy during the day.
- By actively sending a message or give a recommendation to take a break and eat something could prevent her from going home early.

Proposed functions, derived from journey

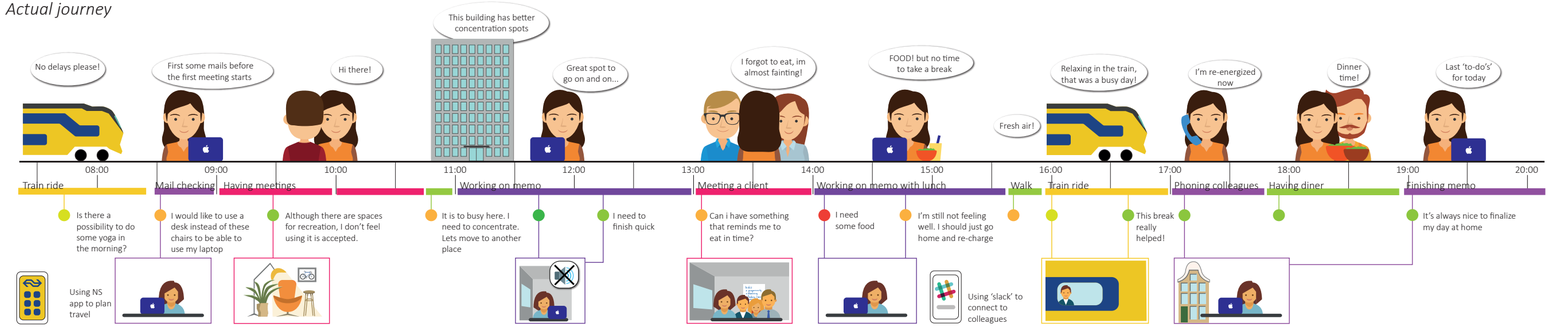
1. Show availability of workplaces
2. Show availability of different types of workplaces
3. Provide a proactive tool that promotes taking breaks and healthy living.
4. Show facilities in the surrounding to have lunch

User journey ING - A

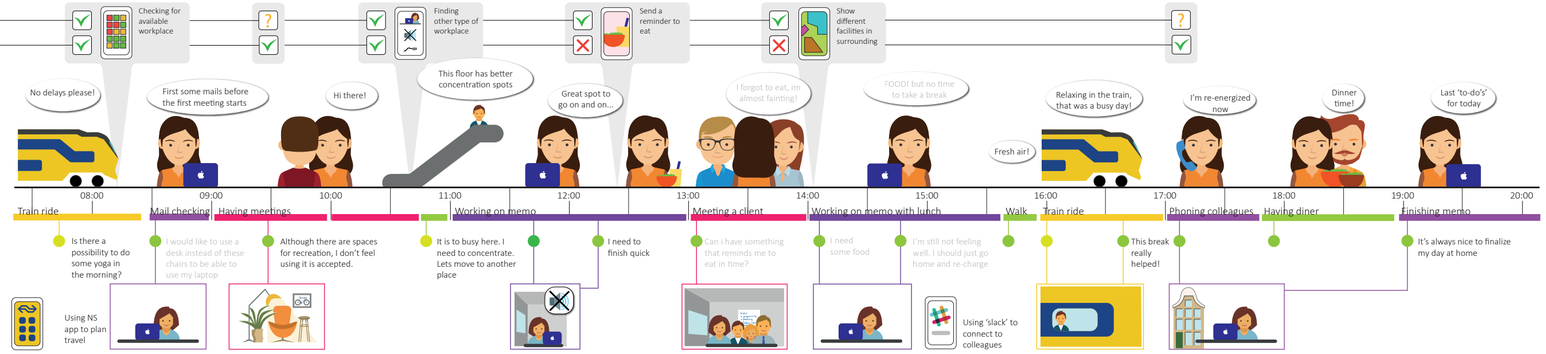
Are problems solvable with a tool?

Is the problem related to the workplace?

Actual journey



Redesigned journey



since 6 months
Freelancer at ING
Satisfied with job
Works on other tasks as well

Background noise during work and failing systems are the biggest annoyance at my work

The ICEC Workplace

People finder is great but to a certain extent. On a building level is okay, dont start right away with tracking to the exact place. For meeting new people, I use colleagues to introduce me to the right people.

Active noise canceling headphone to get rid of noise around you

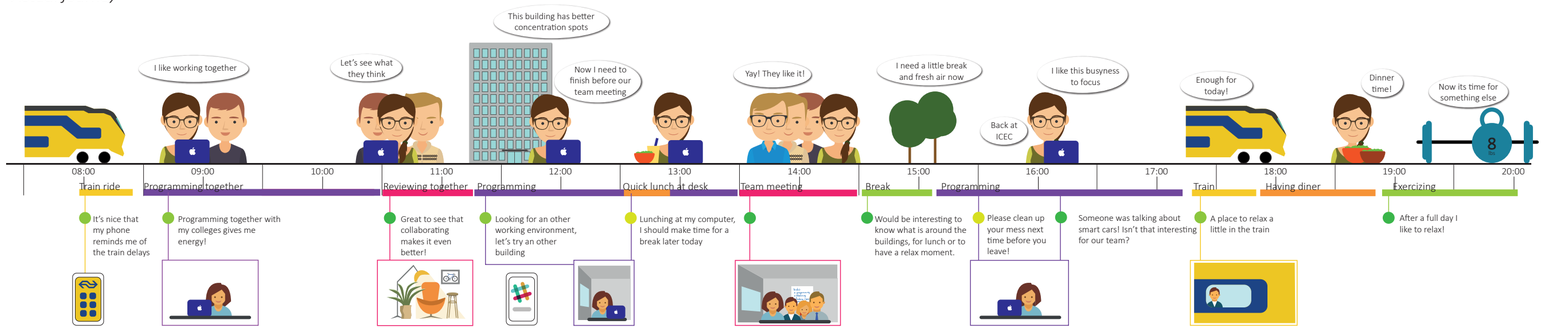
Information on spaces would be great but recommandations should not feel like advertisements. It should fulfill my own spatial wishes and, if possible, learn from my preferences.

User journey ING - B

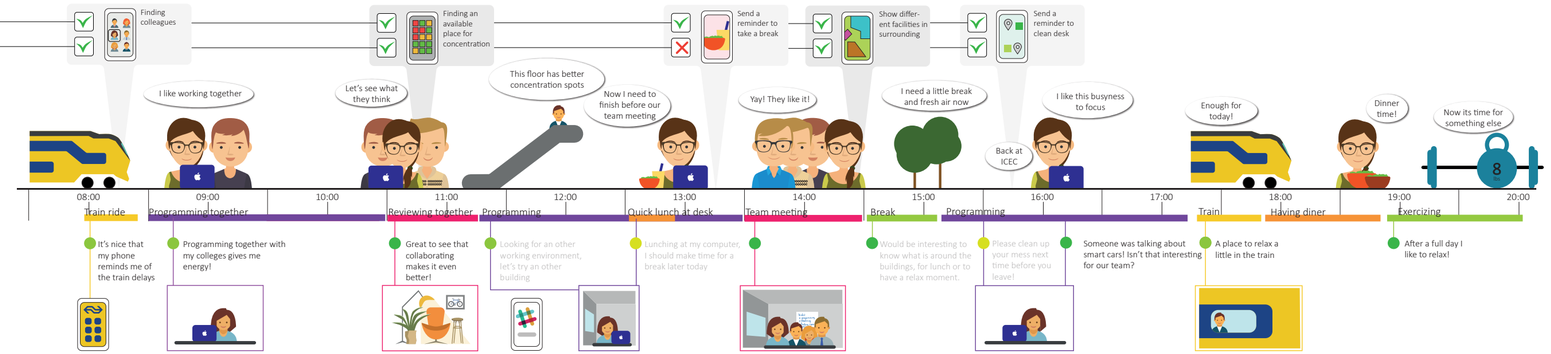
Are problems solvable with a tool?

Is the problem related to the workplace?

Actual journey



Redesigned journey



21 years old
since 4 months
Freelancer at ING
Satisfied with job

I don't like people who do not clean their desk. We have flexible spots, I just want to sit at a clean organised desk without stuff from other people.

It is good to have different kinds of workplaces

Advises on how to work efficiently or a device that helps you to become focussed again

I need some people around me, they give me positive energy.

It would be interesting to know what is around the workplace to work or meet people and see a different environment

It would be nice if the functions are all concentrated in one application

Information on spaces would be great but recommandations should not feel like advertisements. It should fulfill my own spatial wishes and, if possible, learn from my preferences.

User journey ING – D

Main workplace related problems
There are no big problems in this journey. Therefore also possibilities to make it even better are proposed.

- As she likes to work together with her colleagues, a people finder would be interesting to implement. This is only applicable when there are no assigned place, otherwise she will find her colleagues by going to her 'assigned flexible workplace'.

- She actively walks to another building to work in a different atmosphere.
- A smart tool that shows different places would help her to discover new spaces.
- She is curious about her surrounding environment. A tool which shows what is around her or sometimes recommends some places would help her to actually discover the surroundings.
- A messy workplace, caused by the former occupant, is something that annoys her.
- Positively influencing behavior by providing information or 'flexible working rules' can maybe activate people to clean up their desk when they leave.

Other workday related problems which can possibly solved with smart tools
Getting a reminder to do something later that day can be done in multiple forms like putting something in your agenda. On the other hand, promoting a healthy work life is something that can be done in an application. Recommendations based on your activities that day would provide her the information and reminders she wishes. How far do you want to go?

Proposed functions, derived from journey
1. Providing an overview of available places and the characteristics of these places.
2. Show different facilities in the surrounding area
3. Colleague finding tool
4. Provide active recommendations on taking a break and cleaning space.

User journey ING – C

Main workplace related problems

- Related to the workplace, not many problems can be identified from the journey. On the other hand, it is stated that the concentration tasks are difficult to practice from the workplace as there are many distractions. Providing insights in the concentration places in the building would maybe encourage to also do activities that need concentration at the workplace.

Other workday related problems which can possibly solved with smart tools

- Diminishing the amount on meeting is not something a tool can achieve, but encouraging people to have short meetings of walking meetings can help.
- As he also prefers, collaboration tools can help to smoothen collaborating with other people. Maybe this requires less meetings and more effective collaboration time by working together in the application.

Additions

He emphasizes the importance of the use of already existing tools instead of making a copy. This is seen in his day, as he uses lots of already existing smart tools to comfort his day.

Proposed functions, derived from journey

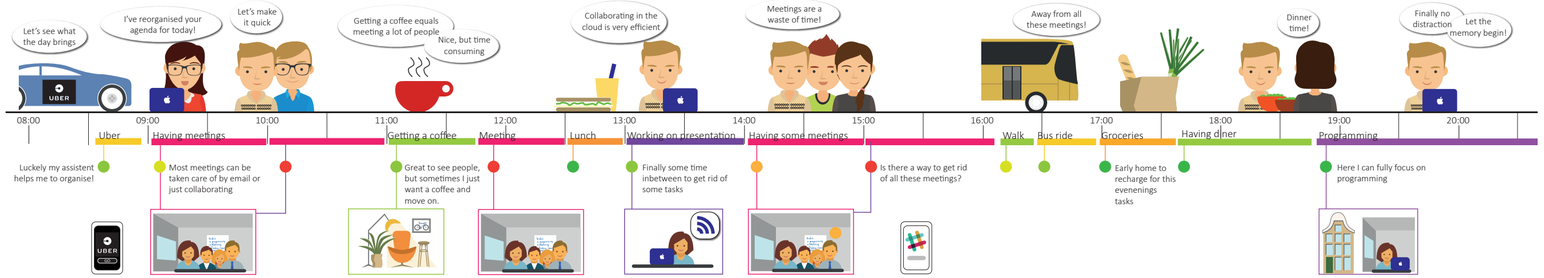
1. Showing available concentration spots in the surrounding
2. Provide information on alternatives for meetings
3. Provide a collaboration tool to speed up meetings

User journey ING - C

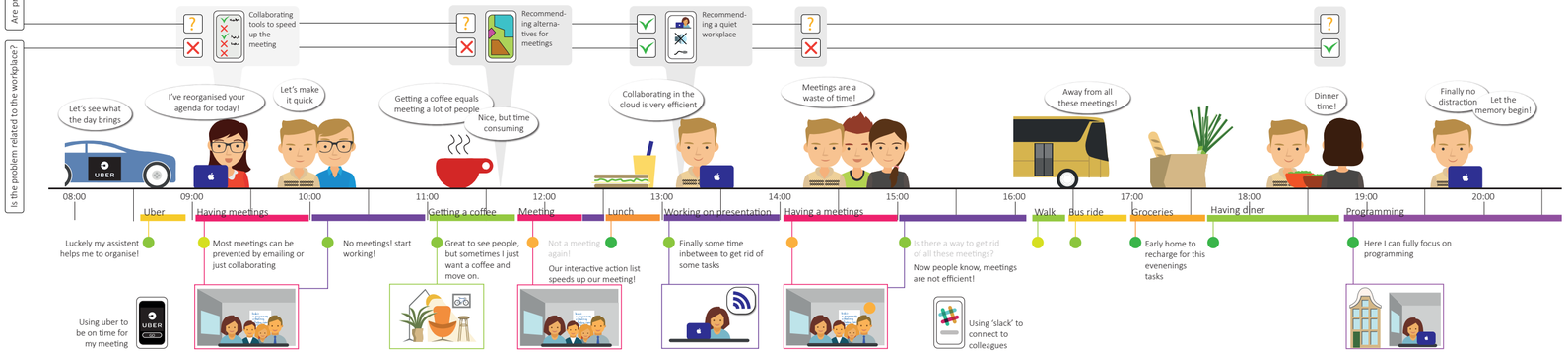
Are problems solvable with a tool?

Is the problem related to the workplace?

Actual journey



Redesigned journey



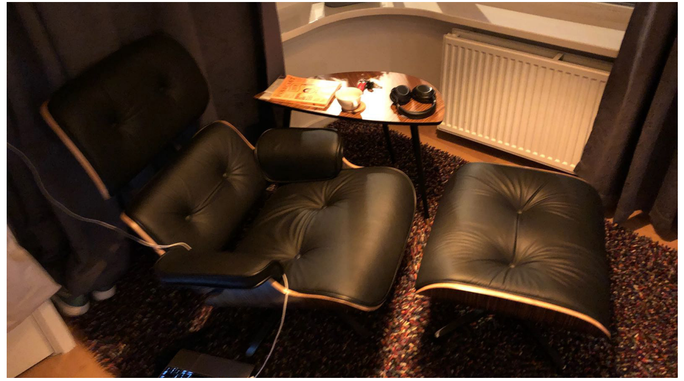
Freelancer at ING
Satisfied with job
Works on other tasks as well

Annoyed by meetings as they are inefficient. And I don't want to be distracted during programming tasks. I don't use tools to use tools, I use them to work effective. Take away the friction

The colleagues to work with

I use tools which are already there. My email is a tool as well. Slack, Whatsapp and traffic information are other examples.

Collaboration tools as Google drive are great. This is really a productivity gain!

