Danish Travel Card(Rejsekort) Proposal

Jorge Y. Castillo Rodriguez
Hussein Salem
Aku Nour Shirazi Valta
Faisal Jarkass
Dhiraj Bikram Malla
Xiaolong Tang

IT University Copenhagen
http://jycr753.github.io/SSEQ-Report/

November 17, 2013

Collaboration Protocol

Purpose: Shared agreements on overall forms of team collaboration.

Team members:

Hussein Salem

Faisal Jarkass

Aku Nour Shirazi Valta

Dhiraj Bikram Malla

Xiaolong Tang

Jorge Castillo Rodríguez

1. **What are the time slots that you can set aside for the team work?** Wednesday: after lectures till 14:00 [12:30-14:30] At a later point we might change the time We could work longer time in the future if we need to.
2. **If you disagree with each other or think that the solutions/products of some of the others is not satisfactory, what is the tone of communication?** Group discussion / democracy
3. **What is the maximum length of postings?** 500 words
4. **What do you do if a team member remains silent?** One of the team members will talk with that individual. And we might talk about it with the TA
5. **Do you expect that team members ask for help if they recognize, they do not manage their tasks?** Yes. We should have an open dialog where our problems and concern can be discussed
6. **Which team conflicts might arise and how do you imagine dealing with them?** Deadline issues, help the one that couldn't do it or perhaps give him more time.
7. **How and where do you share files?*You might consider google docs, dropbox, or the BSCW.*** Google drive - File Sharing Google docs - Document editor Github - Latex Repository share
8. **Which tools for communication will you use for what purpose?** The main communication tool in our group will be Skype, since it is a free services that provides live chat, video and file transfer protocol if needed.
9. **how are you going to communicate asynchronously?** We decided to communicate through Skype and emails.

Prioritised List Of Software Qualities

Software Qualities	Points	Meaning
Safety	82	N/A
Security	**590**	Strong code structure in case hacking into system(F.x SQL injection) -Unit test -Errors report from users
Reliability	**560**	Computer program's ability to perform its intended functions and operations in a system's environment, without experiencing failure (system crash). IEEE-Std-729-1991: "Software reliability is defined as the probability of failure-free operation for a specified period of time in a specified environment" -Random testing -Redeveloping -Testing in different environments
Resilience	37	N/A
Robustness	210	N/A
Under-stability	210	N/A
Testability	270	N/A
Adaptability	310	N/A
Modularity	85	N/A
Complexity	120	N/A
Portability	50	N/A
Usability	**580**	The quality of user experience across websites, software, products, and environments. It is easy for users to understand and using the system. -Usability Design(UI) -Feedback from users
Reusability	82	N/A
Efficiency	150	N/A
Learnability	280	N/A

Development Model

In this section we will arguments the points for the chosen development methodology and how it can use to implement to develop the *Danish Travel Card*'s software while developing its software.

There is many developing software methodologies which describes the development life cycles and each its own importance in software development.

Waterfall Methodology

The ***Waterfall Method*** is one of the oldest and basic developments methodologies which still has a great influence in modern day software development and is follow by many software developments companies around the globe to organize their projects.

The Waterfall Method is a linear process where a sequential methodology is followed, progress is monitored and measured according to the completion of each phase.

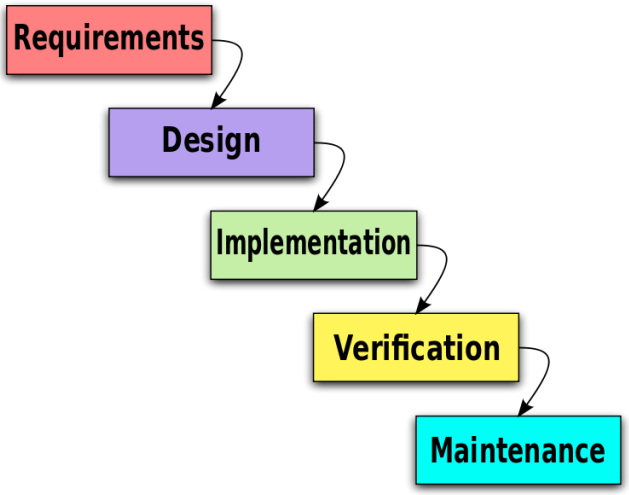


Figure 0.1: Waterfall Method

Waterfall Phases:

—**Requirements:** The first step in this methodology to start with requirement analysis and revise in the project is actually feasible with this methodology.

•**Design:** With the requirements and analysis acquire in the preview step, them a proper implementation strategy can be formulated according to the software environment. Further the design phase is divided in two sections. *system design and component design*. The system design contains details and specifications of the whole system and explains how each component of the system will interact with others. The component design contains specifications as to how each component will work separately.

•**Implementation:** In this phase is where actually some components start being created. The information collected in previews phases are applied in this step to create a functional software.

•**Testing:** This step is where the software developed in the preview phase is tested for any errors or discrepancies. In the Waterfall method the testing normally starts when the code is finished.

•**Installation:** After the software is tested, it can follow to the next phase where it gets installed in the computer or devices that it is build for.

•**Maintenance:** This final phase it could be stretched it for a few month or some years. With this follow up software bugs are fixed and adding/changing additional requirements or functionality to the software.

Advantages and Disadvantages

Advantages:

Since the waterfall method is the oldest and most widely used among software development companies there some advantages to this model:

1. Since it is a linear model, is very simple to implement.

2. The amount of resources to implement it are minimal.
3. Each stage is assigned to separate teams, this approach ensure project deadlines control.
4. Since the documentation is produced at every stage of the software development, this makes its understandably simpler.
5. After every major phase of software programming, testing is done tp the correct runtime.
6. Defined start and end points for each phase of the process, making it more easy to measured.

