E-Wallets

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CAICT COMMUNICATIONS 2011/2

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18 May 2011

ISBN 978-87-92524-12-6

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Abstract: *The purpose of this paper is to contribute to the design of e-wallets. e-wallets are intended to replace the existing physical wallet, with its notes, coins, photos, plastic cards, loyalty cards etc. Four different user groups, including teenagers, young adults, mothers and businessmen, has been involved in process of identifying, developing and evaluating functional and design properties of e-wallets. Interviews and formative usability evaluations have provided data for the construction of first a conceptual model in the form of sketches, and later a functional model in the form of low-fidelity mock-ups. During the design phases, knowledge was gained on what properties the test users would like the mobile wallet to hold and the properties implemented in four prototypes. The identified properties have been clustered as 'Functionality properties' and 'Design properties', which are theoretical contributions to the ongoing research in mobile wallets.*

Keywords: e-wallet; design properties; deign properties, cashless society; digitalization

INTRODUCTION

The digital revolution continues to transform most aspects of our daily life. In particular, the digital revolution has resulted in the vertical convergence of business channel capacities [1]. The digital revolution also continues to transform the public sector organizations and services. For instance, the Danish public citizen portal called borger.dk which forms an online entrance to the public sector with access to public information and digital self-services concerning topics such as family and children, taxation, residence and buildings, and disabilities. Other examples are digital bus tickets bought via mobile phones, online purchases, and social interactions made via SMS, emails and social networks. A next step in the digital revolution is the transformation of the time honored traditional physical wallet into the e-wallet.

There are many mobile payment solutions, but most of them have failed or their adoption rate has been lower than expected. It is suggested that technological development of such solutions should be directed towards a closer cooperation with users [2], and that future mobile payment research should focus on usability, as this is an unexplored area of mobile payments [3]. Set within this context, the purpose of this paper is to propose functional and design properties of e-wallets.

BACKGROUND

In the beginning of the 2000's, early mobile content and services such as ring tones and logos succeeded in the marketplace and made mobile payment services a critical issue of concern. At that time, mobile payments were commonly perceived as a "killer application" for mobile commerce. Later, mobile payments were suggested as an alternative for micro-payments at point-of-sales systems, where the use of cash had been declining for many years. Many mobile and electronic payment solutions have been introduced ever since, but most of them have failed or have had a low penetration rate [3, 4]. Moreover, payment is an institutional act, which cannot be easily changed. Payment is transacted in almost the same way worldwide, and it would become problematic if each country had its own electronic payment system. Further issues arise when companies additionally develop their own electronic payment systems, such as those for public transportation and retail chains. So, there is a need for standardization of mobile payments [5].

Mobile payments around the world

One of the more successful new standardized electronic payment systems is PayPal. Initially PayPal enabled people to perform transactions of small payments by means of e-mails. Since then, PayPal's system has been re-designed and extended several times. Today PayPal has more than 220 million

accounts and is experimenting in the area of mobile payments through a partnership with a start-up that provides stickers for mobile phones that can link the phone to payment terminals in the stores.

Two other electronic payment systems that are successful are the Oyster Card in London [6], and the Octopus Card in Hong Kong [7]. Their success is due to the fact that they initially were introduced to collect fares for mass transit systems, instead of trying to substitute all payments. The Octopus Card has later been extended to include payments at convenience stores, fast-food restaurants, supermarkets, parking meters, car parks, vending machines and service stations.

Other new ideas are Visa PayWave and MasterCard PayPass contactless payment technologies both of which use RFID-technology, which means that you do not have to swipe your card or insert it into another device to pay. They were primarily introduced as smart card technology, but have since been extended to include key fobs and Near Field Communication (NFC) enabled technology.

In 2004, Sony, NTT DoCoMo, and local banks in Japan formed a joint venture and launched a mobile payment system. The system is based on Sony's chip FeliCa and allows customers to use their mobile phones as credit cards, access cards, fare tokens on all kinds of public mass transit, and several other utilities. In Africa, a new kind of mobile payment was introduced in the beginning of 2007. The payment system is called M-PESA ('M' is for mobile and 'PESA' is the Swahili word for cash) and was developed by Kenya's largest mobile network operator Safaricom, which is a part of the Vodafone Group. Within the first week more than 20,000 M-PESA accounts had been registered and two years later in 2009 the number of accounts had reached six million.

