

SimpleWallet : A Mobile Application **Design for Grocery Shoppers**

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Table of Contents

1.	Prob	blem Statement	3
2.	Intro	roduction	3
3.	Liter	erature Review	3
4.	Met	thodology	4
4	.1.	Empathize	4
	4.1.1	.1. Observation	5
	4.1.2	.2. Direct Interview	5
4	.2.	Define	5
	4.2.1	.1. Data Analysis	5
	4.2.2	.2. Problem Statement	6
	4.2.3	.3. Personas	6
	4.2.4	.4. Scope and Constraints	6
4	.3.	Ideate	7
	4.3.1	.1. Brainstorming	7
	4.3.2	.2. Market Research	7
4	.4.	Prototype	7
4	.5.	Test	7
5.	Disc	cussion and Results	7
5	5.1.	Fieldwork	8
5	5.2.	Problem Definition	8
5	5.3.	Product Development / Final Design	10
6.	Con	nclusion / Key Learnings	11
7.	Refe	ferences	13
App	endix	x 1 - Observation Logs	14
App	endix	x 2 - Interview Logs	15
App	endix	x 3 - Data Analysis (Coding)	17
App	endix	x 4 - Personas	20
App	endix	x 5 - Market Analysis of Existing Mobile Apps	21
App	endix	x 6 - Concept #1	22
App	endix	x 7 - Concept #2	23
App	endix	x 8 - Concept Testing, Questions and Feedback	25
App	endix	x 9 - Objective and success criteria	27

1. Problem Statement

Grocery store shoppers are sometimes overwhelmed by the number of items needed to make payment and enjoy savings at the point-of-sale; these items include various forms of credit cards, debit cards, gift cards, reward cards and coupons. Customers need a way to carry less payment items at the point-of-sale because it is inconvenient and time consuming to sort through and use all of their different payment items.

2. Introduction

In an attempt to centralize our project around a focus area which the team members could relate and had interest in, the team decided to focus on the grocery store checkout process. Grocery store checkout is a topic which most people deal with on a weekly to monthly basis, therefore it would be interesting to understand what sort insights and improvements could be discovered. From the use of methodology found in User-Centered Innovation and the 5-phases of Design Thinking, the team utilized multiple techniques in order to define a problem and synthesize a solution. During this process the focus of the project shifted from the broad idea of grocery store checkout, to the area of Point-of-Sale payment process, specifically on the customer side.

In our research, it is clear that many organizations have created a lot of innovative ideas around simplifying the payment process and enabling more savings, but there is currently no product that helps customers achieve ease and simplicity of payment as well as savings at the same time. We have designed a new mobile application that makes it possible for shoppers to manage payment process better by consolidating all their payment cards as well as reward cards and coupons into one interface. The application can be used on any smartphone device and makes it possible to set up different store accounts beforehand to optimize savings at different stores.

This mobile application seeks to address three common problems encountered by grocery shoppers at the point-of-sale. It helps customers carry fewer payment items by consolidated the items needed for payment into one interface, it makes the payment process fast and intuitive, and it helps customers enjoy savings while they shop.

3. Literature Review

In today's highly competitive world customers are bombarded with an array of products; credits cards from various stores and merchants promising cash back deals and reward on different products, rewards cards from various store to ensure customer loyalty and encourage frequent purchase [1] and coupons from stores and manufacturers to incentivize customers to purchase a product. Grocers are ramping up sales in a bid to out discount one another and earn the loyalty of customers. It was estimated that 16.8 percent of items sold in the US by food, drug and mass merchants from Feb 22 2007 to Feb 21 2008 was on sale, a 1.3% increase over the previous year [2]. The first credit card was introduced in 1986 and today about 60% of all credit cards earn some type of rewards in the form of loyalty points, cash back etc. The competition in credit card rewards programs has intensified in 2016, however the competition goes far beyond the shoppers' space. Retailers and merchants have also switched credit card issuers, for example in 2015 the wholesale giant Costco switched from American Express to visa due to increased benefits [3].

From a 2013 U.S. Supermarket Experience Study, shoppers advocate that speed and affordability of the shopping trip are most important [5]. The majority of customers want to take advantage of all these available products and save as much money as possible, however this leaves them with a lot of payment items at checkout which may be difficult to manage. Although shoppers want to enjoy more savings, they do not want to trade convenience for savings, as a result a lot of customers are willing to forgo coupons, rewards and cash back for ease, simplicity and convenience. For the customers who want the best of both worlds, the process of payment and managing coupons, cards and rewards is tasking and time consuming.

There has been a number of innovation aimed at reducing the number of cards people carry in their wallets by consolidating the cards people carry with them into their phones, the most common mobile wallet applications available in the market are PayPal, Apple pay, Android pay and Samsung pay [4]. Coupon apps have also become increasingly popular, they make it possible for customers to store their coupons on their phones or search for coupons on the web and have them handy at the store when they need them. Although mobile wallet and mobile coupons help shoppers to better manage payment and savings at point of sale, these innovative products can only can address one problem at a time or only part of both problems for example while some mobile wallet enable customers to keep track of gift and reward cards they do not incorporate saving using coupons. Using two applications during payment to consolidate cards and ensure savings can be tasking and time consuming. Also, there are a lot of limitations associated with the use of these applications, Apple and Samsung pay can only be used on specific types of phones and Android pay can only be used on phones operating on the Android OS, while some mobile wallets can only be used with certain payment cards e.g. capital one wallet, others can only be used at certain stores like Walmart pay. While these apps all have various benefit, none of them is centered on an end to end improvement of the customer experience at the point of sale. Further market research details can be found in Appendix 5.

4. Methodology

Various models of design thinking have been developed after the early model by Herbert Simon in 1967. For this paper, the five stage model shown in Fig1 below and proposed by the Stanford D school was used. The five stages outlined in this model are empathize, define, ideate, prototype and test. It is important to realize that this is an iterative process, very much rooted in the idea of User-Centered innovation. Multiple iterations in the process ensures that user input is heard throughout the design cycle and should ultimately strengthens the end product.



Figure 1 - Five Stages of Design Thinking © Teo Yu Siang and Interaction Design Foundation [6]

4.1. Empathize

This is the very first stage in the design process, which involves understanding the root of a problem and gaining insight into the needs and opportunities that exist, it involves seeing the world through people's eyes. This understanding goes beyond the designer's perspective, therefore preconceived notions or assumptions need to be set aside. During this stage, empathy is needed and immersion in the physical environment in order to engage with users and understand their experiences, motivation and needs is important. In this project, observations and interviews were used to achieve empathy. The utilization of both these methods is useful in aligning what users actually report, versus what was inferred from observation.