Disadvantages:

1. Fixed requirements difficult to change.
2. No final user visibility of the software until the development phase has been completed.
3. Clients are not very clear of what they want exactly from the software, when changes are mention in between it may cause a lot confusion.
4. Small changes or errors that may come up in the final software could cause a lot problems.

The waterfall works really well for commercial arrangements, but when working for internal customers its more difficult to implement.

Usage

TO BE DONE HERE

Document Convention

This document describes our convention on every document developed by the group or individuals. Which means that we will make sure that each document that we will produce is going to contain the following conventions (metadata):

1. ID
    a) Unique identifier consisting of integers
2. Name of task
    a) Title of the document
3. Version
    a) Version of the document, which will be added for each time the document is updated
4. Author
    a) The author of the document
5. Responsible
    a) The person(s) responsible for the particular document
6. Status
    a) The state of the document - done/undone/redo

Estimation and Planning

Risk Analysis

ID	Description	Probability	Effects	Strategy
1	Group members leave the group	High	Documents and responsibilities is left undone, this may lead to delays in the project	The rest members will have to develop more, this will mean those responsibilities left behind will be divided with in the rest of group.
2	Time fixing/improving the software after debugging	High	More work have to be done	Discuss the case in details and use the supervisor
3	Document delays	High	That the specific group member can't take new tasks	Project manager has to follow up more regularly
4	Planning and Estimating	High	The plans and estimating document has to done again	Use the supervisor to acknowledge the understanding and discuss in detail in the group
5	Misunderstanding of the task	Moderate	The developed tasks is done wrong	Discuss every tasks in the group and/or use the coffee hours to understand
6	A student becomes ill	Moderate	Can't participate in supervisor meeting or can't help developing some documents	Work in groups of two at least or help him come back on track with his work
7	Underestimate size of task	Low	More work have to be done	Discuss the case in details and use the supervisor
8	Tools for debugging	Low	Product and Project delays	Use the supervisor and make a lot of research about the tools
9	Hardware failure	Very low	Losing some documents	Backup more frequently and all group member has a copy
10	Inexperienced	Very low	The documents and/or debugging of the system isn't done properly	Use the supervisor, teacher and make a lot of research

Probability:
Very low < 10%
Low 10% - 25%
Moderate 25% - 50%
High 50% - 75%
Very high > 75%

Project And Product Risks

Risk	**Affects**	**Description**
Staff turnover	Project	A student gets sick or leaves the group
Management change	Project	The role project manager is going to rotate, could lead to changes in priorities
Hardware failure	Project	Hardware fails before taking backup
Debugging change	Project and Product	There will be a larger number of bugs found than first anticipated
Size underestimate	Project and Product	The product to debug is bigger than first anticipated
Planning and Estimating	Project and Product	Some tasks take longer time than first anticipated
Document delays	Project	Some group members doesn't deliver a document at specific deadline
Tools for debugging	Product	Tools to debug doesn't seems to be good as the provider says
Inexperienced	Project and Product	A group member can't deliver a high quality of document or misunderstand the task
Inexperienced Project manager	Project and Product	A group member as a Project manager doesn't priorities correct
Poor Project planning	Project	Dependencies of other documents/tasks leads to delays

Term	**Definition**
Casual user	A person that uses the rejsekort 1-4 times a week.
Laggers (user)	Persons that are slowly to adapt to new technologies.
GPS	Global Positioning System.
Use Case	A list of steps that defines the interaction between the user and the system.
Roles and Responsibilities	A group members role and the responsibilities in the project for the specified date.
Software Qualities	The qualities that are important and agreed upon in the group, which is the corner-stone of the development model.
Work Breakdown Structure	A way to structure the complete project work.
Risk Analysis	Analyze the risks in the project.
Use Context	The context in which the software is deployed.
Rich Pictures	Represent relevant aspects of the problem and application domain as rich pictures.
Interface design	The design of the interface that the user sees.
Mock-Up	Is a scale or full-size model of a design or device, used for teaching, demonstration, design evaluation and promotion.

Interviews Summary

Interview to ticket controller

26. sep. 2013 15:05 at DR Byen station

Have the Rejsekort system made your work easier? *"In the start there were many problems, but it have become better over time, which makes by work a bit easier"*

Which problems do you see the passengers face? *"The passengers using travel card(Rejsekort) forget to check in again when they change transport means under their commute. This entitles them to a fine, which we (controllers in the metro) have stopped to hand out, as there have been much confusion since the travel card came"*

Interview to IT professionals

Observation *26/9-2013 15:00-15:20* at DR Byen station A guy is coming up to the station. He uses his clips card and walk away. A metro just comes in to the station. Around 8 passengers come out. And 2 people get into the train. A little girl comes and check out with a Rejsekort. Then a guy is coming up to the station. He uses his clipe card and wait for the metro. Two guys are coming to station and use their clipe card. After that they are waiting for the train.Then a man put his wallet close to check in machine. Then a man and a woman are coming up to DR station. The man check in with his clipe card. the woman put her wallet close to the check in machine. A guy comes up with his Rejsekort. He checks in and wait for the metro. Then a train is coming into station. A woman is very hurry up to use her clipe card. But her card is bended. So she tries many times and finally she check in with her clipe card. But she missed the trains.

Another train is coming in to station. Many passengers are coming out. Passengers who use rejsekort are standing around the check out machine. Because they are waiting for the passengers who are in front them to check out. Two little girls, they are coming up to the station. They both check in with rejsekort. And they are waiting in the train station. A guy is checking out, but have problems seeing the display on the machine because the sun is reflecting on it. Another woman is checking several people in, but seems a bit confused.