It is, however, not only commercial companies that are working on the diffusion of electronic payments. The GSM Association (www.gsmworld.com) and the European Payments Council (www.europeanpaymentscouncil.eu) are working together to accelerate the deployment of services that makes it possible for costumers to transact payments using their mobile phones. In October 2010 they published the document 'Mobile Contactless Payments Service Management Roles – Requirements and Specifications', with the aim to help the various providers when starting the actual implementation of mobile contactless payment services (http://www.europeanpaymentscouncil.eu).

So, while the most popular payment instruments still are cash, cheques, and debit and credit cards [4] with smart cards being the most serious challenger to traditional cash [2], the ways to make contactless payments and especially mobile payments are increasing. When looking into the future, companies and experts agree that the mobile phone is that technical device that they will try to turn into the new wallet, mainly because of the diffusion of mobile phones, which no other technical device can match, but also due to the fact that most of us carry our mobile phones with us most of the time. If this e-wallet diffuses it is very likely that some traditional payment instruments will decrease. But it is also a possibility that the mobile wallet will just become a new way of entering the current card and account-based payment services [4]. It is impossible to predict whether mobile payments will or will not may not substitute the traditional physical wallet or become complement to existing payment solutions. But, this might be the beginning of a gradual substitution and might take several years to be complete [3]. No matter what will happen, exploring what design and functional properties the users find useful and important in an e-wallet, is a step on the way towards a cashless society.

DESIGN PROPERTIES IN LITERATURE

The literature does not contain much information about the specific properties needed in an e-wallet. That said, some guidelines for the design of an e-wallet were found when examining the literature.

It is argued that electronic payments have several advantages such as accessibility, convenience, speed, privacy and control, and that electronic payments are preferred in simple routine service transactions. They furthermore state that mobile payments should not imply advanced multi-step procedures; PIN codes are preferred for identification and authentication; and consumers consider mobile payment useful, if it is able to constitute several plastic cards. The reasons for using traditional human assistants are security concerns and the opportunity to get help when skills required to use new technologies are lacked or the system malfunctions. A mobile payment channel should therefore furthermore communicate a high level of security and contain a helpful design that guides the user by means of careful communication, in order to make the user feel as comfortable using the new payment channel, as when using the traditional payment channels [3].

This research was done in the context of consumers' adoptions of mobile payments taking consumers' opinions into account [3]. With regard to design properties the results show that mobile payments should be deducted from an already existing account, that payments should be made through another technology other than text messages, and that transactions need to be recorded locally on the mobile phone for documentation matters as well as on the distributed databases. An additional design property identified in the literature is the display of current balance that can be seen before making a transaction [8].

METHODOLOGY

The choice of method was driven by the research problem, which is the identification of e-wallet properties with focus on the interaction between the user and the artifact. The focus on human-computer interaction leads to issues that are complex and grounded in multiple disciplines. Consequently, questions frequently arise that have a thin or no theoretical background, and exploring these, is where Design Science Research – exploring by building – proves useful [9].

The design process

There are several guidelines and approaches on how to conduct design science projects. In this project we draw upon Takeda et al.'s [10] model. The choice is motivated by that it was one of the earliest to structure and formalize the process of using Design Science. The model is also found in recent literature [9].

The process starts with an *Awareness of the Problem* phase, which typically comes from wonder or a problem in current practice that the researcher aims to solve. The output of this phase is a description of the problem and a proposal for researching this problem. The following phase is *Suggestions for a Problem Solution* phase and drawn from existing knowledge (literature and existing artifacts), followed by an attempt to implement an artifact based on the suggested solution (called the *Development* phase). Knowledge in the *Suggestions* phase may refer both to solutions from other areas, theories, or idea from potential users. In the *Development* phase, an attempt to develop and implementing an artifact according to the suggested solution is performed. It is in this *Development* phase that most of the design takes place. The techniques for implementation vary, depending on the artifact to be constructed. The implementation itself can be very ordinary and does not need to involve innovation beyond the state-of-practice for the given artifact; the innovation is in the design, not the construction of the artifact. The output of this phase is findings about the artifact's application and functionality. Afterwards an

Evaluation phase starts where the implementations is assessed, and finally, a *Conclusion* phase indicates that the design project is finished by deciding that the results are "good enough", and by summarizing what the contributions of the artifact are. The phases *Development*, *Evaluation*, and further *Suggestions* are iterative until the results are "good enough" or saturation has been reached.

