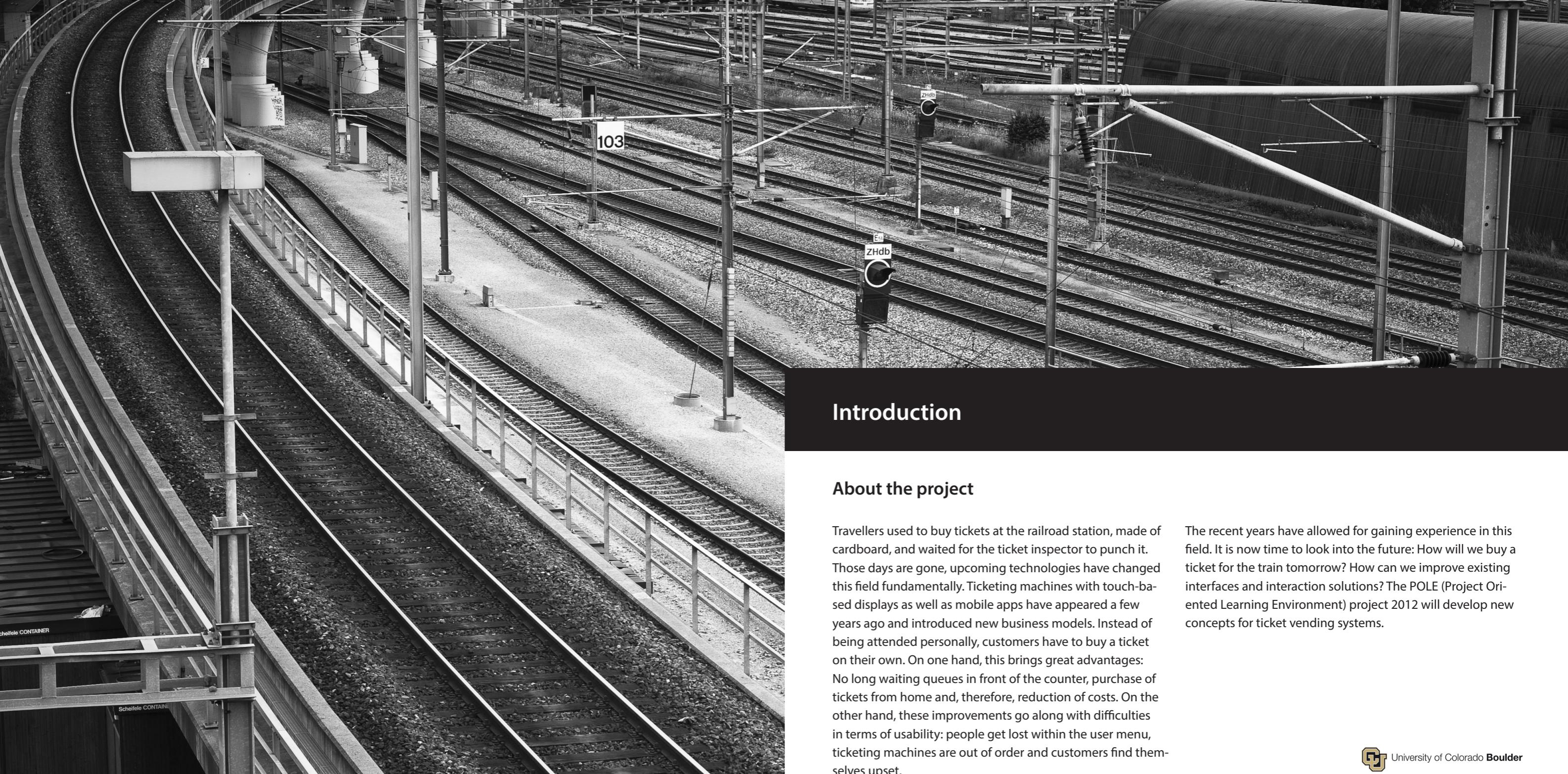




POLE

ON TRACK

TEAM CHRISTOPHORUS



Introduction

About the project

Travellers used to buy tickets at the railroad station, made of cardboard, and waited for the ticket inspector to punch it. Those days are gone, upcoming technologies have changed this field fundamentally. Ticketing machines with touch-based displays as well as mobile apps have appeared a few years ago and introduced new business models. Instead of being attended personally, customers have to buy a ticket on their own. On one hand, this brings great advantages: No long waiting queues in front of the counter, purchase of tickets from home and, therefore, reduction of costs. On the other hand, these improvements go along with difficulties in terms of usability: people get lost within the user menu, ticketing machines are out of order and customers find themselves upset.

The recent years have allowed for gaining experience in this field. It is now time to look into the future: How will we buy a ticket for the train tomorrow? How can we improve existing interfaces and interaction solutions? The POLE (Project Oriented Learning Environment) project 2012 will develop new concepts for ticket vending systems.



Merz Akademie

Hochschule für Gestaltung Stuttgart
Staatlich anerkannte Fachhochschule

n|w
Fachhochschule
Nordwestschweiz



Introduction

About A-Welle – Cooperation Partner

The customer A-Welle, a public transportation ticketing support and marketing company, has several hopes, needs and expectations for the project. We came up with the following points.

- Problem analysis based on current system
- Simple solutions to improve/upgrade existing machine
- More intuitive user interface of a ticket vending machine
- Visionary/innovative yet realistic ideas

- Creative solutions
- New approaches
- Envision situation/solution of 2020, what we should do for 1 year improvement to achieve vision of 2020
- Possible proposal such as union of other ministrations/region
- Increase simplicity, safety

and security of the service

- Raise customer satisfaction
- Give clear information about ticket buying process and options
- Positive image and achievement of customer loyalty
- Affordable ticket pricing

About FHNW as Organisator and Partner Universities

The faculty of FHNW, University of Engineering, Northwestern of Switzerland, supports the whole iPole project process. They provided the learning platform to enable an interdisciplinary process. But it was not just the FHNW in Windisch that organized everything. They also left the responsibilities of disciplinary supervision of the students to their home universities - University of Colorado, Boulder and Merz Akademie, Stuttgart.

About Team Christophorus

POLE's fascinating process put together this dynamic team:
Sarah Geissberger, FHNW from Switzerland
Kevin Himmelsbach, Merz Akademie from Germany
Jeeeon Kim, University of Colorado from South Korea
Reto Lehnher, FHNW from Switzerland
Sibylle Ramseier, FHNW from Switzerland
Stefan Zimmermann, FHNW from Germany

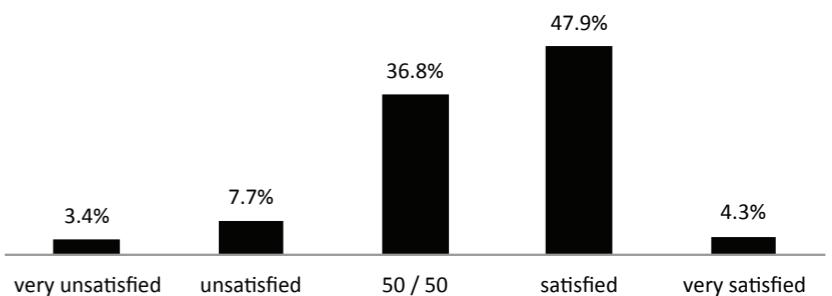
Our Team Spirit and Philosophy

We work iteratively and tend to an agile project management. The team members are responsible for their tasks and deliverables. Our delivery time is based on two week iterations.

Our Vision

We design the new travel experience focusing on simple, fast and flexible solutions.

Design / Esthetics

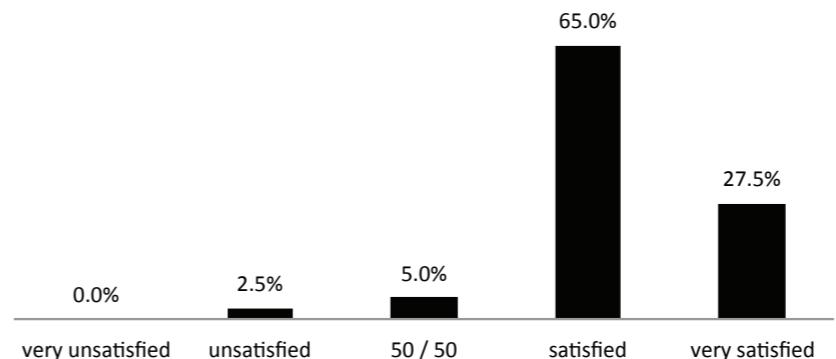


Today's A-Welle TVM

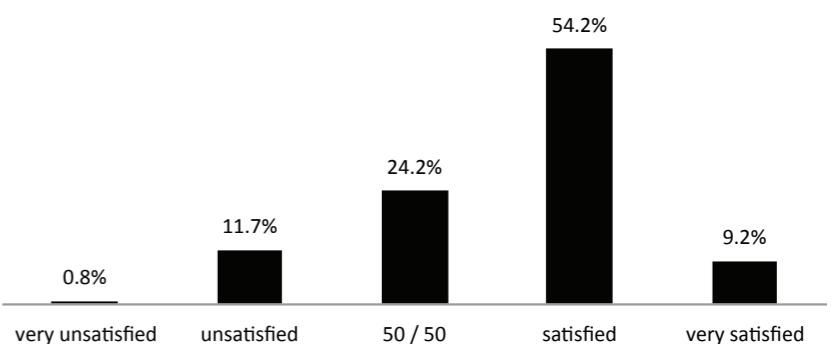
Within Switzerland different types of ticket vending machines exist. E.g. in the area of A-Welle the traveller can buy a ticket on an A-Welle Ticket Vending Machine (TVM) or on the SBB's TVM. This is quite confusing for the customers as the interfaces are not the same.

In the beginning of the project, we conducted a questionnaire based survey. How satisfied are you with regard to the listed characteristics?

