

# Konferanseapplikasjoner i universitets- og høgskolesektoren

En evaluering av brukerakseptanse med  
technology acceptance model

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# Sammendrag

Universitets- og høyskolesektoren gjennomfører en rekke konferanser hvert år av ulik kompleksitet. UNINETT ønsker å utvikle en konferanseapplikasjon for å støtte gjennomføringen av slike ordninger, med mål om å lette det organisatoriske aspektet for deltakerne og administratorer. I tillegg ønsker Norges teknisk-naturvitenskapelige universitet å undersøke brukerakseptansen av slike applikasjoner.

Dette prosjektet følger metodologien design science research, og er en videreføring av forfatterens fordypningsprosjekt som ble gjennomført høsten 2014. En plattformuavhengig og responsiv webapplikasjon ble utviklet med prinsipper for brukervennlighet, og brukertesting ble gjennomført to ganger for å forbedre brukergrensesnittet. Applikasjonen ble brukt på konferansen Læringsfestivalen 2015, og brukerakseptansen ble evaluert med technology acceptance model. Det ble benyttet to elektroniske spørreundersøkelser for datainnsamling. En konferanseundersøkelse ble sendt ut til deltakere på Læringsfestivalen 2015, mens en webundersøkelse ble sendt ut til et større publikum som ikke deltok på denne konferansen. Structural equation modeling og partial least square analysis ble utført for å analysere dataene.

Resultatene som er basert på 69 observasjoner fra konferanseundersøkelsen og 100 fra webundersøkelsen, viser at det er en interesse for konferanseapplikasjoner i universitets- og høyskolesektoren. Den mest foretrukne enheten er mobil, men resultatene motstrider hverandre på hva som er den andre og tredje mest foretrukne enheten. Resultatene viser også at oppfattet nytte er den viktigste determinanten for brukernes intensjon om å bruke applikasjonen, mens den oppfattede brukervennligheten kun indirekte påvirker brukernes intensjon om å bruke applikasjonen.

De motstridende resultatene tyder på at det kan være et behov for å legge til andre variabler i akseptansmodellen. Selv om modellen er i stand til å forklare mye av variansen til intensjon til å bruke applikasjonen, bør videre forskning forsøke å legge til flere variabler, eller benytte en annen modell for å undersøke hvordan andre variabler vil påvirke intensjonen til å bruke applikasjonen.



# Abstract

The university and college sector conducts numerous conferences each year, of different complexities. UNINETT wants to develop a conference application to support the implementation of such arrangements, with the goal of easing the organizational aspect for the participants and administrators. In addition, the Norwegian university of science and technology want to investigate the user acceptance on such applications.

This project follows the design science research methodology, and is a continuation of the authors' specialization project conducted in the fall of 2014. A platform independent and responsive web application was developed with usability principles, and usability testing was conducted two times to improve the user interface. The application was used at the Læringsfestivalen 2015 conference, and evaluated for user acceptance with the technology acceptance model. Two electronic surveys were conducted for data collection. A conference survey, which targeted participants at Læringsfestivalen 2015, and a web survey sent out by email, targeted a larger audience not attending the conference. Structural equation modeling and partial least square analysis were performed to analyse the data.

The result, based on 69 and 100 observations in the conference and web survey respectively, show that there is an interest for conference applications in the university and college sector. In addition, it shows that mobile is the most preferred device to use. However, the results from the two surveys contradicts each other on the second and third most preferred device. The results also show that perceived usefulness is the major determinant for intention to use, while perceived ease of use only indirectly affects intention to use.

Simplicity, rejected hypothesis, and contradicting results show that it may be a need to add other variables in the research model. While the research model is able to explain much of the variance for intention to use, further research should extend the technology acceptance model with additional variables, or apply a different research model to investigate how other variables would affect the intention to use conference applications.



# Problem Description

The university and college sector conducts numerous conferences each year of different complexities. UNINETT wants to develop a conference application to support the implementation of such arrangements, with the goal of easing the organizational aspect for the participants and administrators. In addition, the Norwegian university of science and technology want to investigate the user acceptance on such applications.

Based on the results from the specialization project conducted fall of 2014, a conference application is developed and tested at a real conference, and evaluated in a rigorous manner using an acceptance model approach.

The project is expected to follow a design science research approach, producing and evaluating an artifact in a scientifically sound manner. Code to be produced should be made available under an open source license. It is preferred that the project report is written in English. The results from a good thesis should be possible to use as a basis for developing a scientific publication.





# Preface

This project was defined by John Krogstie at the Department of Computer and Information Science at the Norwegian University of Science and Technology, and Thorleif Hallèn at UNINETT. We would like to thank them for their guidance and support throughout this project.

We would also like to thank Vegard Moen for giving us invaluable insight in the conference domain.