User involvement and data collection

The users involved in this project were mainly found at Facebook among peripheral acquaintances and friends of friends, in order to keep prior knowledge of the interviewees to a minimum and minimize biases. A further selection criterion for the interviewees was the degree of use of technology in their everyday lives, as this was estimated to be necessary in order for the interviewees to be able to understand the mobile wallet concept. The number of users was 26 for the Suggestion phase and 16 for the Evaluation phase. Table 1 provides information on the number of participants and demographics.

Table 1. Participants involved.

User groups	No. of part.	Age	Time Period (2010)	Location
Suggestion phase				
Young Teenagers	8	13-15	Sep-Dec	Home and school
Young Adults	8	19-25	Sep-Dec	Home and library
Mothers	5	32-37	Sep-Oct	Home and workplace
Business Men	5	46-53	Sept-Dec	Home and workplace
Evaluation phase				
Young Teenagers	4	15	Jan	Home
Young Adults	4	20-22	Jan	Home
The Mothers	4	30-37	Jan	Home
Business Men	4	46-53	Jan	Home and workplace

The participants for both phases represented four different user groups: Young Teenagers (YT), Young Adults (YA), Mothers (M) and Business Men (BM). The reason for choosing these four user groups is the fact that they loosely cover the phases of Wells and Gubar's [24] widely used consumer life cycle. Furthermore, one of our underlying assumptions is the need for multiple solutions from different user groups. The interaction time between researcher and user varied from 15 to 60 minutes and were conducted in the autumn of 2010. To avoid the issue of the artificial environment intimidating the interviewees, the interviews were held at a place chosen by them, mainly their residence or work place.

THE IDENTIFICATION OF E-WALLET PROPERTIES

The Awareness and Suggestion phase

The starting point of the design process was the identified lack of an e-wallet and its design properties. The problem was grounded both in the literature and in the practice (experts interviews).

The *Suggestion* phase is where the work with the proposal from the previous phase (*Awareness*) is initiated. The work with the *Suggestion* phase took its starting point in the users, 26 people were interviewed during this phase. We recruited participants from the four user groups based on the assumption that the groups would differ from each other, regarding their needs and expectations to the wallet. Munck [8] emphasis the understanding of end-users' behaviors and needs is a success criterion for contactless and mobile payments. This phase involved four steps:

1) Usability goals and user experience goals

If the primary objective of developing a product for a group of users is made clear, it is easier to understand these users. Classifying the objectives in terms of usability goals and user experience goals can do this. Usability goals are concerned with meeting specific criteria of usability, whereas user experience goals are concerned with developing user experiences [12]. However, as this project only focused on design properties and not on the user experience, the usability was the focal point while user experience goals were not written. Yet, it is important to note, that the two kinds of goals are not clearly separable, since each of the goals is fundamental to the other. But, since this project is an exploratory study that forms the basis for future research, it is acceptable that not all perspectives of the wallet are covered. The following overarching goals were identified during the first round of interviews:

- *Efficiency*: Carrying out a common task such as paying with the e-wallet, should imply no more than six steps, which is the number of steps it takes to pay with a payment card today (take the card out of the wallet – place it in the payment terminal – type the PIN – click OK – remove the card from the terminal – put it back in the wallet), see also [2].
- *Safety*: It should not be possible to make a payment by mistake. This goal was chosen since; security is perceived important according to the interviewees and stressed by [4].
- *Utility*: The e-wallet should provide an appropriate set of functions that will enable users to carry out their conventional tasks from the physical wallet, in the way they want to do them. This was chosen as a criterion for usability because of the fact that the interviewees had so many different ways of using their wallets.
- *Learnability*: It should be possible for the user to work out how to use the e-wallet by exploring the interface. This is important, as people do not like spending a long time learning how to use a new system, and two of the interviewees told that they do not read instruction manuals. Learnability is especially important for interactive products intended for everyday use [12].

2) Personas

After having defined the usability goals, four personas were created representing the four user groups. A persona is a thorough description of a typical user of the system that is developed. Hence, the designers can focus on designing the system to this user, rather than to a whole group of users. A persona is not a description of a specific person who exists in reality, but a mixture of an amount of user data [12]. Generally, these descriptions are called fictitious user descriptions. We followed the proposed structure in the second phase of The Persona Lifecycle, which focuses on persona conception and gestation [13].