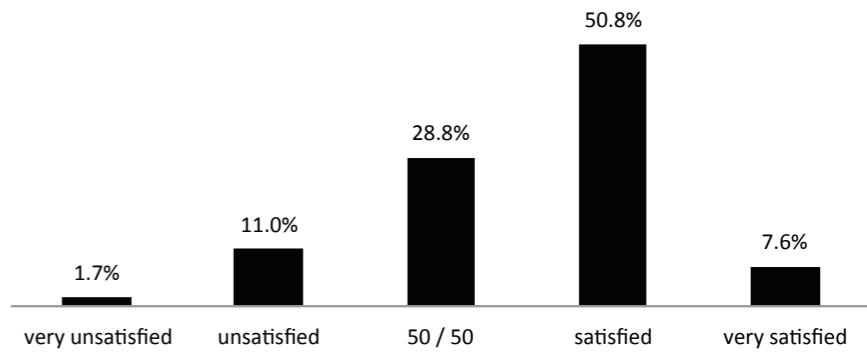
Type Size



Place of Location



The Number of TVMs



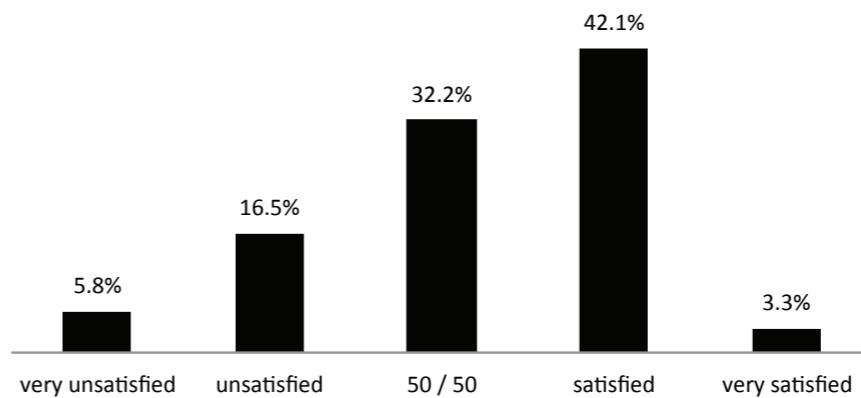
How do you usually buy your ticket?

Options	Answers	Percent
TVM	147	62.3%
counter	44	18.6%
smartphone	24	10.2%
computer	6	2.5%
others	15	6.4%
all in all	236	100.0%

What do you use the TVW for?

Options	Answers	Percent
buying a ticket	184	71.6%
recharge cell phone	23	8.9%
don't use it	43	16.7%
others	7	2.7%
all in all	257	100.0%

Handling in general



When do you usually buy your ticket?

Options	Answers	Percent
just before departure	170	75.2%
0,5h before departure	5	2.2%
1h before departure	4	1.8%
24-hour	14	6.2%
more then 1 day	33	14.6%
all in all	226	100.0%

Which means of payment do you usually use?

Options	Answers	Percent
paper money	121	30.5%
coins	134	33.8%
bank card	88	22.2%
credit card	23	5.8%
don't use TVM	24	6.0%
others	7	1.8%
all in all	397	100.0%

Questionnaire

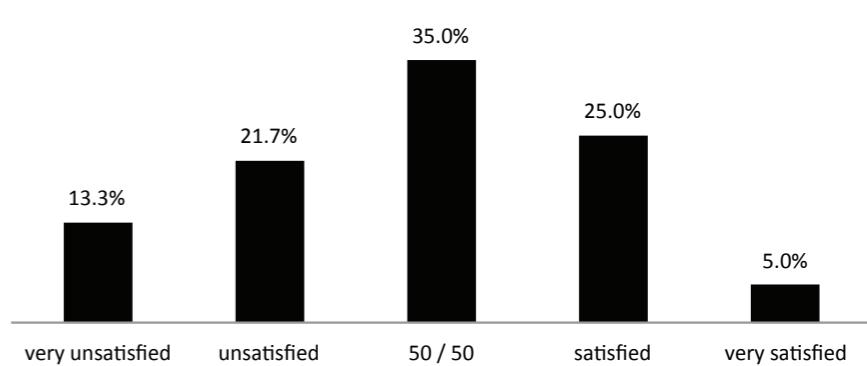
Where do you look at the timetable?

Options	Answers	Percent
timetable screen in train station	79	19.6%
counter	3	0.7%
smartphone	167	41.4%
computer	149	37.0%
others	5	1.2%
all in all	403	100.0%

Do you know the A-Welle TVM?

Options	Answers	Percent
yes	134	57%
no	101	43%
all in all	235	100%

Clearness



Index

1. A-WELLE
2. Canton Argau
3. SBB
4. Public Transportation Operator
5. Annex Network System (Tariff Network)
6. Customer
7. Ticket Vending Machine Manufacturer
8. Support and Maintenance Staffs
9. Conductor
10. Each University
11. Media
12. Telecommunication Company
13. Credit Card Company
14. Environments

A-WELLE

Role

- Ticket pricing and marketing (transportation association of parts of canton Aargau, Basel and Solothurn)

Expectation & Goals

- Modify current ticket vending machine's user interface
- Increase simplicity, safety and security of the utilization
- Raise customer's satisfaction
- Offer clear information on ticket buying process
- Positive image and gaining customer loyalty
- Affordable ticket pricing
- Reduce costs on staff training and system maintenance
- Total product range is online available
- Less counters (reduce ticket sales over the counter)
- Extend network tariff on annex network systems (like Libero, Bern or ZVV, Zürich) to improve the customer satisfaction.
- Facts and figures for statistical evaluation
- Not overwhelm cost coverage, budget

SBB

Role

- Biggest public transport operator
- Responsible for the delivery of transport contract
- Responsible for adherence to the franchise condition

Expectation & Goals

- Default starting point
- No default for time of departure
- Separation of choice per destination or by type of product- Sequential path
- No unnecessary inputs
- Special offers depending on context after product choice before payment
- No 'shopping cart'
- Redundant product storage
- Business objectives are:
 - Customer satisfaction
 - Annual profit
 - Free cash flow
 - Market share
 - Ecological sustainability
 - Image
 - Staff satisfaction
 - Punctuality
 - Security

Stakeholder Analysis

This chapter gives an overview of the main stakeholders we have determined, as well as their roles and expectations.

The whole stakeholder analysis document can be found on WUALA - Web based accessible storage.

Canton Aargau (State of Aargau, Switzerland)

Role

- Order for the public transportation operators

Expectation & Goals

- Provide «service public»
- Good quality
- Alternative to private transport
- Shift private transport to public transport to improve the CO₂ balance (acc. Kyoto Protocol: reduce emissions by 8%)

Public Transport Operator (Concessionaires)

Role

- Provide local public transportation in buses, trams etc. (RVBW = urban area Baden, Post, AARE = urban area Aarau)

Expectation & Goals

- Ability of installation and setting up of TVM or validator in busses
- Less maintenance of machines
- 99% availability of service (TVM in buses, validator).

Annex network system (Tariff Network)

Role

- Ticket pricing and marketing
transportation association of neighbouring cantons increases percentage of purchase of products other than single tickets
- Revise of zone plans
- Make interactive intelligent support possible
- Integrate DV (SBB) problematic and states

Expectation & Goals

- Support of mental model through accompanying communication
- Payment methods change: missing combined cash and paper money function
- Reducing general complexity of product range

TVM-Manufacturers

Role

- Produce vending machine and check-in devices
- Design visual & interactive interfaces for machines
- Connect to the main server for transaction
- Install machine to the station
- Maintain and repair when TVM is out of order
- Upgrade software and check status of system on a regular basis

Expectation & Goals

- Little steps for maintenance
- Few system-failures / stable systems
- Remote upgrade without physical access
- User-centered interface design
- Easy access for maintenance staffs

Conductor

Role

- Check ticket validation
- Assist customer when buying a ticket
- Advise and help customers

Expectation & Goals

- Easy and simple steps to validate ticket
- Stable devices and few change

Stakeholder Analysis

Customer

Role

- Buy a ticket with SBB TVM or A-WELLE TVM
- Hold available ticket
- Show ticket when it is needed by conductor

Expectation & Goals

- Simple ticketing, fast and self-explanatory
- No confusion
- Each user group has different interests
- Buy ticket on mobile/web/TVM
- Get help and buy ticket with support

Support and Maintenance staff

Role

- Know the standard manual for operating TVM
- Maintain/service the TVM's

Expectation & Goals

- Few system-failures / stable systems
- Fast recovery manual in case of breakdown
- Easy to maintain and repair
- Remote observation system and repair

Each University

Role

- Co-work with industrial partners : A-WELLE, Canton Aargau
- Manage students in terms of discipline
- Manage whole project process

Expectation & Goals

- Follow timeframe
- Deliver project deliverables on reasonable time, in professional level
- Be creative as much as students can
- Respect current limitations – budget, time issue, etc.
- Be holistic

Media	Credit Card Company (Potential)	Environment
<p>Role</p> <ul style="list-style-type: none"> ■ Promotes for A-welle in newspaper and magazines ■ Influence on people's opinion on A-Welle, tariff system and their services including transport operators. ■ Convey credential information and news to mass <p>Expectation & Goals</p> <ul style="list-style-type: none"> ■ To be informed what the a-welle plan to do ■ Offer adequate information on changement in transportation systems for customer ■ Get much advertisements opportunity by conveying A-Welle's news ■ More subscribers(customers) ■ Get good reputation, have positive influence 	<p>Role</p> <ul style="list-style-type: none"> ■ Invoice the system / journeys ■ Manufacture new card chipset embedded ■ Gather travel history per month <p>Expectation & Goals</p> <ul style="list-style-type: none"> ■ Consistent price formations ■ Recruiting more clients ■ Inducing more use and transaction ■ Alliance with appropriate business partner ■ Easy access to the card usage information 	<p>Role</p> <ul style="list-style-type: none"> ■ Have effects on people's daily life <p>Expectation & Goals</p> <ul style="list-style-type: none"> ■ Stay be clean

Stakeholder Analysis

Telecommunication Companies (Potential)
<p>Role</p> <ul style="list-style-type: none"> ■ Support telecommunication for users including 3G/4G data network, wire/wireless internet ■ Maintain good access speed and quality <p>Expectation & Goals</p> <ul style="list-style-type: none"> ■ More customer, more usage ■ More coverage area ■ Support good internet/data network speed and quality ■ Trust from customer, and get royalty ■ Raise customers' satisfaction rate ■ Alliance with co-partners for marketing

Requirement Specifications

Based on our personas and our stakeholder analysis we worked out the requirements. We gathered all the requirements of each stakeholder, went through all of them together and prioritized each requirement. The following list includes all the requirements with their respective categories, description and prioritization. A complete list including rationale, originator, fit criterion, customer satisfaction, customer dissatisfaction and conflict can be found in the attachments on Wuula.