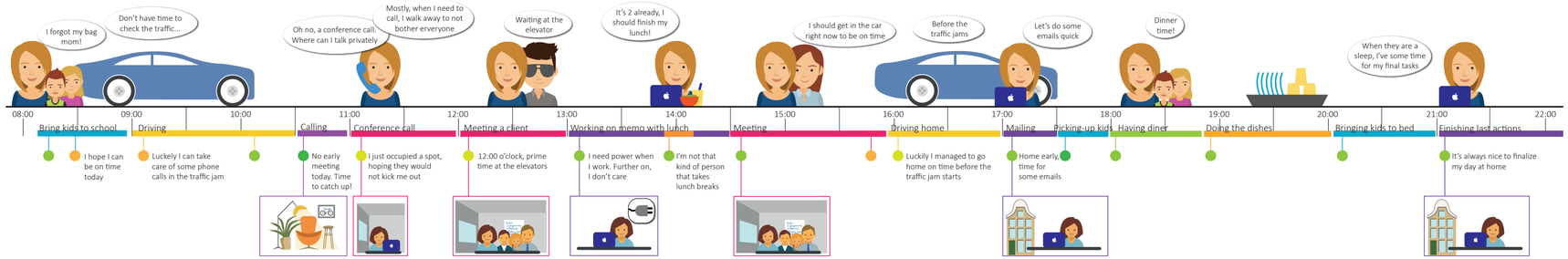


User journey ING - D

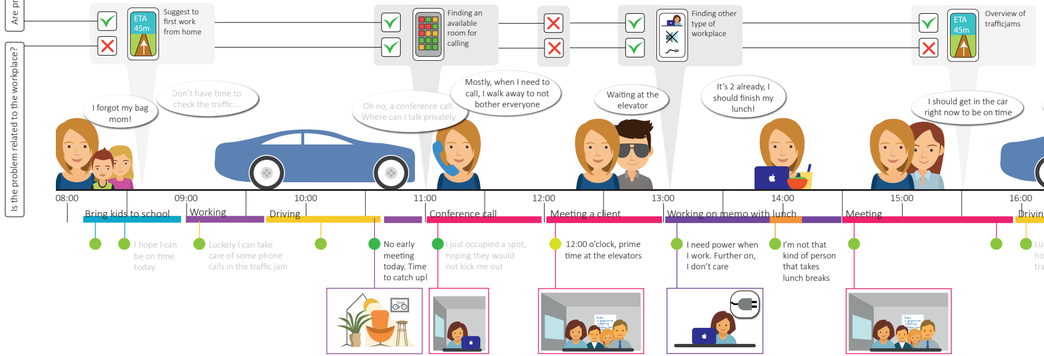
Are problems solvable with a tool?

Is the problem related to the workplace?

Actual journey



Redesigned journey



41 years old
since 2012
Freelancer at ING
Satisfied with job

I need to be back home on time to get my kids

I would really like a tool that shows available workplaces. I don't need much, just functional space for the activity i do.

I'm willing to switch to other places if that suits my functional wishes better.

I would really like to know what kind of amenities are around the campus. No I mostly recieve new spots by talking to other colleagues.

User journey ING – D

(does not match requirements on new campus user)

Main workplace related problems

- As you cannot always have a conference call when people are working around you, a small room would be great.
- Showing which places are available and also be able to see the future bookings would be a great opportunity to use a room when it is not booked.
- The only important facility a desk has to have is some power to charge the laptop
- Providing an overview of these kind of spaces would help to navigate around in unfamiliar places.

Other workday related problems which can possibly solved with smart tools

- When there is a slight delay in the morning, the traffic jams are mostly worse which makes it difficult to be on time at work.
- A navigating tool which shows the shortest route would good to have. Especially when this is connected to the calendar. Then the application could propose to stay home a little longer to work and avoid the big traffic jams.
- This is also applicable for the ride back home. As getting the children on time is such an important requirement.

Additions

- Smart elevators could solve the peak moments at the elevators.
- Apparently she enjoys finalizing her work at home. There is no need to facilitate her in providing extra insights in workplaces.

Proposed functions, derived from journey

1. Showing room availability and future bookings to be able to use it ad hoc.
2. Provide availability or places and their functions
3. Integration of outdoor navigating with calendar

Synthesis

In what way are the problems identified by new users aligned to the options delivered by currently available smart tools and are these smart tools already incorporated in the campus vision?

Case findings

ING has much ideas and high ambitions with its IoT platform and smart campus. The focus of this research only partly covers these broad ideas and will focus on the workplace related smart tools. The focus is on building a network of communicating elements (the internet of things), therefore the focus is not on finding one tool which can do everything but on finding the best suitable tool for a specific function. This is reflected in the notion of one of the interviewees who said that the measurement of rooms is completely different from measuring desks.

The preference to cluster departments has an influence on the 'need' of tooling to find a workplace. If people are only able to use one of these 100 places, the area to look for a place is much smaller than the complete campus and a people finding function is less valuable because everyone is close to that specific spot. The strictness of this clustering has therefore implications on the kind of smart tools that can be implemented, as the possibility to choose another spot changes. ING has also departments with different security levels, as they are a bank. This makes it more difficult to go to a total flexible workplace concept.

The interviewees' days, reflected in the journeys, show much opportunity for different kinds of tools. This is much broader than the workplace alone. Themes on health and productivity are frequently seen in the journeys. All interviewees are willing to swift places now and then for several reasons. They have a specific demand, for example a quieter workplace, and walk to another place. Currently, all of the interviewees are already using different applications during their day. As one interviewee said, copying an existing great application like we transfer does not make any sense, it will not be better than the original one. It is about taking away friction. So, integrating and using already existing applications can be also a way to make the workday more fluently.

IoT platform
The platform is made based on small pilot projects to see how the smart tool function can be implemented and if the function actually helps users. When the benefits are proven, it can be implemented into the IoT platform, which is owned by ING itself. In this ING is the owner of the derived data and has the option to switch to another system easily.

Table 8: Overview of functions preferred by users

Proposed smart tools functions

Based on the overview of functions preferred by users, listed in Table 9 on page 89 the folloring smart tool functions are proposed for this case.

Functions connected to planned journey

- The pilot project on releasing spaces when they are booked but not in use is requested in one of the journeys. It would help to work flexible, without the need to reserve a room all the time.
- Five other functions can be connected to the vision for the IoT platform; Showing the availability and characteristics of different workplace types, show different places in the surrounding, integration outdoor navigation, information on alternatives for meetings and a proactive tool to promote healthy living.

Additional functions

- Colleague finding application
- Collaboration tool to work together more effectively

Smart tool example
As the room booking function is already in a pilot phase, this function is not required anymore. The smart working app which also includes a people finding possibility and gives the ability to change the temperature and lighting. This last function is not mentioned, therefore the smart building app would be interesting to reconsider as well. This tool gives additional information on the level of comfort of the specific place. Combining this with the function of Spacefinder gives an overview of the different functions within and outside the buildings.

- The other functions are out of scope of the tool analysis. (part 1 of this chapter)

Conclusion

The functionalities derived from the user journey are similar to the already existing ideas on the development of the IoT platform. As this platform needs to be composed out of buildings blocks which have all a particular goal, like the pilot on room booking, the identification of functions is in this case a more suitable conclusion then the connection to available smart tools. The connection with the real estate vision on workplaces is important to choose the right function, as a vision on clustering workplaces can diminish the

ability of people to pick a spot in a totally different wing or building. A connection to HRM is preferred as most interviewees see the use of applications during their workday much broader then only the workplace itself. Health and productivity are important as well.

Function	Number of requests	Additional explanation	Incorporated in Planned journey
Showing the availability and characteristic of different workplace types	4 (different types of requests)	People ask for different workplace characteristics like concentration spaces and just another environment.	Partly, can be part of the smart building ideas
Show different places in the surrounding	2	To find a new place to eat or work, away from the main office.	Partly, can be part of the smart building ideas. Is in line with the future ideas on sharing bikes with other companies in the surrounding.
Room booking	1	The function should focus on using un booked rooms on an ad hoc basis.	Yes, a pilot is in place
Find a colleague	1	To know where your nearest colleagues are	Partly, can be part of the smart building ideas
Integration outdoor navigation with calendar	1	To streamline arriving and departing the office	Partly, can be part of: Mobility as a service
Info: alternatives for meetings	1	Exploring ways to shorten the meetings	-
Collaboration tool	1	To work remotely with colleagues.	Partly, can be part of the smart building ideas
Proactive tool to promote healthy living	2	Get recommendations to eat in time, take a break and so on. This can maybe help to change the culture as well.	Partly, can be part of: Well being / Gamification and nudging

Table 9: overview of functions preferred by users

Tech company, The Netherlands

Introduction

Case angle
Currently this tech company investigating the possibilities of implementing smart tools in their new campus building in the Netherlands. Together with CBRE and Royal Haskoning DHV, this smart project needs to be shaped to the preference of this tech company. In collaboration with these two parties and the real estate department of this tech company, this case is constructed.

Limitations
During the period of data collection, it was only partly possible to interview users to make an actual journey. Therefore, in two cases, the actual journeys are based on personas and evaluated within the team, see also the table above. These two 'composed' journeys are not based on one person's activities but on the activities a person like this could experience, based on information derived from a persona. This persona is made with the help of employees from different departments of the tech company. This method deviates from all other drawn actual journeys. Further information on the method to collect this data is given in the research method chapter and in the interview protocol in the appendix. The composed journeys are evaluated with the senior project manager real estate from the tech company and an advisor and consultant of both CBRE and RHDHV to verify if the composed journey matches the day of a booking employee in the section of both tech and product. The two other actual journeys are composed by conducting the preferred method. Nevertheless, one of these journeys does not match the requirements for the length of working at the organization.

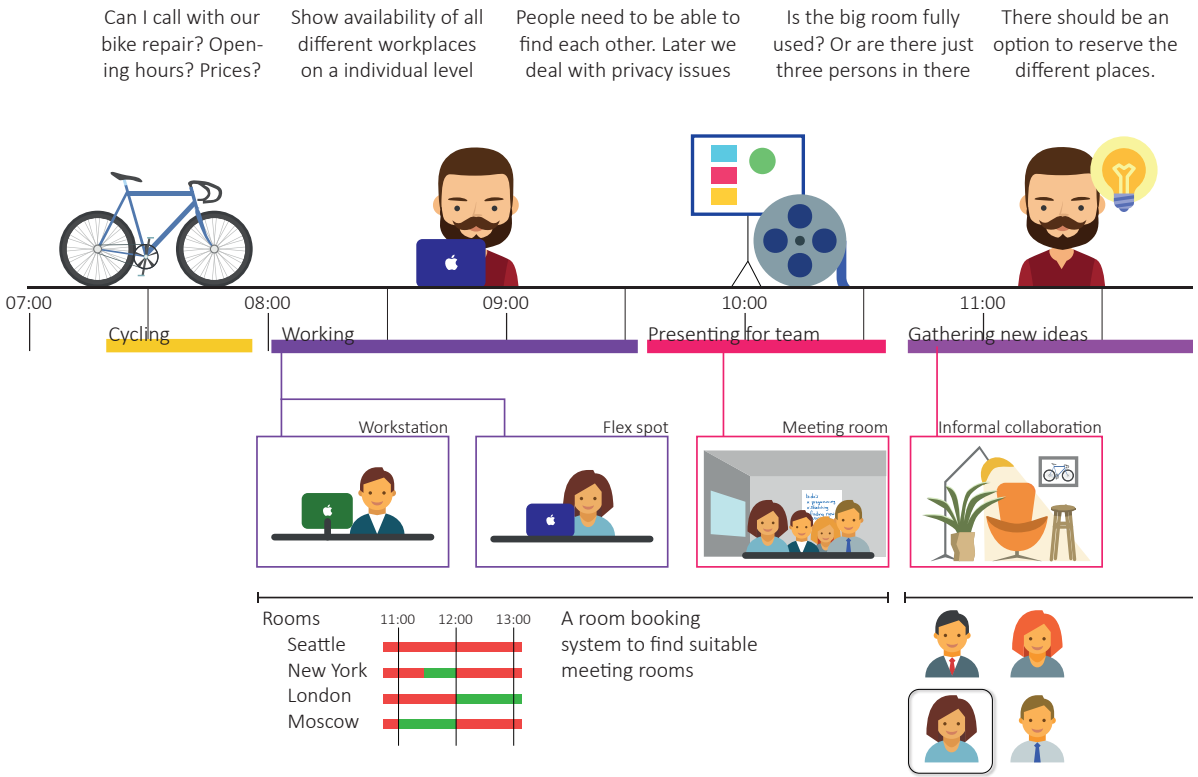
List with interviewees
This list is showed on page 92

Confidentiallity
Company related information is removed for confidentiallity reasons.

Institution

This tech company is founded in 1996 in the Netherlands. Nowadays it is one of the biggest e-commerce companies in the world.

Size	15.000 employees
World coverage	70 countries, 198 offices
Core business	e-commerce



Campus

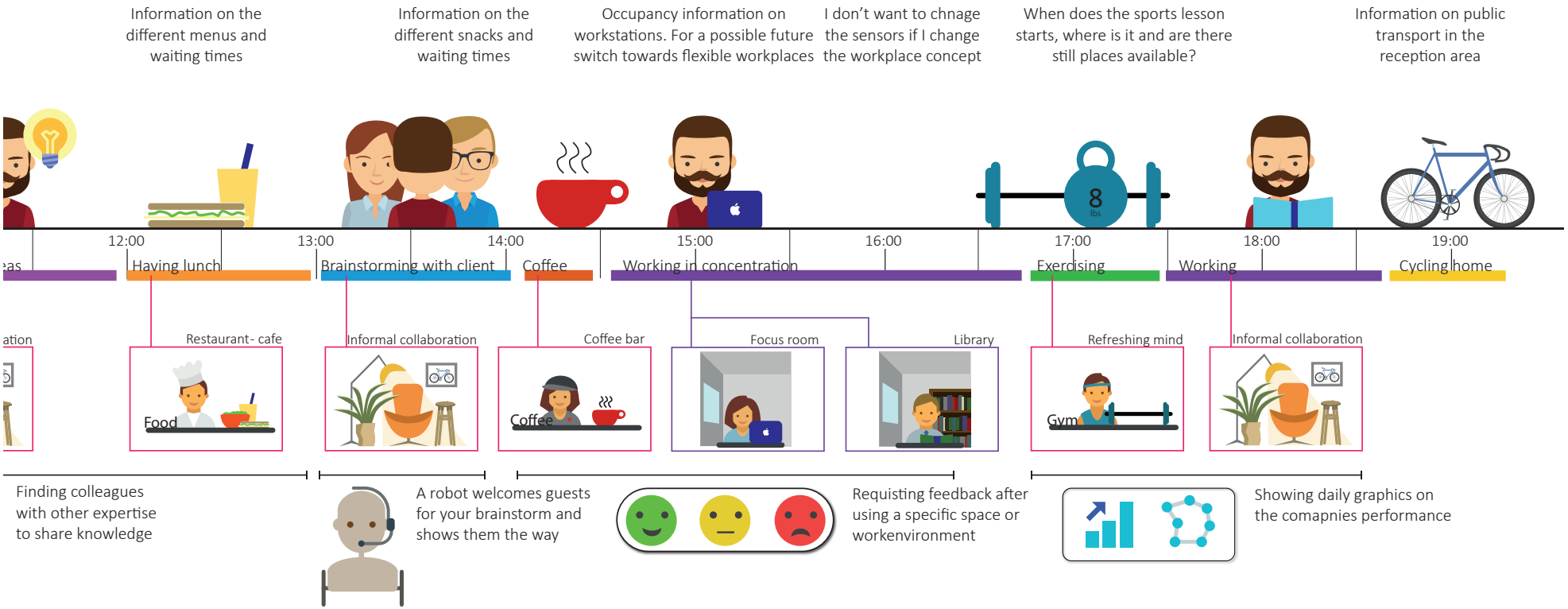
In the Netherlands, a new headquarters is built. With its 45.000 square meter and its campus philosophy, a big part of the company's employees will move to this building when it is finished. It is not clear jet which other offices will remain open. The general real estate vision for this new campus is: Seamless and Frictionless, intuitive, inspirational and inclusive. For the workplace concept, the activity base working principle is leading. The workplace should enhance agile ways of working, which is the main way of working at this tech company

Smart tools

Currently one of the initiatives the IT department is developing is an improved system for conference calling. This will be linked to the room booking process and calendars to smoothen the process of organizing a meeting (see further the appendix). Also a pilot with smart lighting is done in one of the offices. For the new building there is an ambition to make the building smart. Ideas derived from a focus group are about people finders and a robot to welcome guests at the desk. Also the ability to change the comfort level of the workplace is preferred. The smart tools should enhance the vision on creating a frictionless environment. Privacy is an important topic.