4.1.1. Observation

According to Klaus Barrensten and John Trettvik, human cognition cannot be understood separately from the physical and cultural environment they grow up in and therefore human-technology interaction needs to be analyzed in this perspective [10]. Ethnography was employed for the first stage of this project, according to Spradley JP et al, the aim of ethnography is to understand another's way of life from a native point of view [8]. The goal of such a study is to grasp the native's point of view, his relation to life and realize his vision of the world.

4.1.2. Direct Interview

User interviews are a great way to extract information from users about their experiences, they are relatively cheap and easy to conduct and can be conducted by anyone who can ask questions and record the answers [11]. Direct interviews were conducted during the field research in the same stores used during the observations. The interviews involved the use of pre-planned questions and started out with introductory questions which provide background information on the respondents. The interviews then graduated into questions that were able to elicit responses that reflected the experiences, feelings, needs and emotions of the users, sometimes follow-up questions were asked to get more information based on a previous response. The interview was done with intuition, imagination, and emotional sensitivity to extract the right kind of insight from the respondents and to help hear beyond what they were saying.

4.2. Define

This is the stage where all the data gathered during the empathize stage is analyzed and synthesized in order to define a problem; the problem is usually defined as a problem statement. This second stage of design thinking involves definition of the personas by focusing on a memorable and manageable cast of character to design for that share similar characteristics

4.2.1. Data Analysis

In order to make sense of large amounts of observation and interview data collected from the Empathize phase, it is essential to utilize raw data processing techniques. There are several methods available for data analysis, such as affinity diagrams, various software, and manual coding. In this project, a method called "the 3 C's of Data Analysis" was utilized to allow the team to sort, refine and categorize the raw data into meaningful information. This method, shown in Figure 2 below, was described by Lichtman [9].



Figure 2 - Three C's of Data Analysis: Codes, Categories, Concepts [9]

This method allows for the input of raw data, in the form of observation logs and interview logs, in a systematic way. In this project, there were several pages of handwritten and typed observation and interview logs across three team members. Each log was transferred into a shared excel file, line by line. If a sentence or idea from the log file contained multiple ideas, it would be broken up into multiple rows to convey each idea separately.

Once all of the data was entered, it was then reviewed to begin "coding". The process of coding is to evaluate each row(idea), and assign a number to each unique idea. Multiple rows may be assigned the same number, if the data is interpreted as the same.

After the coding effort, it is useful to then sort all of the data to group the "codes" in order. From this, each code number is reviewed and assigned a category description. Multiple code numbers may be grouped under the same category. This technique allows for the gathering of ideas and forming areas of focus under which these ideas belong.

Once categories have been created, developed concepts can be formed. The team must once again sort through the data, and for each code number (sometimes common to many rows of data) a concept shall be defined. This process allows the team to further interpret what the idea really means to the customer and what the end message is from the data.

With this process completed, the concepts can then be analyzed as desired. Our team decided to sort the concepts by number of occurrences. In doing so, the top running concepts were identified for the team to focus on. This process, while time consuming, seems rather effective in distilling down the multiple forms and sources of data. It is recommended to review and adjust the coding and categories after they have been completed in full. Since the data has been fully digested and the process becomes better understood, it is likely that some of the initial codes and categories may need to be refined. This process, as most others, is subject to interpretation; therefore, one must restrain from imposing their own views and assumptions into the analysis. Some drawbacks of this method can be noted, such as limiting the exploration of ideas and limiting the further exploration of outlier concepts.

4.2.2. Problem Statement

A problem statement is a key stage in the design thinking process, which gives the team a jumping off point to begin defining and developing possible solutions. Problem statements can be written in a few different forms. In general, a problem statement should be human-centered; it should be broad enough for creative freedom and narrow enough to make it manageable.

In this project, a Point-of-View (POV) problem statement was used. The POV statement has the following form: [user-" descriptive"] needs [need-" verb"] because [insight-" compelling"]. A Point-of-View statement is an actionable problem statement that is defined based on insight and understanding of the users as well as their needs during field work. The statement is should be wide enough to provide scope, however should not be too narrow that it limits the design. A Point-of-View statement should never contain information about the product design or on how to satisfy the needs of users.

4.2.3. Personas

Personas have been used since the mid-1990s and since then have gained popularity in the design community. A persona is an example of a user that is given a name and face. Each persona is carefully described in terms of needs, goals and tasks. There can be several personas defined for a project such as primary, secondary and anti-personas. Each persona represents a group of users with similar needs and desires. The goal of the design process is to satisfy the needs of the primary persona(s), while also observing how the design may impact the secondary and anti-personas.

4.2.4. Scope and Constraints

It is very important during this stage to define the scope and constraint of the design, of the needs displayed by users in the field, which is worth pursuing, what part of the product needs to be changed, what the design capabilities are and what the success criterion for the product is. Defining the scope and constraints for the design provides necessary direction and guidance and helps ensure focus and drives better performance.

4.3. Ideate

This is the stage where ideas are generated to find the possible solutions for the problem statement defined in define stage. With all the data collected from observations during empathize phase and final interpreted problem statements, personas, scope, constraints during define phase are the main two inputs for Ideate stage. With all the generated ideas, a final best solution is carried forward to the design stage.

4.3.1. Brainstorming

Brainstorming is the method used for generating ideas in a group. When the group of people discusses about ideas, a lot more ideas are generated. For this project, brainstorming was helpful tool which we used frequently; especially at ideate stage to generate ideas about the possible solutions.

4.3.2. Market Research

Sometimes while working on any design, there is very good chance that similar product is already available in the market. And if similar product is available, may be looking for its success or failure might help in the design process. To do that, we did market research for similar solutions with the solution which we were designing. For that, we read online literature and reviews. That market research data helped work towards a better design.

4.4. Prototype

Prototyping is the creation of non-production ready parts or products, using various means of manufacturing. The manufacturing of these prototypes is generally done with non-production processes and materials. Prototyping is essential in communicating product designs and concepts; therefore it is an important tool to use in the user-centered design process, regardless of how mature the product design is. Prototyping, in terms of conceptual prototypes, can be carried out using paper, cardboard, or computer generated visualizations. In this project, prototypes were created via computer software using Microsoft PowerPoint and Paint. Product concept images were created at various stages of the design process, and could be printed out or viewed digitally for communication purposes. The use of these conceptual prototypes was key in further developing and defining the product design, and conveying the concepts both between team members and to potential users.