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# Chapter 1

## Introduction

### 1.1 Motivation

The conference setting is great arena to widen ones professional horizon by gathering people with the same interests to share information through sessions and personal interactions. However, with a large amount of information to be shared in a short period, it can be cumbersome to get an overview, and keep oneself updated on the conferences many variables such as people, content, and social activities. When conducting conferences, the participants often receive a printed program that could contain limited information. Changes occur to the program, however it may not be noticed by the participants in time due to weaknesses in the communication medium. It may result in participants going to a canceled session. Feedback to the administration or speakers are mostly received through a participant's responses to a survey, either on paper or web, possibly several days after termination, which could reduce the quality and quantity of the result. UNINETT wishes to mitigate these challenges and enhance participants benefit from the conference by the development of a platform independent conference application. The application could be available as a self-managed service to different universities and colleges in the future. There are multiple studies related to technology acceptance of information systems, but it seems to be none or few studies of technology acceptance of a responsive conference web application. However, it has been conducted studies related to various other aspects of conferences [27, 82, 2]. The technology acceptance model has been widely used for many years, and is one of the most accepted models for examining the acceptance of a technology [9, 42, 77, 12]. This project applies the model to investigate the acceptance and interest for a conference application, resulting in the two research questions

1. Is there an interest for a conference application in the university and college sector?
2. How applicable is the technology acceptance model for responsive platform independent conference applications in the university and college sector?

## 1.2 Project objectives

The objective is to investigate user acceptance with the technology acceptance model, and the interest for a conference application in the university and college sector. The evaluation are conducted by means of an artifact, a platform independent conference application that will be delivered to UNINETT when the project is finished. The application should be able to use as a foundation for further development.

## 1.3 Project description

This project is a continuation of the authors specialization project conducted in the fall of 2014 [71]. During that project, a prototype for a conference application was developed based upon information gathered through semi-structured interviews, and studies of other conference applications. The prototype underwent a refinement cycle based on the results from usability testing that provided valuable feedback. The specialization project resulted in a large list of suggested requirements for conference applications based on users needs, the authors' experience about design, and development practices, and its many pitfalls.

This project follows the design science methodology to examine and evaluate the interest for conference applications in the university and college sector. The results from the specialization project formed the base for further work on a new and more complex conference application, which is the artifact. It utilizes different principles for design, and many different techniques that should enhance and ease further development and actual use of the application. There has been conducted research on different technologies that enables the development and hosting of a platform independent foundation for the conference application. In short, this includes working with different frameworks for both front end and back end development, code principles and editors, application and network security, and operating systems. In addition, Norwegian laws and regulations were examined in order to lawfully conduct this project.

The evaluation was conducted by the means of two surveys, one conducted on a real conference, and another conducted through the web with different participants.

The data from the surveys are used to investigate the interest for conference applications, and to evaluate the user acceptance using the technology acceptance model. The results are presented in this report.

## 1.4 Report outline

A short overview of the content of the report follows

**Chapter 2** describes the design science research methodology and relates it to this project.

**Chapter 3** presents work conducted in the specialization project fall 2014 which the project builds upon.

**Chapter 4** contains the literature review on research methodology and evaluation conducted during the project.

**Chapter 5** presents the domain model and the conference application solution.

**Chapter 6** presents the settings and instrument used for evaluation, then the results from evaluation of usability testing, usage at the conference, descriptive statistics, and statistical analysis.

**Chapter 7** discusses the results from evaluation and development, and its contributions to the research community.

**Chapter 8** concludes the project and suggests further work and research.

The appendices contains

**Appendix A** The English and Norwegian surveys that was used to collected data.

**Appendix B** Jakob Nielsens 10 usability heuristics.

**Appendix C** The system usability scale.

**Appendix D** Literature review on technology used for development of the conference application.

**Appendix E** Various technical notes which is made during the project.

**Appendix F** Various results from statistical analysis. It includes cross loadings for the statistical analysis in chapter 6.6, and the results from partial least square analysis when dividing the data in different subgroups.

**Appendix G** Comments given by the participants in the surveys.

**Appendix H** Lists the digital attachments delivered with this report.



## Chapter 2

# Research methodology

This chapter presents the design science research methodology which is followed in this project.

### 2.1 Design science research methodology

Design science research is one of two paradigms often used in the information systems research discipline with the other being behavioral science. It seeks to extend the boundaries of human and organizational capabilities by creating and evaluating artifacts using rigorous methods intended to solve identified organizational problems and contribute to research [31].

#### 2.1.1 Artifacts

An artifact is defined as constructs, models, methods, or instantiations. Constructs are the vocabulary and symbols that forms a language where problems and solutions are communicated [63]. When modeling a database scheme, tables and attributes must be named, and these names forms the construct of the artifact.

Models are abstractions of the world which use constructs to represent the concepts of the problem and solution domain. When returning to the database example, the model would be the scheme itself.

Methods are algorithms and practices created to reach a solution to a problem. Considering the database example, a join operation could be such an algorithm.

Instantiations are constructs, models, and methods combined to create a fully or partially functional system.