Users

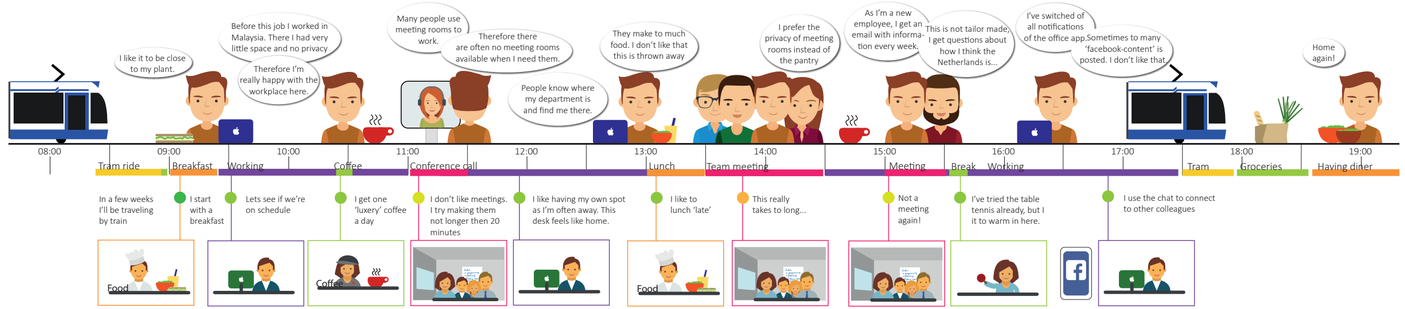
The average age of this company's employees is around 32y. 20% of the employees has a Dutch background. With 60 to 100 new hires the company grows very quickly. Depending on the specific function, 60% of the employees do not work longer than 2 years at the company. Therefore, most people who are actually working here are not experiencing the new campus, as they already left for another job.



Purpose	*function*	*Department (Company)*
Contact person, Smart tools, planned journey	Senior Project manager Real Estate	Tech company
Contact person, Smart tools, planned journey	Business director smart real estate	Industry & Building, Royal Haskoning DHV
Contact person, Smart tools, planned journey	Advisor	Project Management, CBRE
Planned journey, Personas	Associate Director	Workplace Strategies & Design, CBRE
Planned journey,	Senior Project manager	Project Management, CBRE
Planned journey,	Real estate	Tech company
Actual Journey	IT lead	Tech company
Actual Journey	IT member	Tech company
Composed Journey, based on persona 'product'	Reviewed with:	*Product*
	- Real estate	Tech company
	- Advisor	Project Management, CBRE
	- Consultant	Project Management, RHDHV
Composed Journey, based on persona 'tech'	Reviewed with:	*Tech*
	- Real estate	Tech company
	- Advisor	Project Management, CBRE
	- Consultant	Project Management, RHDHV

Actual journey

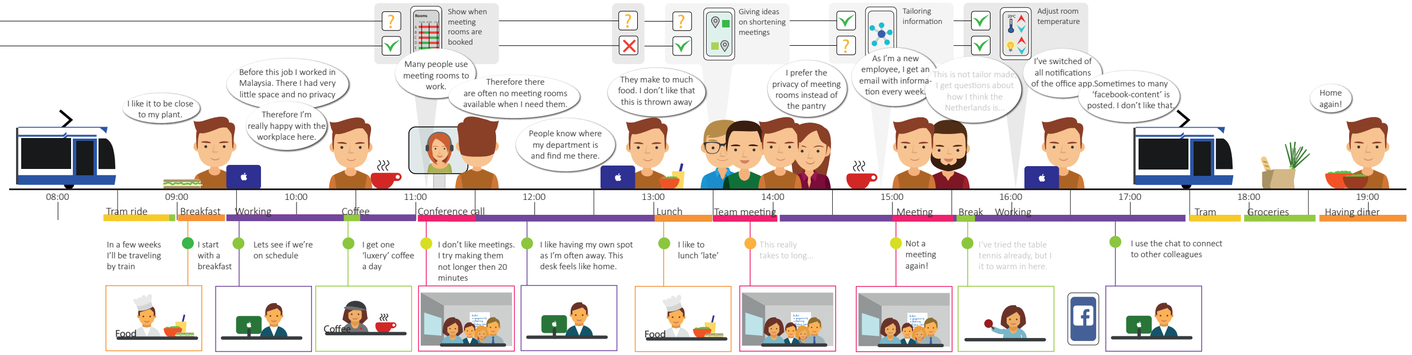
User journey TC - A



Redesigned journey

Are problems solvable with a tool?

Is the problem related to the workplace?



since some weeks
IT Team member
Satisfied with job

I don't like meetings. I try to make them as short as possible!

I like my workplace and the fact of having my own place.

Finding people on a people finder app would help. We have so many people in the buiding, this would make it easy to find everyone. I don't think there is a privacy issue.

'

User journey TC- A

Main workplace related problems

Meeting rooms are often used by people who just work in the space. Therefore many rooms are occupied and it is hard to find one when you really need one.

- Actively inform meeting room users when the room is booked so people won't stay to long in the room. Actively promote other spaces for collaboration tasks.
- This interviewee does not like meetings and prefer to make them not longer than 20 minutes.
- Providing environments to shorten meetings or give advice on how to shorten a meeting could help to take this annoyance partly away.

The office temperature is sometimes quite high.

- Providing an application to adjust the room temperature would help to resolve this issue.

Other workday related problems which can possibly solved with smart tools

New employees get impersonalized emails to get used to the organization and the country.

- Personalizing these information could be more effective.

The kitchen makes too much food every day and this is thrown away. The interviewee does not like this.

- Information on the number of people that did already visited the canteen and the total number of users in the building, would help the kitchen to reduce the amount of food at the end of the lunch.
- All kind of analytics on when people are going to have lunch could help to reduce the amount of food that has to be thrown away.

Proposed functions, derived from journey

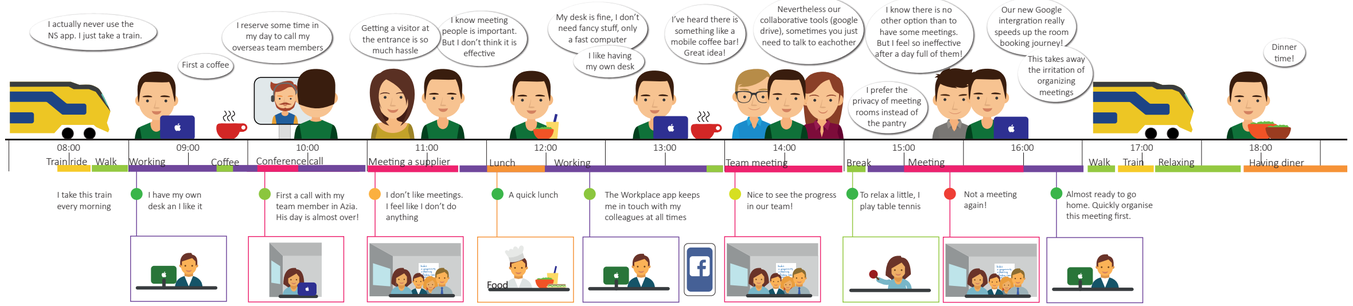
1. Provide information on when meeting rooms are booked
2. Actively give ideas on where other types of spaces are for activities like collaboration
3. Provide a tool to adjust the room temperature
4. Giving ideas on how to shorten a meeting
5. Provide personalized information for new employees

User journey TC - B

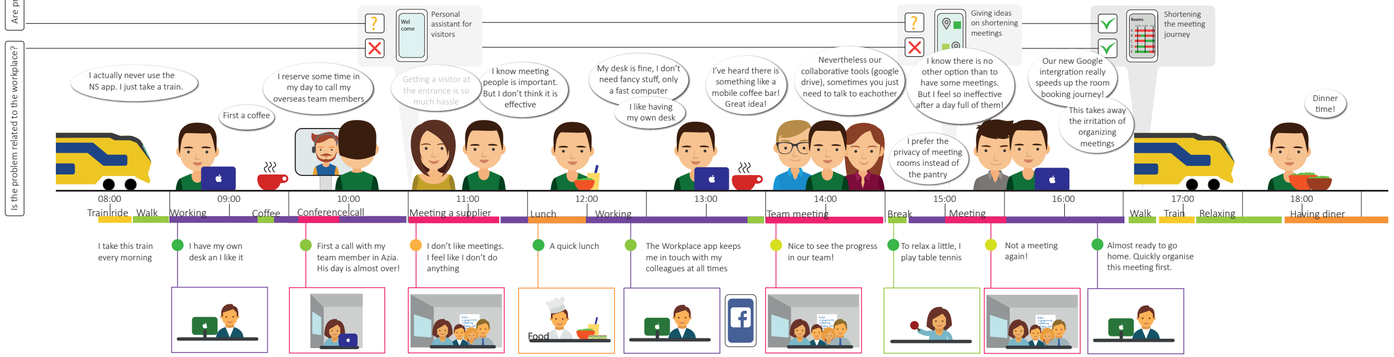
Are problems solvable with a tool?

Is the problem related to the workplace?

Actual journey



Redesigned journey



since 9 years
IT Team Lead
Satisfied with job

I don't like meetings. I know we need to have them, but I think it is ineffective.

I like my workplace, I don't expect much, just functioning equipment

Optimizing the meeting room journey, one of my onw projects, not only saves time, it also takes away annoyances.

Wayfinding in the building can be effective for visitors. I know the building and my own workplace.

User journey TC – B

(does not match requirements on new campus user)

Main workplace related problems

Setting up a meeting is a very time consuming process which requires a lot of steps. As the interviewee is involved in redesigning this process, this is a 'problem' decreases in priority but is still accurate because there is still improvement possible.

- The integration with email, calendar, conference call system and rooms is already started and will be improved in the near future.

Having meetings is not the favorite activity of this interviewee. An ineffective feeling is mostly the result at the end of the day when this interviewee attended many meetings

- Providing users with tools or ideas on how to shorten meetings could possibly shorten some of the meetings.

Other workday related problems which can possibly solved with smart tools

Suppliers who often have a meeting with this interviewee know the way in the building but are not allowed to walk on their own in the building. They need to be picked up at the reception. This takes long and involves an unnecessary amount of time.

- Finding ways to accommodate visitors with a pass or device which granted a limited access to the place he / she needs to be, for a certain time frame, would help to save time in collecting visitors but also gives them the feeling that they can be trusted in the building. A way finding application would enable this system also for new visitors.

Proposed functions, derived from journey

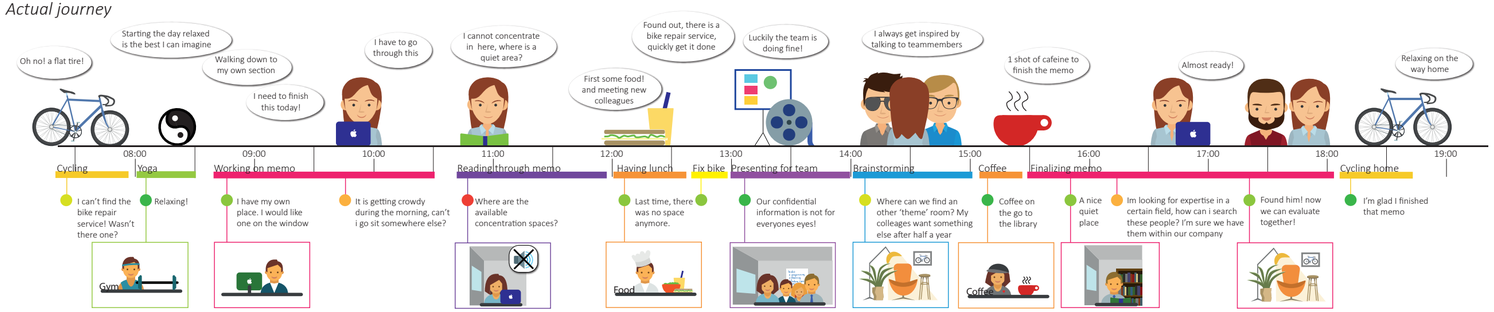
1. Integration of different systems from the meeting room journey.
2. Device for visitor to have access to parts of the building.
   a. With a navigation tool
3. Proactive tool which shows insights on how to shorten meetings

User journey TC - C

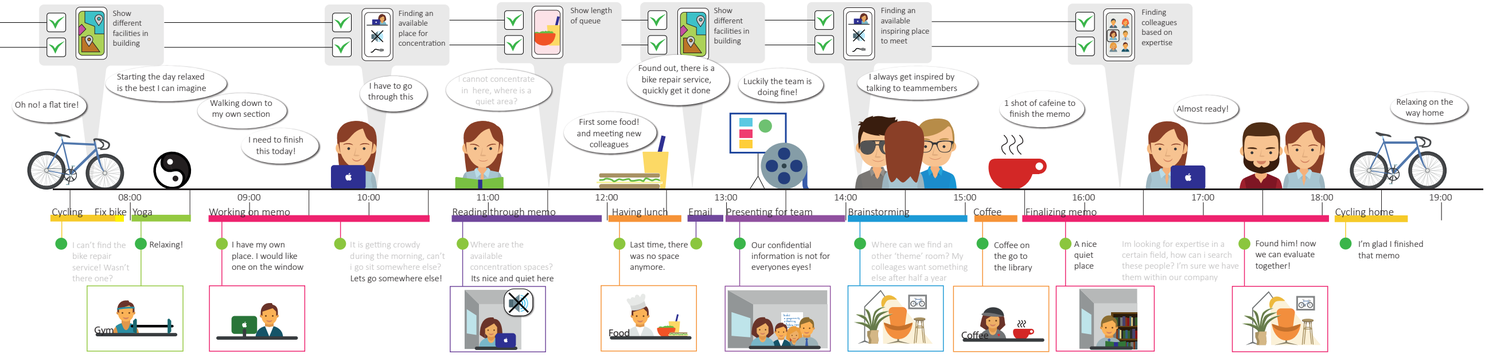
Are problems solvable with a tool?

Is the problem related to the workplace?

Actual journey



Redesigned journey



Based on product persona
since 3 months
Member of pruduct team
Satisfied with job

I don't like boring places, I need to be inspired.

Starting the day with Yoga makes me feel great! Also collaborating with people helps me getting through the day

Getting ideas on activities and work related stuff helps me to start to know my workplace

Information on the place and availability of different workplaces gives me the possibility to choose the right spot for that moment.

User journey TC – C

Composed based on Product persona

Discussion with experts

This journey could be a day of a product employee. The proposed smart tools are something the real estate department is looking into, to facilitate in the new building.To keep the full flexibility for the future also information on availability of desks is something this tech company would like to know. Although users will still have their own desk, based on the information derived from sensors, this strategy can change in the future. Also people finders are important in such a large building. The privacy issue that is connected to this function should be discussed and different variants should be compared. Information on public transport is still missing in this journey. Based on the criteria for the Breeam certificate, information on public transport should be available in the entrance hall. Ideally, this should also be connected to the software of the smart tools.

Main workplace related problems

When writing a report, a normal work station can sometimes be a little too noisy. Therefore it would be helpful to know where available concentration places are.

- Provide real time information on concentration places would help.

In a large building, the restaurant can be quite busy.

- Showing the busyness in the restaurant to prevent people from going there at the busiest moments of the day.

There are plenty of inspirational spaces in the building but we are using always the same one.

- Suggesting alternative rooms, when users are asking for it, could help to experience new working environments.

The building has so many experts on different fields. But how to reach all these different experts when there are so many of them.