3) Sketching

Following the personas, the next step of sketching process was started when the interviewees from the previously mentioned interviews were asked to draw a sketch of an e- wallet. As Linus Pauling once said: *"The best way to get a good idea, is to get lots of ideas"*. Thus, the interviewees' ideas ended as sketches for four different wallets; one for each of the user groups. The sketches from each group were then mixed into one composite sketch, i.e. controlled convergence [14]. This approach is widely used, among others see for instance [15]. Besides controlled convergence, which is about discarding ideas or part of ideas, Pugh used another notion, called concept generation. Concept generation is about expanding the scope by adding new ideas. In figure 1, we show the design sketch from the Young Teenager. The text in the figure 1 and also in 2 and 3 is translated from Danish to English.

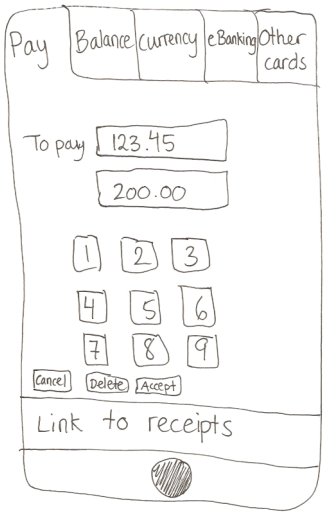


Figure 1. Design sketch Young Teenager.

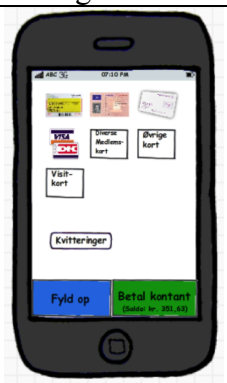
4) Scenarios

In this project, the new ideas came from the writing of scenarios that followed the sketching process. *"The scenario is a narrative written in a natural language. It focuses on a user using the system. The goal of the scenario is to explore design solutions"* [13]. Personas and scenarios are inextricably linked, as personas are useless without scenarios [13].

Development phase

In the development phase, four e-wallet mock-ups were created. A mock-up is often used as a topic for conversation in for example an interview, but the mock-ups in this project were used as prototypes. A prototype is a more or less functional model that enables stakeholders to interact with the imagined product. In that way, the prototype can be tested by the intended users in realistic environments, which leads to the designers' becoming aware of design issues they had not thought of themselves. A prototype is of great help in the design process because of the fact that the designers are brought to perceive completely new considerations, when they are going to take something from inside their minds and turn it into something physical and/or digital.

Table 2. Initial prototypes used in the evaluation phase.

Prototypes			
Young Teenager	Young Adult	Mother	Business Man
			

Evaluation phase

The Evaluation phase consists of an analysis of the gathered findings and an assessment of to what extent the artifact fills in the imperfections made explicit in the proposal from the *Awareness of Problem* phase. As Hevner et al. [16] explain it:

> *"A design artifact is complete and effective when it satisfies the requirements and constraints of the problem it was meant to solve."*

Where the *Evaluation* phase focuses on what went good or badly, and decides whether or not iteration is needed, this section provides the basis for making these decisions. During this phase we involved 15 people to evaluate the design solution. The questions asked were concerned with:

- The users' understanding of the e-wallet's properties
- What impression they got when they first saw the e-wallet
- What they thought about the properties that was specific for the e-wallet compared to the physical wallet
- If they would like to have any other properties in the wallet
- Three things that they liked and three things that they disliked from the e-wallet

In the reminder of the section we present several quotes illustrating the key design properties.