#### 2.1.2 A nominal process

Figure 2.1 shows a nominal process for a design science research approach. The process must not be strictly followed since it is possible to enter the research from different phases, and it may be executed through multiple iterations. A short explanation to each phase in Figure 2.1 is presented next.

### Identify problem & motivate

An identified problem justifies the development of an artifact that can provide a solution. It eases and motivates in the pursuit of a solution, however it requires knowledge about the state of the problem.

### Define objectives of a solution

The objectives are inferred from the identified problem. It could be a description of an artifact that solves a non-addressed problem. It requires knowledge about the state of the problem and possible current solutions.

### Design and development

The artifact is instantiated. Artifacts are explained in Section 2.1.1.

### Demonstration

It must be demonstrated how the artifact solves the identified problem. Demonstration may be conducted through simulation, experimentation, or a case study.

### Evaluation

The artifact must be observed and measured to see how it addresses the problem.

### Communication

The research in its entirety must be communicated to contribute to the research community.

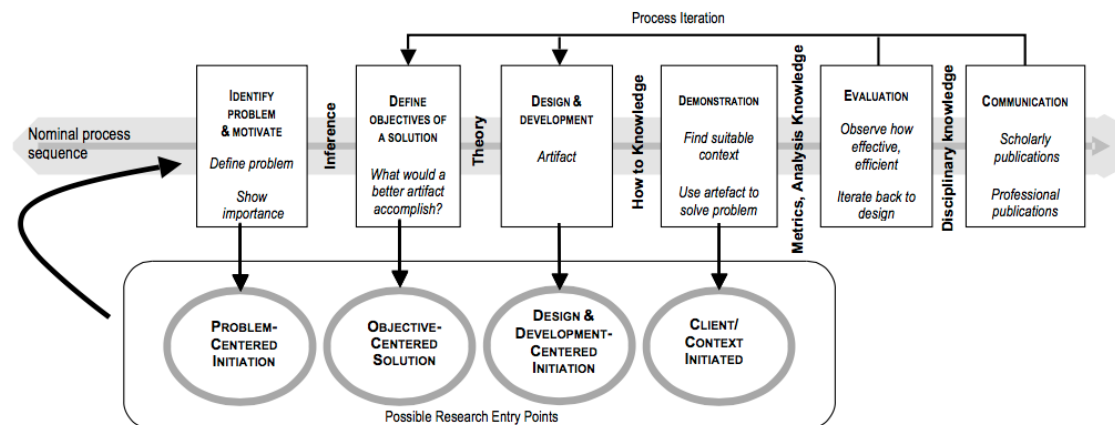


Figure 2.1: Design science research approach - A nominal process model [59]

## 2.2 Guidelines for conducting design science research

Hevner et al. [31] has developed seven guidelines that are used to assist in effective design science research. The degree each guideline should be followed may vary, but they should all be addressed for a complete design science research.



The guidelines are summarized in Table 2.1 and a mapping to the conduction of this project are presented next.

Guideline 1 states that *it must be produced a viable artifact*. The conference application is the produced instantiation artifact, which is presented in Chapter 5.

Guideline 2 states that *the objective is to develop technology-based solutions to important and relevant business problems*. The motivation is explained in Chapter 1.1, objectives are explained in Chapter 1.2, and further background from the specialization project in Chapter 3.

Guideline 3 states that *the utility, quality and efficacy of the artifact must be rigorously demonstrated through well-executed evaluation methods*. Usability testing of the artifact are conducted twice for the improvement of the user interface to prepare for acceptance evaluation. The results of usability and acceptance testing can be found in Chapter 6.

Guideline 4 states that *it must be provided clear and verifiable contributions in the areas of the design artifact, design foundations, and/or design methodologies*. The artifact is used to evaluate the user acceptance with the technology acceptance model. The results are provided as research contribution in this report.

Guideline 5 states that *design-science research relies upon the application of rigorous methods in both the construction and evaluation of the design artifact*.

The rigorous methods are derived from different theory and methodologies for research and evaluation, and used throughout this project. This chapter presents the overall research methodology. Methods for usability testing and user acceptance evaluation are presented in Chapter 4. Related research questions, research model, settings and the instrument are presented in Chapter 6.

Guideline 6 states that *the search for an effective artifact requires utilizing available means to reach desired ends while satisfying laws in the problem environment*. The search process for an effective artifact started with the specialization project, and ends with the result of this thesis. A description of the project can be found in Chapter 1.3.

Guideline 7 states that *design-science research must be presented effectively both to technology-oriented as well as management-oriented audiences*. The research is presented through this thesis.