- A people finding application, based on fields of expertise, would help to share knowledge in such a large organization.

Proposed functions, derived from journey

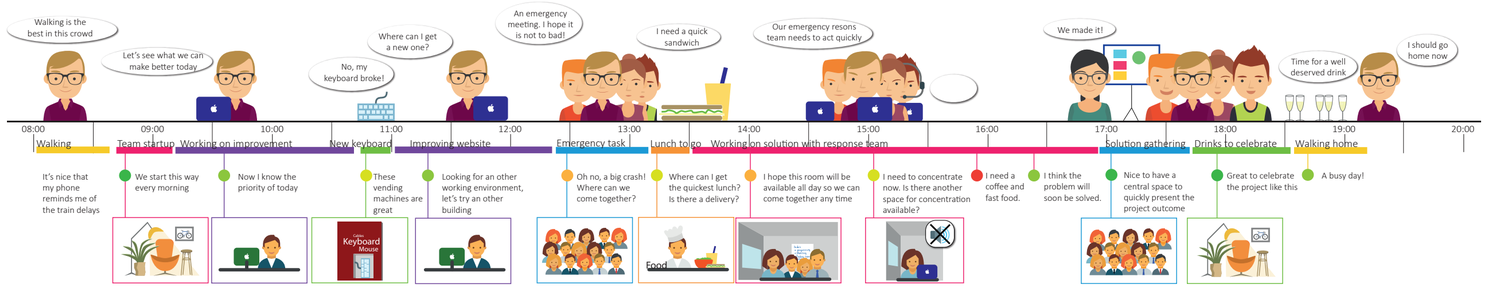
1. Show real-time information on different type of workplaces
2. Also in differences within a group. E.g. Another brainstorm room.
3. Show real-time information on different facilities of the building
4. A people finder.

User journey TC - D

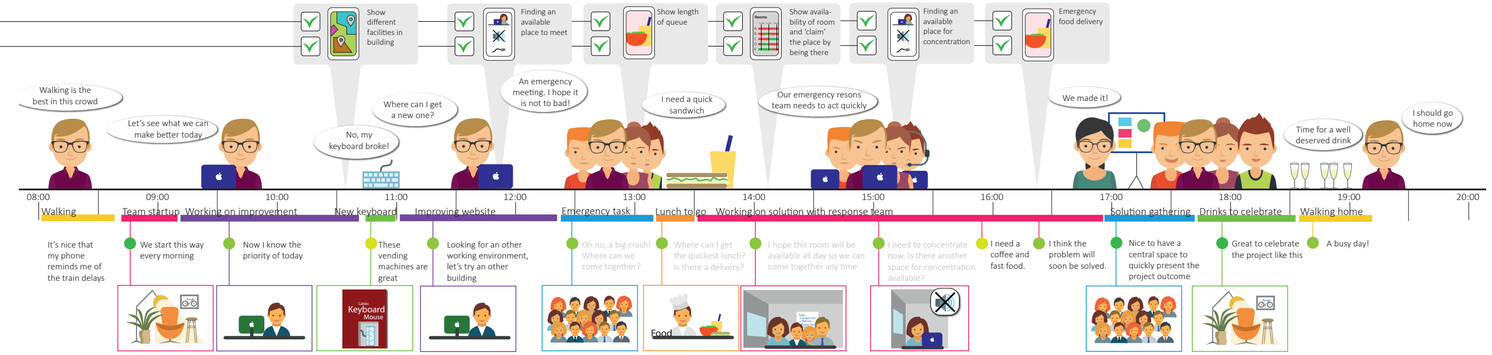
Are problems solvable with a tool?

Is the problem related to the workplace?

Actual journey



Redesigned journey



Based on Tech persona
since 5 months
Team member Tech
Satisfied with job

I don't like it when my computer is slowing me down. I don't want to wait on it.

Celebrating wins. This releases the pressure I sometimes experience during the day.

Information on the availability of rooms and the possibility to claim them for a tiny moment helps to work flexible.

User journey BO – D

Composed based on Tech persona

Discussion with experts

In this journey, all elements could be part of the day of a tech employee. Adapting the comfort on a desk or group of desks level is not included. This could also be a function that this tech company wants to explore. The level of accuracy that is preferred by this tech company is on the individual desk level, not on a more general floor level. In this way, the derived information can also be used for future workplace strategies. It is not clear jet, if it would be the best solution to use one sensor throughout the whole building or to tailor this on the specific activity and function. E.g. a different sensor system at the restaurant than at the workstation.

Main workplace related problems

The vending machines where a new mouse or keyboard can be collected are great. An overview of the places where these kind of functions can be found would be great.

- Provide an overview of all additional services in the building.

Sometimes a meeting room is needed right away. How can we find an available one?

- Provide real-time availability of the meeting rooms
- Make it possible to 'claim' a space are entering the meeting room. This prevents that the room will be booked by other users.

After the emergency meeting, a quick lunch is preferred. But where is the shortest queue?

- Show the busyness of the different lunch places
- To help people who are under a large amount of stress, additional services can be thought of like delivering food.

Working together is nice but a place for concentration is sometimes needed to focus.

- Show the near-by available concentration place.

Other workday related problems which can possibly solved with smart tools

As this journey is constructed based on personas, other workday related problems are not thought of as this exceeds the scope of this research.

Proposed functions, derived from journey

1. Provide an overview of the different services in the building and provide information about busyness.
2. Provide real-time information about the availability of meeting spaces and make them claimable.
3. Show the real-time availability of different workplaces in the surrounding to match activity and workplace.

Synthesis

The main workplace related problems are identified in the user journey. The redesigned journey shows the possible smart tool functions that can be introduced in the journey to take these problems away or at least to diminish its impact. To verify if these introduced smart tool functions are in line with the vision of the campus and in what way similar functions are incorporated at other organizations, this synthesis is made. The main question is: In what way are the problems identified by new users aligned to the options delivered by currently available smart tools and are these smart tools already incorporated in the campus vision?

Case findings

The interviewees both point at rather specific problems in their days, not on general information. One of these specific problems is about the meeting room. A project is ongoing to reduce the time for planning a meeting both also the experience in the room will be optimized. Information on when the room is booked will also provide the flexibility to use a room when it is not booked. This focus on the meeting room can be explained by the fact that most employees have their own work station. Therefore there is no need to know the availability of desk in different settings. Only information on other types of workplaces is interesting for the user. The meeting room, in different sizes, is the only additional room that is present in the actual journey of interviewee A and B.

The term 'frictionless' is one of the main concepts in the vision of the new campus. Things need to go fluently, do not need extra attention, to make sure that the core activity 'doing your job' will not interrupted. This means that tools should work fluently but also mistakes by smart tooling should be prevented, to not cause any additional annoyances.

The vision on smart tools is still broad in this stage of the process. At this stage, it is important for this tech company that all kinds of smart tools can still be implemented in a later phase. So compatible hardware is important to keep the flexibility in the later phases of the process.

The information derived from the workplace will also be used for strategic purposes. The interview with the real estate department helps to illuminate the ambitions of the organization. Knowing the occupancy of desks can be helpful to develop a future office strategy on flexible working. This is something this tech company is interested in monitoring for the future.

Proposed smart tool functions

Based on the overview of functions preferred by users, listed in Table 10 on page 98 the folloring smart tool functions are proposed for this case.

The focus on improving the meeting room journey reflects the preferences derived from two actual journey and one composed journey. Showing real-time availability of the meeting rooms on the room itself can help to make this 'journey' even better by providing insight in the reservations. This helps people who use the room to know when they should leave the room and gives people the opportunity to use a room for a couple of minutes when it is not reserved.

Functions connected to planned journey
At this moment, this tech company wants to have the flexibility to implement many functionalities and also add functions later on in the process. Therefore the scope is broad at this moment. All mentioned functions are still fitting the scope of this tech company, in a later phase a decision will be made if a specific function will actually be implemented.

Smart tool example
The room booking functionality will already be developed based on the current systems. Therefore this smart tool example focusses on delivering the other preferred functions, which are derived from the user journeys.

As the range of preferred functions is quite large, from showing the availability of different places to adjusting the temperature and finding people, a more complex tool seems to be the way to go. When reviewing the classification on different smart tools, see page 46, there are three options which partly fulfil these preferences namely the Smart working app, office 3.0 and Mapiq – Philips. The most notable difference between these smart tools are the level of accuracy. Both the smart working app and office 3.0 are based on one single workplace or person. The Mapiq – Philips combination focusses on a group of tables.

The Delve / workplace analytics combination would be interesting to look at as this 'people finding' smart tool focusses on the same functionalities as requested in the journeys. Finding people based on their expertise, not their current location.

Also the Spacefinder application can be an inspiration

for booking. By filtering out the preferred facilities a user wants to use, different options will be recommended. Also the overview it gives can be used as an example to show the different services of the building and beyond. Equipping this function with real-time information would give it an extra dimension.

Frictionless
An important aspect of the vision document is a friction less environment. Therefore it is important to take a closer look at how the specific smart tool will be used by its users. For example, the Mapiq – Philips smart tool requires to log in at a desk. As part of this frictionless vision, this is therefore maybe not the most suitable smart tool example for this tech company.

Conclusion

The functionalities derived from the user journey meet the ideas sketched in the vision document. There is a high ambition on smart tools which is not very specific jet, in this early stage of the project. A high level of flexibility is preferred to have the possibility to anticipate on specific preferences that arise in the near future during the designing process but also during the use phase. The current strategy on assigned workstations does not influence the choice for smart tooling, as the organization wants insights in use to monitor and react on this information. Therefore a connection between the smart tool functions and the management – support layer is important, as the measured information about the workstations will in the beginning be only of value for this 'client' of the system. When flexible working will be implemented, this information will also be of value for the users.

Table 10: Overview of functions preferred by users

Overview of functions preferred by users (only A & B)

Function	Number of requests	Additional explanation	Incorporated in Planned journey
Room booking	2	1) Information in the room on when the room is booked 2) Shorten the process of the meeting room journey	Yes
Adjust comfort level	1	Possibility the change the temperature of a specific area	Not clearly but fits the scope
Additional information	2	Provide ideas on shortening the meeting	Not clearly but fits the scope
Indoor navigation	1	Provide indoor navigation and access to specific areas for a specific time frame to frequent visitors	Yes
Additional information	1	Personalized information for new employees	Not clearly but fits the scope

Overview of functions derived from composed journeys (C & D)

Function	Number of requests	Additional explanation	Incorporated in Planned journey
Show real-time availability of different workplace types	2	Provide information on different types of workplaces and also about different styles within this type	Not clearly but fits the scope
Room booking	1	Show when places are booked and make them claimable.	yes
People finder	1	Provide information on the different expertise's that are present at the organization	yes
Show real-time information on additional services	2	Show the a place and busyness of different services like the restaurants, coffee bar and vending machines for new equipment	Not clearly but fits the scope

Synthesis

In this chapter the findings of this study will be connected to the literature and related to each other. First the synthesis chapter will compare the four in-depth case studies and draw some parallels to the smart tool findings. The conclusion will answer the main research question and present an product and process based advise for the campus manager. In the discussion, limitations and recommendations section, the research will be reflected to other literature and recommendations for further research will be listed.

Synthesis

In the previous chapter conclusions are made on the basis of a single case and based on the smart tool analysis. The information derived from the four cases gives an insight in the smart tool functions that could be implemented and shows the vision of the institutions on smart tools. The tool classification acts as an input to formulate the functional preferences of users as specific as possible. The sub research question that is central in this chapter is: What lessons can be learnt from the comparison between the case findings and the smart tool classifications to provide guidance for the campus manager during the exploration of smart tool possibilities at the campus. This is done to make a translation from the user preference and information on smart tool possibilities towards the perspective of the campus manager, who needs to weight possibilities and views from different stakeholders to define a strategy for managing the campus. The conceptual model is used to provide structure in this synthesis chapter.

Differences and similarities

The user journeys presented a large variety of problems which users encounter during their day at the workplace. The smart tools that could be implemented to smoothen these problems were therefore also diverse and going beyond the workplace itself. The planned journey was in all cases, to a certain extend, reflecting the user preferences. The two public organisations were planning on implementing less complex smart tools, in contrast to the more complex ideas from the two private organisations which were less specific at the point of reporting. The workplace is strongly related to the smart tool requests of users, as users who have an assigned desk are not searching for a workstation. The user journeys reflected this lack of interest in smart tools which show the availability of desks, but these users showed other focus points for example, requesting information about the meeting room. Besides that, information on the workplace occupancy was requested by the campus manager, as a basis for future workplace strategies.

New users

As mentioned before and stated on the information sheets of the user journeys, not all interviewed users meet the requirements of being no longer than 6 months connected to the organization. Also the journeys of people who were for a longer period present at the organization are included into the data set.

Navigation

When reviewing the difference between users who are connected to the organizations for different periods of time, three groups can be distinguished. Firstly, group A which consists people who are no longer than 1 month at the campus, secondly, group B which consists of users who are at the campus between 1 month and 6 months and thirdly group C, the group who is longer than 6 months connected to the organization.

The five people from group A show two different preferences. The two students were mainly orienting and finding ways to understand all the new impressions of their new environments. The three other interviewees, two PhD students and one employee had all their own work station and therefore less stress on finding their way to specific places.

The function that shows a relation to the ‘extend of being new’ is the way finding function. Counting all the times this function was requested results in the following Table 11. The two students from group A both requested a way finding application.

Table 11: Navigation

	Requests way finding	Does not requests way finding
< 1 month	2	3
1 > < 6 months	1	6
> 6 months	1	4

The users who would like to have way finding had specific moments when they would like to use that. The two interviewees from group A were interested in knowing how to get at a specific place and how to navigate in this building (AU – D) and (TU – E). One interviewee from group B would like to have an indoor way finding application when she needed to go to a new building (TU – A). The interviewee from group C requested a way finding functionality to find buildings that she was not familiar with (AU – E). So the function way finding is mainly requested by very new people to know how to get to different places and to people who explore new parts of the campus.

In the smart tool classification, the function way finding is only provided by Mapiq and is in all examples combined with the function 'show real-time availability of different workplace types' and 'room booking'. A map that show a certain available spot does indirectly indicate the position of this place, but Mapiq provides shows the route to follow to get to the specific place. It can be stated that other smart tools that show real-time availability of workplaces, provides a way finding function to a certain degree, depending on the way the information is presented. So, the solo functionality of way finding is a preferred function for brand new users (group A). To enlarge the options for workplaces that a campus user can occupy, a combination of possible available places and a way finding function to get to this place is needed. This is in line with the findings form Priestner *et al.* (2016) on the spacefinder application, presented in Figure 15 on page 20. This figure shows that every month when new students arrive at the campus, the number of users is higher than other months. This smart tool does not provide availability which can in can be an interesting feature for existing users to enlarge their number of optional workplace.

Smart tools

A broad range of smart tools is requested by users. This range goes in many cases beyond the boundaries of the workplace. Besides that, also the connection to already existing 'smart tools', being WhatsApp or We Transfer, is mentioned. Some interviewees prefer WhatsApp to connect to others, instead of some kind of tracking device due to privacy concerns or just because they use WhatsApp already and are satisfied with it. The privacy concerns are mainly based on the large groups who has access to the information. Interviewees indicated that they are okay with sharing their location with close friends but not with the whole campus.

Future functions of smart tools

Monitoring is only the first step of the possibilities smart tools can offer following Baumer *et al.* (2017). Several interviewees were interested by the functions smart tools could offer but were also anxious to lose control over their life. Some advises were given based on the increased intelligence of smart tools:

- Recommendations should not feel as advertisements but should be carefully tailored. The possibility to turn such a function off would help earning trust. Also changing the information that the tool used to provide recommendations should be changeable by the user. This makes it possible to erase settings that do not reflect the interest of the user
- One interviewee related this intelligence feature to the function that Spotify provides. She stated that she did not like the recommendations of Spotify in the beginning but that, after half a year, they really helped her finding new music that completely reflects her taste. See Figure 30 for illustration.