27/9-2013 8:30-8:45 DR Byen station A guy who take a cup of coffee is coming up to the train station.He puts his rejsekort from his pocket. And he puts close to check in machine. The trains are coming every 4 minutes. There are a lot of people are waiting in the train station. There are crowd of people are standing in front of check out machines. Then a train is coming to station. there are around 12 people getting off from that train. A girl takes rejsekort. She press the machine. She checks in not only for her but also for her friend. There are still a crowd of people in the station. There are 3 people standing in front of check out machine.

A train is coming in to station. Most of people go inside. And two little girls are coming out of train. Two men are coming up to station. They both check in with rejsekort.

Classes Mock up

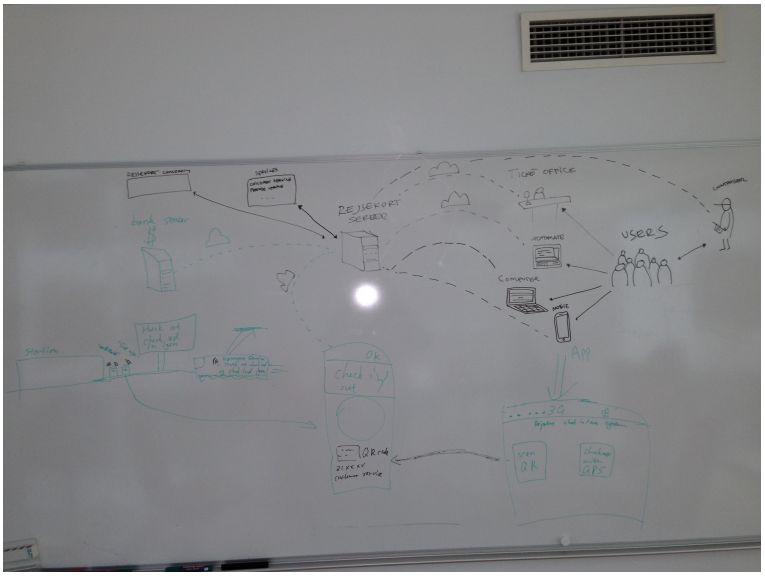


Figure 0.2: Class Diagram Draft

Class Diagram

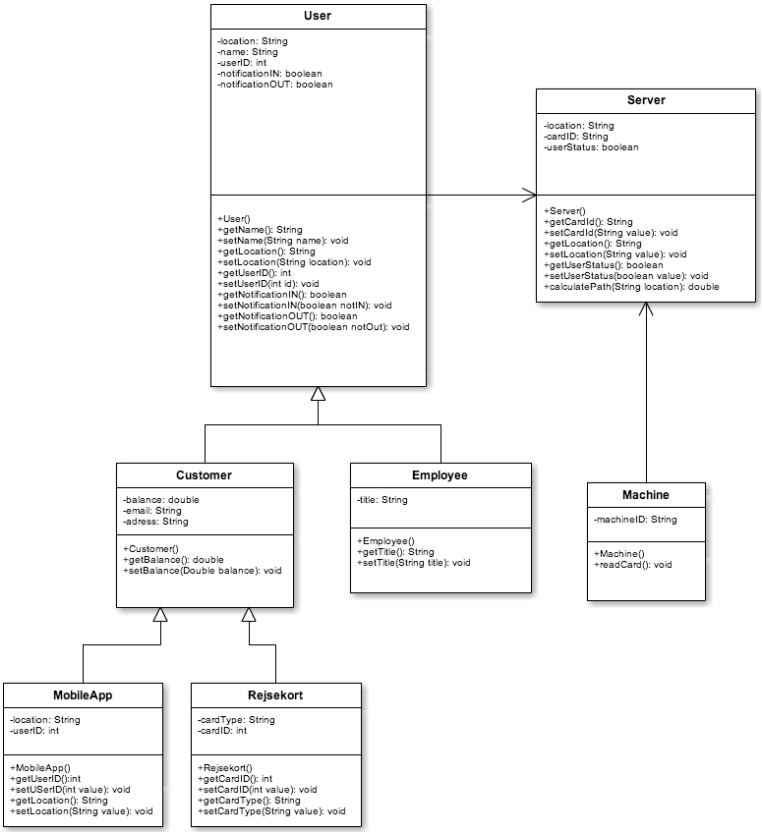


Figure 0.3: Class Diagram

Description

User

There are two types of users in this system. They are customers who use the system to travel. And also employee works in the public transport company. And both users can access to users' status(check in/out) and location (zone area).

Customer

Customers have more functions than the User class. Customer has the balance value. That means customers can check and charge their own balance accounts. The customers have two ways to use the system. One is rejsekort. Another is mobile app.

Employee

The employees who use the system are ticket controllers. They can only access to users' ID, status and location.

MobileApp

Mobile app can get users' ID, status, location(with GPS) and return all the data back to the server. Users also get balance data from server.

Rejsekort

Customers can always use the card to check in/out and check balance through the machines in the station. The card contains customers' ID, name and etc.

Machine

Machines are located all the stations and buses in Denmark. The machines can read rejsekort. And they can send customers' informations and location back to server. And the machines can also get customers' balance base on customers' ID from the the server.

Server

The server contains all the customers' ID, status, location, balance and customers' information. The server can receive all the data from the mobile and the machines. The server can also calculate the price base on check in/ out location and charge that price from balance account.

Use Case Description

Actors

Customer: Costumers is all kind of persons that does use *Rejsekort* system to travel from a location to another, this include regular travelers, such people that goes and back from work, kinds/young that goes to school, disables, retired people. So technically an user is all costumers that uses the system.

Customer service: Technically this a person who works for the Rejsekort's company as part of their customers service stuff. This person does have all the rights and permission to control all users account such, balance check, history, block card. But it can not control the actions that require physical response from the user such *Check in* and *Check out* since this only can be done by the user true a rejsekort machine or smart phone application.