The priorities are structured as following:

- must have to succeed
- critical
- normal
- nice to have

Nr.	Category	Description	Priority
1	Cultural and Political	Assure data security, so no personal data can be stolen/resold	normal
2	Performance	Ticket buying process should be fast	critical
3	Cultural and Political	Reasonably priced transportation solutions	must have to succeed
4	Usability and Humanity	Simple mobile ticketing solution	must have to succeed
5	Usability and Humanity	Simple ticketing solution for vending machine, mobile app and online buying	must have to succeed
6	Functional and Data	Default starting point	normal
7	Functional and Data	Cover the whole A-Welle product range	normal
8	Functional and Data	Visualize process with reasonable symbols/pictogram	normal
9	Usability and Humanity	Indicate the whole ticketing process visually	critical
10	Functional and Data	Log in and load personal information	critical
11	Functional and Data	Store and reload previous travel history	normal
12	Functional and Data	Print receipts from travel history	nice to have

Requirement Specifications

Nr.	Category	Description	Priority
14	Functional and Data	Show current timetable	normal
15	Functional and Data	Show train location tracking in real-time	normal
16	Functional and Data	Show customized map for route on the ticket	nice to have
17	Usability and Humanity	Link ticket information to user's portable devices	critical
18	Operations and environment	Support web-based ticketing	must have to succeed
19	Usability and Humanity	Detect user's voice/face	normal
20	Usability and Humanity	Support voice input service	must have to succeed
21	Functional and Data	Total product range is available online	must have to succeed
22	Functional and Data	Validation/ticket buying is provided in buses or at busstations	must have to succeed
23	Functional and Data	Ticket pricing is based on the a-welle zones (give user information about zones)	must have to succeed
24	Usability and Humanity	Traveller with a personalized account is able to buy a ticket from a to b with 2 clicks.	critical
25	Maintainability and Support	Pricing updates must be seamless/simultaneous on all devices at any time	critical
26	Cultural and Political	Traveller can see how much the trip will cost	critical
27	Usability and Humanity	Interfaces on the devices enhance learning	critical

Nr.	Category	Description	Priority
28	Functional and Data	Cashless service with debit or credit card is provided	must have to succeed
29	Cultural and Political	Devices should be sustainable and ecological	normal
30	Cultural and Political	Multilingual: german, french, english and italian	critical
31	Functional and Data	Ticket is valid for destinations local transport facilities	nice to have
32	Functional and Data	Transferable ticket	critical
33	Functional and Data	When buying a ticket the customer sees all intermediate stops of his journey	nice to have
34	Maintainability and Support	System is recovered from failure quickly	must have to succeed
35	Usability and Humanity	User interface is appealing and consistent in both color as well as look & feel	normal
36	Operations and environment	User can pay with cash, credit card, and NFC payment on TVM	must have to succeed
37	Political	Parking ticket (car, cycle) and a public transportation ticket can be paid with the same smart-card (e-ticket)	nice to have
38	Operations and environment	Proposed solutions are linked to user stories based on the personas	must have to succeed
39	Operations and environment	Suggested solution is feasible	must have to succeed
40	Cultural and Political	Solution is comprehensive and innovative	normal
41	Cultural and Political	Process benefits from transdisciplinary cooperation	normal

What is a persona?

Our personae are fictional people and identify major user groups in the A-Welle public transportation system.

We selected the characteristics that are most representative of those groups.

We refined our personae which were an important source for our requirements and concept development. The detailed personae can be found on wuala.

Rachel – Adventurous Tourist from Westminster (USA)

Age: 28; Graduate Student of University District of Colorado
Her hobby is travelling to countries using various languages, so spent free time to trip to different countries. She is eager to learn many languages but too shy to ask anonymous people for help when she is a stranger.
Rachel's needs: multiple language supports, self explanatory ticket vending machines, exact map to transfer from train to tram.

Hermann – Old fashioned Engineer Baden

Age: 72; Retired Engineer He retired but he is still very active, likes to go to Jazz concerts all around the country as well as in Germany, France, and Italy. If possible, he likes to take the train because he likes to drink a few glasses when he listens to good music. When he takes the bus he buys a ticket at the TVM in the bus, but he only uses the ticket for 3 stations that allows him to push a single button.
Hermann's needs: Various distance options, family discount, simple ticket vending machine

Monika – Family Traveler Brugg

Age: 38; Medical Assistant She lives with her family in a house with garden. Her place of work is Leuggern – hospital. She goes to work by car. With her child and the child's friends she likes to ride by train when they are doing things in their spare time – visiting Technorama, Zoo Basel or Zurich, Verkehrsmuseum and so on. She used to buy the SBB railway's special offer tickets.
Monika's needs: One time pay with child, special offers for family

Johann – Passionate Conductor

Age: 42; Conductor He has been working at SBB for over 20 years, as a train ticket validator. As technology has been evolved, his work responsibilities decreased because multiple devices support his tasks and so take his role as a ticket validator and seller in the train. If his personal check-in device breaks down, he cannot issue a new ticket for those who do not have ticket a in the train.
Johann's Needs: simple validation system, easy manual device, low breakdown

Katie – Blind Career Woman

Age: 36; Rehabilitation Counselor She was born with a birth defect, so she had never seen characters during her entire life. Yet, she has positive mind for her life, and she is a highly educated woman who has PhD degree in Public Health. Nowadays, she feels uncomfortable with current technology development, because she was able to use computer, mobile phone, even TVM too before, with tortuous input device such as keyboards once she is familiar with the fixed position of it. Currently she struggles with the electronic devices with its embedded touch screens.

Katie's needs: Voice detection, easy way to get ticket, help free ticketing

Personae

Matt – impatient Heavy User Zurich

Age: 54; Business Consultant, Executive Manager
He spends a lot of time on the way for business trip. He commutes every day from Zurich to Baden. He buys his ticket whenever he travels far away despite he does not want to spend his valuable time on ticket buying.
Matt's needs: Security, simple process of buying tickets, refined UI design

Lisa – Smart Device Follower Aarau

Age: 32; occupation: Business Analyst
Her position involves a considerable amount of travelling. She has got a ZVV and an A-Welle travel pass with a validity of 12 months. She has a membership of Mobility. Since she loves hiking, she rides a bike to the mountain on the weekends.
Lisa's needs: ticket for bicycle, buying ticket on smart-phone, timetable app

Anna – Student Wettingen

Age: 20; Student ZHAW Winterthur
Next to her business administrative studies at the ZHAW in Winterthur, she is working part-time in a small firm as a personal assistant to finance her studies. Anna uses the train and other public transportation systems such as tram and auto bus every day to get to university or to work. Also, in her spare time, she likes travelling around Switzerland.
Anna's needs: comfortable long ride, subscription, student option

Yusuf – Potential Frequent User Stuttgart, German

Age: 9; Primary school student
He is good at school, especially in math and sport. His older brother lives in Windisch and he visits him very often (about once a week). They play football a lot, and if they do not play they watch it together on TV or in the stadium in Basel. Yusuf also travels a lot around in Switzerland with his family.
Yusuf's needs: pay by parents, no awareness for price

Thomas – Casual Traveler Bern

Age: 38; Team Leader at Medium sized IT company
He now plays in a local amateur soccer-team, so takes part in a friendly match once a week. Thomas hasn't always been a frequent train passenger, but over the last several months, he had to travel about once a week for a meeting with clients and a new supplier which is located outside of Zurich. In his spare time he prefers to travel by car, as it is a bit more convenient in the area where he lives.

Thomas' needs: simple zone system, fast way to buy a ticket, receipt for expense reimbursement





Research

Case Studies

For our research we emerged to get an overview of broad and world-wide implemented public transportation ticketing systems. These case studies show us feasible aspects on a complex public transportation system with different operators and zone systems.

All case studies are uploaded to wuala: London (Oyster card), South Korea (iPhone App, UI), Hong Kong (Oyster-Card), Taiwan (UI, easy to use reservation system), Bologna (contactless card), Oslo (using RFID and reduced complexity of zoning system), Quebec (Opus contactless card, operators with different requirements), Southern Sweden, Singapore (Oyster card).

Southern Sweden

The system provides rail and bus commuters with greater convenience by speeding up boarding times and giving them the option of using the Internet to automatically reload value onto their smart cards.

links five counties

more than 1'500 buses and 70 rail stations are integrated by the system

regional system is interoperable with Denmark's national TravelCard

Hong Kong

The Mass transportation system operates since 1997 with the magnetic plastic cards as fare tickets. The card is a rechargeable contactless* stored value smart card used to transfer electronic payments in online or offline systems. Today the card is commonly used in most, major public transportation, fast food restaurants, supermarkets, vending machines, convenience stores and many other retail businesses where small payments are frequently made by customers. You can buy the cheapest loan card for HK\$7.

Bologna

In Bologna ten operators brought up a interoperable transport area. They set up a ticketing with magnetic, contactless* cards with an equipment customized to fit the regional zoning system and extendability for Bologna.

Links up to 10 public transport operators

1'240 buses and trolleybuses operate on a network of 173 urban and intercity lines

1.3 million inhabitants are served

Bologna network contains 50 zones

Quebec

The urban and intercity transport network serving Montreal, Laval, Quebec, Longueuil and Sorel-Varennes is extremely complex, and run by a large number of operators each with their own ticketing system. They created a contactless card with the ability to store up to four different tickets, e.g. monthly season ticket or booklet of tickets, and offer a temporary ticket for occasional users. The equipment like ticket vending machines and validators is connected with a central system that gathers the data required to distribute revenue.

Links 6 opertors

2690 buses, 189 coaches, 5 metro lines, 5 suburban train lines 1'200'000 conactless cards*

* Contactless smart card is any pocket-sized card with embedded integrated circuits and is based on the technology NFC (Near Field Communication). The card can be used for identification, authentication.



	Simple Card anonymous	Simple Card registered	Premium Card
Personal information	Only travel history	name and address of customer saved on account	Name and picture of owner printed on card
Online Account (Card can be managed through website)	no. card can be upgraded	Can be added to online account	
Thief-proof account	if card is lost, there is no way to retrieve value and tickets on card	if card is lost, the card can be locked. Value and tickets are transferred to a new card.	
Payment with cash/debit card	Enabled on TVM		
Payment with prepaid balance	Enabled		
Payment on credit	not possible		Possible, user can link card to his bank account or credit card. His expenses are charged by end of month.
Subscriptions	not possible	only non-transferable subscriptions	Also GA, half-fare passes supported
Favorites (Quick Buy)	not possible	Can add favorites to quickly buy tickets on the TVM	
Print receipt at home	not possible	Can be printed on website in the account	

Distinction of different card types

The current paper based ticket will be replaced by the Simple Card. Owners of a personalized pass, like the half-fare or Generalabonnement will receive a Premium Card.

Solution

We have identified the personalization of features on the TVM as one of the central enhancements to the TVM. On the other hand the existing different ways to buy tickets (SBB Smartphone App, sbb.ch, ticket counter) are popular and should also be provided by the A-Welle. With those aspects in mind we developed a solution based on customer profiles that are saved on a database, linking every ticket or subscription (like GA, Zone-Abos etc.) to a profile. A profile can be anonymous or personalized. But as a minimum it is linked to one ID which stands either

for a NFC based ticket card or the ID of the customer with an NFC enabled Smart Phone. Focusing enhancements of the TVM, we have mostly focused on the NFC based travel card.