Young teenager

Starting with the Young Teenagers, their first problems were caused by the 'Currency' tab in the top of the wallet. Both of the test users thought it was nice to have, but said that they would not use it that much:

> *"Maybe it should not take up such a big part of the window, but I do not know where it should be placed instead, because you are not abroad that often […]. I would actually like if it converted automatically. And if you wanted to pay in Danish kroner, you should have the possibility to change it manually […]. Both [currencies] should be there so you do not have to calculate it yourself" (Young Teenager).*

Another concern was regarding the security:

> *"I think that it is a bit insecure to have it in the phone. […] try to imagine that you lose your phone and other people can use it for travelling in your name" (Young Teenager).*

One of the test persons had an idea for how to load money to the mobile wallet:

> *"I think a lot about eBanking as I consider it almost the same as this phone-thing. I think that it should be possible to do it at home […] thus loading it from your computer at home into it [the mobile phone]" (Young Teenager).*

Young adults

The two Young Adults, who evaluated the first mock-up of their e-wallet, would not use the possibility of containing business cards in the e-wallet:

> *"[…] business cards do not belong [in a mobile wallet]. New mobile phones can hold so many data in the contacts/phonebook with emails, addresses, private phone numbers and*

work phone numbers and much more […] and so, it is completely needless" (Young Adult).

The icons in the e-wallet were preferred to the text buttons (see Figure 2), and it was suggested that the 'Receipts' button should be changed to an icon:

"It looks rather unsystematic, careless [that the 'Receipts' button is placed where it is]. […] you could have an icon looking like a receipt" (Young Adult).

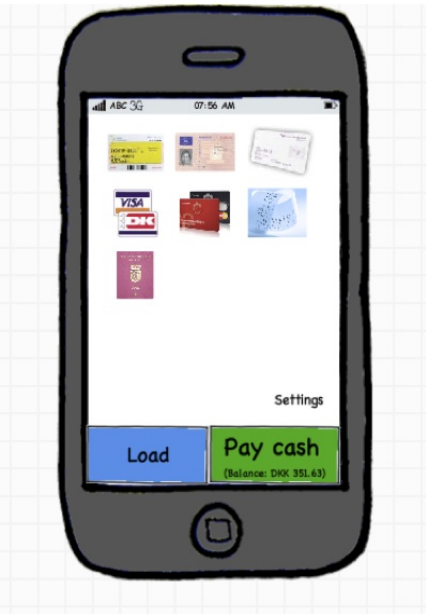


Figure 2. Mock-up, 2nd round Young Adult.

An application to the bank was also suggested:

"[…] I like having a receipt telling me how much money I have on my account. So, if there was an app to the bank […] like 'kontokik' [a function provided by the bank, enabling the user to see transactions on his account, but not to transfer money] for instance, where you could see how much money is on the account, what the money was spent at, and when withdrawals were made […] [it should be] just 'kontokik', not money transferring" (Young Adult).

Mothers

With regard to receipts, one of the test users from this group suggested that the balance should be a link leading to a kind of receipts or a list formed like a bank statement showing transactions. The other test user said that it would work for her if the receipts were in the e-wallet, as she did not need to have the receipts physically. She would, however, not keep all receipts:

"I would only keep those for expensive things. I would not keep those from buying milk and flour and eggs" (Mother).

The same user later proposed an additional function for the receipts:

"[...] if you keep the receipts, you could make some sort of fast search, to find out just how much money has been spent at the drug store this month [...] so, when you are working with your budgets or something like that, you could find out exactly what happens to the money" (Mother).

It was additionally suggested that there should be added radio buttons for different accounts, and that these accounts should have names:

"[…] it should be named as the account it came from, e.g. budget account. Because, my budget account is another account than my VISA card account. […] in that way I could see where they came from. My daughter has an account, [and it could] be there, and it could be that [card] you used for buying toys or clothes […]" (Mother).

Businessmen
Both businessmen users from this group liked the structure of the e-wallet, and both were strong advocates of sorting the cards in categories:

"They [i.e. the cards] should be placed underneath [a category] […]. Each page should only hold 7 – 9 – 10 [icons], just like when running a slide show; you should only have five lines of text on a slide, or else people will not be able to take it in. So: categories and then moving downwards [to find other functions / cards]" (Business Man), and: "I think that [i.e. the categories] would be better. You could have some of the common [cards] up in the first [row], and furthermore have a section where you could make your own categories" (Business Man).

In addition to this, one of the test users suggested that all the mobile wallet's contents shown on the front page should be ordered in categories represented as bars:

"[...] so when I entered [the wallet] I would like to have a bar called 'Payments', and when I pushed it some of this [pointing at the top row of cards] would appear. And afterwards some 'ID'. And then there could be a 'Other cards'. And then I might have the possibility of structuring it myself, if I would want an additional bar" (Business Man).