Controller: The controller is the person who checks if a passenger is traveling with a properly validated card or proper checking with the mobile application. Otherwise the controller has the power to issue a fine to the infractor.

Financial institution: Financial institutions can process the request from users to add credit to their rejsekort from either a credit card, Dankort or direct transfer, but this function can be trigger as well true costumer service.

Use cases

BlockAccount: An account can be blocked either by the customer or the customer service.

CheckBalance: This function in the software is to allow users to check their own account balance or either call costumer service and check it true them.

BlockCardAccount: A customer or the customer service can block a specific card on a customer account.

CreateAccount: A customer can create an account or request the customer service to create it.

AddBalance extends Withdraw : User can add credit to its balance or contact consumer service to do it.

CheckOut extends Withdraw: When a passenger ends his commute he is able to checkout, which also can be done by the customer service in case it is needed

Withdraw: Depending of customer's choice, the financial institution withdraws money from the customers bank account, credit card or Dankort, then the balance is added to the Rejsekort account credit, also this function can be trigger if auto fill up is enable; this means the balance will auto fill up with a pre conditioned amount if the balance is too low after a commute has be done.

CheckHistory: The customer service or the customer himself can check the history of activities on the account.

CheckCustomerStatus: It is possible for the customer, the customer service and the controller to check whether the passenger traveling on Rejsekort have been checked in.

SendMail: Basic email communication format via email from users to costumer service and vice versa.

EraseFine: The customer service can erase a fine given to a customer.

CheckIn: Costumers traveling can check in, also they also have more options while check in, such as:

1. AddBicycle
2. AddAnimal
3. AddAdult
4. AddKid

GiveFine: The controller can give a passenger a fine.

Configuration Management Plan

Objectives and scope

Even though there is no way to manage what it is unknown, it is essential to have a detailed knowledge of the of the infrastructure in order to make the best use of it, to develop a good CM it should include among other things:

- Faster problem solution, for better quality of the software and the service, a common problem is the connection to the servers may be down, errors in the magnetic reader of the card/login machine or is not up to date with the latest software containing the latest encryptions keys. Having to detect this most common errors without having a optimal configuration management database can increment the solving time of the problem in a larger scale.
- Efficient change management, it is very important to know all the changes made to the system or structure of it, this way changes can be design not to produce errors of incompatibilities or problems.
- Cost reduction, detailed documentation of all the elements of the configuration allows to avoid unnecessary duplicates, for example: a) Cost of licenses by avoiding having multiple software that has the same functionality b) Illegal copies could carry viruses or any other kind of malware that could put in risk the software/hardware in risk c)Legal requirements with licenses or any other third party application legal requirements that could have a negative impact in the organization and by extension in the system.
- Security it is a big part of our software and having its configuration management database up to date allows to find and fix vulnerabilities in the software.

Terminology

To have a proper CM there is the necessity to have some pre-defined rules, which includes the follow:

- Naming conventions this agreement will be a contract to keep the same name structure for all files, folders, classes, methods, for example:
  - **Classes** it will always start with a package name abbreviation, capital letter for each different word describing the class for example: $VYXZSomeReallyImportantClass\{\}$
  - **Method**, it will have same format as it predecessor but no including the package name, but it will also include what type of method it is or what kind of value it does return or print in the software scope, for example: $SomeImportantMethodBoolean()\{\}$
  - **Folders** and txt files this will always need to have the $date(YYYYMMDD)$ that was created, person initials, a location of the original file, every different values separated by a dash $(-)$, for example: $20131023-GD-JC-filename.extension$
  - **Version** number of the software it will go with 1.0 for the start, if there is bugs fix it will increment by 0.1 and if their major changes to the system it will increment by 1.0
  - **Source** control by using git to control the status of the system, by dividing the source into different branches and only margin them into the final products when all steps of debugging and cleaning the code has been done.
  - **Store location** to keep control of all files that are produced during project evolution, most of files are stored in Google Drive for backups, and the rest of "Software" related files are placed into a private repository to make it accessible from different locations to programmers, developers and designers of the system.

Collaborators

During this project since we are using the initials of the person to define the file that it is being created so each member should have an unique initials containing 2 - 3 character depending on availability and a git or mercurial username to being able keep control of our document changes in the central repository or own branch.

List of collaborators:

1. Jorge Y. Castillo (JC) - *jycr753*
2. Xiaolong Tang (XL) - *xiaolongtang89*

3. Faisal Jarkass (FJ) - *faisal1985*
4. Dhiraj Bikram Malla (DB) - *djbik*
5. Hussein Salem (HS) - *husalem*
6. Aku Nour Shirazi Valta (ANV) - *nourshirazi*
7. All members (AM) - N/A

This guidelines will help to build a solid CM that it is required to have a efficient software development environment, and post software maintenance or bug fixing. Even though this rules are important and be follow, there is always exceptions for example: Initial software structure mock ups, or hardware placement mock ups.

Control of sub responsibilities and 3rd party software or hardware contractors, to control what the 3rd party software developers have access the only thing that it is available to them, is close source API with the correct list of classes that they can use and how they can extend to be able to do their job programming the required extension for the software.

Software Requirements Specification

This **SRS** needs to have some basic structure that will made its use more efficiently when following its guideline, this have to be seeing as a guideline more than an absolute guide, never the less following this document will void major flows and errors in the software while developing the project or afterwards. In this case the basic document architecture consist in the follow:

⇒ **Introduction**: Describe how requirements are handled for waterfall model and the system's function.

⇒ **Requirements**: Describe the functional system requirements and non-functional requirements.

⇒ **Glossary**: Define the technical terms used in this document.