All tickets and subscriptions will be connected to a travel card. As a measure against fraud and other misuse the cards will only store an ID that links them to the profile on a server where all the ticket informations, travel history attached to the card and possibly other information about the user is saved as well depending on whether

it is an anonymous or a personalized card. There are some distinctions between different forms of anonymous and personalized travel cards, as described in the table on the next page.

Obtaining a travel card

A customer without a card will get one when buying his first ticket on the TVM or at the counter. He can then decide, if he wants to add a prepaid value, so he can buy additional tickets without the need of cash or a debit/credit card.

Reusability

The cards are highly reusable. Travellers with a card can use the card to load additional tickets and subscriptions onto it. The card will have a depot, which will be given back, when the card is returned. The travel history linked to the returned card will then be archived and cleared. The card will go back to the circulation.

Transition Phase

There is a need for a transition phase until the pure travel card based system can

be implemented. During this phase it will also be possible to buy print-at-home tickets with a QR-Code linking to a profile. This also applies to smart phones that don't have NFC functionality enabled.

Validating the tickets

Validating the tickets will be possible with special devices that resemble the current devices for the validation of QR Code based tickets. Additionally to the QR Code scanner the devices will be equipped with an NFC reader. Each card

will be read and the id of the card together with the id of the validation device will be transmitted to the server. The validation process will take place on the server. If the ticket is valid a very short response is returned by the server. In the other case, the server returns a list with the latest linked tickets for the card, to avoid confusion about why a ticket isn't valid.

Website and Smartphone

In addition to tickets can also be bought via an online account and added to a

card which is linked to this account. This requires a registered «Simple Card» or a «Premium Card». The account is also used to manage favorites, so the customer can quickly buy tickets on TVMs. The same functionality is offered via a smart phone app. If the hosting smart phone is NFC enabled, there is no need for a card.

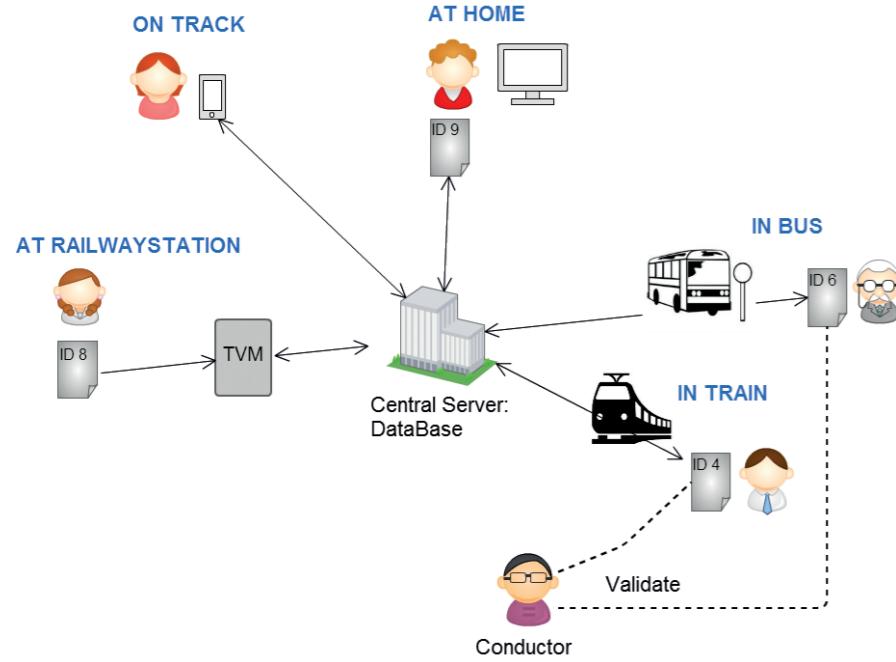
Optimization of client server communication

Checking the validity of a travel card requires a mobile connection from the vali-

dation device to the server. Even though the transmitted data to validate each card is small, there are some more measures to even further minimize this.

Each validation device will cache the IDs of subscriptions (mostly GA, but also some Zone Abos). On each day, the device will be synchronized, loading the changes to the device. This synchronization will take place over a secure and wired connection.

As each validation device is linked to a specific conduc-



tor, there is an additional opportunity for preloading some data locally. Based on the operation schedule of the conductor Zone Abos are also preloaded on the device.

Relationship Card – Server

We decided against storing additional information besides of the ID on the travel card. One reason is the flexibility with which new ticketing models and subscriptions can be implemented without having to change the data models on the card. The second reason is security: only authorized devices can access the profile information that is linked to an ID.

Prototype

To simulate the behavior of a central server and as proof-of-concept, we developed a web app providing an interface (API) to our prototype of TVM UI. The communication between the two parts happens over HTTP – as this protocol has quite a overhead compared with a lower level communication protocol like TCP. An actual implementation of a server would possibly use TCP as protocol.

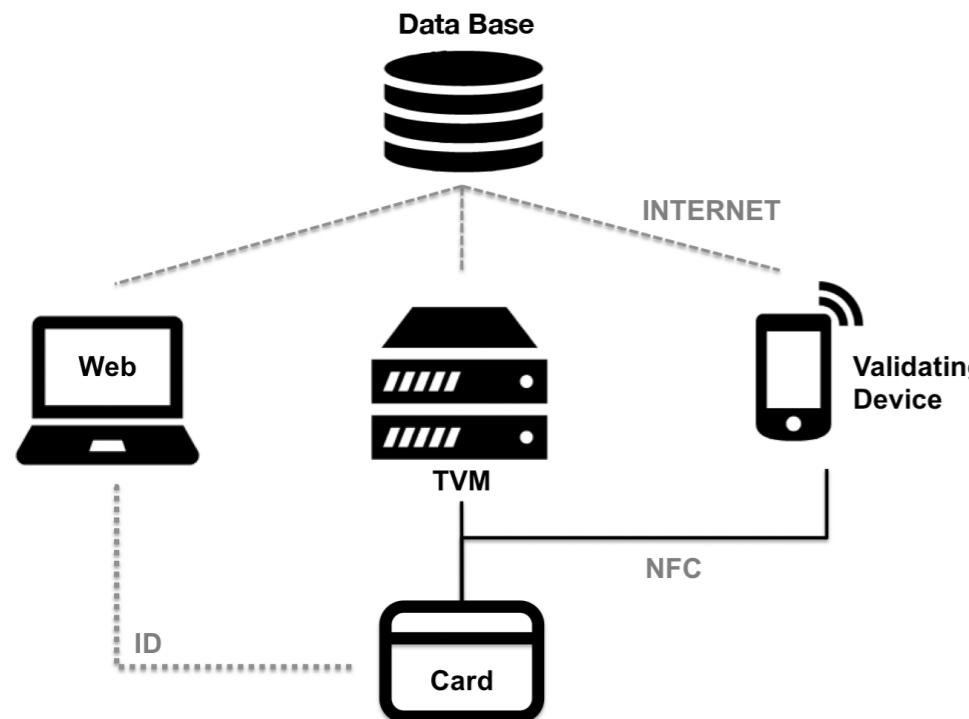
As formatting standard, we've chosen JSON which is much less verbose than for example XML and still offers a good readability. The JSON-Files that are transmitted offer a base for the calculation of the data transfer rates and can be used to develop a more optimized and efficient data format.

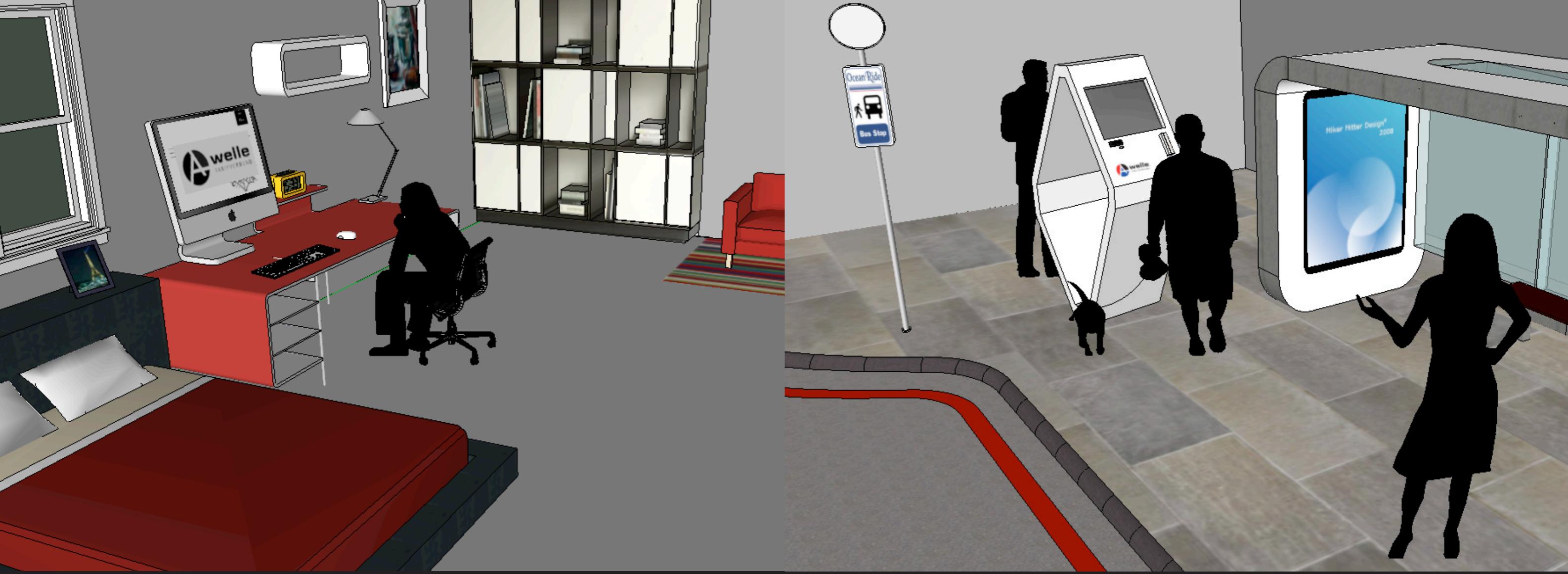
How to get the source code
The source code for all our prototypes is in password protected GitHub-Repositories. Access to those repositories is granted to the client and the coaches on demand, please contact reto.lehn-herr@students.fhnw.ch

A development snapshot is saved on the WUALA directory.

Solution

Communication Paths





Solution

Situation 1. Create account & buy ticket at home

Create an account

- Task 1. Access to the web-ticketing site from A-WELLE.
- Task 2. Create a new account for access – including payment information.
- Task 3. Register the NFC card.