Step 0 – providing information

Although the potential of smart tools, the function 'providing (static) information' was often the first step to assist users in making decisions in the workplace.

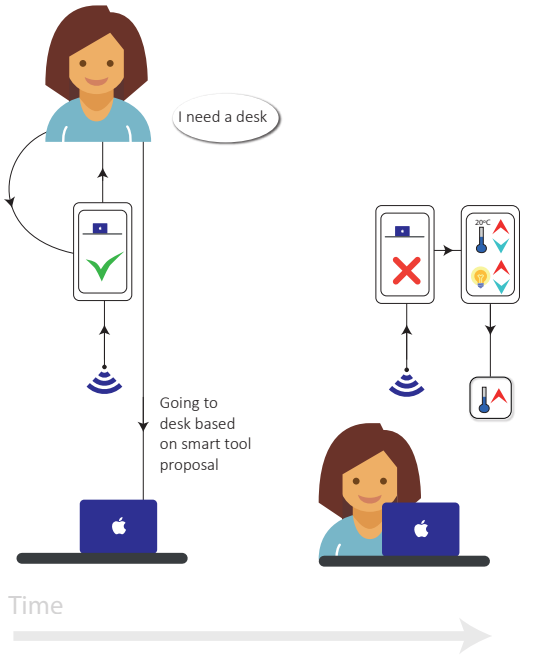


Figure 30: Working of a smart tool. own illustration

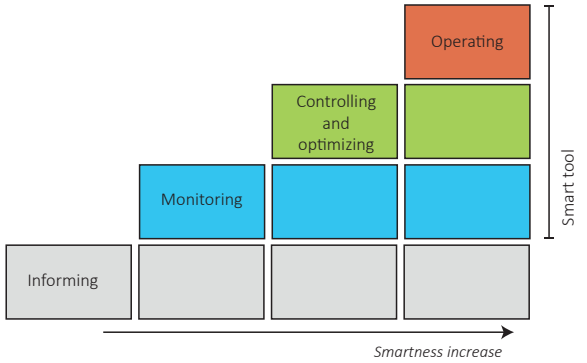


Figure 31: Step 0, informing. Added to the origional stages defined by Baumer et al. (2017)

Although, static information is not a 'smart' function, which requires a real-time data flow, and is therefore

not a part of a smart tool. Nevertheless, in some examples, implementing this step zero gave users already very valuable information. The Århus find application and Spacefinder from Cambridge are the best examples. All interviewees in Århus mentioned the application and thought it was very helpful, despite it only provided static information. Therefore the stages of Baumer *et al.* (2017) are extended with a 'step zero', which is informing. See Figure 31 on page 104 for the illustration.

Privacy

All interviewees react differently on privacy issues. Some do not have any problems with it, based on the statement that there is no privacy at work, only at home. Others have problems with being on camera but do not bother being measured. An often returning solutions was an opt-in and opt-out possibility integrated in the smart tool. This allows users to 'close to door digitally' for other people, to not get bothered when they want to focus or based on other reasons.

The framework proposed by Van Zoonen (2016) could provide insights on the difficulties and or objections users can have with technology that collects data about their presence or activities. In the TU delft cases, an experiment was executed with a countcam, a camera that counts people. Many people had questions what the camera above the door was doing. The framework can anticipate on associations users can have with specific smart tools and their related measurement methods. In this way a communication plan can be developed to precede that users have a questions about the sensors in their work environment.

The connection between smart tools and existing infrastructures of the organization

The drawing, made by an interviewee from the IT department in Århus, shows a gap between the maturity and restrictions of the organizational IT infrastructure and the needed flexibility for exploring with smart tool. At a certain point in the explorative process of the developing and choosing a smart tool, a connection needs to be made with the formal IT structure of the organization to secure the alignment of systems but also privacy aspects, to fulfil the requirements of the future legislation on privacy. On the other hand, flexibility and freedom is needed to be able to experiment with smart tools and find out what the positive and negative aspects are. Therefore frequent collaboration between IT and smart tool initiators is needed to secure the phase beyond the piloting stage. How can the systems be integrated, when the smart tool will be implemented in all departments of the organization? See Figure 32.

ING was experiencing the same difficulties. After their proposed IT infrastructure was not in line with the strict security measurements, the proposed IoT platform now needs to be built inside the IT environment of ING. This requires new decisions in the domain indicated with 'A' and delays in the 'B' section, as the compatibility with the new infrastructure is not clear.

Balancing between the freedom and flexibility outside the organizational restrictions and the strictness and maturity of the chosen IT infrastructure where privacy and security are settled. Connecting these different fields is important to secure the more mature phases of smart tools in the organization.

Scope and accuracy

When reviewing the combination of functions which is requested within the cases and the intended approach to experiment with or implement a set of functions, a dissimilarity can be observed. Whereas ING is experimenting within a very broad field of functions, the ideas at the Aarhus University and the TU delft are much more focussed on the workplace. The ambition on smart at the tech company (case 4) is rather broad again, similar to ING. This scope difference for smart tool functions is also recognized in the smart tool

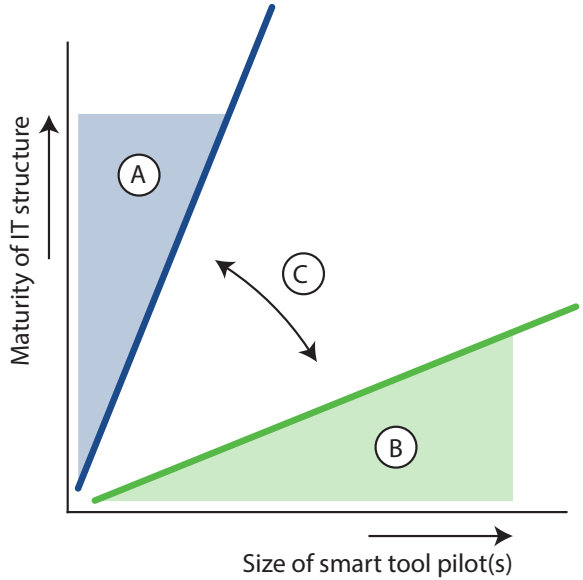


Figure 32: Relation IT structure and smart tool freedom, derived from interviewee from Arhus.

analysis, whereas the public organizations predominately focused on 1 function (>60%) whereas more than one-third of the private organization combined three or more functions, one-third combined two functions and one-third had one function. So, among different organizations there can be a difference in the number of combined functions. Besides that, functions do not need to be combined in one smart tool. In the ING case, functions are seen as part of the IoT platform. Think about the buildings blocks that together form a working building. The building blocks are the functionalities that are tailored on a specific issue. An example is the mapped smart tool of ING which is a functionality to release meeting rooms when they are not used. As one of the interviewees said, measuring the availability of a desk is completely different from measuring the usage of a meeting room. This is reflected in the smart tool data set, as smart tools which provide both information

on desk availability and meeting room availability are mostly using different types of sensors to prevent reporting wrong information. Releasing a booked meeting room, because it is not used, gives under-used spaces back to its users, but a flawless measurement is an important condition, because releasing a used room will only result in disappointments, for the current users of the room and the new users who thought the room is available. Therefore, in this example, a very high level of accuracy is needed to provide a proper function to users.

So when reviewing the functions listed in the previous chapter, it can be concluded that smart tool functions can deviate in terms of level of accuracy and in terms of combination of different functions. This size of the combination of functions is the answer on how smart an organization wants to become. This information can be translated to Figure 33

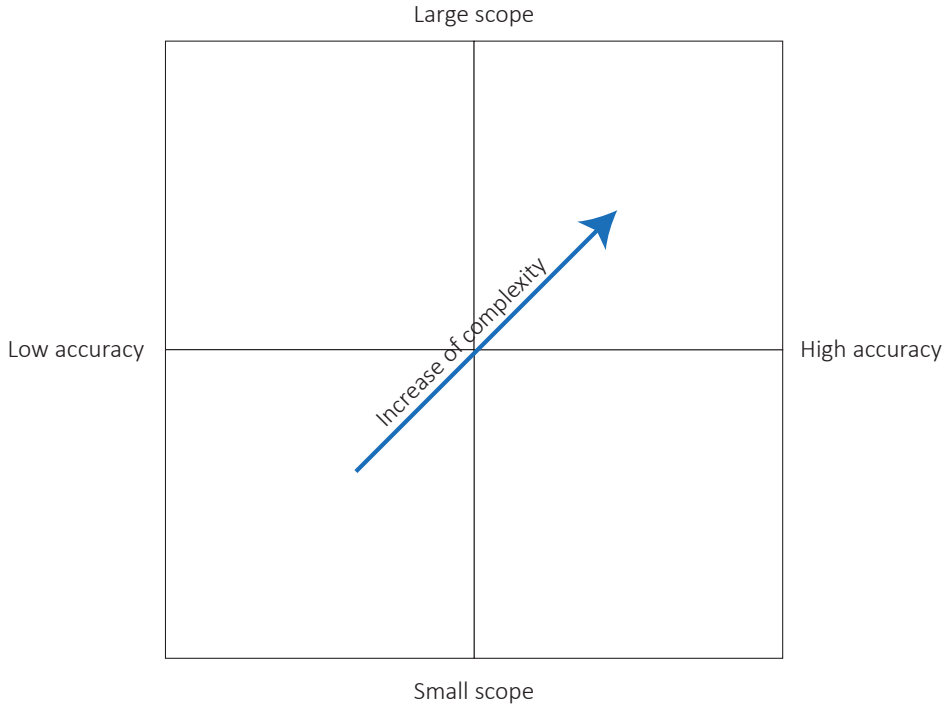


Figure 33: shows the different variables of the group of smart tool functions which organizations can have, based on findings from smart tool analysis and cases.

The workplace

Only a part of the campus is used
Not one of the interviewees uses all parts of the campus. They stick to the area they are assigned to and only explore in these areas. A commonly known function, like the library, attracts users from all places but even some users were not using the library because of the travel distance, unfamiliarity of the place or unawareness of offered facilities.

Extending the visited places is mostly based on scheduling, a meeting or lecture was scheduled in a specific building so people go there, or based on advises of other users' good experience. Using smart tools as an information source for knowing where to find what, can help to enlarge the 'field' people use during their day. Providing real-time information gives extra value to the information.

Satisfaction depends on previous experiences
New users, being group A and B, often referred to their former workplace. Based on the provided services and workplaces, people were more or less enthusiastic about their current workplace. This formed there reference frame and resulted in very much frustrations or high satisfaction. One new users was referring to the 24-7 opening hours in the week previous to the exam week at his faculty back home. Therefore he was fairly disappointed to discover his new workplace did not have this kind of extended opening hours (TU-E).

Broad range of preferences
In accordance with the literature, users have very different preferences regarding their workplace. This is depending on their activities but also on their personal preferences and references to former workplaces.

The campus manager

The campus manager needs to balance different perspectives to come to a suitable strategy of campus management, see Figure 5 on page 10 for scheme, made by Den Heijer (2011). Therefor this section focusses on delivering the accountability to other sections in relation to the implementation of smart tools.

Preferences of the campus manager, from a real estate management and facility management perspective
Although this research focusses on the preferences users can have regarding smart tools, also the campus manager can have its own preferences of ambitions on smart tools. The tech company case illustrates this difference between the ambition of the campus manager and the workplace related problems users encounter during their day. These differences are in the tech company case based on the desire to use occupancy data for future workplace strategies and adaptations of the current workplace. In the discussion the deviating role of different organizational stakeholders will be discussed more thoroughly as this exceeds the scope of this research.

Benefits of smart tools
The benefits of smart tools are not easy to describe. Studying the benefits of smart tools could be a research on its own. Nevertheless, the data set of the smart tools research group gives some examples on how it is done in their situations.

Effective space use
A tech company connects the function of showing availability of places directly to the implementation their new office concepts which is based on the activity-based working principle. By providing information on the availability of workplaces, they will reduce the floor space assigned to a department by 20%. Additional spaces, like 'collaboration places' will be realised in the canteen area, so user do not have to book a room when they have a conversation with another user or want to work together in another environment. It should be evaluated if users' satisfaction is still on the pre-refit level or is decreased or increased. This example shows that when the amount of space is decreased information on the availability could help to facilitate people to still get a space in the building.

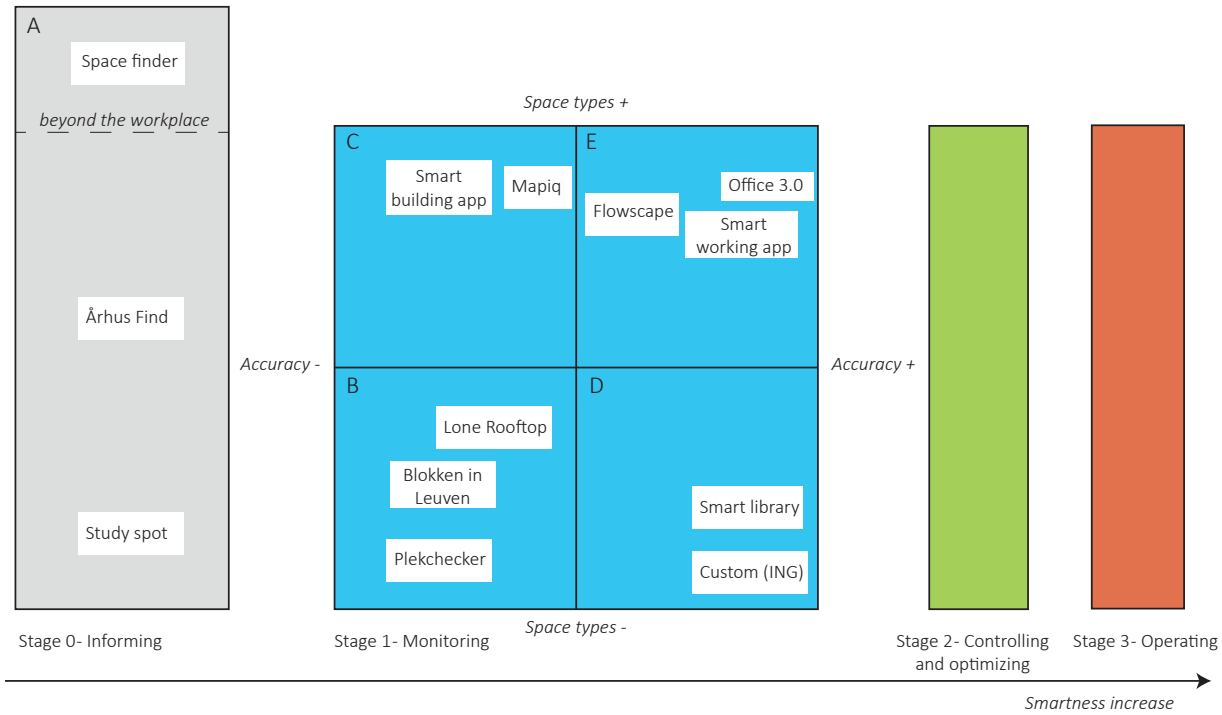
Productivity
The business case of the plekchekcer application is built on the search savings that can be achieved by showing available places to users. The productivity will increase when users do not have to search for a workplace. The second expected benefit is that reacting on places that show low occupancy rates, and adapting these places to a more satisfying place, can raise the occupancy of these places. Besides that, the normal way of practicing their job can be changed by advising to organise a meeting on the Friday afternoon instead of doing this on the busy Tuesday or Thursday.

Scale
ING calculated that when their IoT platform would operate, the break-even point will be reached when 10.000 people are connected to this platform. This figure is based on exploring all kinds of separate functions. The connection between these functions, so using the data to enable other functions, significantly adds to make the business case profitable. Nevertheless, an investment is needed to be able to implement the smart tool.