Guideline	Description
Guideline 1: Design as an Artifact	Design-science research must produce a viable artifact in the form of a construct, a model, a method or an instantiation.
Guideline 2: Problem Relevance	The objective of design-science research is to develop technology-based solutions to important and relevant business problems.
Guideline 3: Design Evaluation	The utility, quality, and efficacy of a design artifact must be rigorously demonstrated via well-executed evaluation methods.
Guideline 4: Research Contributions	Effective design-science research must provide clear and verifiable contributions in the areas of the design artifact, design foundations, and/or design methodologies.
Guideline 5: Research Rigor	Design-science research relies upon the application of rigorous methods in both the construction and evaluation of the design artifact.
Guideline 6: Design as a Search Process	The search for an effective artifact requires utilizing available means to reach desired ends while satisfying laws in the problem environment.
Guideline 7: Communication of Research	Design-science research must be presented effectively both to technology-oriented as well as management-oriented audiences.

Table 2.1: Design-science research - Guidelines [31]

## Chapter 3

# Previous work

The chapter contains a presentation of the some of the work conducted in the specialization project [71], providing background information that affects further research and development decisions. It includes a presentation of different conference applications, the initial prototype which acts as a foundation for the conference application solution developed in this project, and the final requirements list.

### 3.1 Other conference applications

It already exist many applications for supporting conferences. Some companies focus entirely on conference applications and have been developing them for a while. Therefore it is interesting to see how, and with what technology they are built upon. Three different conference applications, which mostly focus on the participant perspective were examined. These specific applications were chosen because they were either mentioned during a conference which the authors attended, or in interviews they conducted. The examination of the other applications is based on the information available from the applications web sites, and available demo applications.

The applications contains various amount functionality which has been grouped and is presented next

#### **Platform**

Which platforms the application is available at.

#### **Social**

The social functionality in the application. Typical functionality is posting to social network sites such as Facebook, Twitter, LinkedIn. It could be interpreted to partially overlap with Communication. The distinction is that social includes only social functionality, not the communication itself.

#### **Feedback**

The functionality to provide different types of feedback to a session or the conference itself.

### **Sponsorship**

The functionality available to promote sponsors or exhibitors. This could be facilitated through banners in the application, and gamification.

### **Administrative**

The functionality for the administrators, such as: managing the conference program, create groups, manage maps, manage the information center, send messages to users, and creating surveys. Functionality in the other groups are managed here.

### **Personal**

The functionality specifically to the participants. The most common functionality is creating a profile, personal program, notes to sessions, and contact cards. It also includes an information center which contains information that is commonly wanted, but it is managed by the administrator.

### **Communication**

Different forms of chat in the application, such as one or two-way chat.

#### **3.1.1 Guidebook**

The application requires a code for the conference to start downloading the guidebook with all the information about a specific conference. Figure 3.1 shows the main screen on iOS, and the conference schedule can be seen in Figure 3.2.

##### **3.1.1.1 Platform**

The application is available as both web, and native application on mobile and tablet.

##### **3.1.1.2 Social**

Social functionality includes social networks, maps, and adding photos and connections. The users may post to Facebook and Twitter, check in at the conference, add other users as friends, and upload pictures to photo albums that are shared with the whole conference. In addition, functionality for finding facilities can be added, however was not added to the conference in Figure 3.1.

##### **3.1.1.3 Feedback**

Surveys can be created in the content management system, and users provide feedback in the application.

##### **3.1.1.4 Administrative**

Everything seen in this application can be managed from the content management system. A quite polished web interface rich of features is used to manage the settings for a conference, such as the functionality to include, which can be seen in Figure 3.1.

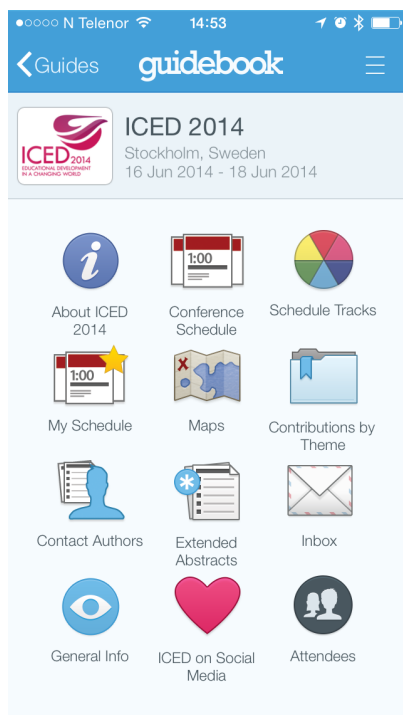


Figure 3.1: Other conference applications - Guidebook main screen on iOS

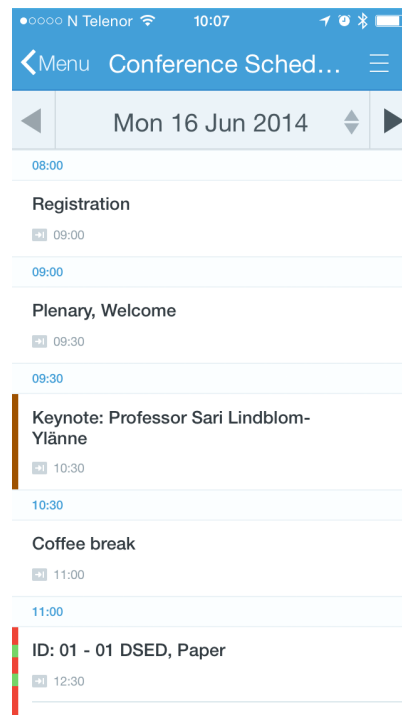


Figure 3.2: Other conference applications - Guidebook conference schedule on iOS

Other functionality supported by the application is a mobile ticketing system, handling of registration, creating interactive maps, and listings of speakers.