4.5. Test

The testing of a product or design can be carried out in many forms and at different stages of product development. The maturity of the product design is very much a driving factor to what types of testing can be carried out. Testing can include concept testing, ergonomic testing, functional testing, and so on. Due to the nature of this project and its timeline, it was appropriate to only perform concept testing with the aid of visual prototypes. The incorporation of user concept testing and looping customer feedback back into the design process is a crucial step in the user-centered design approach.

In this project, testing consisted of presenting the prototype concepts to users and evaluating their acceptance of that prototype. Questionnaires were developed to ensure our testing audience was of the appropriate demographic to align with the pre-defined personas. The users were then presented with the prototype concept, along with some verbal explanation to convey the concept. A final questionnaire was presented to the users to aide in evaluation of the prototype just reviewed. Prototype iterations were performed based on the feedback, and then this process was repeated with the same user audience.

5. Discussion and Results

As described in our methodology section, our team followed the 5-stage design model shown in Figure 1, with additional process influences from the ETM556 class lectures and readings of Creative Confidence [12]. This section will be discussed in three stages: Fieldwork in which we employed 'Empathy', Problem Definition in which we employed 'Define', and Product Development in which we employed 'Ideate', 'Prototype' and 'Test'. These sections will discuss the details of the design processes used and the results obtained. It will be shown how a user-centered design approach aided the team in incorporating user needs and insight throughout the course of the project, in order to arrive at an end product concept.

5.1. Fieldwork

To gain a better insight into the experience and needs of shoppers at point-of-sale, direct observation of grocery shoppers was carried out in their natural environment. Appendix 1 shows data from observations at four different grocery stores in the Portland Metro area. These stores include Walmart, Trader Joe and Fred Meyer stores in Hillsboro, and a Fred Meyer store in Scappoose. Roughly 20 people were observed across these different stores, mainly during the checkout process. Users were observed silently to determine by direct observation and inference method their experiences, their highpoints, their frustrations and needs. Some notable observations were: issues with payments, people in line frustrated with others taking too long, some struggles with locating payment cards or coupons, struggles with entering phone number or rewards card, lots of interaction with cashier, and interruption from children during checkout. During the observation process, although we were not interacting with people, it was very insightful and we really began to feel the frustrations or struggles that people were encountering.

To further empathize, interviews were carried out across 7 diverse people. The respondents were male and female grocery shoppers between the

ages of 26 and 57. Appendix 2 provides information about the interview question and answer sessions. From these interview sessions, the team was able to begin reinforcing many of the insights and issues discovered during the observation stage. Additional concepts emerged from interviews, some of which were very much different from our observations. A select few respondents were interested in new age grocery shopping process, looking for ways to eliminate redundancies in the shopping experience (such as placing grocery items in and out and back



Figure 3 - Fieldwork highlights

into the cart). However, the bulk of the feedback pointed to issues in the checkout process and environment.

5.2. **Problem Definition**

To better understand our raw observation and interview data, the team used a data analysis method called 'coding'. As the team coded, sorted and refined the data, inferences and needs began to form while trying to

Concept 🔍	Occurances	T
Customers want fast and intuitive payment method	1	3
Customers want fewer payment items to carry	1	0
Customers want checkout to be fast and efficient		8
Customers want rewards process to be fast and easy		6
Customers want children to be well-behaved during checkout		5
Customers want secure payment method		5
Customers want fewer steps during checkout/payment		4
Customers want the cashiers to be friendly and helpful		4
Customers want alternative shopping processes		3
Customers want intuitive checkout process		3
Customers want to limit uneccessary interuptions		2
Customers want checkout process to be accurate		1
Customers want to be engaged to avoid boredom		1

Figure 4 - Final Concepts from Coding

maintain the empathetic mindset. Appendix 3 shows the full coding spreadsheet. The coding exercise resulted in 63 lines of raw data "ideas" which were derived from the observation and interview data. A total of 18 'codes' were identified, meaning that out of all 63 separate ideas communicated and inferred from our empathy study, only 18 ideas were unique. 3 categories were formed to help encapsulate these 18 ideas and further understand what they mean. The 3 categories were: checkout environment, checkout processes, and payment processes. From the codes groups of ideas, the team discussed and inferred what the customer looked to gain from those ideas and synthesize 'concepts'. These concepts are the end needs upon which the team was able to focus on. However because there were so many diverse needs, it was appropriate to sort by occurrence and

focus on the top occurring concepts. Figure 4 above shows the final concepts identified and the ranking of those concepts by number of occurrences. The three concepts highlighted vellow, 'customers want fast and intuitive payment', 'customers want fewer payment items to carry', and 'customers want rewards process to be fast and easy' were the concepts which we carried forward with. The three concepts highlighted in orange we felt were more of secondary needs which can easily be covered by the three primary needs we identified in yellow.

In further discussions of the three primary concepts, the team had to narrow down the focus of the project to a single concept (problem). Some brainstorming sessions took place to take a first look at what sort of solutions might be feasible to provide for the 3 concepts. In doing so, it was determined that the team could focus on the concept 'Customers want fewer payment items to carry', and still provide some relief to the other 2 concepts. While it was not the highest occurring concept in our list, this concept was both realistic to accomplish and could resolve a variety of secondary concerns with a high impact.

Based on observation and interviews, synthesis of data, and selection of a single problem concept, the team was able to further define the scope of the project. The Point-of-View problem statement was defined as follows: Grocery store shoppers need a way to carry less payment items required at the Point-of-Sale because it is inconvenient and time consuming to sort through and use all of their different payment items (payment cards, rewards cards, gift cards, coupons, etc.).