Road map

To support the campus manager in setting up a smart tool project, this section will provide a product and process approach about smart tools.

Product
Knowing the organization is very important when researching which kind of smart tool can be implemented. Therefore it is not possible to just pick one smart tools and state that this is the best for all cases. Nevertheless the function: Show real-time workplace availability was requested in almost all interviews (15 out of 17), which makes it a safe function to start the smart tool project with. An important variable is to explore what kind of information is really needed, see the stages of Baumer *et al.* (2017) in Figure 31 on page 104. Figure 34 on page 108 shows the different smart tools which provide the function: show real-time workplace availability, and place them at the stages defined by Baumer *et al.* (2017). Within these smart tool provides, two main distinctions can be made. Firstly, the amount of space types that the smart tool shows and secondly, the level of accuracy of the information, ranging from a building to a desk level.



Five smart tool categories are defined, all having their own specific focus. Below each category is typified based on the functions it can offer for the user. See Figure 34

A. When users do not know where the spaces are. Based on the organization, a tool that shows one space type or multiple space types can be chosen.
B. When users have difficulties finding available workplaces, predominantly within one workplace type.
C. When users have difficulties finding available workplaces with multiple characteristics, e.g. meeting room, desk or silence area.
D. When users have difficulties finding an available workplace on a floor, predominantly within one workplace type.
E. When users have difficulties finding an available workplace on a floor with multiple characteristics, e.g. meeting room, desk or silence area.

The classifications, Figure 26 on page 41 and Figure 27 on page 43, show the options of all the other functions and can guide the process of choosing a smart tool based on the specific user preferences and organizational characteristics. Other functions can build onto the function of showing real-time workplace availability, like adjusting room temperature or a people finding function, or can be complementary, like a meeting room booking function.

Figure 34: Mapping smart tools in the stages of Baumer et al. (2017) and based on the differences in level of accuracy and number of functions

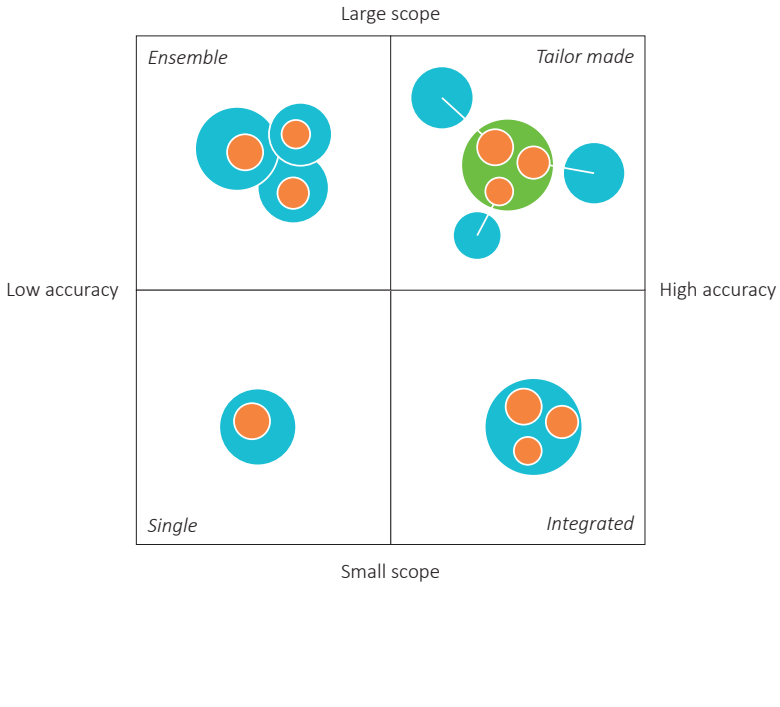


Figure 35: Ambition framework. presents four different strategies regarding the implementation of smart tools. Own illustration

Strategy for the campus manager

Pattern derived from the four cases
Although the approach for the implementation of the smart functions is in all cases still work in progress, in all four cases pilot projects are shaping the thoughts on how smart tools can eventually be implemented at the campus. This information on the intended implementation strategy, can be combined with the defined quadrants of Figure 33 which leads to the following Figure 35.

Exploring the strategies
Below the four strategies, sketched in the figure above, will be explored to give an insight structure of the proposed tool and indicate the pros and cons of the strategy.

Single
When one specific function should be implemented in the organization, this could be easily provided by one supplier.
Pros:
- The smart tool is straightforward and the business case is easy to develop as this does not cross other domains.

Cons:
- Maybe the information is already available or other departments are interesting of using it.
- Who is the owner of the information?

Integrated
When a smart tool is preferred that combines different functions and can be provided by one supplier.
Pros:
- The benefit of connections within the smart tool are used as this information will be combined in one tool.
- One supplier takes care of the smart tool. Contract management will only be with one party.

Cons:
- The specific measurement method of this supplier can make it difficult to switch to another supplier in the future.
- Who is the owner of the information?

Ensemble
When different functions across the borders of the workplace should be implemented.
Pros:
- Suppliers take care of the infrastructure.

Cons:
- Connections between the suppliers to benefit from the different information streams are hard to establish.
- Who is the owner of the information?

Tailor made
When a high ambition is set in the vision on smart tools and many functions need to be connected.
Pros:
- The organization owns the information and the infrastructure of the platform.
- Connections can easily be made within the own structure and there is no buy-in problem as functions can be replaced.

Cons:
- Privacy issues: following the system of Van Zoonen (2016), privacy concerns can occur if the full scope of the IoT platform is not communicated.
- Maintaining the platform requires resources, both financial and IT knowledge

Steps of choosing a smart tool

The strategies can prioritize which kind of smart tool would fit the organization. Most example cases have a piloting phase to test different functions and suppliers. This test in the real situation can also help to find interesting other parties in the organization and shows insight in the presumed benefits. After retrieving user information on smart tools the following steps can help to manage the process of choosing a smart tool.

- Focus on the benefits of a function
  The benefits that smart tool functions can have are very specific. The examples used for the smart tool analysis provide insights on the benefits for those settings.
- Explore the possible connections to other domains.
  Functions are often related to other domains in the organization, like HR, FM, CREM and IT. Connections to these departments can help to improve the business case and prevent inconsistencies with the IT infrastructure in a late phase of the process. It is important to keep a balance between the limitations of the formal IT infrastructure and the freedom of experimenting with smart tool functions.
- Test the function in a small project
  By proofing the concept in a small scale experiment, the benefits of the smart tools can be proven and more extended user data can be gathered by assessing a pre and post experiment survey. Actually trying out the smart tool makes it easier for other parts of the organization to relate to the future possibilities or implementing such a functionality.
- Formalize the process to be able to scale the smart tool towards the whole campus
  Depending on the current IT infrastructure, preferences of other organizational domains, budget, benefits, scope and user preferences, a process can be developed to implement a functionality.

Conclusion

The aim of this research is to gather a deeper understanding of the problems new users encounter during their day at the workplace and to connect these problems to specific functions of smart tools.
By showing the connection between workplace related problem and smart tool, insight is given on how the working experience can be optimized during the day on campus and what the role of already available tools in this process can be. These findings can help the campus manager in making plans for the exploration or implementation of smart tools in the workplace. The central research question is: Which functions of smart tools are needed to assist new campus users in choosing an appropriate workplace throughout the day and what are the implications for the campus manager of the lessons learnt from these user insights, when exploring the possibilities of smart tools at the campus? This question focusses on a product and process based answer. A product answer regarding the smart tool functions that can assist users in choosing an appropriate workplace and a process answer to give recommendations for the campus manager. Based on the main concepts of this research, begin user, smart tool, workplace and campus manager, this conclusion chapter is structured. In the campus manager part, the product and process recommendations will be given.

Users and their preferences regarding the workplace

When reviewing all composed actual journeys, in every journey a problem or request was formulated that could be solved by a smart tool in a direct or indirect way. Requests were very closely related to the available or assigned workplace of the specific person. All interviewees who had their own assigned desk, were not interested in finding another desk but their problems were focussed on different workplaces like finding an available meeting room. Although the research prior focus was on the workplace, most interviewees connected smart tools also to other domains when talking about their workday. Frustrations and ideas about services, organizational culture and on current IT systems were often infused in the journey. This shows the potential connection to other 'supporting' domains of an organization like HR, FM, IT and CREM. The importance of this connection is also given by, among others, Haynes, Nunnington, *et al.* (2017)

Different requests from brand new users
Users who were only for a couple of weeks at the campus showed two different patterns. Users without an assigned workplace were requesting navigating functions to know how to get at certain spots. Users who had an assigned spot were not requesting this function. Their request was more focussed on specific information about the meeting room availability. In 15 out of 17 actual journeys, a request for information on surrounding workplaces could be implemented in the redesigned journey, to get knowledge on specific workplace types in places they would not accidentally discover. This function therefore enlarges the number of workplaces a user can visit. Providing real-time availability of these places and indicating the travel distance of these spaces can provide an alternative for the current workplace, when the current workplace is not fulfilling the preferences of the user.

Large differences per person
The journeys provide a wide range of personal preferences and ideas on, for example, privacy and the degree of smart technology in the workplace. To resolve privacy concerns, many interviewees point at an opt-in and opt-out function to be able to be unfindable for a certain period. This opt-in and opt-out function could also help to personalize complicated applications as not everyone prefers to use all functions that a smart tool can offer. Turning of functions can provide self-determination for the users and prevents annoyances from receiving information that is not preferred. The ability to turn functions on and off gives users the possibility to set their own ambition level when it comes to smart tools. Some people would be grateful

Category	Function	Accuracy level
Assist users in choosing an appropriate workplace	Show real-time workplace availability (one type)	Floor / building Workplace
	Show real-time workplace availability (different types)	Floor / building Workplace
	Show 'third places' in neighbourhood	-
	Room booking	-
	Way finder	Indoor
Enhance collaboration and well being	People finder	Desk Person
	Adjust temperature and lighting	Group of people Individual
Providing information	Gives additional information	-
	Gives recommendations	-

Table 12: Overview of smart tool functions

with every new sophisticated function the smart tool provides them with, while others could become suspicious and annoyed by the overload over information and measurement.

Smart Tools

The analysis of 25 smart tools resulted in a classification of tools focussing on the functions they provide for users. Nine different functions were found, that could be categorized in three groups. Within the functions, a distinction could be made based on the level of accuracy, some smart tools provided information on a floor or building level, other on an individual desk or personal level. See Table 12

The combination of functions that a specific smart tool can provide is given in the second classification scheme. These tables can be found on page 40- 43

Systems

A smart tool is a part of several systems.

- It is a measuring and communicating part that can be connected to other smart objects which form the Internet of Things. The data gathered from the sensors adds to the big data stream that feeds the smart tool in becoming intelligent and can be used to make future strategies.
- It is one of the materials that works together with the skills and images from users, to produce and re-invent practices.
- It can connect different organizational domains (HR, IT, FM and CREM), depending on the combination of functions that the smart tool offers.

Input for the campus manager

User journeys give detailed information on the preferences, requests and problems a specific user encounters during his or her day. Due to the specific information, it does not present the preferences of the whole organization. Therefore it can be used as an example to indicate on specific functions that could be used in the workplace of that specific organization. In the limitations sections, there will be elaborated on this and other limitations. The typology and strategy concerning the physical workplace has a direct relation to the functions that are requested by users. Nevertheless, it can be the strategy of the CREM department itself to measure and show real-time availability of workplaces, although they are assigned to specific users, to gather information and have the flexibility of moving towards a flexible workplace strategy. The ambition level of smart tools should therefore be established by the campus manager, but user information can point at specific functions that could work for users. Another

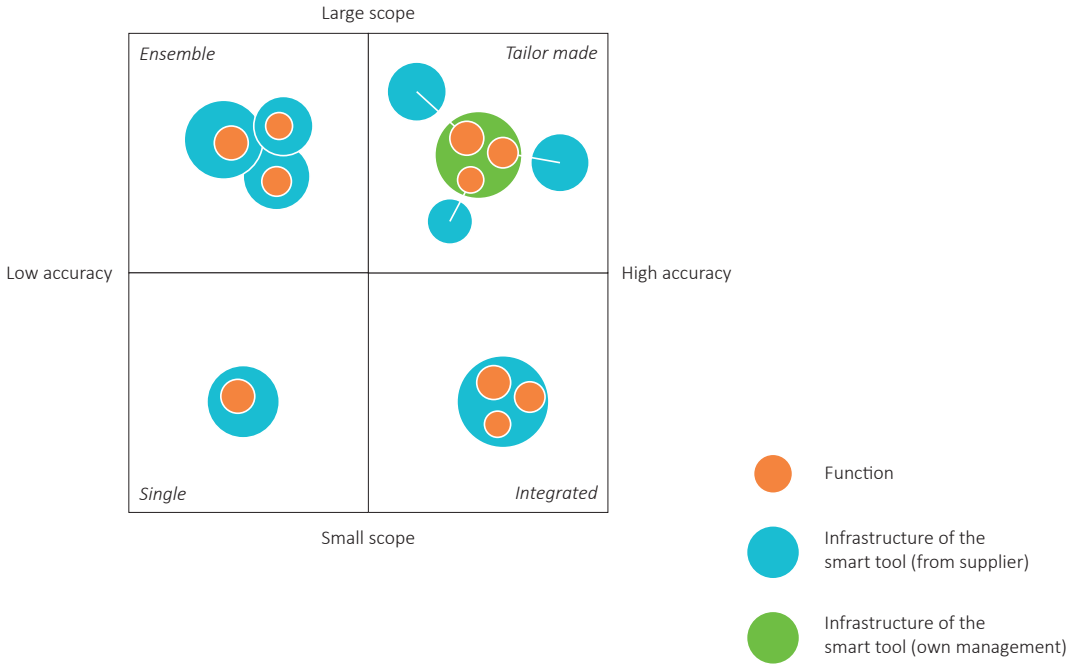


Figure 36: Ambition framework

thing campus managers should not forget about is the function other applications offer. Especially the university campus users did not understand why a people finding smart tool should be helpful, as they just use WhatsApp when they want to find someone on campus.

Different purposes within one function

Smart tools have different functions and within these function group further differentiation is found. This makes it difficult to give a generalized advice on which smart tool could fit in an organization. Based on the type of information users are requesting, a smart tool can be chosen. For the most requested function, being: show real-time workplace availability, a framework is made, see Figure 34 on page 108. The variables that steer the decision for this specific function are:

- Amount of available information on workplaces. Do user know where all meeting rooms are?
- Differentiation of types. Are users looking for one workplace type or multiple types?
- Accuracy level. Do users have troubles finding an available place at a floor or do they want to know if the building is busy or quiet.

Based on the requested other functions, like adjusting room temperature or a people finding function more complex smart tools can be chosen.

Ambition framework

Based on the accuracy differences, derived from the smart tool analysis, and different scopes, derived from the in depth cases, the ambition framework is established. This framework shows the different options an organization can have based on these two variables. All four strategies have their own pros and cons on several aspects. By positioning the preferred functions in this framework, an indication for the connection between functions can be given. Also future ambitions can be mapped to indicate how the smart tools strategy can grow in the future. See Figure 36.

Steps of implementing a smart tool project

After retrieving user information on smart tools the following steps can help to manage the process of choosing a smart tool.