### 3.1.1.5 Sponsorship

Small spaces in the application can be reserved for sponsors, and gamification can be utilized to encourage users to visit exhibitors or attend to sessions while playing a mini game.

### 3.1.1.6 Personal

To utilize the personal functionality, it is possible to create a new account, or use an existing account from Facebook, Google, LinkedIn, or Twitter. While logged in, users have access to a todo-list for taking notes, and sessions can be added to a personal schedule. In addition, multiple contact cards can be created, depending on what information one want to share with others.

### 3.1.1.7 Communication

Communication is one-way. Push messages can be sent from the conference administration to the users, which is useful to notify about important information.

### 3.1.2 EventMobi

EventMobi is a company and an event application with functionality related to pre-event, on-site and post-event. It claims to be the #1 event application, used by many large companies [16]. A demo application is available for testing, and pictures from the demo application can be seen in Figure 3.3 and 3.4.

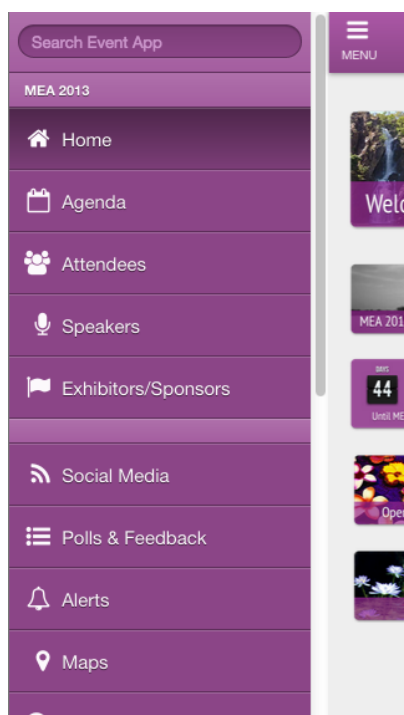


Figure 3.3: Other conference applications - EventMobi's menu in the demo application)

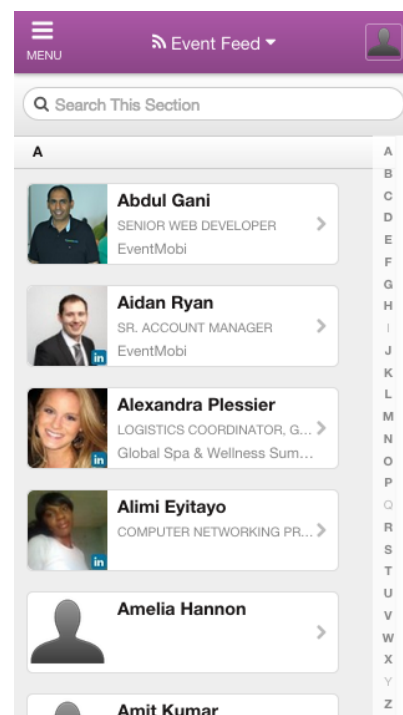


Figure 3.4: Other conference applications - EventMobi's list of attendees in the demo application

#### 3.1.2.1 Platform

EventMobi is available as web and native applications. The application is built with their own Fusion 2.0 platform which is available on multiple platforms. The web application simulates some native capabilities such as notifications. They also provide options of one-click generation of what they claim to be native applications to Android, iOS, Windows Phone and Blackberry. This enables utilizing native capabilities such as push notifications and deeper integration with the calendar.

### 3.1.2.2 Social

Users can tweet links to pages inside the application, or post to Facebook and LinkedIn to increase the user engagement in social media.

### 3.1.2.3 Feedback

Surveys or live polls seen in Figure 3.5 and 3.6 are created in the content management system, and the users responds inside the application.