Buy a ticket

- Task 1. Access to the web-ticketing site from A-WELLE.
- Task 2. Log on to the account.
- Task 3. Buy a ticket.

Manage the account data

- Task 1. Access to the web-ticketing site from A-WELLE
- Task 2. Log on to the account
- Task 3. See my ticket information
- Task 4. Manage my favourite trips, edit my address, lock or cancel a card, migrate to different card, print receipt.
- Task 4.1. Recharge balance on prepaid card

Situation 2. At a Station

Buy a ticket for the first time

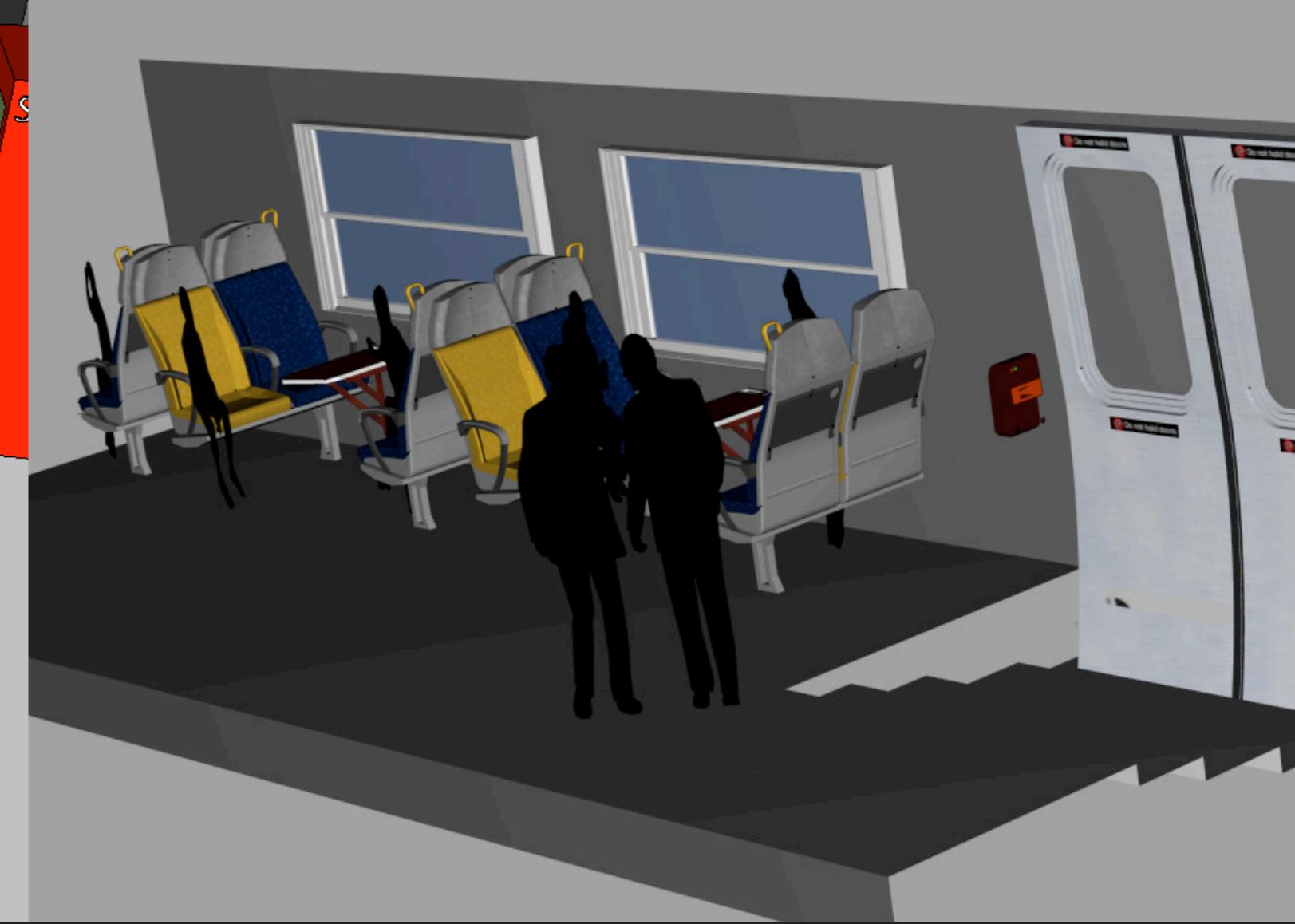
- Task 1. Access TVM.
- Task 2. Enter place of departure and destination, choose ticket options.
- Task 3. Pay ticket in cash or with credit/debit card and get the NFC-card.

Buy a ticket with a prepaid NFC-card.

- Task 1. Access to a TVM.
- Task 2. Load ticket information.
- Task 3. Make any change of ticket option.
- Task 4. Pay ticket and check the amount over available savings.

Buy a ticket with NFC-Card without prepaid-value:

- Task 1. Access Tto a VM
- Task 2. Sign in with the existing account
- Task 3. Load ticket information
- Task 4. Make any change of ticket option
- Task 5. Pay again by any method – credit card swiping, automatic pay with checking account, or cash;
- Task 6. View bought ticket;



Solution

Situation 3. On the road with smart phone

- Task 1. Launch the app.
- Task 2. See my account information
- Task 3. Check available credits
- Task 4. See previous travel history
- Task 5. Choose a frequently used route to buy a ticket
- Task 6. Buy a ticket without accessing the TVM at a station

Situation 4. At a Train/a Bus

- Task 1. If a customer has enough credit on the card, s/he can buy a ticket directly on a device near the entrance of the train. You can also check if you have a valid ticket loaded on the card using this device.
- Task 2. Conductor checks the NFC card with a his NFC card reader.

Welcome-Screen

This is the screen you'll see when you arrive at the TVM. If you put your NFC-card on the „NFC-Card“-field, you automatically log into your account. If you don't have an NFC-card yet, you just have to click on the display.



Start-Screen

After you entered the welcome-screen you'll see this start-screen. This is the screen where the magic begins.



Handling

The system works with an touchscreen. If you want to manipulate one position to set your account or your ticket buying process, you just have to press on the area of the position an vertical scroll by dragging your finger up and down. The item at the height of the others is chosen. Additional it's highlighted with an blue glow.

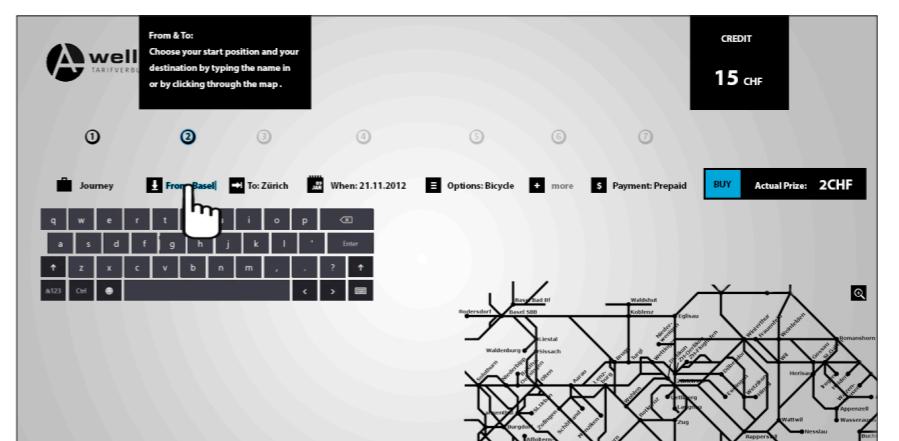
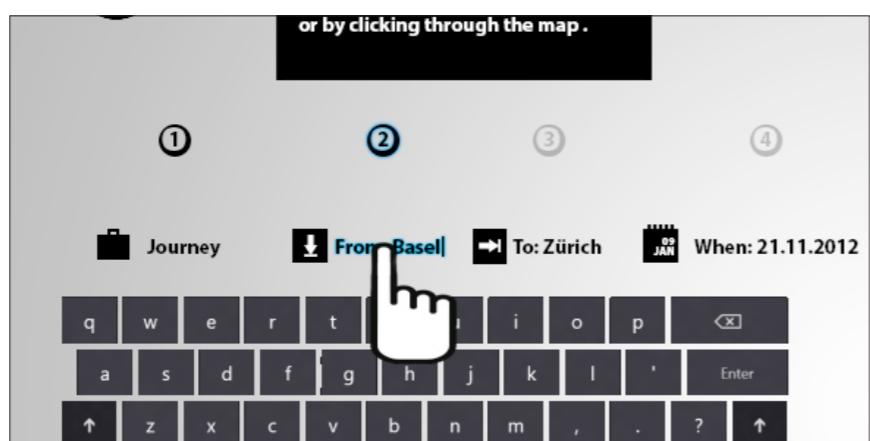
Tooltip

Over the point your setting at the moment is a little black box with the according tooltip.

Interface – TVM

Position-Numbers

A number is displayed over every setting. This helps you to not forget any setting plus it shows your current status. If the number is black, you already have set the option. If it is black and with a blue glow, you're working on that setting right now. If the number is grey, you haven't done anything on that option till now.

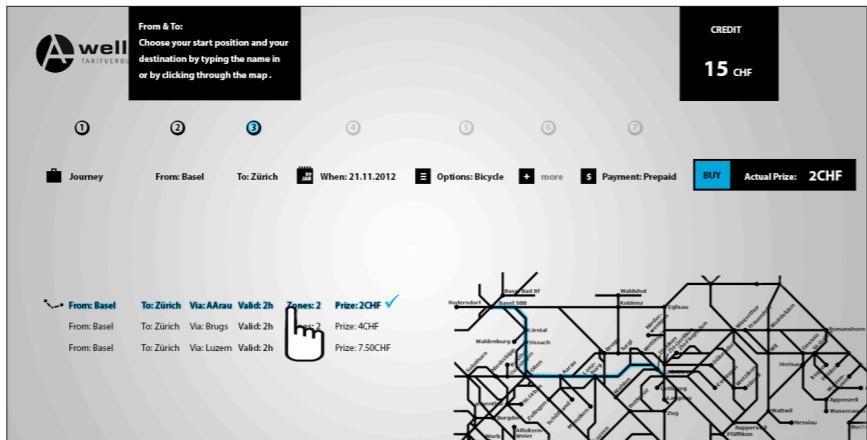


Changing handling-system

If you arriving at the point of „From:“ „To:“ or „When:“ the system changes from vertical scrolling to an little keyboard. Now you can enter your settings by just typing it in.