With this problem statement in mind, and the recollection of the observants and interview participants, personas were able to be defined. From our field observation we observed different trends in user's behaviors, user needs and goals, some of the users displayed a lot of similarity in their behaviors while others were quite different. While some of the users interviewed were from mid income homes and were more concerned with achieving convenience and comfort by reducing the number of items needed at checkout and did not mind losing out on coupons, other users stated that their greatest challenge was remembering to bring the coupons to the store and ensuring they received their rewards, some group of users wanted to enjoy both saving and convenience and some others had no problems remembering to bring coupons to the store and using them but could benefit from making the entire process of easier to manage. Personas were developed



Figure 6 - Primary Persona One, Sarah



Figure 5 - Primary Persona Two, Jerry

based on these differences in behavior and needs observed. The two primary personas were defined as Sarah (Figure 5, above) and Jerry (Figure 6, left), which aided the team in designing a product which would target these 'end users'. These two 'users' are the typical grocery shoppers who are looking to save money, be efficient during payment, and have a simple way to checkout without struggling to use multiple forms of payments, rewards and coupons. Additional personas were defined; Appendix 4 shows all four personas developed for this project in full. The secondary persona, Mike, is an affected person of our potential product because they are the typical cashier at a grocery store checkout. While the team would not directly design for Mike, it was important to keep him in mind and understand how our solution might affect Mike and his checkout line. The last persona defined is an antipersona, Joseph, who is a user that we identified as someone that the solution will not apply to. The use of personas in these ways was beneficial to the team in further empathizing with the 'user groups' and provided a way to communicate about the design solution in context to the users.

The final stage of problem definition involved describing the full scope and constraints of the potential

design solution. Keeping in mind the limitations of the project, the insights we have gained, and the research completed, it was then possible to narrow down the problem definition. The design project was now focused on a solution that would meet the needs of the shoppers and not the grocery stores, the design had to be capable of incorporating at least two payment items out of the four commonly used at checkout (credit/debit cards, gift cards, coupons and reward cards), and it could take any form (app, item or device). Additionally, the design shall not involve change to the point-of-sale terminal.

5.3. Product Development / Final Design

In order to generate as many solution ideas as possible, our team had decided to use the brainstorming method. All the team members sat together and used sticky notes to write down all the ideas for possible solutions. While doing this, we intentionally avoided to discuss the feasibility of any idea. We did not even discuss any idea in detail. After collecting all the ideas, all the ideas were grouped. Ideas having some common grounds were put in one group. For example, ideas for electronic fob, electronic card were together, because those were related to designing a separate physical device. Some ideas were very broad like face/hand scan, or building a complete new store. We grouped those together under 'out of scope' ideas. And then, other ideas were all related to a mobile application, building a new application, changing some features, adding some features etc. We grouped those ideas together under the group 'APP'. After discussing all the feasible solutions in details, we decided to design a new 'mobile application' as a solution to our problem statement. Figure 7 below shows a board with sticky notes, used during our brainstorming method.



Figure 7 - Brainstorming for solutions using sticky notes

Before starting to design the application, we decided to check what kind of other similar mobile applications are available in the market. We found many apps available covering different spectrums of "electronic wallets" and shopping convenience [4]. There are apps which only do rewards cards well, some that do coupons well, some that do payment well. While others combine some of these methods with other areas of shopping, such as promotional ads and online coupons, shopping lists, etc. The Google Play and Apple store comments were reviewed for these apps to determine what level of satisfaction they were currently performing at, and what possible features they were lacking. Appendix 5 shows the details of this market analysis. When performing a 'GAP analysis' of these existing apps versus our problem statement, we concluded that there are currently no apps targeting purely the Point-of-sale checkout experience with a focus on integrating payment cards, coupons and reward cards. There continues to be a need for an app that integrates just those key checkout/payment features in a convenient method, without all the extra features not needed during checkout. So, that research allowed us to go ahead with our mobile application design development.

With all the data from fieldwork and problem definition stages, we designed our initial design 'concept #1'. We used Microsoft PowerPoint to draw the concept and used it as a prototype. The detailed concept #1 prototype images are shown in Appendix 6. It is a simple mobile application which users can download in their mobile phones, irrespective of mobile brand. The application can work for Android and Apple phones. Once downloaded, the user can create a separate profile for each store. Then, a unique payment method can be saved for each store profile by scanning it in via smartphone camera. There is master code for coupon and rewards. So, once the user scans the paper coupons and reward card into the application with the camera, all those coupons will be linked to that master coupon code or master reward code. So, no need for the user to carry multiple payment cards, coupons or reward cards anymore. For making the application is password protected or the user can utilize finger scanning for unlocking the application if support by their smartphone. At the point-of-sale, the user can unlock the application and select the profile for the store (Figure 8, below). Then, the cashier will scan the master code for

reward card code and coupon master code. With that, automatically user can get any related discount. Also, the reward points get added to the user's card. Finally, the user can make the payment with the already stored payment method and finish the payment process utilizing the "tap-to-pay" feature from the smartphone to the terminal. In short, once the user has properly setup the app, they simply unlock the app, select a store profile, the cashier scans the barcodes, and then the user "taps-to-pay".

After creating the prototype concept, we decided to test it by interviewing people, closely relate to the defined personas. Pre-interview questions were asked to help us identify which persona the user most closely resembled. It was found that we had test users relating to both of our primary personas, Sarah and Jerry. We conducted 6 interviews, and we received useful inputs from the users (see Appendix 8). Some users were unsure about setup, others were concerned about flexibility of the app in using profiles, and some brought up concerns of speed and coupon usability. Evaluation of this user testing against the group's objectives and success criteria can be seen in Appendix 9.

With all the feedback from user testing and our success criteria evaluation, we went back to the ideate phase. We discussed all the feasible solutions for the problems which came from the user testing interview process. We iterated the initial design in an attempt to resolve most of the issues identified. This concept iteration was labeled 'concept #2', and for this project was our final design (see



Figure 9 - Concept#1, profiles



Figure 8 - Concept#2, profiles & GPS

Appendix 7). In the new design, we added several new features. First of all, instead of selecting the profile manually at checkout, the user can take the advantage of GPS. Upon initiate setup of the store profiles, the user can set the GPS location for each store. Once he enters a store, GPS will locate the store and therefore bypass the need to select the store profile manually during checkout (Figure 9, left). This feature has eliminated one more step from the payment process. Additionally, to give user flexibility in using their loaded payment cards, 'concept #2', can allow the user to swipe to a different payment card than the default loaded to a store profile "on the fly". This gives the user flexibility if they temporarily want to use a different payment during checkout at one of their normal stores. On top of that, users can label or place notes on the payment cards to easily identify which cards they are swiping through and using. Also, there is a now a new 'Quick pay' profile, with which a generic payment can be completed regardless of if the user has a profile created for the store. This adds one more layer of flexibility and ease to the app. Another issue is that the coupon expiry can be forgotten and users lose the advantage of saving option. To avoid this, application gives the user the option to receive a notification of any upcoming coupon expiration dates. Additionally, users felt that setup of the app might be difficult, so we defined a setup process to consider (see Appendix 7).