Introduction

In software development, Requirements phase focuses on defining and capturing the needs and problems that a software application is to address and solve. The requirements phase is the first phase in waterfall development model, setting the stage for the rest of the phases of the software application development.

The requirements phase aims to come up with Requirement Specification document or documents. The aim is to define the requirements in as clear and as detail manner as possible. Normally in order to capture, collect and gather the requirements; a dedicated team is setup to capture the requirements.

Requirement

In our software requirement document we are going to use the graphical notation and structured specifications, in order to handle and define each requirement. The choice of the graphical notation is based primarily on the fact that it is far more readable for us as developers, the structured language notations use templates to specify system requirements.

Software description:

Requirement ID: Identification number for specific requirement **Title:** the title of the specific requirement **Description:** Specific description and details on what the requirement functions does, and how to how to proceed when an action takes place **Priority:** Define the priority of this requirement for the entire project **Risk:** Define the risk if this requirement is not meet.

Priorities:

Low: Good to have functionality but not required to make the software work. **Medium:** Some functionality that could have to implement the UI/UX while interacting inside the GUI **High:** It must have to function

Risk:

Critical (C)**:** It must be developed to make the software work **Medium** (M)**:** Optional functionality but not essential to make the basic software work **Low** (L)**:** Function that will be implemented for as a complement for the software but present no risk for its functionality.

An adult is a person in the age of 16+, where a kid is a person in the age $12-16$. For kids under the age of 12 the journey is free of charge, but the person has to be accomplished by an adult or he has to pay the minimum fee.

Requirement ID	01
Title	Block Account
Description	User can block his account that which put a stop to any kind of travel or transactions made with the travel card or mobile application until further notice.
Priority	High
Risk	Critical

Requirement ID	02
Title	Check Account Balance
Description	This required the such account has been authenticated, and show the account current balance.
Priority	High
Risk	Critical

Requirement ID	03
Title	Create Account
Description	Open an account, which it has to include the username, last name, billing address, telephone, and credit card information. This has to be made true a secure channel (https) with their valid SSL certificate and have a two steps verification to validate users fx: SMS to verify phone.
Priority	High
Risk	Critical

Requirement ID	04
Title	Check History
Description	This required to have access to the users travel data, balance history and spending data, to be able to show a complete list or historical spending of the users.
Priority	High
Risk	Medium

Requirement ID	05
Title	Check Customer Status
Description	Make possible for: customer, customer service and controller to check whether the passenger traveling on Rejsekort have checked in.
Priority	High
Risk	Critical

Requirement ID	06
Title	SendMail
Description	Both the customer and service can communicate by mail
Priority	Medium
Risk	Medium

Requirement ID	07
Title	EraseFine
Description	The customer service can erase a fine given to a customer.
Priority	Medium
Risk	Medium

Requirement ID	08
Title	CheckIn
Description	A passenger traveling with Rejsekort can check-in when he starts his commute and if he wish he can add additional passengers such as adults and kids, bicycles or animals
Priority	High
Risk	Critical

Requirement ID	09
Title	GiveFine
Description	The controller can give a passenger a fine.
Priority	High
Risk	Critical

Requirement ID	10
Title	BlockCardAccount
Description	A customer or customer service are able to block a specific card
Priority	High
Risk	Critical

Requirement ID	11
Title	AddBalance
Description	The customer service or the customer can add balance to his account.
Priority	High
Risk	Critical

Requirement ID	12
Title	CheckOut
Description	When a passenger ends his commute he is able to checkout, which also can be done by the customer service in cases it is needed.
Priority	High
Risk	Critical

Requirement ID	13
Title	AddBicycle
Description	A passenger traveling with Rejsekort can check-in when he starts his commute and if he wish he can add an bicycle to his journey. It is permitted only with two wheel bicycle.
Priority	High
Risk	Medium

Requirement ID	14
Title	AddAnimal
Description	A passenger traveling with Rejsekort can check-in when he starts his commute and if he wish he can add an animal to his journey. For animals meant Small dogs, cats, birds and other small animals. Animals may be included for free, but must be placed in a bag or cage and remain there for the whole journey. For larger dogs mean dogs that can not be carried in a purse, a cage or similar. Each passenger may only include one large dog, and this must be on a leash and under the passenger's control. For dog paid child price.
Priority	High
Risk	Medium

Requirement ID	15
Title	Add Adults
Description	A passenger traveling with Rejsekort can check in when he starts his commute and if he wish he can add an adult to his journey.
Priority	High
Risk	Medium

Requirement ID	16
Title	Add Kids
Description	A passenger traveling with Rejsekort can check in when he starts his commute and if he wish he can add an animal to his journey.
Priority	High
Risk	Medium

Requirement ID	17
Title	Withdraw
Description	Depending on the customers choice, the financial institute withdraws money from the customers bank account when balance is added to the Rejsekort account or when checking out.
Priority	High
Risk	Critical

Glossary

A functional requirement has the following properties:

Requirement ID	Uniquely identifies requirement
Title	Gives the requirement a symbolic name
Description	The definition of the requirement
Priority	Defines the order in which requirements should be implemented. Priorities are assigned values from low to high
Risk	Specifies the risk if this specific requirement is not implemented. It shows how critical the requirements is to the system as a whole. The following risk levels are defined over the impact of not being implemented correctly. -Critical (C) it will break the main functionality of the system. The system cannot be used if this requirement is not implemented. -High (H) It will impact the main functionality of the system. Some function of the system could be inaccessible, but the system can be generally used.