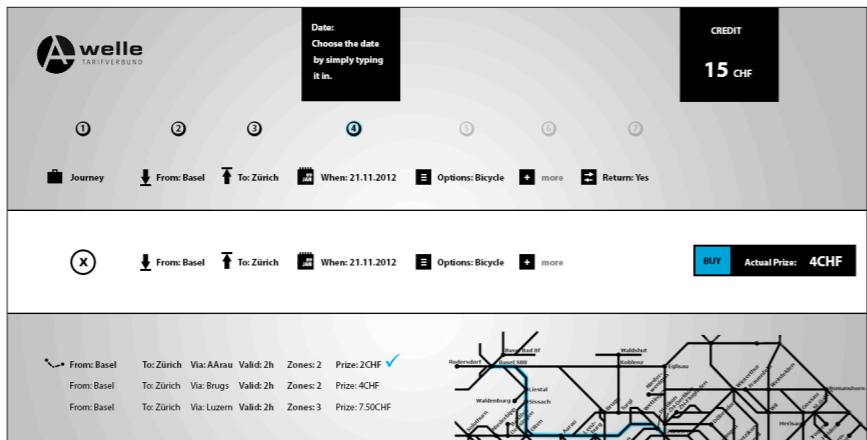
Via Option

After you have typed in your destination the via option fades automatically in. Here you have a few possibilities to choose via which routes you want to travel. You choose by just pressing on the route.



Return Option

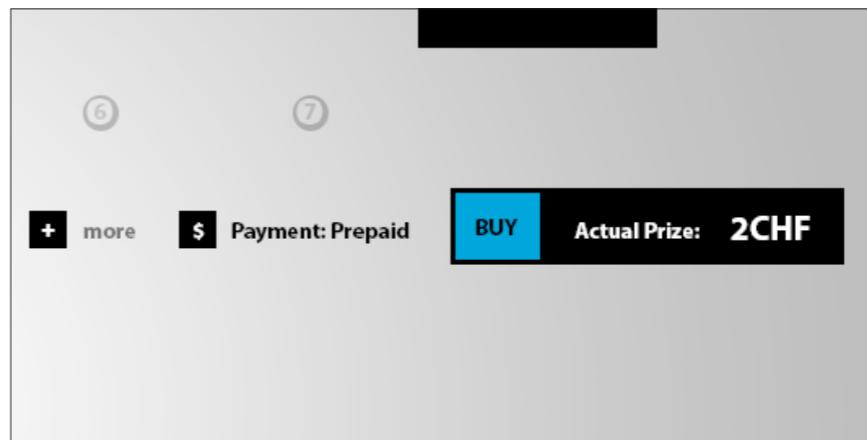
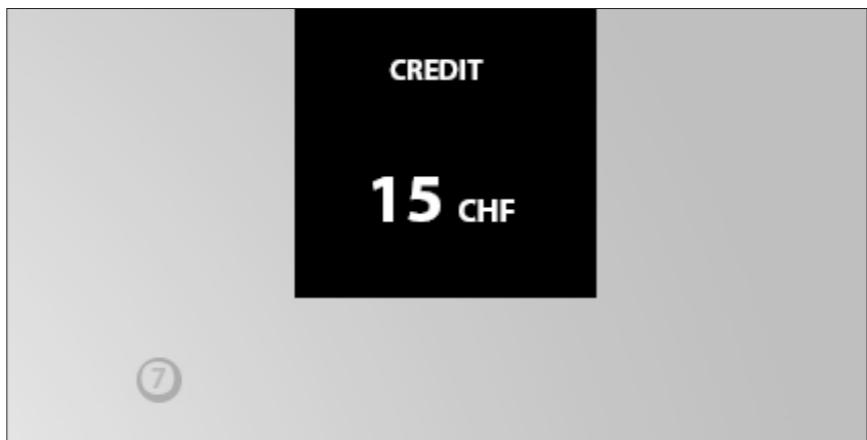
If you choose the return option. There will fade in another line with the according options.



Interface – TVM

Credit Status

At the right top, you will see your credit if you have a prepaid account.



Last Journey

If you have an prepaid account you are able to choose really fast between three of the last routes you have taken.

Last Journey & Full Account

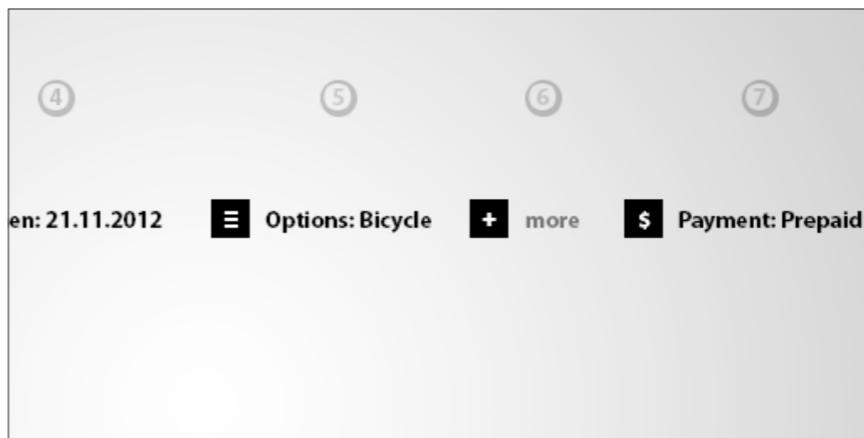
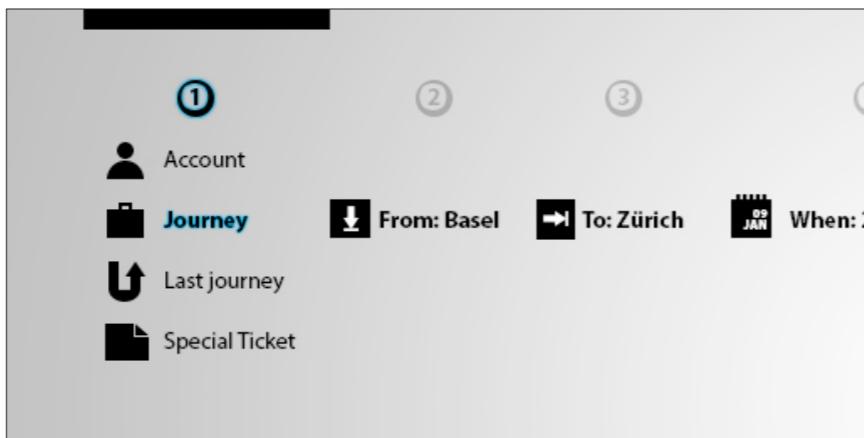
If you have an personalized account you'll be able to add 2 routes to your favourites.

Current Price & Buy Option

At the end of the setting line, you see the whole time the actual price for your ticket. Next to that, there is the buy bottun with that you're actually buying the ticket.

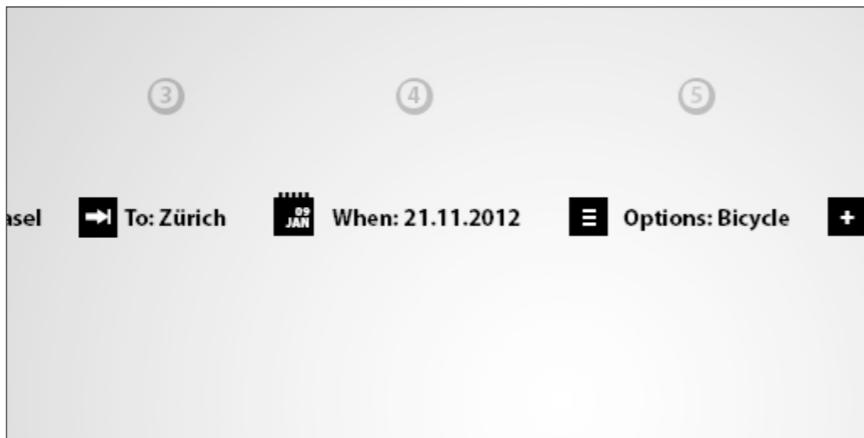
Main-Options

On the first position you're able to choose between Account, Journey, Last journey and Special Ticket. Depending on your chosen option the rest of the interface changes. On the account option you're able to change your account settings. On Journey you buy your normal ticket. On Last journey you can choose between one of your last or favorite journeys (depending on your account) and on Special Ticket you are able to buy special tickets like a day pass.



Icons & Text

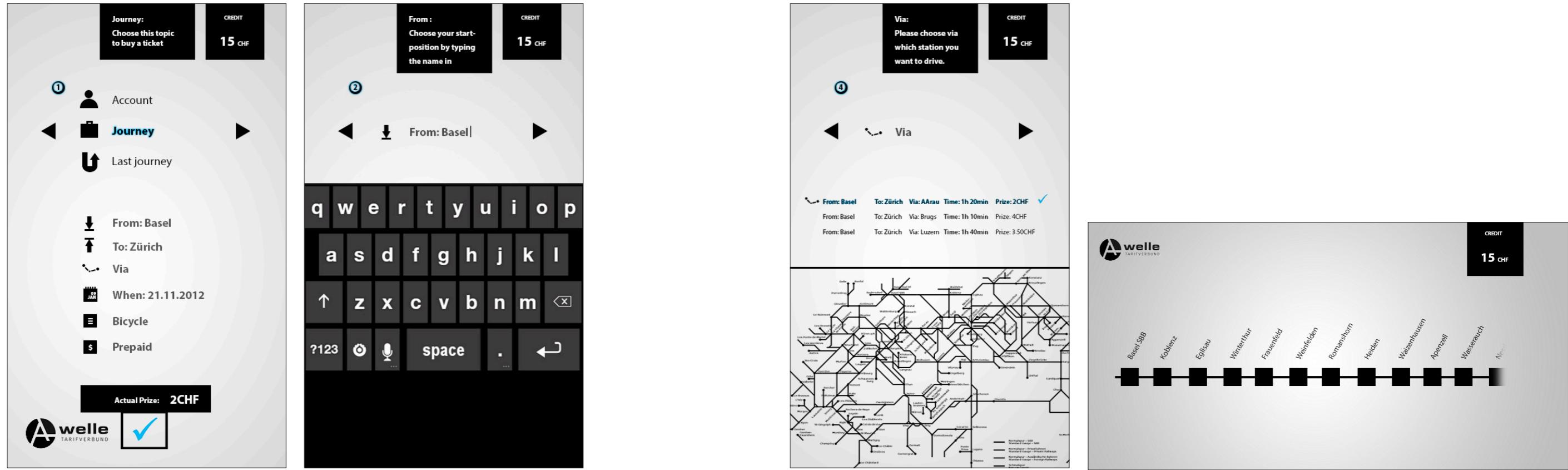
The interface uses for every setting a little icon and the explaining word. This helps you to understand what you're doing on that position.