With all these new features in concept #2 and the addition of the setup details, we again interviewed the same 6 users and received 'user testing' feedback. They responded more positively (see Appendix 8) as compared to our initial concept. From this, we again evaluated against the success criteria (Appendix 9) and found that we were in line with our vision for this product. For this project timeline, it is here we must stop with our concept#2, which we can now call our 'Final design'. However, if more time were available, it would be interesting to evaluate our final concept across a larger audience and also see how our Secondary Persona (Mike) might be affected by this product. The use of physical prototypes would also be a crucial next step in evaluating the feasibility of this product.

6. Conclusion / Key Learnings

It was very interesting and a valuable learning experience for our team to go through all the 5 phases of design thinking, while working on this project. All the principles, which we have been reading in the book 'Creative Confidence' [12], were experienced to some level. Each phase of design including empathize, define, ideate, prototype, test was a learning experience for us. While working on the direct interviews and observations, we got many perspectives from users and this really helped the team empathize and get insight into their struggles and enjoyments during the checkout experience. Those perspectives helped us to determine the problem statement.

These data gathering techniques of observations and direct interview helped us to understand users, and this understanding was not limited to the 'empathize' phase, but it was also critical for the final 'test' phase.

At the 'define' phase, when we had an overwhelming amount of raw data, 3 C's of analysis method was a tool that helped us. With this, we learned to synthesize the data, group the data and analyze the data, leading us to meaningful ideas and user needs. Had we more time, it could have been beneficial for the team to explore additional data interpreting techniques such as Affinity Diagrams, to be able to draw out more obscure ideas and focus on outliers from the fieldwork. Throughout the process, brainstorming was the most effective tool for us. Especially, at 'ideate' phase, when there was no known solution with us, we used brainstorming method to flush ideas out. There were lot of ideas and we started thinking out of the box, which helped to stimulate our creativity. And from this we started believing the 'creativity within us'.

Another major learning is when we were in 'prototyping' phase. As explained in the book of Kelly brothers, prototype is a useful method. In our case, we just showed the users some concept images of the interfaces of mobile application, which we designed. It was easy to get their perspectives, views and comments using this method, however it would be even more useful if the team could have gotten to a point to use physical prototypes and a large audience. We understood the unavoidable part in the design process, which is iteration. When we started testing the design with users, we found some shortfalls in the initial design concept. That made use to go back to 'ideate' phase and change the design. But this iteration process helped us to improve our final design.

Overall, this project provided very valuable learnings and experience for us to learn the user-centered innovation process from end-to-end. We look forward to applying these techniques and methods in future work in order to gain better insight to user needs and get to that point of 'delighting the user in an unexpected way'.

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Appendix 1 - Observation Logs

Fred Meyer, Hillsboro on 02/06/17

- Lady 30-35 years with a kid doing self-check-out difficulty in check-out because kid was interrupting
- Old lady doing self-check-out took time to remove card from wallet, even little confuse while scanning items
- Young boy doing self-check-out fast and efficient
- Lady at cashier counter issue with scanning then cashier called supervisor but supervisor could not solve it so lady decided to skip that item people behind her were little irritated
- Couple having nice talk with cashier

Walmart, Hillsboro on 2/12/2017

• Young woman about 30 with a daughter who was about 3 years old waiting in line at the cash register... The daughter was sitting on the cart which was overflowing with groceries, she was asking a lot of questions, the mom was typing away on her phone and answering absent mindedly.

Fred Meyers, Scappoose on 2/7/17

- Male, 50's: slid his card backwards twice with dismay that wasn't working, cashier pointed out his card was backwards. He chuckled and turned it around. Did not see if he entered rewards number.
- Female, 60's: handed cashier her Reward card and many coupons, continued to pull her card out of her wallet, slid card without issue.
- Female, 30's: used phone to "tap and pay", cashier seemed surprised it worked. Cashier reminded to enter phone number for rewards.
- Males, 20's: entered phone number for rewards. Looked unsure what card to use in wallet, pulled out one, then put back and pulled out another. Continued to insert to chip reader, but pulled out card too fast. He had to insert again. Then he seemed to be waiting for the cashier but it turned out the cashier was waiting because he still needed to sign. He seemed a bit confused/embarrassed by the process. Looked back at other customers (as if he felt he was holding them up?).
- Female, 20's: with kids, had a stack of coupons pulled from wallet, struggled to find rewards card then handed to cashier. Inserted card to chip reader but seemed to have issues (pulled too fast?), had to do it again. She seemed frazzled as her kids kept interrupting her during this process. Customers behind her looked slightly irritated.
- Male, 30's: entered phone number for rewards, slid card, then inserted card into chip reader, then for some reason he had to enter his phone number again for rewards.
- Male, 20's: handed cashier rewards card, tried paying with card by swiping but seemed not to work, then he proceeded to insert for chip reader, also seemed not to work. He looked frustrated, then grabbed his phone from his pocket and "tapped to pay".
- General observations:
 - Many people in checkout lines seem somewhat uncomfortable and discontent
 - Seem tired from shopping experience and just want to get through checkout as fast as possible
 - Some do seem to enjoy chatting with the cashiers and other shoppers while in line.
 - Depending on children, some people have a difficult time checking out with their kids and cause dismay in line. People sometimes frustrated behind them

Appendix 2 - Interview Logs

Interview 1: 32 years working woman with a kid of 3 years

- Does not like to remove card from wallet and swipe it, feels like wastage of time
- If using debit card does not like to type the password, feels insecure if there are customers behind her
- At the checkout, she needs to take care of lot of things, kid, cashier talk, stuff etc. So sometimes gets frustrated

Interview 2: Working woman French culture 30-35 age

- Has many cards, so does not like to spend time to find the right card and use it
- Needs mobile application but feels less secure to share data
- When she does self-checkout, gets confused about where to scan, where to put scanned item and where to put items need to be scanned
- She would prefer to give order online and pay online and just collect stuff from store
- Hates waiting if people in front of her takes more time
- Does not like to sign the receipt each time
- When she buys vegetables/fruits, many times the tag is not good, and she does not like to talk to store assistant
- She has lost some gift cards, so wants a way NOT to carry gift cards each time

Interview 3: Male working professional

- When purchased items which needs to remember the scanning number (like cashew, almonds etc.) so at check-out needs to remember the number, so thinks that as waste of time and inconvenient
- Does not like to swipe the card/give the mobile number every time to get store points
- Does not like to go for self-checkout for vegetable purchase

Interview 4: female, 26, married, working, no kids

- Is anything that makes checkout enjoyable or more pleasant? With someone you know. When it goes fast and smooth.
- Do you like using rewards card? Yes it saves money. Don't like using card, rather use phone number. More of a hassle when getting gas and you don't have a card (have to yell out phone number).
- What's preferred method of payment? Phone-Samsung. Easiest and fastest, don't like carrying cash and cards very much. Don't like having to carry wallet.
- What makes checkout unenjoyable? Slow checkout, kids being loud, too busy line, when item doesn't ring up for correct price.