Moreover, one of the test users suggested the payment page as a picture of the receipt, which after the completed payment is sent to the mobile wallet. The payment page should therefore hold the name of the receiver of the money:

"[It should] show the hotel's receipt or the 'restaurant's receipt. That is, with name, so it can be used as receipt you can use as a voucher in your accounts" (Business Man).

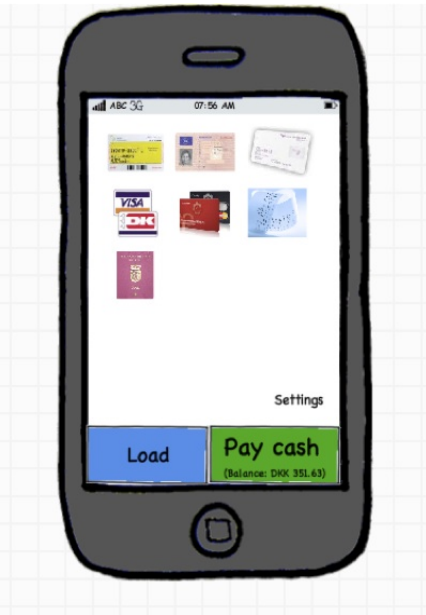


Figure 3. Mock-up, 2nd round Businessmen.

Conclusion phase

The test users for the second mock-up of the Young Teenager's mobile wallet, reflected upon how many items in the mobile wallet, they would like to secure by PIN or a password, in order to prevent strangers spending their money or using personal data, if the mobile phone should get lost or stolen. Both test users considered it insecure to have the passport in the e-wallet, but disagreed on how many of the e-wallet's cards should be secured. The usability goal of safety has thus not been fully reached, as the mobile wallet that was tested not made the users fell completely safe.

The tests of the second mock-up revealed that the usability goal of learnability has not been reached by this version of the Young Adult's mobile wallet, as both test users did not understand the 'Load' button. The test users additionally proposed new properties for the e-wallet, e.g. a text appearing when payment is completed, a 'Cancel' and a 'Load' button on the payment page, bus passes, a possibility to change the structure of the mobile wallets front page, a bank application, and many more. All these additional properties indicate that more functionality is needed in the mobile wallet, and the usability goal of utility has therefore not been reached.

During the user tests of the second mock-up of the Mother's e-wallet, one of the test users proposed a text appearing on the mobile e-wallet's screen when payment is completed. The adding of an eBanking function, a receipt option, and an automatic scanning of membership cards were proposed as well. A further suggestion was that the payment methods should include the user's different accounts, as a user might have more than one bank account. Moreover, the test users had different suggestions for what should happen to the receipts if a mobile wallet was introduced, and a further investigation of this matter is therefore needed. All these things lead to the conclusion that the usability goal of utility is far from being reached by this version of the mobile wallet.

Through the user tests of the second mock-up representing the Business Man's e-wallet it became clear that a category structure was preferred to the structure with all the cards visible on the wallet's front page. The mobile wallet would therefore reach the usability goal of learnability to a greater extent, if the

category structure were applied. An additional thing that would improve the learnability is the moving of the receipts from their present place. Through the user tests of the second mock-up representing the Businessman's e-wallet it became clear that a category structure was preferred to the structure with all the cards visible on the wallet's front page. The mobile e-wallet would therefore reach the usability goal of learnability to a greater extent, if the category structure were applied. An additional thing that would improve the learnability is the moving of the receipts from their present place, into the payment methods where the test users thought they belonged. The revised prototypes after the evaluation phase are presented in table 3.

Table 3. Revised prototypes.

Prototypes			
Young Teenager	Young Adult	Mother	Business Man
			

RESULTS

Besides the final prototypes presented above, table 4 presents a listing of the design properties across the four personas (Teenager, Young Adult, Mother, and Business Man) from the prototypes developed as a result of the second design iteration. The design properties were clustered into four different categories: Home Screen, Services, Interaction and Interface. The design properties for the Home Screen cluster refer to features and aspects that were deemed essential or desired for the starting page of the mobile wallet. Services cluster collects the functional design properties. Interaction cluster consists of navigational aspects. Finally, the interface cluster collects the design properties related to placement, look-and-feel and other user interface aspects.