More

If you have chosen an option at the option-position there will be a new position with more. On that position you can choose another option. This will be every time the same until there won't be any options left. So you're able to select every option for your ticket.

Interface – TVM



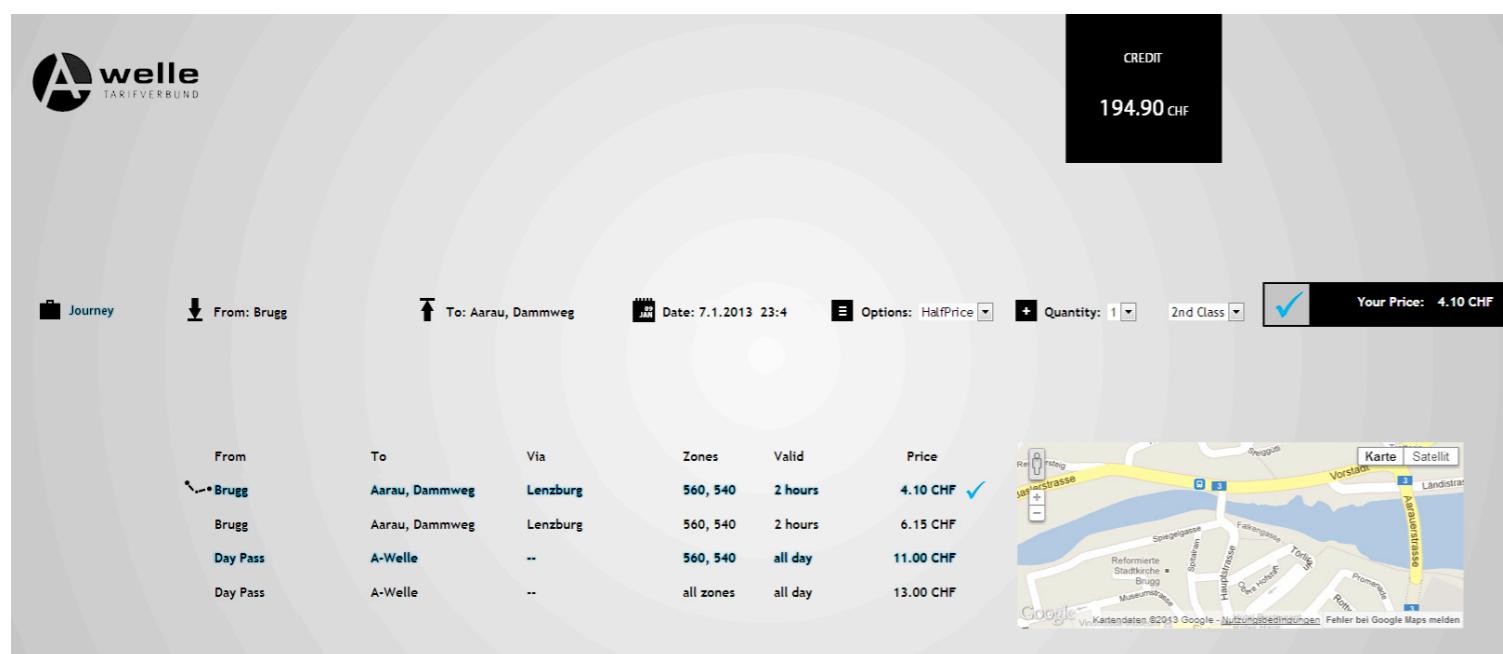
Interface – Smart Phone & Bus/Train

Smart Phone

On the smart phone the interface works the same way the TVM-interface does. By clicking the settings, the head area changes to the setting with the according handling system.

At Bus/Train

If your short on time, you are able to buy your ticket really fast at the Train/Bus (just possible if you have an prepaid account with credit on it or an fully personalized account with credit card). The next stations of the route of the bus/train are displayed on the screen. You just have to click on your destination to buy the ticket.



Screenshot of the UI prototype that was used for the user test

Tester	Usability	Enhance Learning
Denise	I was lead through the process of buying a ticket	I could learn a lot of new features.
Observations		
	She hesitates where to push to continue the process and buy the ticket Missing single/return ticket (Button to buy a return ticket). Time to buy tickets: about 2 Minutes.	
Observations		
Roland	I was lead through the process of buying a ticket	I could learn a lot of new features.
	It was hard to know what I have to do Unclear where you can confirm the ticket; Searching for 1/2 price ticket.	Next time it will work faster.
Observations		
	Uses symbols, credit is visible, where is the halfprice option, where to buy the ticket is unclear, he changed the time, he analyzed alternative journeys well and selected the day pass, he clicked on the symbols rather than the fields next to them. When clicking on „options“ the dropdown menu should pop up.	

Interface – User Test Results & Feedback

Subjects

Expert-User

commuter, know-how of zones and using tvm

Novice-User

non-frequent public transport, little know-how of zones

Denise, 50 year old, Novice-User

Roland, 50 year old, Novice-User

Rudolf, 50 year old, Expert-User

Lena, 19 year old, Expert-User

Test Scenario

Buy two tickets from «Brugg» to «Aarau, Bahnhof»

- 1 ticket for an adult
- 1 half price ticket

Choose the cheapest journey.

Your timetable:

time of departure: 09:10 am

time of return: 05:10 pm

Tester 1

I was lead through the process of buying a ticket.

Problem how can I buy a second ticket – searched the buy / more ticket button.

Observations

Buying Process: how can I buy a ticket; didn't find the buy button; return ticket?; a shopping cart sign would be clarify what is bought. The big blue check mark is unclear – what's the meaning. The blue check marks in the list of alternative journeys is self explanatory.

Tester 2

I was lead through the process of buying a ticket

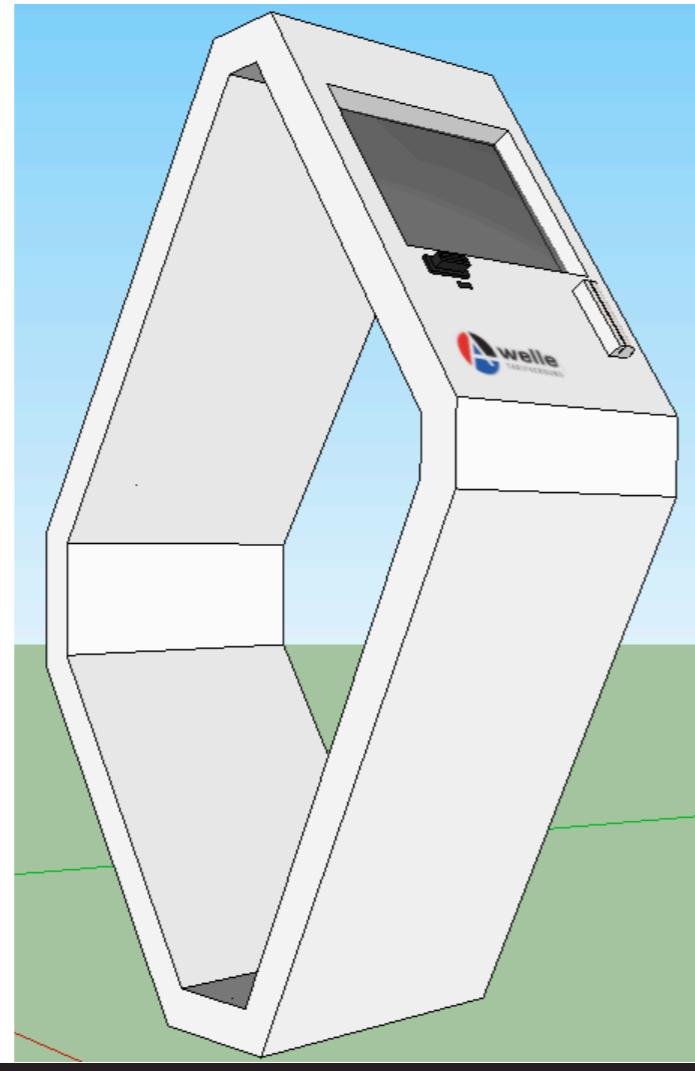
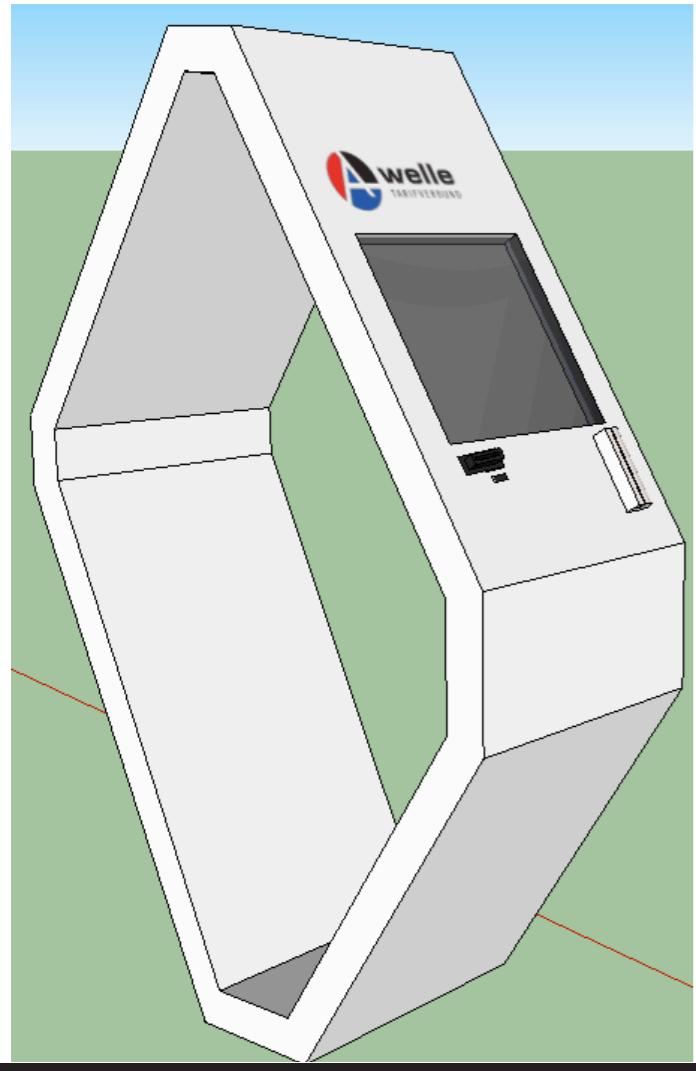
I needed help on buying ticket. The next time I will be do this task independently.

It was hard to know what I have to do.

confirmation of buying ticket ?; missing single/return ticket button/option.