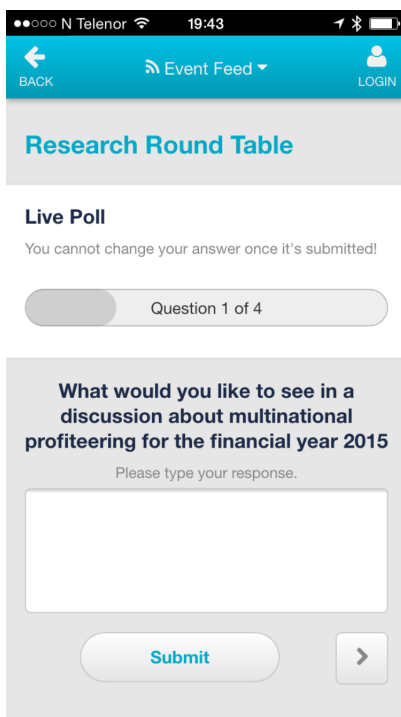
A screenshot of a mobile application interface for a live poll. The top status bar shows 'N Telenor' and '19:43'. The app's header is blue with a back arrow, 'Event Feed', and a 'LOGIN' button. Below the header is a grey box with the title 'Research Round Table'. The main content area is titled 'Live Poll' with a warning: 'You cannot change your answer once it's submitted!'. A progress bar indicates 'Question 1 of 4'. The question is 'What would you like to see in a discussion about multinational profiteering for the financial year 2015' with a text input field and a 'Submit' button.

Figure 3.5: Other conference applications - EventMobi feedback 1

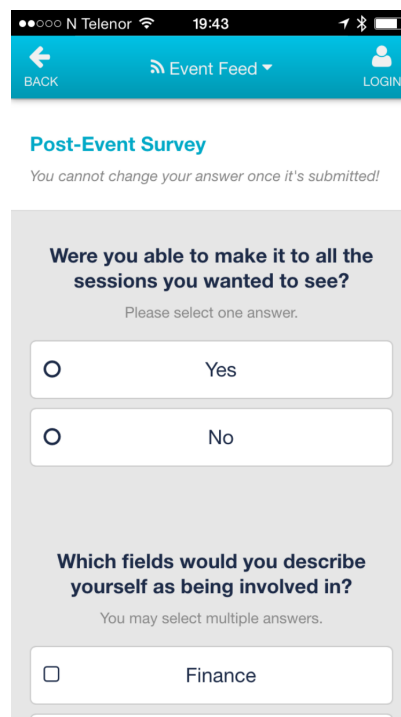
A screenshot of a mobile application interface for a post-event survey. The top status bar shows 'N Telenor' and '19:43'. The app's header is blue with a back arrow, 'Event Feed', and a 'LOGIN' button. Below the header is a grey box with the title 'Post-Event Survey' and a warning: 'You cannot change your answer once it's submitted!'. The main content area has two questions. The first is 'Were you able to make it to all the sessions you wanted to see?' with radio button options 'Yes' and 'No'. The second is 'Which fields would you describe yourself as being involved in?' with a checkbox option 'Finance'.

Figure 3.6: Other conference applications - EventMobi feedback 2

### 3.1.2.4 Sponsorship

Small spaces for banners in the application can be reserved for sponsors. In addition, they can be promoted with gamification. Gamification is available and includes different modes such as education quiz, networking, check-in, and scavenger hunt. If using the web application, gamification is available as another native application. In the case of using a native application, gamification is integrated.

#### **3.1.2.5 Administrative**

The administrator use a content management system to administrate the event, which can be set to be either public or private. Attendees can register to an event in the application and be placed in groups such as VIP or speakers by the administrator. Further, the administrator is then able to target the different groups with messages. At the time of writing, seventeen languages are supported in the application. Interactive maps can be created so attendees can easily find locations.

EventMobi claims to enable easy integration and sharing of information across systems, which is an advantage because the information may be stored in other systems.

#### **3.1.2.6 Personal**

New functionality is available when one is authenticated. It is possible to check in to a session, and start adding connections. Another functionality includes taking notes for a session, a personal schedule, a message inbox, a list of added interesting partners, and adding documents. Exhibitors can create rich profiles which can be browsed by attendees. There is also an infobooth available, which contain various practical information. One can also use unified search to find information in the application.

#### **3.1.2.7 Communication**

There is a two-way private chat that could lower the threshold to connect with others. Questions can be posted and upvoted in sessions. There is a help desk chat for those with questions related to the conference. Alerts can be sent from the team to all attendees, or specific groups.

### **3.1.3 DoubleDutch**

DoubleDutch is an event and conference application. The main screen can be seen in Figure 3.7 and Figure 3.8.

#### **3.1.3.1 Platform**

Native applications exist for phones and tablets on iOS and Android. Web applications are used for other platforms.

#### **3.1.3.2 Social**

Social functionality includes integration with social networks, activity feeds, and networking opportunities. Participants can see if they share common interests with others and start communicating via two-way private messaging. Social accounts from Twitter, Facebook and LinkedIn can be added to a profile.

Different groups such as users, speakers and exhibitors have profiles. Users may visit the exhibitors profile to learn about them.