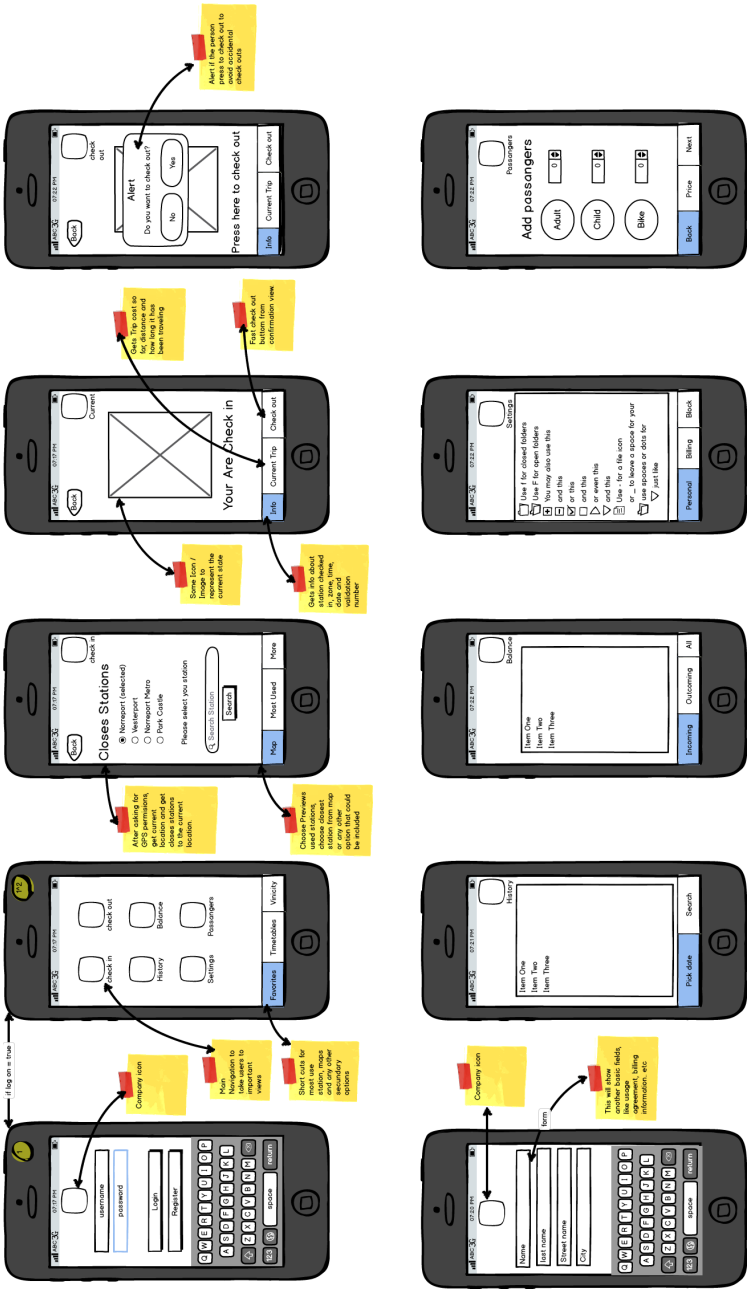


Figure 0.4: Mobile App Mock op

Quality Assurance Plan

First we need to define what *QE(Qualities Ensures)* roll will be in our software project, to understand this there is need to be defined, this method is widely used in manufacturing industries, but its methods and terms can widely applied in software developments. When applying this methodology it defines the standards and quality of the final software to insure that the final product becomes a high quality product.

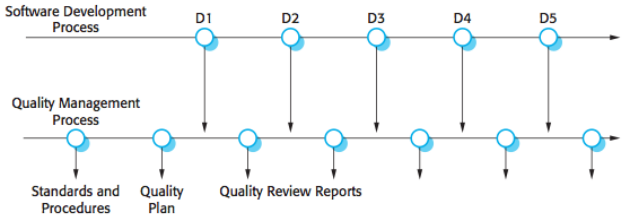


Figure 0.5: Chapter 24 page 653

Quality management ensures there is a check for quality of the software during each phase of its development, lets take into consideration the above graphic: Lest take $D(x)$ as each milestone in the waterfall method, and Q as the quality management process, so in other words for each D that is complete there will be need to check D and its quality requirements before proceeding to the next development phase.

By producing an accurate and well defined quality management document that includes the desire software qualities and describes how this are assessed.

According to Humprey (1989)[1], he suggest a solid structure for the quality plan, which includes:

1. **Product introduction:** A description of the product, its intended market, and the quality expectations for the product.
2. **Product plans:**The critical release dates and responsibilities for the product, along with plans for distribution and product servicing.
3. **Process descriptions:** The development and service processes and standards that should be used for product development and management.
4. **Quality goals:** The quality goals and plans for the product, including an identification and justification of critical product quality attributes.
5. **Risks and risk management:** The key risks that might affect product quality and the actions to be taken to address these risks.

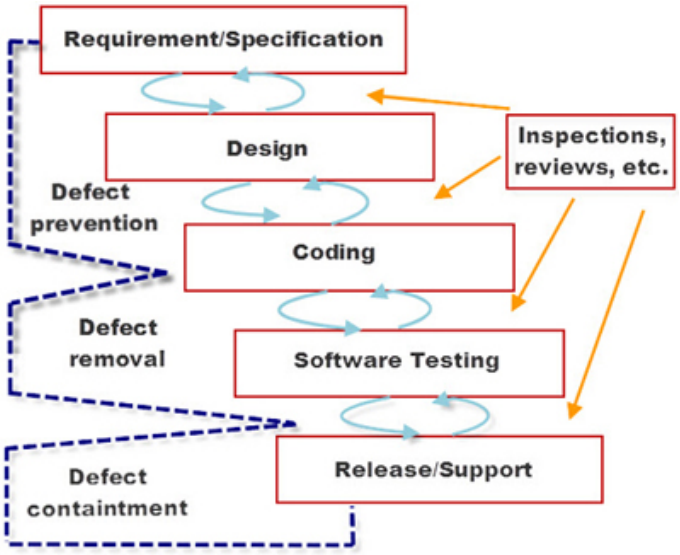
Software testing is an essential and important part of the waterfall model, which also is the main part of the quality assurance activities. In the waterfall model there may be phases which does not explicit explains the quality assurance activities, but an assurance can be included where needed in the shifts of the different phases, such as the inspections and the reviews etc..