Observations

clicked on symbols (signs). Buying ticket is unclear – where to continue the process; missing single/return ticket option. It's annoying to enter the data more than once. She bought first the ticket for adults (one ticket in the morning; one ticket in the evening). She repeated the same procedure for the halfprice ticket.



Ticket Vending Machine

We designed several concepts for the physical TVM model that has its advantages each. We finally decided us for a cube-shaped design with touchscreen displays on both sides. We chose to design an asymmetric TVM because people have different body heights. As our solution is paperless we did not need a bulky, massive TVM to store all the paper and a printer, but still need credit card swiper and coin charger for payment. Our physical A-Welle TVM combines design aesthetics and human engineering in one concept.



Name this hangout...

chat

Invite

Screenshare

Google Docs

Google Effects

YouTube

+ Add app

Off

On

Settings

Exit



People



Apps



Team Process

Communication tools

- Hangout
- Google docs
- Google community
- Trello
- Github

Every Wednesday from 8:00pm till 10:00pm (Standart European Time, GMT +2), we met using google+ video chat, a tool for virtual workstation, to brainstorm on upcoming tasks and to check if everyone has done their jobs. It was quite useful to discuss ideas and to distribute tasks for the upcoming week by sharing screen each other. Everybody attended to the meetings with few exceptions and the connection worked quite well.

At a later stage, we decided to form subgroups when we agreed that it will be an asset. Depending on tasks to do we mixed those subgroups and there have been always three or four team members. In the subgroups, we met twice a week, once to deal with the tasks in the subgroups and once to bring it together in the main meeting on wednesdays where everybody was present.

For each main meeting we appointed a leader and a minute taker. We switched the roles every week so that in the end everyone was leader and minute taker for around two or three times.

The schedule for those meeting roles, the meeting minutes and all other documentation was handled with google docs. We created quite a lot of documents so a good structure became more and more important. Although not everyone had experience with the google collaboration tools it had been proved to be very useful.

To complete our google collaboration tools we launched iPole-Christophorus, a google community, towards the end of the project for discussing and sharing problems, achievements and open issues concerning the project.

Another platform we used for collaboration was trello. This tool helped us to plan the current tasks.

Furthermore the technical subgroup used github to share and discuss their code which was later extended for the HTML-prototype by the design subgroup.

Through the stages of this project we fleshed out several prototypes and sketches.

Starting from visualisations illustrating ticket design and travel concepts in a more general way allowing some wild ideas to be considered and effectively discussed we moved on to designing more concrete concepts such as 3D models done with google sketchup (see chapter 5 test protocol for images) and Graphical User Interface prototypes done with Photoshop honing in on our final solution which manifested in the following prototypes:

A prototypical implementation of a Server that manages the data for used by the system. The prototype is developed to test the communication with a prototypical TVM interface and to have a base for estimating the amount of data that has to be transferred. The server runs on heroku, a cloud based application hosting service and we use the Python based micro-framework flask together with mongoDB for the storage of the data.

As counter part to the Server we've implemented a UI prototype that simulates the most vital part of our UI-Design but is actually linked with the Server: tickets bought on the UI prototype are saved in the corresponding profile on the server.

Parallel to this an additional UI prototype was built using HTML and Objective-C. This prototype simulates the UI on a smartphone.

**Marcel | 25 | iCompetence |
FHNW HT | Baden, Switzerland**

Marcel is 25 year old music and drawing enthusiast. Apart from being a fulltime student he works as a sound engineer on weekends.
In projects he likes to focus on identifying problems and or contradictions. Design and usability are his main points of interest. He likes to take on new roles and thinks working with people from different fields and cultural backgrounds is very interesting even if or dare I say because there are a lot of conflicts in the process.

Lessons learned

- As leader in online meetings it's hard to involve every member of the team equally
- It's important not to aim too high in the beginning
- Online collaboration tools are very useful but internet problems become a risk



**Jeeeon | 26 | Computer Science |
Univ. of Colorado, Boulder | Boulder, USA**

Jeeeon is 26 year old single woman lives in Boulder, USA. She was born in South Korea but travelaholic, so have been over 20 countries. She graduated University 3 years ago with work experiences as an intern at LG and Samsung, developing user interfaces for mobile phones. After graduation, she entered to the Samsung but moved to the Korea Telecom that paid more for her. However, she decided to quit her job and study more to widen background in her major. Jeeeon likes working as a team, as she is able to learn from others who have different capabilities. She is now fully enjoying working with people come from different countries, have different perspectives.

Lesson Learned

- Be ambitious as much as can, the result will always be smaller than whatever initially expected
- Try to „show“ what were done finally, instead of just working on processes



**Stefan | 32 | Applied Psychology |
FHNW APS | Weil am Rhein, Germany**

Stefan did his Bachelor degree in Applied Psychology at FHNW in Olten, Switzerland and enrolled to the Masters programm. He is also working at Fraunhofer Institut for Solar Energy Systems ISE in Freiburg, Germany, department User Behaviour and Field Trials. His Bachelor Thesis covered some psychological aspects in the field of energy supply and he is very interested in sustainability in this context. He loves travelling, especially by train and therefore he thought this project would be a great opportunity to work on the future of ticketing.

Lessons learned:

- explain your thoughts
- ask twice
- take time



**Sarah | 23 | iCompetence |
FHNW HT | Baden, Switzerland**

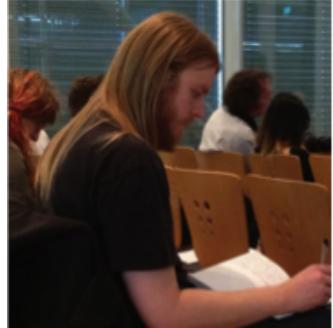
Sarah is 23 year old single woman studying iCompetence. She was born in Germany but moved to Switzerland when she was still very young. She has been working part-time besides school since the age of 16. Starting to polish up her pocket money and now having several jobs to afford travelling as much as possible next to her studies. She has been to 26 different countries so far and is sure that she wants to live abroad in the near future at least for a couple of years. She really likes to work in cross-cultural teams and with people from different sectors.

Lessons learned:

- do not underestimate the difficulties of working in cross-cultural teams
- make advised decision and do not mull over again



Team Members



**Sibylle | 46 | iCompetence |
FHNW HT | Baden, Switzerland**

Sibylle is studying iCompetence. She is married and have got two childrens (16 and 18 years old). She works part-time as web project manager besides school. She likes to work in teams – a good team can reach more than a person. She is interested in human-computer interaction. She likes travelling by train. She likes reading, biking and chatting with friends. She hates boring work and when her cat is sitting on her office chair. It's quiet stressful to study besides family and work, but it's a big motivation to learn about processes and methods getting up a project running.

Lessons learned:

- a feeling working in interdisciplinary teams
- working with github, coding jquery
- on virtual meetings it's much more important to draw and write that all teammember are involved and have the same understanding

**Reto | 30 | iCompetence |
FHNW HT | BERNE, Switzerland**

Reto is a 30 year old, living in the most beautiful city of Switzerland. He has a background in print design. Having grown up with Macintosh computers it is somehow obvious that he eventually started studying Computer Sciences. His goal for the project is to find a solution, that enhances the travel experience in Switzerland. He sees his personal role as a contributor of ideas and concepts and as a coder who will deliver some kind of a software prototype.

Lessons learned:

- Do not postpone every decision
- It is sometimes needed to clearly state obvious aspects
- Address misunderstandings as early as possible
- Working with Python, MongoDB, Flask and GitHub

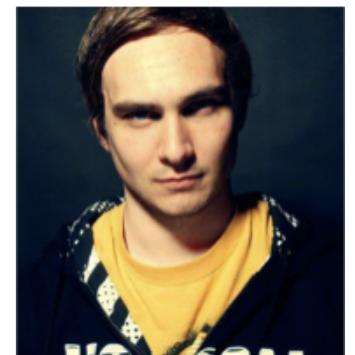
**Kevin | 25 | Interfacedesign |
Merz-Akademie | Stuttgart, Deutschland**

Kevin is a 25 year old single man and is studying interfa-cedesign at the Merz-Akademie in Germany. Besides the studying, he's working as a web-designer and -developer at advertising agency. Before he had started studying he made a education as a media designer based on printmedia. His passion is design. In his freetime he likes to go to the gym or meeting up with friends. In the POLE-project he sees a great opportunity to develop himself by working with different people who have different backgrounds.

Lessons learned:

- It's quite difficult to match every opinion, but it is not unmakeable.
- Do not loose sight of the goal

Team Members



Summary

The general motivator for this project was user dissatisfaction with the current A-Welle system as a recent A-Welle customer survey showed. And the A-Welle ticket vending machine will have to be replaced because they are close to reaching the end of their life span.

As a project team participating in iPole it is our assignment to develop and present concepts for the future. That means to create new approaches increasing simplicity and raising customer satisfaction based on thorough problem analysis.

In the first phase we focused on problem analysis using a user survey, case studies, stakeholder analysis, a set of personae, requirements elicitation and documentation. Other than that we concentrated our energy in brainstorming sessions coming up with ideas for a simple, fast and flexible travel experience.

The second phase dedicated to refining our concepts and designing the system context. We evaluated different approaches based on our research and created the outlines to our solution: a NFC-card based system with central server integration.

The third phase consisted of evaluating the scope of our deliverables and their implementation. We implemented three main elements ranging from proof of concept to functional implementation simulating the system behaviors: iPhone app (proof of concept), services provided by a webapplication and a functional HTML-prototype of the TVM UI. Based on our HTML-prototype we conducted user tests and analyzed the results as to further improve our interface design. In preparation for our final presentation we created 3D situation models illustrating our solution in context as well as a scale model of our TVM design.

Reflection

The kickoff-week of this project played a major part for building up the team spirit. We all enjoyed working together and to get to know each other. It was an outstanding performance which we all wanted to be continued when we are back at our home universities.

The virtual collaboration was a challenge; in the beginning the main challenge was to continue the creative part of the work via videoconference and to get used to the peculiarities of a videoconference with six (later seven) people at all. But we found our way to deal with it and got along. To integrate our new team member Kevin from Stuttgart succeeded without any difficulties. It enlarged our capabilities from the beginning he joined in.

The change of roles (leader and minute taker) for each meeting had two aspects: On one hand it was good so everybody had the chance to contribute within these roles, on the other

hand a clear and undisputed leader was missing through the whole project. Everybody was having a different picture of the state of the project sometimes. We often got lost on some detailed aspects, losing focus on some core ideas of our vision.

Interdisciplinary cooperation could have been considered more in terms of overlaps and also regarding the specific know-how of each profession. Other parts like generating ideas, information gathering, analysis or the management of the project kept us busy for the most part. All in all it was a very gainful experience to work with all these different disciplines and in the end there are always things to improve.