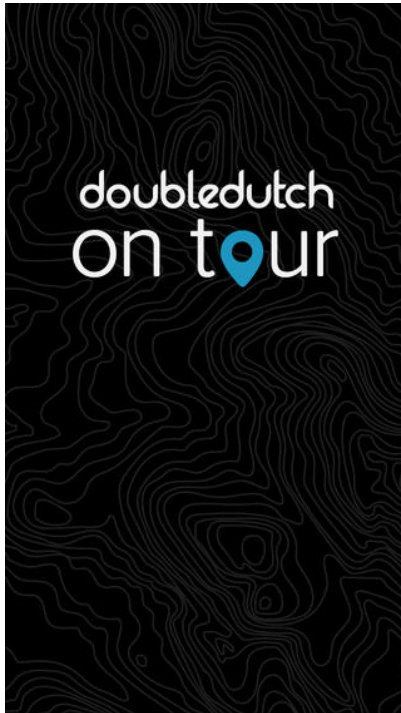


Figure 3.7: Other conference applications - DoubleDutch on tour main screen on iOS

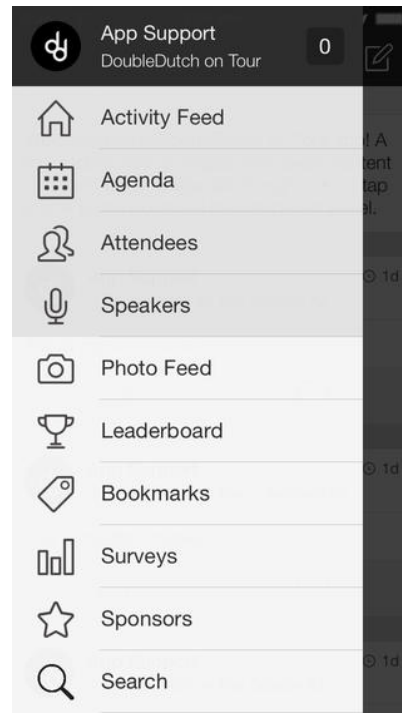


Figure 3.8: Other conference applications - DoubleDutch on tour menu on iOS

In the activity feed, one can see what others are talking about, browse photos, and find trending sessions and discussion topics.

#### 3.1.3.3 Feedback

The application has support for surveys and live polling. By participating in polling activities, users may be awarded with points which can be a motivational factor, and the administrators can see engagement reports.

Bluetooth location based technology and iBeacon can be utilized. iBeacons are small low-energy Bluetooth transmitters that can send messages to a phone based on proximity (location-aware services). Head counting is utilized to enable organizers measure attendance at session by automatic check-ins. Network nearby is another technology that is meant to encourage networking by letting attendees see when someone they follow is nearby.

#### 3.1.3.4 Sponsorship

Sponsors can be targeted by sending push notifications to users, promoted posts in activity feed, and sponsored badges via gamification, where participants receive points,

badges and leaderboards for doing various tasks. On the leaderboard one can compare oneself to others.

#### **3.1.3.5 Administrative**

Everything is managed from a content management system. It includes lots of functionality which is partially mentioned in this text. The application can be set up to accept registrations for a conference, host documents and push notifications can be sent from administration to users. The system provides functionality for making interactive maps and way-finding.

#### **3.1.3.6 Personal**

Users can create a profile and then interact socially, and start adding events to a personal schedule.

#### **3.1.3.7 Communication**

Two-way private messaging and push notifications are available.

### **3.1.4 Summary**

The conference applications examined are similar in functionality, but seems to contain some unique functionality. Since Guidebook is a native application, it has the advantages of integration with notifications and calendar in smartphones and tablets. EventMobi also have the advantage of easy integration and sharing of information with other systems and richer feedback functionality.

Functionality for managing a conference is located inside a content management system. The administrator can to some degree define the look of the application and what functionality to include, and may insert advertising banners from the sponsors in the application. Groups of participants may be targeted with push messages, both from the administration and the sponsor.

Some common functionality is browsing the conference program and adding events to a personal program, a participant list, and the possibility to provide feedback. Other functionality are writing notes, download papers and presentations, connect with other participants, chat, and swap virtual contact cards.

For navigation, static and interactive maps gives an overview of the rooms and exhibitors.

Feedback, such as surveys, rating of session or conference, and polls are shown in Figure 3.5 and 3.6.

It is possible to be social and share content to Twitter, Facebook and LinkedIn. The speakers have profiles, and they fill in interesting information so others can read about them, or even try to connect.

With participant lists one can see who has checked in to a session or conference.

Another utilized concept is gamification. This involves creating small games which is focusing on the conference and shall increase user engagement around the conference.

## 3.2 The final requirements list

This section contains the requirements that was derived during the specialization project. However, during this project it has been added some explanations to requirements.

### 3.2.1 Functional requirements

The functional requirements specifies what the conference application should be able to do. The requirements are structured both from a administrative and participant's perspective. Usually, from the administrative perspective a requirement in the participants perspective is managed. The effected functionality includes maps, and programs. The functional requirements are grouped into 11 groups

**PFR** Program Functional Requirement.

**CFR** Communication Functional Requirement.

**CMFR** Content Management Functional Requirement.

**PMFR** Participant Management Functional Requirement.

**NFR** Navigation Functional Requirement.

**SMFR** Social Media Functional Requirement.

**AFR** Advertisement Functional Requirement.

**FFR** Feedback Functional Requirement.

**ICFR** Information Centre Functional Requirement.

**GFR** Gamification Functional Requirement.

**PAFR** Platform Affinity Functional Requirement.

The following list presents the conference application requirements from the specialization project. The requirements are written in a should format and meant as a broad guidance of what to include in a conference application. This is because a specific requirement may be relevant in one situation, and irrelevant in another. Some of the requirements contain supplementary information beyond that of the requirement itself noted by the italic text.