Most of the activities in our quality assurance plan can be summarized in the model seen at left. The model illustrates the different quality assurance activities related to the waterfall model**??**[2] and its processes. If we compare Humpreys (1989)[3] suggested points to the quality assurance in the waterfall model, they can be summarized to three important key characteristics:

1. The testing phase, which is the main stage of the quality assurance activity.
2. Inspections and reviews that are made and carried out at the transactions of the phases.
3. Preventing errors especially in the early phases, and removing them during coding and testing.

These three key point have to be implemented into the Rejse Kort project in order to make sure that the qualities are meet and lives up to what is expected. The implementation of these quality assurance activities related to the Rejse Kort system are explained below.

[1]Software Engineering page 653b
[2]http://qatestlab.com/knowledge-center/QA-Testing-Materials/waterfall-process-in-the-quality-assurance-activities/
[3]Software Engineering page 653b



Testing phase

In our case, we design the unit test before we start coding. After coding, the program return the results that should pass the test code.

We also going to test the functionality, in order to do so we will use black/white box testing.

The black-box test, tests the functionality outside the software, ex. the application developed for the customers, has some intended functionalities, that we will have to ensure works properly, and doesn't act crazy. Here we will have to create a document which specifies each test and document the outcome. On way of doing it, is to use fabricated answers, which means that we know what the result will be and then compare it against the outcome of the application.

The white-box test, tests the functionality inside the software, which means that each method, class etc. has to be tested, in order to achieve it we will have to provoke the application and see the outcome. Here we will also have to produce a document, with the specified tests, and compare it against the fabricated answers.

Inspections and review

The inspection and reviews should take place at every transaction of a phase is order to check whether the output lives up the intended result. The quality reviews will be based on documentation that are produced during the different phases, and necessarily at the software development processes. The reviews will check the consistency and completeness of what is produced during the phases in the waterfall model.

It is worth mentioning that the reviews and inspections should be tools to improve the Rejse Kort system, and not be used as tools to inspect or access the performance of the teams or the individual who are part of the process.

Our review will basically be divided into three steps in every phase:

1. Pre-review activities
2. Review meeting
3. Post review activities

The pre-reviews activities focuses on the review planning and preparation. Once these pre-reviews activities have been settled a review meeting can take place where the authors of a document or other *"products"* being reviewed should *"walk through"* or explain the *"product"* with those whom are reviewing it. Once a reviewing meeting have taken place, the post review activities can take place, which handles and should address the problems and issues which were addressed at the meeting.

Preventing and correcting error

The program must pass all the test code before we use it. If the program cannot pass the test code (errors and receptions), we will use log to record it, trace the errors/receptions and fix the code. After updating the code, we test the program again and again until it can pass the test code.

Interview Questions

There will be 3 participants

1. passagers(structured)
   a) Rejse Kort users
      i. How old are you?
         Range:15 - 25 26- 35 older
      ii. How often do you use Rejse Kort?
         A. Every day
         B. 1-3 times a week
         C. 1-3 times a month
         D. twice a year
         E. or less
      iii. Which type of Rejse kort are you using?
         A. Personal card (Rejsekort personligt)
         B. Anonymous card (Rejsekort anonymt)
         C. Flex card (Rejsekort flex)
      iv. How did you order your Rejse Kort?
         A. Online
         B. Ticket office
      v. How do you charge your Rejse Kort?
         A. Dankort agreement / automatic recharge
         B. Online
         C. Machine
         D. Ticket office
      vi. Which transportation do you use very often?
         A. Metro
         B. regular train
         C. S train
         D. bus
         E. boat
      vii. Why do you choose Rejse kort at the beginning?
         A. price
         B. new technology
         C. convenient(easy, cover all Denmark etc.)
         D. others...
      viii. What the problems are you facing when you use Rejse Kort?
         A. Checking in
         B. Checking out
         C. Loading credit/balance
         D. No, I don't have yet
         E. If yes, Please explain
         F. Other problems?
      ix. Which improvement do you expect from Rejse Kort?
         A. Open answer
   b) non user passengers

i. How old are you?

Range15 - 25 26- 35 older

8. How often do you use public transportation?

A. Every day
B. 1-3 times a week
C. 1-3 times a month
D. twice a year
E. or less

iii. Which type of tickets are you using?

A. single ticket
B. period card
C. youth card
D. clip card
E. app ticket
F. pension card
G. other

iv. Why are you not using Rejse Kort?

A. Price
B. New technology
C. Difficult
D. Not convenient
E. other

v. Which improvement would you suggest Rejser Kort then you can use it in the future?

A. Open answer
B. I would never use it

c) company IT professionals(semi-structured)

i. How do you think about rejse kort system?
ii. Which kind of problems do you face with the Rejse Kort system ?
iii. What could be improved? and how?
iv. How many percent of users in Denmark do your company expectful?

d) ticket controllers(semi-structured)

i. Which kind of problems do you face working with the Rejse Kort system ?
ii. What could be improved?
iii. How does this card help you work? F.x make easy for your work?
iv. Which of the transportation ticket you prefer? why?

It can be concluded from our observation and interview that the current Danish TravelCard system have issues which can be improved and corrected. Some of the problem are listed below:

⇒ Passengers did not manage to find out how to check out, or simply forgot to do so.