Interview 5: female, 57, single, working, kids grown

- Checkout person being friendly,
- Yes but don't like having another step, forget a lot, already have to do payment card and ID card when in Washington. Phone number is less of hassle than card
- Debit card, just swipe and sign. Cards with chip are time consuming, hassle. All the questions at pos terminal are annoying, too many.
- Pressured to get their store credit cards, even after saying no. Not friendly cashier

Interview 6: Young man early 30s, looks like he is single, also looks tech savyTrader Joes 2/11/2017

- Q1. How do you feel about grocery shopping A1. Enjoys shopping for groceries.
- Q2 How do you checkout. A1 Does self-checkout for 1 item and uses the cashier for several items
- Q3.Is there anything you like about checking out. A1 Likes the interaction with the cashier,
- Q4 What do you dislike about checkout. A1 Hates the chip card, too time consuming although it is

safer.Does not like using cards because it is unsafe, there is no mechanism for adding security, says as long as you can read what is on the magnetic strip you have the card number, expiration date and csv code, card can be read on any machine with magnetic strip and it is also possible to duplicate cards. Credit cards are not convenient method of payment because you have to carry them all with you especially if you have cards that earn points and you want to use them.Says he does not like to use cash because it is dirty, says it is not safe to carry around, apart from possibility of theft, you might lose it and unlike credit cards you can't block it. It is not convenient to carry large amount of cash says some stores would not even accept large denominations

• Q5. How would you prefer to pay. A2 Prefers contactless payment especially if it is on the phone because it is faster and also convenient, you don't need to carry a wallet, is able to switch cards easily with the tap of a phone and also likes the safety features, uses near field communication and if the phone is lost the data can easily be wiped out.

Interview 7: Walmart 2/12/2017. Young woman about 30 with a daughter who was about 3 years old waiting in line at the cash register.. The daughter was sitting on the cart which was overflowing with groceries, she was asking a lot of questions, the mom was typing away on her phone and answering absent mindedly.

- Q1.DO you like shopping. A1 She says she hates to but someone has to do it, hates shopping because she has to walk everywhere around the store to get stuff and if she forgets something in a location she has to push her full cart all the way back to get it
- Q2 Do you use the cashier or self-checkout. A2 She mostly pays to the cashier and hardly ever does checkout because most times she has a full cart
- Q3 What do you like about the cash register? A3 She says she likes that someone else does it and she doesn't have to look for items without a barcode on the flat panel screen or call someone to help
- Q4 What do you hate about the checkout process. A4 She hates that she has to load all her items into a cart, wait in line, unload them from the cart to pay and load them again into the cart, she doesn't think it is efficient
- Q5 Any issues with payments? A5 None, she says she hates the new chip cards but has just one credit card and therefore does not experience issues arise from having multiple cards
- Q6 What would you like to change about the payment process. A6 Says she would love to pay at the aisle as she picks up the item

Appendix 3 - Data Analysis (Coding)

Table A3- 1 : Coding Exercise

Source	Idea/Description	Coding	Category	Concept
Gandhali - Interview2	frustrated by people taking too long in line	3	checkout environment	Customers want checkout to be fast and efficient
Gandhali - Observation1	children interrupting	1	checkout environment	Customers want children to be well- behaved during checkout
Gandhali - Observation4	people in line frustrated with hold up at register	3	checkout environment	Customers want checkout to be fast and efficient
Gandhali - Observation5	enjoy conversations with cashier	7	checkout environment	Customers want the cashiers to be friendly and helpful
Josh - Interview 1	do not like busy checkout lines	3	checkout environment	Customers want checkout to be fast and efficient
Josh - Interview 1	do not like children being too loud in line	1	checkout environment	Customers want children to be well- behaved during checkout
Josh - Interview 1	likes when accompanied by someone	7	checkout environment	Customers want to be engaged to avoid boredom
Josh - Interview 2	likes when cashier is friendly	7	checkout environment	Customers want the cashiers to be friendly and helpful
Josh - Observation General	people in checkout seem uncomfortable when waiting	16	checkout environment	Customers want checkout to be fast and efficient
Josh - Observation General	people in checkout seem tired from day/shopping	16	checkout environment	Customers want checkout to be fast and efficient
Josh - Observation General	some people have difficulty with their children in checkout	1	checkout environment	Customers want children to be well- behaved during checkout
Josh - Observation General	some people enjoy conversations with people in line and cashier	7	checkout environment	Customers want the cashiers to be friendly and helpful
Josh - Observation 4	embarrassed for holding up line with payment issues	3	checkout environment	Customers want checkout to be fast and efficient
Josh - Observation 5	children interrupting mothers checkout process	1	checkout environment	Customers want children to be well- behaved during checkout
Josh - Observation 5	customers in line irritated with children/slow checkout	1	checkout environment	Customers want children to be well- behaved during checkout
Roli - Interview 1	like interacting with cashier	7	checkout environment	Customers want the cashiers to be friendly and helpful
Gandhali - Interview1	frustration with many things going on (kids, cashier, checkout)	18	checkout processes	Customers want fewer steps during checkout/payment
Gandhali - Interview2	Would like order items online, pay online, pickup instore	12	checkout processes	Customers want alternative shopping processes
Gandhali - Interview2	Self-checkout confusing	13	checkout processes	Customers want intuitive checkout process
Gandhali - Interview2	issue with produce barcodes not working	13	checkout processes	Customers want intuitive checkout process
Gandhali - Interview2	do not like talking with store assistants	11	checkout processes	Customers want to limit unnecessary interruptions
Gandhali -	do not like items with	13	checkout processes	Customers want intuitive checkout