- Focus on the benefits of a function
- Explore the possible connections to other domains.
- Test the function in a small project
- Formalize the process to be able to scale the smart tool towards the whole campus

Discussion, limitations and recommendations

In this section, the findings of this research are connected to other fields, to put them in a broader perspective and illuminate limitations of this research and possibilities for future research. This section is structured following the main concepts of this research

Users and the workplace

Differentiation

The new user was the focus of this research. Other researchers make a distinction in gender or age, although there are conflicting findings on the differences between women and men or between generations (Rothe *et al.*, 2012). Leesman (2017b) makes a distinction in the mobility profile of the user, differentiating from 'The camper' to 'The true transient', meaning respectively someone who stays at the same place almost the whole day to someone who uses multiple workplaces and is barely attached to a specific place. Acknowledging that there are many different types of users on a campus is an important lesson. Focussing on a specific user type can leave out the preferences of others. As this research focussed on the new user, it focusses on making someone familiar with a place. At the other side of the spectrum, the user who is connected to the organization for many years needs probably another tool to facilitate its specific wish. Besides the actual users, also visitors, suppliers and job candidates are users of the workplace. Depending on the organization, these groups can be interesting to look at.

Balance of technology and personal contact

Jaitli and Hua (2013) mention the increased mobility that technology can offer to users across time, space and physical boundaries. Nevertheless, Duffy (2008) is one of the authors that assigns an increased importance to the physical workplace for collaboration and to embody the organizational culture. Therefore the balance between virtual and physical should always be balanced. The perspective of De Been *et al.* (2016) highlighted the society as a driver for increased technology in the workplace, as the users of the workplace are using the technology in their private lives as well.

Recommendations

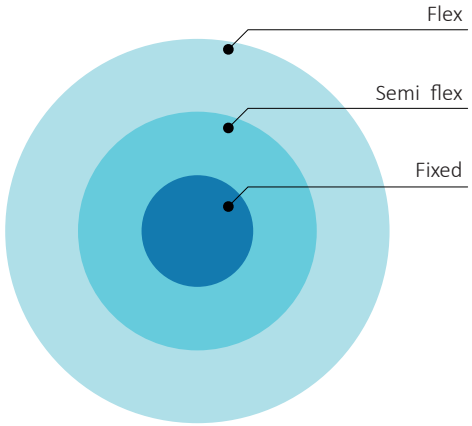
The interviewees pointed on the relation between the distance of an available workplace and the amount of available places. When are people willing to switch to another place? The expectation, based on the limited information derived from the user journeys, are that there is a relation between the frustration level, distance to a new workplace and number of available workplaces. Because users need to be sure that at the other place is still a place available when they arrive, but if their current workplace is causing very much annoyances, they are probably more willing to walk a little further or take a higher risk.

Besides that it would be worthwhile to research what the influence of real-time information on the availability of workplaces is on the mobility of users. The interviewees on the campus of the TU only used a part of the campus, mainly because they did not know what the other buildings had to offer. But would they actually use other buildings when there is information about the facilities and when are users willing to switch?

Smart tools

No pick, plug and play

Involving users in the initiative phase of the process does not mean that further user involvement in the process is not needed anymore. Brunia *et al.* (2016) emphasize on the importance of involving users in the implementation process of new office concepts. Although implementing a new smart tools does not mean that the total office concept is changed, it has a clear relation with the workplace and can change the way how people use the workplace because additional information becomes available. Dery *et al.* (2017)



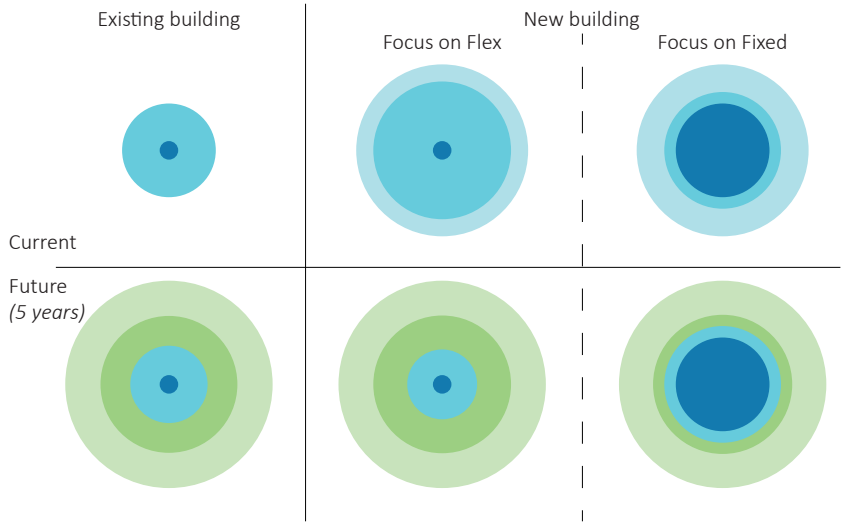


Figure 37: Division fixed, semi flex and flex
Figure 38: Differences in flexibility and future changes

concludes that 'effective digital workplaces require employee connectedness and responsive leadership'. This means providing technology, collaboration platforms and inspiring physical spaces to enhance employee connectedness and involve users, use different data sources and communicate clearly about the development process of the digital workplace (Dery *et al.*, 2017). So the process of implementing smart tools in the workplace does require a process that involves users also during the process and communicates about the changes. In the process approach, which is described in the synthesis chapter, the focus is purely on picking the right tool and connecting it to other structures (financial, IT and so on). But communication and leading a change program are even as important as picking the right tool. It is not a pick, plug and play process.

Integration with other systems

As already described in the background chapter, Haynes, Nunnington, *et al.* (2017) make a distinction between using IT to monitor the building performances, by installing a building management system (BMS), and using IT and HRM insights to balance the physical and virtual workplace and facilitate interaction. This research focussed on the latter aspect of IT but a connection can be made to the building management system in some cases. Some smart tools can be connected to existing sensors or other data gathering systems. Lone rooftop, for example, uses the Wi-Fi-network of the building to gather occupancy information. Although the accuracy of this measuring method depends on the structure of these Wi-Fi-points, it is a way to use the existing infrastructure. In the example of Mapiq and Philips, the lighting sensors are integrated with a desk availability and people finding function. Especially in new buildings, during the design process it is important to decide to what extend different structures in the building, like IT infrastructure or the building management system, will be used for the smart tool data collection. On the one hand, this can save additional costs and use sensors effectively for multiple functions but on the other hand, the robustness of this fixed structure can limit the possibilities for smart tool functions or lack the specific information the smart tool needs. See Figure 37.

During a workshop with data and smart solution experts from Royal Haskoning DHV, the following model was constructed. The fixed part refers to the solid infrastructures in the building, like the building management system. The semi flex circle indicates the decentralised hardware, as sensors under one single desk. The flex section refers to the software that can be developed to make additional connections between data streams to provide information.

In elaboration of this model, in new buildings the position of the sensor can be placed in either fixed or semi flex. Integrating it with other systems gives less flexibility but can result in a cost reduction. Figure 38 gives a future perspective on the different scenarios for the implementation and integration of smart tool sensors.

The campus manager

Other perspectives
In the synthesis chapter, the four perspectives the campus manager has to balance are already touched upon. In the tech company case, explicitly going through the smart tool possibilities with the campus manager showed the mutual interests it can have regarding a function. For example, for strategy or maintenance purposes, decisions for a specific system can be made. On the other hand, clearly stating what the costs and benefits of smart tools are is important to make progress with the implementation process. As stated before, most organizations are still experimenting with smart tools and cannot clearly indicate or measure what the benefits are. The example cases, presented by Valks *et al.* (expected 2018) give an indication of the benefits.

Other domains
Extending to other domains within the organization can help to increase the benefits and create support. Narasima Venkatesh (2017) and (Li & Herd, 2017) both write about the possibilities of IT in the workplace, from a HRM perspective. In many of the user journeys also a connection has been made to topics that have a closer connection to the field of HRM then CREM or FM.

Recommendations
Solid information on the benefits of a specific function is not clearly available jet. As this research focussed on the user perspective, incorporating all possible smart tool benefits was out of scope. Nevertheless it is important to make these benefits explicit to realise the project. The program manager of ING concluded that many assumptions need to be incorporated to formulate the benefits of smart tools. Insight in the benefits of different smart tool functions within different scopes and level of accuracies could help the campus manager to make a feasible business case and realise the smart tool project. Although many people see the benefits of smart tools, making it explicit is needed to actually implement smart tools in the organization.

Research method

This research provides an in-depth view on how users experience their workday and how workplace related problems could be solved by implementing smart tools. First of all the information is case specific and is about personal user preferences. These preferences can be influenced by several factors like culture, habits and the physical workplace itself. It should be seen as an example to learn from, not an approach that can be copied to every single context.

The user journey method is a playful way to present a user's view on his or her day. Many people were enthusiastic when reviewing their own journey. One interviewee did change one of her habits because she became aware of the ineffectiveness of 'forgetting to eat'. As for this research, the user journey is only used in the initiation phase, to illustrate user preferences, it would be interesting to research what the role of this method can be during the other phases of the process. Following the notion of van Boeijen *et al.* (2014), the user journey method is an applicable method thoughout all design phases. Following the interviewee who changed one of her habits on the basis of reviewing her own user journey, creating awareness can be one of the results of making a user journey.

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Appendices

Protocol for making the user journey

To be able to compare the case studies, they should be comparable. To make them comparable, the protocol is made to gather the same information at each university or organization. The table below provides an overview of all steps.

	Step			Format
Gathering information for drawing the CJ	Step 1 8 hours	Goal:	Understanding the organisation and scoping the customer journey.	
		Method:	Conducting semi structured interviews and reviewing organisational documents.	Using protocol 1
		Product:	Having an overview of the organisation and scope of journey.	1 page fact sheet
	Step 2 10 hours	Goal:	Composing the assumed customer journey.	
		Method 1:	Conducting semi structured interviews with Real estate manager and reviewing organisational documents about vision, ambition and supply.	Using protocol 2
		Method 2:	Customer journey mapping	Using the assumed CJ model
		Product:	An assumed customer journey	Visualised in a scheme
	Step 3 20 hours	Goal:	Making the actual customer journey	
		Method 1a:	Conducting semi structured interviews with users and mapping their daily experiences.	Using protocol 3a
		Method 1b:	Conducting semi structured interviews with researchers and analysing existing information about different users	Using protocol 3b
		Method 2:	Customer journey mapping	Using the actual CJ model
		Product:	At least 4 maps of actual journeys	Visualised in a scheme
Analysis and synthesis	Step 4 8 hours	Goal:	Analysing and comparing the journeys	
		Method:	Aligning the journeys and searching for deviations	Logic model analysis
		Product:	Overview of deviations between journeys	Overview of journeys
	Step 5 4 hours	Goal:	Combining smart tools to the ‘gabs’ of the journey	
		Method:	Synthese, combining information on possibilities of smart tools with the (gabs within the) journeys	
		Product:	List of recommendations for smart tools	List
	Step 6 8 hours	Goal:	Redesigning the customer journey	
		Method:	Customer journey mapping	Using the new CJ model
		Product:	Customer journey map combined with proposed smart tools	Visualised in a scheme

Step 1 Understanding the organization

Protocol 1

The factsheet, the deliverable of this step, will be the guiding tool for this first interview. Questions will be conducted on the basis of 5 themes; (1) Organisation, (2) Users, (3) Space, (4) Tools and (5) contacts for further research. These first four themes are based on the conceptual framework of this research. Based on the specific case, additional information can be added. There is no specific list of questions, the factsheet is used as a guidance for this interview.

Factsheet

Organisation:
- Size (people and Sqm)
- Buidlings
- Place
- Core business
- Main goal – vision of the organization
- Short history

Users
All users:
- Average age
- Average time working / studying at the organization
- New employees/ students per month or per year

Dynamic users
- Types
- Specific demands
- How is users incorporated in vision
- Expected changes concerning visitors in the (near) future

Space
- RE strategy on workspaces (e.g. Flex /agile or strict personal spaces)
- RE strategy in general
- Typical demand for the organization
- Overview of amenities

Tools:
- Overview of existing smart tools (and, if possible, map the tools)
  - o Ambition on smart tools
- Is there a known demand / wish from users?

Step 2: Making the assumed journey

Protocol 2

Depending on the sequence of the interview, the questions can also be clustered in a thematic way, instead of a time bounded way. In that case, at every theme, the differences between current and future strategy should be explicitly distinguished.

Getting an idea on the organizational supply of real estate and future vision; kind of office concept, different types of environments, tools, importance of real estate in the organization.

RE strategy
- What are the main focus points in the current RE strategy / supply
- What is the workplace concept
  - o Are employees bound to a certain area, what is the freedom of choosing a place all around the building / campus

On campus amenities
- What kind of amenities are available to the employees / students
  - o Listing possible activities on campus and connect to vision

New users
- Are there extra measures taken for new users

Tools
- What kind of tools are used in the current building to facilitate users in their spatial demands?
  - o Why is this specific tool implemented?
  - o Does the tool meet the expectations?

Making the Assumed Customer Journey
Explaining the idea of the assumed journey and the customer journey.
The customer journey visualizes the journey of a person during a specific time. The assumed journey is a representation of this journey from the perspective of the real estate manager. So the question 'How should the ideal journey of a temporary user look like?' is the basis of composing the customer journey. This is based on the vision on real estate.

- What kind of activities would be possible in the ideal day of your temporary employee / student
  - o Composing elements of the assumed journey.
- If you look at a typical day of your temporary user, what would be the main components?
  - o Indicating the importance of activities
- How are smart tools embedded in this journey?

It would be the best to draw up an assumed customer journey together with an interviewee and to check the journey with a broader range of people to verify it. It differs from organization to organization which people need to be consulted.

Step 3: Making the actual journey

Depending on the research what has been done already and the quality of this research, either protocol 3a or 3b can be followed. To assess the quality the following questions can be used:

1. Is the qualitative research on user preferences conducted recently?
2. Is the research distinguishing different groups within the population of the organisation / university and within these groups, is the temporary user one of them?
3. Is the researcher who conducted the interview available for one or more interviews?
4. Is the research conducted questioning the future possibilities instead of only assessing the current situation?

The more questions can be answered with 'yes' the better the done research connects to the purpose of this research, which means that this data can be used. If possible, it would be helpful to verify the data and customer journeys by consulting users. This can be done individually or in groups.

The target for this step is to compose 4 actual journeys.

Protocol 3a Interviewing users (4 times in total)

This interview will be mainly on the basis of customer journey format. The question and themes below can be used to fill out this format in the right way. Scheme indicates the focus / position in time. The following sequence will be used.

1. Introduction to the topic
2. Composing the journey
   a. Defining a sequence of activities
   b. Connecting these activities to the underlying demand / whishes of the user
3. Reflecting this journey towards the current setting
   a. Connecting emotion to the activities
   b. Describing what the remarks considering the activities and accompanied emotions
4. Discussing the change of activities in the future
5. Discussing how technology can improve the journey

Protocol 3b Interviewing researchers

Depending on the available information, more or less time with the researcher is needed. The following sequence will be used.

1. Interview with the researcher: Finding out what kind of information is available
2. Preparing journeys on the basis of done research and different personas. (following the sequence of protocol 3a)
3. Testing journeys with researcher (following the sequence of protocol 3a)
4. If possible Testing journeys with users. (by organising a workshop of interviews)

Depending on the quality of conducted research, protocol 3a and 3b can be used both.

Standardized information sheets, smart tools

Only the sheets used for the in-depth cases and the additional smart tool maps for the exploration in collaboration with the smart campus research team, which are gathered by Linda Supheert, are presented in this appendix.