⇒ The fair billed was not the cheapest fare as promised in the advertisement, especially for kids and pensioners.

⇒ Passengers who were accused by ticket controllers of not paying could not proof that they had checked in though they, at least, thought they did so. Passengers do not get a receipt. With other words: errors caused by the system could not be proven to the ticket controller.

⇒ Control over billing data and privacy – also in the light of the current revelation of privacy issues with foreign and local authorities collecting data 'for stock' is an issue as well.

⇒ The sounds is coming from the machine is quite confusing to the passengers.

⇒ The machine is sometimes not functioning thus making it hard to check in or check out.

⇒ The out and check in machines look very similar.

Waterfall

Advantages

Every phase has a defined start and end point. Progress can be conclusively identified (through the use of milestones) by both vendor and client.

Disadvantages

If there are many errors in the results, developers need to go back all the processes. No user interaction. Its major problem is the inflexible partitioning of the project into distinct stages

Characteristic

The waterfall model is an example of a plan-driven process—in principle, you must plan and schedule all of the process activities before starting work on them

In principle, the waterfall model should only be used when the requirements are well understood and unlikely to change radically during system development.

Agile

Advantages

Saving time for the developing team. Customer satisfaction by rapid, continuous delivery of useful software. People and interactions are emphasized rather than process and tools. Customers, developers and testers constantly interact with each other. Working software is delivered frequently (weeks rather than months). Close, daily cooperation between business people and developers. Regular adaptation to changing circumstances. Even late changes in requirements are welcomed. Constant Learning, Knowledge Creation and Knowledge Sharing

Disadvantages

In case of some software deliverables, especially the large ones, it is difficult to assess the effort required at the beginning of the software development life cycle.

There is lack of emphasis on necessary designing and documentation.

Characteristic

Individuals and interactions over processes and tools.

Working software over comprehensive documentation.

Customer collaboration over contract negotiation.

Responding to change over following a plan.

Rational Unified Process (RUP)

Advantages

Full of the documents describing for the project. It is good for large project. There are iterations in the different phases.

Disadvantages

The team members need to be expert in their field to develop a software under this methodology.

The development process is too complex and disorganized. It is wasting time to make many documents for a small project.

Characteristic

RUP provides a full lifecycle approach covering a series of product lifecycle phases called inception, elaboration, construction, and transition.

RUP provides a software development method and a set of software engineering practices that cover the majority of software development disciplines.

RUP is incremental: Each iteration builds on the functionality of the prior iteration; the software application evolves in this fashion with the benefit of regular and continuous feedback.

Spiral

Advantages

Risk management as inbuilt feature. Changes can be done later without spending much time.

Disadvantages

High cost involved in this model. Expertise needed as product has to review and redone time to time.

Characteristic

The main difference between the spiral model and other software process models is its explicit recognition of risk. A cycle of the spiral begins by elaborating objectives such as performance and functionality.

Prototyping

Advantages

User is involved throughout the development process, which increases the likelihood of user acceptance of the final implementation.

Small-scale mock-ups of the system are developed following an iterative modification process until the prototype evolves to meet the users' requirements.

While most prototypes are developed with the expectation that they will be discarded, it is possible in some cases to evolve from prototype to working system.

Since in this methodology a working model of the system is provided, the users get a better understanding of the system being developed.

Errors can be detected much earlier.

Quicker user feedback is available leading to better solutions.

Missing functionality can be identified easily

Disadvantages

Leads to implementing and then repairing way of building systems.

Practically, this methodology may increase the complexity of the system as scope of the system may expand beyond original plans.

Incomplete application may cause application not to be used as the full system was designed.

Too much involvement of client, is not always preferred by the developer.

Too many changes can disturb the rhythm of the development team.

Characteristic

A basic understanding of the fundamental business problem is necessary to avoid solving the wrong problem.

Prototype model should be used when the desired system needs to have a lot of interaction with the end users.

Extreme Programming

Advantages

Developers write test code first. It is test driven development. The aim is using test code to design the structures of system. It is good for developers to consider the risks that could be in the structures.

It is fast to develop the software products.

Disadvantages

XP is more related to the technical people. Business users cannot be part of development.

There are few documents. It is hard to use in the large project.

XP ignore the software design.

There is no specific process for developing.

Characteristic

Extreme Programming is an Agile methodology, there are characterized to be an open for adjustments running on development. User words is law, and developers should always have users priority of, which part which must be developed next time, and approval by the fact that it developed was actually what they needed.

Incremental Development

Advantages

- Generates working software quickly and early during the software life cycle. - More flexible – less costly to change scope and requirements. - Easier to test and debug during a smaller iteration. - Customer can respond to each built. - Lowers initial delivery cost. - Easier to manage risk because risky pieces are identified and handled during it'd iteration.

Disadvantages

- Needs good planning and design. - Needs a clear and complete definition of the whole system before it can be broken down and built incrementally.

Characteristic

In incremental model the whole requirement is divided into various builds. Multiple development cycles take place here, making the life cycle a "multi-waterfall" cycle. Cycles are divided up into smaller, more easily managed modules. Each module passes through the requirements, design, implementation and testing phases.

Rapid Application Development

Advantages

Reduced development time.

Increases reusability of components.

Quick initial reviews occur.

Encourages customer feedback.

Disadvantages

Depends on strong team and individual performances for identifying business requirements.

Only system that can be modularized can be built using RAD.

High dependency on modeling skills.

There are times when the team ignores necessary quality parameters such as consistency, reliability and standardization.

Characteristic

RAD should be used when there is a need to create a system that can be modularized in 2-3 months of time.

It should be used if there's high availability of designers for modeling and the budget is high enough to afford their cost along with the cost of automated code generating tools.