Interview3	numbers (bulk foods)			process
Josh - Interview 1	do not like prices not coming up correct	11	checkout processes	Customers want checkout process to be accurate
Josh - Interview 1	likes when checkout is fast	17	checkout processes	Customers want checkout to be fast and efficient
Josh - Interview 2	too many steps in checkout (rewards, payment, questions, id card)	18	checkout processes	Customers want fewer steps during checkout/payment
Josh - Interview 2	do not like sales pitch for store credit cards	11	checkout processes	Customers want to limit unnecessary interruptions
Josh - Observation 3	used tap to pay with ease	17	checkout processes	Customers want fast and intuitive payment method
Roli - Interview 2	do not like shopping, hassle walking everywhere when forget things	12	checkout processes	Customers want alternative shopping processes
Roli - Interview 2	would like to pay as she picks up items in aisle	12	checkout processes	Customers want alternative shopping processes
Roli - Interview 2	likes cashier to handle scanning items	17	checkout processes	Customers want checkout to be fast and efficient
Roli - Interview 2	do not like entire grocery shopping process (load items, unload items, payment, then load items in cart again)	18	checkout processes	Customers want fewer steps during checkout/payment
Gandhali - Interview1	do not like swiping cards	4	payment processes	Customers want fast and intuitive payment method
Gandhali - Interview1	do not like removing cards from wallet	2	payment processes	Customers want fewer payment items to carry
Gandhali - Interview1	do not like entering debit pin (privacy)	10	payment processes	Customers want secure payment method
Gandhali - Interview2	too many payment cards to dig through	2	payment processes	Customers want fewer payment items to carry
Gandhali - Interview2	do not like carrying gift cards, lost some	6	payment processes	Customers want fewer payment items to carry
Gandhali - Interview2	do not like signing receipts	14	payment processes	Customers want fewer steps during checkout/payment
Gandhali - Interview2	Likes idea of mobile app but concerned about security	10	payment processes	Customers want secure payment method
Gandhali - Interview3	do not like to swipe card	4	payment processes	Customers want fast and intuitive payment method
Gandhali - Interview3	do not like to enter phone number for rewards	15	payment processes	Customers want rewards process to be seamless and integrated
Gandhali - Observation2	elderly slow with cards in wallet	2	payment processes	Customers want fewer payment items to carry
Josh - Interview 1	do not like carrying cash or cards, or wallet	9	payment processes	Customers want fewer payment items to carry
Josh - Interview 1	do not like using reward card, prefer phone number	15	payment processes	Customers want rewards process to be seamless and integrated
Josh - Interview 2	do not like chip cards, time consuming	5	payment processes	Customers want fast and intuitive payment method
Josh - Interview 2	do not like having another card for rewards	15	payment processes	Customers want rewards process to be seamless and integrated
Josh - Interview 2	likes phone number for rewards	15	payment processes	Customers want rewards process to be seamless and integrated
Josh - Observation 1	slid payment card backwards	8	payment processes	Customers want fast and intuitive payment method

Josh - Observation 2	many items to keep track of (rewards card, coupons, payment card)	9	payment processes	Customers want fewer payment items to carry
Josh - Observation 3	forgot to enter phone number for rewards	15	payment processes	Customers want rewards process to be seamless and integrated
Josh - Observation 4	payment card would not swipe (chip card)	5	payment processes	Customers want fast and intuitive payment method
Josh - Observation 4	not familiar with chip reader process	5	payment processes	Customers want fast and intuitive payment method
Josh - Observation 4	too many payment cards to use	2	payment processes	Customers want fewer payment items to carry
Josh - Observation 5	issue using chip reader process	5	payment processes	Customers want fast and intuitive payment method
Josh - Observation 5	many items (rewards card, coupons, payment cards)	9	payment processes	Customers want fewer payment items to carry
Josh - Observation 6	payment card would not swipe (chip card)	5	payment processes	Customers want fast and intuitive payment method
Josh - Observation 6	had to enter phone number for rewards card twice	15	payment processes	Customers want rewards process to be seamless and integrated
Josh - Observation 7	frustration with chip reader process, used phone instead	5	payment processes	Customers want fast and intuitive payment method
Roli - Interview 1	likes tap to pay phone (fast, no wallet needed, secure)	10	payment processes	Customers want fast and intuitive payment method Customers want fewer payment items to carry
Roli - Interview 1	do not like chip cards, time consuming (but feel it is secure)	5	payment processes	Customers want fast and intuitive payment method Customers want secure payment method
Roli - Interview 1	do not like carrying many different payment cards	2	payment processes	Customers want fewer payment items to carry
Roli - Interview 1	do not like magnetic swipe cards (not secure)	10	payment processes	Customers want secure payment method
Roli - Interview 1	do not like to use cash (dirty, not secure)	10	payment processes	Customers want secure payment method
Roli - Interview 2	do not like chip cards	5	payment processes	Customers want fast and intuitive payment method

Appendix 4 - Personas



I wish payment could be faster and I dealt with less issues at checkout

Profile: Age 30, Female, Healthcare professional, Married with daughter, Lives in Hillsboro Frustrations:

- Chip cards take too long
- Too many cards in wallet
- Paper coupons too much trouble
- **Observations:** Minimalist, Frequent shopper

Figure A4-1: Primary Persona One, Sarah



I would like checkout to be simpler, easier to use coupons

Profile: Age 55, Male, Consultant, Married, Lived in Portland

Frustrations:

- Forgets to enter rewards phone number
- Chip card is troublesome
- Wife has too many coupons

Observations: Shops mostly with his wife, enjoys chatting with cashier

Figure A4-2: Primary Persona Two, Jerry



Appendix 5 - Market Analysis of Existing Mobile Apps

KevRing - rewards cards, online coupons/ads, shopping list. GPS location for notifications. Cloud syncing for rewards info. Does not have payment method Does not accept paper scans of coupons Reviews: 4.1-4.4 Users complain of slow startup time Switching between apps for rewards and payment is cumbersome Takes too long to search for appropriate rewards card in the app Samsung Pay - payment cards, secure (fingerprint or pin), some support for rewards cards, location based promotional deals. Only can use on Samsung phones. -Accepted at almost any terminal, just needs magnetic strip -Does not have coupon scan in or lookup. -Does not group cards and rewards or allow profiles Reviews: 4.7 -Not enough variety of cards allowed -Not all rewards cards can scan in -Users feel abuse of Samsung due to no option to uninstall this function and no way to disable notifications or app. They do not want to use simply because they feel it is being forced on them. -Find it is faster to use app than chip cards -Sometimes not sure which card is which, have cards that look similar and there is no way to label/use notes on the cards Apple pay - payment cards. Can pay instore and online with some apps. Can store boarding passes and select tickets. Only can use on apple phones. -Only accepted at "apple pay" and tap-to-pay compatible terminals -No coupon scan in -Very limited rewards cards allowed Reviews: 3.5-4 -too many limitations -can't use everywhere

<u>Market analysis</u>: Many apps available covering different spectrums of "electronic wallets" and shopping convenience. There are apps which only do rewards cards well, some that do coupons well, some that do payment well. While others combine some of these methods with other areas of shopping, such as promotional ads and online coupons, shopping lists, etc.