Table 4. Clustering of Design Properties

	Persona Groups			
Design Properties	**T**	**YA**	**M**	**BM**
Home screen				
Health card	X	X	X	X
Passport	X	X	X	X
Driver's license		X	X	X
Payment card(s)	X	X		X
Membership cards	X	X	X	
'Membership cards' category				X
Receipts	X	X		X
Gift vouchers	X			
Hotel / car rental cards				X
'ID cards' category				X
Services				

Balance	X	X	X	X
Purchasing list	X	X		X
Automatic currency conversion	X			
Currency converter				X
Amounts given in two currencies when abroad				X
Total amount of goods being bought	X	X	X	X
Headline on front page saying 'Your electronic wallet				X
Headline on payment page stating the payment method				X
Service message (illustrated as yellow circle with a number)				X
Shortcuts to most used functions				X
Optional background picture			X	
Interaction				
'Settings' button	X	X		
'Pay' button	X	X	X	X
'Load' / 'Transfer' button		X	X	X
Icon representing 'paying cash' and leading to payment page				X
Icon leading to the choice of payment method			X	
Radio buttons for choosing payment method			X	
eBanking shortcut	X			
'Back' button on the payment page				X
Interface				
An icon structure	X	X	X	X
Icons placed from the top of the wallet and downwards	X	X		X
Icons placed in the bottom of the wallet			X	
Balance a part of the 'Pay' button on the front page	X	X		
Balance placed near the 'Pay' button on the front page			X	
Balance placed above the list of what is being bought on the payment page				X
'Pay' button in the bottom of the wallet's front page	X	X		
'Pay' button in the middle of the wallet			X	
'Pay' button on the payment page	X	X		X
Payment card icon in the bottom of the wallet next to 'Pay' button	X			
'Load' button in the bottom of the wallet next to 'Pay' button		X		
'Load' button on the payment page				X
'Transfer' button above the icons			X	
Total amount of goods being bought visible on the payment page	X	X		X

In Table 4, only five design properties were universally required personas across the four user groups). Home Screen and Interface clusters contain the highest number of design properties requested by the four user groups. Further, 24 design properties were needed by just one user group with the Business Man persona having the highest need for specific design properties Figure 4 presents a quantitative summary of the design properties clusters across the four personas.

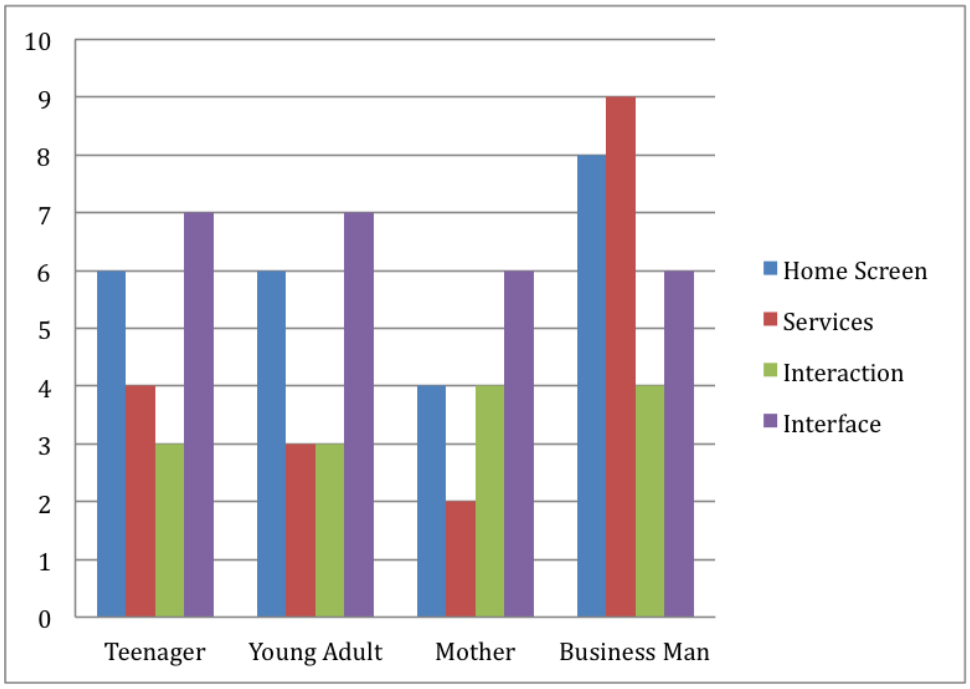


Figure 4. Properties and user groups.