AU — Aarhus University — design brief

phase: Design brief
scale: 16 buildings, 40.000 m2
duration: expected Q4 2017

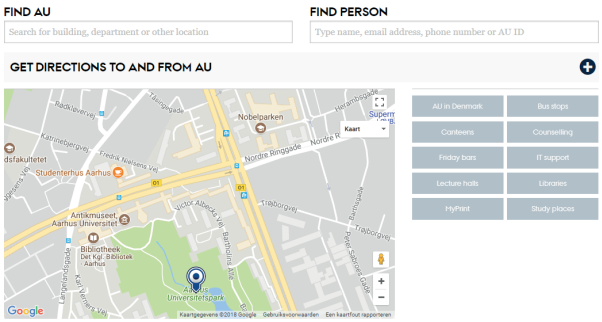
Project description

The project was started to make it easier for visitors to navigate on campus. In the conceptual stages it was also identified that monitoring study places could be interesting: we believe that there is a great potential in giving the students a real time overview of available study spaces on campus in order to reduce the wasted time looking for places to study. Using iBeacons looks like the best solution, because the study places at AU are scattered across the campus in many different buildings

Foreseen developments

In further stages of the project the use of Location-based services (LBS) are foreseen. In a '2.0' version push services for activities on campus could be included, and in a '3.0 or 4.0' version push services based on the needs of the users

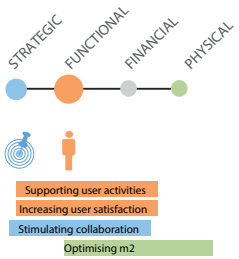
Building Map Aarhus University



Web based version with the possibility to find functions. (image of current tool)

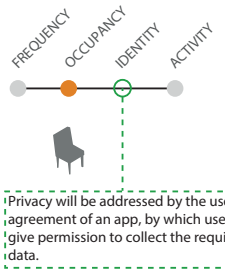
Profile

Why: Objectives



Functional goals have priority. Physical and financial benefits are a welcoming effect of the main objectives.

What: Measurement



Privacy will be addressed by the user agreement of an app, by which users give permission to collect the required data.

The amount of devices connected via Bluetooth to an iBeacon.

How: Measurement method

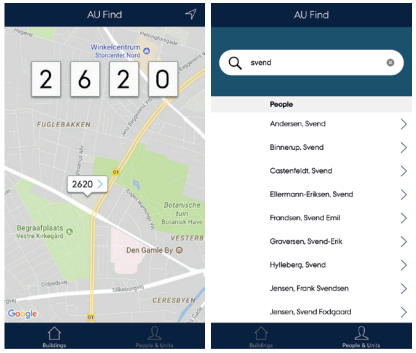
iBeacons measure the amount of occupants by letting devices connect to the iBeacon via Bluetooth. Bluetooth is switched on via an app

AU — Aarhus University — design brief

functionalities: Wayfinding, (Find a study place)
space types: Whole buildings (study places)

User information

The user will be able to review its own location and the new location to find their way on campus. Besides that, real time availability of spaces will be given on a room or floor level so people can search for available spaces.

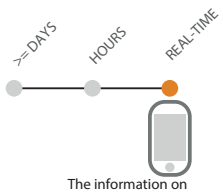


Finding buildings and people's offices by the AU find smart phone application (image of current tool)

Management information

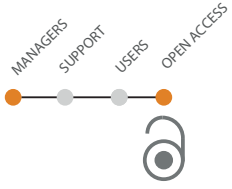
Besides the information of users, the management will be able to retrieve information on a longer period on a specific building or space type. This gives the opportunity to, in the future, provide the preffered spaces and know what need to be enlarged or what is not used. It helps to make space use more effective.

Actuality of the information



The information on available study places will be updated in near real time.

Access levels



Everyone can access the wayfinding application via a smartphone app.

Benefits

The main objective is to enlarge user satisfaction. So far this is not jet translated to any figures. By measuring the space usage, different spaces can be assigned to the users who need it. This will result in more effective space use.

The data used in reporting goes from real-time to as far back as possible.

Campus management has access to the reporting tool.

Side notes

The images on this page show the current tool. The web based version offers additional information on the position of different facilities on campus.

TUD-1 | TU Delft | Mapiq - Blinq Systems

phase: **Implementation**

scale: **26.000 m2**
2 buildings

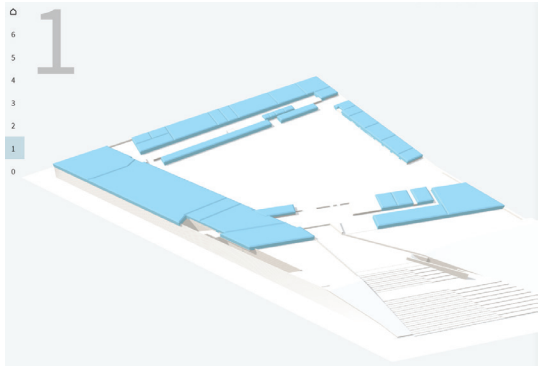
duration: **2014-present**

Project description

Mapiq is a product that has been developed by two TU Delft alumni. The Library has decided to implement it because of their service concept and the services they want to offer to students. In the development of Mapiq the faculty of Industrial Engineering was done as a pilot, after which Mapiq has been kept running. Recently a number of sensors have been added in the Library to indicate actual use.

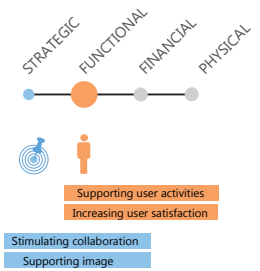
Foreseen developments

The future developments depend on how the users experience the partial availability of information from sensors in the building. We are looking at options to increase the amount of information offered to students based on already available sensors.



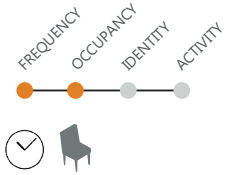
Profile

Why: Objective



Mapiq supports user activities by offering information with regard to the amenities in the Library and by enabling reservation of project rooms. That indirectly stimulates collaboration.

What: Measurement



The frequency of meeting rooms is determined: both via reservations (booked) and via sensors (in use). The occupancy of 100 workplaces is shown real-time.

How: Measurement method

The data source used is reservations, from the reservation system of Mapiq.
Infrared sensors have been added on 100 workplaces; they measure activity on that workplace. 10 infrared sensors have been added to meeting rooms; they measure activity in the room.

TUD-1 | TU Delft | Mapiq - Blinq Systems

functionalities: **Wayfinding, find a study place, book a project room**

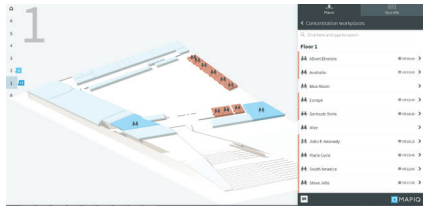
space types: **study places, project rooms**

User information

The user can search for a space by space type in the interface, e.g. workplace with a computer or workplace for group. Then the user can see the availabilityof these spaces.

For project rooms the user can make a reservation via a reservation system. The availability of the room is displayed, based on already made reservations.

For each space a route from the entrance to the space can be given.

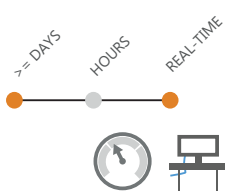


to do: add powerBI image.

Management information

The campus manager can design reports and dashboards in PowerBI. Dashboards show real-time information; Reports show information over the whole measurement period.

Actuality of the information



De displayed information on the webpage and in the PowerBI dashboard is (near) real-time.

The reporting function in PowerBI shows real-time data until as far back as possible.

Access levels

De blueprints, location of each space and availability is visible for everybody; reservations can only be made by students and employees.

Support staff can access a backend to the booking tool. PowerBI functions can be accessed by specific individuals.

Benefits

The objective was to improve the service towards students; students are satisfied with the service and the Library has a reduced workload because of the self-reservation system.

Side notes

The implementation of Mapiq has been received very positively by students. The Student Council regularly has meetings with the Library, which are also about Mapiq. They would like to see more information on the availability of study places given the business in the Library during exam weeks. Information on where study places are and which amenities they have, is seen by them as an important first step.

ING-1 ING Room booking tool

phase
pilot

scale
1.600 employees
1 building

duration
halfway 2016
- present

Project description

The pilot is part of a greater project to develop an Internet of Things (IoT) network at ING. This pilot focusses on room booking only. The objective is to give booked rooms, which are not used, back to the users.

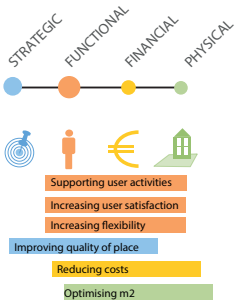
Foreseen developments

The next step is to make the room booking process easier and faster by connecting several components of this meeting scheduling process. Besides that, experimenting with voice recognition to welcome the room users and call latecomers, will make the experience in the meeting room more interactive.

-

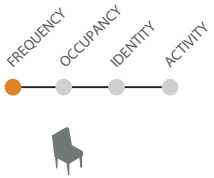
Profile

Why: Objectives



The main objective is to support the user in flexible space use by giving back booked rooms which are not used.

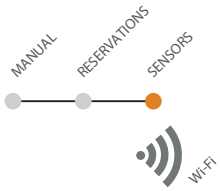
What: Measurement



Frequency data is used by management to optimize building use.

External sensors for measuring temperature and CO2

How: Measurement method



External sensors for measuring temperature and CO2

ING-1 ING Room booking tool

functionalities
Monitoring space use,
find a workplace and book a room

space types
Offices,
(whole building)

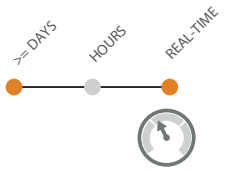
User information (employees)

Users are able to view available rooms on screens and (in the near future) on an application

Management information

Managers are receiving information on room occupancy and frequency to increase efficiency and effectiveness. The data is also used for further development of the internet of things platform.

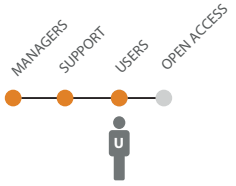
Actuality of the information



The information displayed on screens and in an application.

The data used in reporting goes from real-time to as far back as possible.

Access levels



Only employees have acces to the app. There is a possibility to review the information on a screen so visitors can review the information as well.

Manager can derive report about occupancy. Support can use data to develop the IoT platform.

Benefits

First of all, it is about lowering the time accompanied to roombooking. The idea is to bring that process to 3 minutes. Then everything for a meeting should be done, from booking the room, inviting colleagues and providing acces to the building to external people and booking parking spots

Besides that, it is found that 33% of the rooms which is booked, will not be used. The objective is to give these spaces back to the people. It is important that this measurement is very accurate. There should be no annoyances by giving back the booked room when it is still used for example.

Side notes

This pilot is part of a greater project on the development of an IoT platform. All other spaces of the building will be measured as well. This will be done with other measurement systems, which are better suited for the specific task.

TC -1 Tech Company Google integration

phase
research

scale
All buildings

duration
summer 2017
- present

Project description

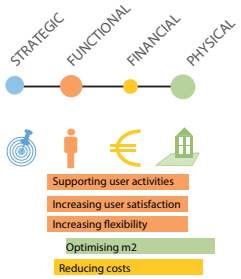
There is a wish to integrate the steps of booking an using a meeting room. The integration is about connecting the video conference option, the screen sharing option, the available of rooms on different locations and the availability of people and their locations.

Foreseen developments

After the goal is reached, no future developments are forseen now.

Profile

Why: Objectives

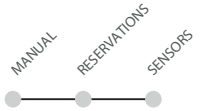


The main objective is to support the user by making the process 'frictionless'

What: Measurement

There is nothing measured. Only invited guests of the meeting have acces to the meeting facilities as screen sharing and video conferencing.

How: Measurement method



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TC -1 Tech Company Google integration

functionalities
Book a room

space types
Meeting rooms

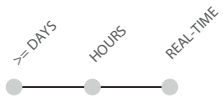
User information (employees)

This tool focusses on making the booking process easier for users. In the end situation, an organiser of a meeting should only need to fill in which people should be present at the meeting and what the meeting is all about. The system should provide possible options and schedule and organise the meeting by its own. It is not about providing information, but about taking away organising and comparing tasks to organise a meeting.

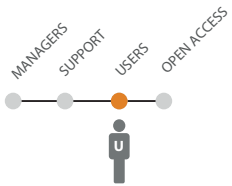
Management information

-

Actuality of the information



Access levels



Users are assisted in the room booking process. The system will take over some of the organising steps.

Benefits

During the research of this integration, the time accomapnied to roombooking and organising meetings is already going down as the components of this process are already communicating to each other.

Reducing the annoyance that is accompanied with the room booking journey at this moment

Side notes

AHR-1 Ahrend Ahrend smart working app

phase: implementation
scale: 120 workplaces, 5 building
duration: start 2016 - present

Project description

The development of the tool started from the original business of Ahrend; (office) furniture. Based on providing extra services to the user, the development started. The development is very demand (user) driven. The problem statement is that users have difficulty to find collegues and suitable workplaces in a large open office. At the same time, users often have empty batteries.

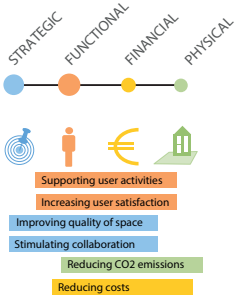
Foreseen developments

The first development is implementing the so called ergonomic passport. This passport is connected to a specific user and remembers the personlized settings for the height of the desk. This will be developed towards the comfort workplace, a decentralised way of heating, cooling and lighting which is integrated in the workplace. The main room temperature will be lowered and the desks will have additional heating and cooling elements integrated. This adapts to the specific user at a specific moment. Besides these new developments, also the existing elements are upgraded.

Impression - map to find available spaces

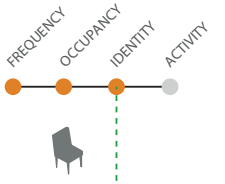
Profile

Why: Objectives



The demand side has priority, so strategic and functional. The supply is a result of the demand oriented approach.

What: Measurement



The identity of persons is measured by making a connection to a personalized application. The table makes a connection with the phone, so no movement is measured. There is an depersonil-sation fucniton

identity is visible for all application users to find each other in the building. Fequency is used for reporting and occupancy for finding an available space.

How: Measurement method

i-beacon + Qi, combined in the PUK

AHR-1 Ahrend Ahrend smart working app

functionalities: Monitoring space use, find a workplace and find a colleguege
space types: Offices, (whole building)

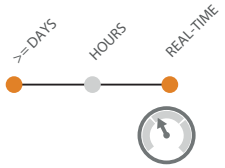
User information (employees)

Users are able to see who is in the building and which working spaces are still available. This is registrated by putting your phone on a certain spot at the desk (called the PUK). If you leave the desk, it will be available after a certain period, based on the wishes of the company. The PUK is measuring activity within a certain distance, upto 1 to 2 meter around the PUK. Only after the phone has been physically on the PUK, the PUK will detect an nearby phone, to prevent the PUK from connecting with every single closeby phone. The user can see available workplaces and meeting rooms and find colleagues.

Management information

The manager is able to review occupancy throughout the whole building. This is visable per specific workplace. The information is connected to a specific workplace and not to a person. The specific person, who used a certain spot, is depersonalised by the system. In this way, it is not possible to monitor where a specific person is sitting during a period longer than one day. Every users gets a new code every day in the data base. This makes it impossible to know who is connected to which number, only at the current day.

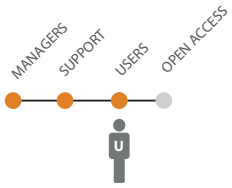
Actuality of the information



The information displayed in the on screens and in the application in floorplans and reports and is (near) real-time.

The data used in reporting goes from real-time to as far back as possible.

Access levels



Only employees have acces to the app. There is a possibility to review the information on a screen so visitors can review the information as well.

Manager can derive report about occupancy. Identity is depersonal-ized.

Benefits

The main aim of the tools is providing a better service to the user and in the end happy and healthy employees. Other benefits as lower energy costs and more users per square meter are connected to the main aim but are an effect of the tool. These latter benefits are also important for the business case. We are measuring the satisfaction rate of employess via questionairres and interviews (before a new working concept and after). Occupancy can be monitored via the online dashboard.

Side notes

There is a 'depersonalisation-button' so users can make themselves unvisable to find. Only the occupancy will be measured than, but no personal information will me made available to other users.