<u>GAP analysis:</u> No apps targeting purely the Point-of-sale checkout experience. Need an app that integrates just those key checkout features in a convenient method, without all the extra features not needed during checkout.

Appendix 6 - Concept #1







Concept#2 - Setup Descriptions

•Create a new profile for each store you wish to have a unique payment method and rewards/coupons for.

•Load your payment cards and rewards cards to the wallet with your smartphone camera. Each card can be labeled or have notes for easy identification.

•Set default payment and reward cards for each store profile, or to "quickpay" for any generic checkout.

•Scan in paper coupons to your wallet with your smartphone camera, you can choose 1 or more profiles to associate the coupons to.

•To use GPS auto locator, set location(s) of the stores to each profile.

Appendix 8 - Concept Testing, Questions and Feedback

Pre-test questions	User 1 - similar to Persona 2	User 2 - similar to Persona 1	User 3 - similar to Persona 1	User 4 - Similar to Persona 2
Profile questions: Age, Gender, Occupation, Kids/Married/etc.?	34, male, married, no kids	24, female, married, 1 kid	29,female,married,no kids	32, male,married, no kids
How often do you go to the grocery store?	3-4/month	1+/week	1 or 2 times a week	1 time/week
How do you feel during the checkout process?	generally ok, sometimes frustrated	sometimes annoyed, grumpy, hungry, content	time consuming process	the process takes time
How many payment or gift cards do you carry in your wallet?	8	9	2 cards + coupons	8
How many rewards cards do you carry in your wallet?	4	10	use phone number	2
Do you ever use paper coupons?	yes often	yes	yes	yes
Do you ever find yourself unsure of which payment card to use?	yes often, try to use credit card with highest cash back but forget sometimes	sometimes	yessometimes	no
Do you ever find yourself scrambling at checkout to gather your required payment items (coupons, payment card, rewards card)?	yes	sometimes if not ready or distracted, talking to someone, etc.	many times	yes
If yes, Do you ever feel as if you are holding up customers behind you?	yes sometimes	yes	yessometimes if there is crowd, I just do not spend time to find the coupon and feel bad for not saving	yesdefinitely
Do you wish you could have fewer items in your wallet?	yes	yes	yes	yes
Do you own a smartphone?	yes	yes	yes	yes
Do you normally bring your smartphone with you for shopping?	yes	yes	yes	yes
Would you consider using a smartphone app to consolidate your payment cards, rewards cards, and coupons (assuming it is secure)?	yes	possibly	yes	yes

Table A8 - 1 : Pre-interview questions for persona alignment

Table A8 - 2 : Concept#1 User Testing Q&A

Post-test questions (CONCEPT # 1)	User 1 - similar to Persona 2	User 2 - similar to Persona 1	User 3 - similar to Persona 1	User 4 - Similar to Persona 2
Would you consider using this app?	yes	yes	yes	yes
If not, why?	-	-		
Do you think this app is secure?	yes, assuming transfer of payment info is encrypted	yes	cannot say	may be
If not, what would need to change?	-	-		something like PayPal
Does the app seem intuitive to use?	mostly	yes	yes	yes
If not, what would you change?	more clear on how to setup profiles	-		

Does the app seem to be missing anything? Any questions or concerns?	How do I make a payment at a store which I do not have a profile set- up?	why do I need a different profile for each store? unsure that barcodes will always scan correctly at cashier	No	It might be useful to get coupon expiry before a week or so.
Do you think setup of this app would be an issue for you?	possibly	possibly	yesmay be	no
Would you be more satisfied with an all-in- one solution like this, compared to your current methods?	yes	possibly	yes	yes
How do you feel this would change your checkout process?	may be more efficient. not have to carry as much	not much different	it will save my time and struggle to find the coupons and do not have to enter the phone number for rewards	more efficient
Do you think this would make checkout more enjoyable?	yes, less stressful to have pre-defined payment profiles	no	yes, i can spend time talking to cashier which I like better than spending time of finding cards etc.	may be
Do you feel this would give you better opportunity to save money (using rewards/coupons?)	yes	possibly	yes	yes

Table A8 - 3 : Concept#2 User Testing Q&A

Post-test questions (CONCEPT # 2)	User 1 - similar to Persona 2	User 2 - similar to Persona 1	User 3 - similar to Persona 1	User 4 - Similar to Persona 2
Would you consider using this app?	yes	yes	yes	yes
If not, why?	-	-	-	-
Do you think this app is secure?	yes	yes	cannot say now	may be
If not, what would need to change?	-	-	-	-
Does the app seem intuitive to use?	yes	yes	yes	yes
If not, what would you change?	-	-	-	-
Does the app seem to be missing anything? Any questions?	no	just concern about barcode scanning	no, i guess	no
Do you think setup of this app would be an issue for you?	no, now that I understand the process better	no	may be	no
Would you be more satisfied with an all-in- one solution like this, compared to your current methods?	yes	possibly	yes	yes
How do you feel this would change your checkout process?		somewhat better		
Do you think this would make checkout more enjoyable?		possibly		may be
Do you feel this would give you better opportunity to save money (using rewards/coupons?)	yes	possibly	yes	yes

*2 users feedback omitted due to lack of space

Appendix 9 - Objective and success criteria

OBJECTIVE and SUCCESS CRITERIA	CONCEPT1	CONCEPT2
Customer must feel secure	\checkmark	\checkmark
Customer must feel product is intuitive to use		\checkmark
Reduce number of payment items	\checkmark	\checkmark
Reduce time spent during payment	X	\checkmark
Reduce customer struggle during payment	X	\checkmark
Increase happiness by enabling saving	\checkmark	\checkmark

Figure A9 - 1 : Results of Criteria Evaluation