Figure 4 shows that the Business Man persona (as it is to be expected) requires the highest number of services and home screen features. On the other hand, the Teenager and the Young Adult personas place greater emphasis on the interface design properties. This tells us that while functionality is the critical design consideration for the professional user segment, aesthetic and experiential aspects of design should be prioritized for the teenager and young adult user segments. For the persona of Mother and other user segments with time pressures, a minimalist mobile wallet is to be designed.

DISCUSSION AND CONCLUSION

An observation that emerged from our design science project is that the design and functional properties of a mobile e-wallet are somewhat different to those of mobile payments. The way the user tests of the mock-ups were conducted proved to be very useful for this project, as the interview approach to the tests, allowed for explanations when needed. And they were indeed needed. Some of users, had difficulties grasping the idea of an e-wallet. Those who understood it had, on the other hand, many questions, especially concerning security and other aspects of mobile payments that are still uncertain. Security issues are one aspect that needs to be further explored, not only in the case of e-wallet but for on-line shopping in general, since it might be in conflict of other usability goals, such as efficiency and learnability. The user tests additionally revealed that it is of great importance, when testing an innovative product, to ask the test users to ignore the questions of whether they would use it, as this showed to affect a couple of the tests. Another observation showing that some users did not quite grasp the idea, was made when some of the users suggested that the mobile wallet should hold the possibility of reading text messages and checking Facebook, because they would not want to be without it. Along the way, it was therefore decided to explain to the test users, that they still had all their other functions in the mobile phone, and that the mobile wallet was just another function.

The user tests did moreover inspire to asking further questions that had not been planned, and which might not have been asked to all the test users. But in the given situation, they seemed right to ask. For example, if the test users proposed ideas that had not been proposed before, it happened that the test users in the following tests were asked about this proposal, in order to have their opinion. This project was, however, an explorative design project, and nothing was given in advance. It was therefore all right to test several ideas. An expert is after all a person who has tested all kinds of solutions, in order to find the right one, and to learn from those who went badly.

Through the last iteration of user tests, several new ideas were proposed, and the user groups were still getting inspired by each other's designs of the mobile wallet. The evaluation assessed that a new iteration is needed, it is concluded that the mobile wallet proposed by this project, is not yet ready to be launched. It was, however, never the purpose or in the scope of this project to design a fully functional mobile wallet. Instead, the objective was to document design and functional properties than can help inform further research into mobile payments in general and mobile e-Wallets in particular. This has been achieved by proposing the set of design and functional properties for the mobile wallet. It is a possibility that the mobile wallet could hold a settings function allowing the user to edit the contents of the wallet, but it need to be explored if it is desirable for the users to have a lot of options.

A big challenge in the work with the mobile wallet was to clarify what functionalities each button should have. There were almost as many opinions as there were test users. This was revealed in the evaluations, where the usability goal of utility was the goal most far from being reached. The usability goal of learnability was not close to being reached either, mainly because the test users within each group had different opinions about the structure of the wallet and kept being inspired by the mock-ups of the other user groups' mobile wallets. It could thus have been tested whether it was possible to create one single mobile wallet for all users, by having one group's test users to test another group's mock-up. This would explore how it would work for them and what changes they would propose. By switching mock-ups through many iterations of tests, the possibility of having one design satisfying all the users, could thus have been tested. However, this project did not have this approach, but focused on developing wallets for different user groups. It was from the beginning assumed that a standardized wallet would hold many customization options, hence would be confusing to the user. This could lead to a situation where the user would not want to use the e-wallet. The evaluation revealed that all the user groups actually had suggested such a settings function to be added to the wallet. It is therefore needed to be further explored, how the users would use such a wallet, for instance through user tests of more functional prototypes allowing them to interact with the artifact representing the mobile wallet. The test users who suggested the adding of a settings function might, have done so as they did not like to say directly that they wanted the mobile wallet to be different from what they were presented with.

ACKNOWLEDGMENT

This work was carried with the support of Copenhagen Finance IT Region (www.cfir.dk) and was funded by the Danish Enterprise and Construction Authority grant number ERDFH-09-0026. Any opinions, findings, interpretations, conclusions or recommendations expressed in this paper are those of its authors and do not represent the views of the funding agencies.

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