**PFR1** The application should support a room allocation tool.

**PFR2** The application should support an automatic program scheduling tool. *The goal of the scheduling is to let the target groups experience as many sessions targeting them as possible (no parallel sessions). This tool would be great to have at a huge conference with a lot of parallel sessions.*

**PFR3** The conference program with conference activities should be accessible to all participants.

**PFR4** The program activities should at least contain the following information: title, description, time, and place.

**PFR5** The program should differentiate between session events and social events.

**PFR6** Participants should be able to construct a personal program for the conference.

**PFR7** Participants should be able to add sessions derived from the conference program to their personal program.

**PFR8** Participants should be able to create personal events in their personal program.

**PFR9** Changes to the session events should be automatically updated in all the personal programs they reside.

**PFR10** Participants should get a notification if one of the session events added to the personal program is changed.

**PFR11** Participants should be able to export their own personal program to calendar files such as iCal and vCal, and subscribe to it.

**PFR12** Administrators should be able to import calendars files such as iCal and vCal into the conference program

**CFR1** Administrators (session leaders) should be able to receive one-way communication from participants containing anonymous/named questions during sessions. *Which the session leader can pass on to the speaker.*

**CFR2** Participants should be able to perform two-way communication with other users of the application.

**CFR3** Administrators should be able to send information through a news feed available to everyone at the conference.

**CFR4** Administrators should be able to contact specific groups (such as speakers, exhibitors, and participants signed up to specific session) or individual participants in a one-way communication manner.

**CFR5** Participants should be able to use their devices as a microphone during a session.

**CMFR1** Administrators should be able to reserve hotel for the content providers through the application. *Preferably through a one-click action.*

**CMFR2** Exhibitors should be able to reserve a room from a list of available rooms. *This is due to the exhibitors needs of having meetings and presentations with the participants on the fly during the conference.*

**CMFR3** Participants should be able to suggest content to the conference ahead of time.

**CMFR4** Administrators should be able to review the suggestions given by the participants.

**CMFR5** Speakers should be able to send a message targeting every participant registered to their sessions. *This would help the participants prepare and get more context of the session.*

**CMFR6** Administrators should be able to review the message from the speakers before accepting or rejecting distribution to participants.

**CMFR7** Administrators should be able to invite the speaker to send presentation resources to the application ahead of time.

**CMFR8** Participants should be able to download the presentation resources.

**CMFR9** Administrators should be able to configure the UI to accommodate the conference style.

**CMFR10** The application should support different language profiles.

**CMFR11** Administrators should be able to configure language profiles and write conference content within the individual profiles.

**CMFR12** Participants should be able to switch between the language profiles supported by the conference.

**PMFR1** Participants should be able to register to the conference.

**PMFR2** Participants should be able to register to sessions.

**PMFR3** Participants should be able to register to social events.

**PMFR4** Participants should be able to check in when arriving at the conference.

**PMFR5** Participants should be able to check in when attending a session.

**PMFR6** Administrators should be able to get an overview of the participants that are registered, and what event that person is checked in to.

**PMFR7** Participants should be able to pay for goods and services provided by the conference through the application. *The price of the goods and services are set by the administration. The administration should be able to change the price at any given time to be able to offer participants different prices, such as reduced prices for early enrollment.*

**PMFR8** Administrators should be able to group the participants of a conference (such as participants, speakers, and exhibitors).

**PMFR9** Participants should be able to take notes through the application.

**PMFR10** Participants should be able to configure their own user profile.

**PMFR11** Participants should be able to disable/enable others to view their profile.

**PMFR12** Participants should be able to view other participants enabled profiles.

**NAFR1** Administrators should be able to add one or more conference facility maps available for all participants to see. *This would enable administrators to insert maps of more than one floor, or different facilities.*

**NAFR2** Administrators should be able to insert a global interactive map so that participants can see the conference location.

**NAFR3** The map should locate the users who have accepted tracking by the application on the map.

**NAFR4** The map should be able to give directions to the users.

**SMFR1** Participants should be able to share content on the following social media sites: Facebook, Twitter, and LinkedIn.

**AFR1** The application should inform about the conference's sponsors. *This could be done through banners in the application.*

**FFR1** Participants should be able to rate the individual sessions, exhibitions and social events.

**FFR2** Participants should be able to rate the conference as a whole at the end of its time frame.

**FFR3** Administrators should be able to create surveys.

**FFR4** Administrators should be able to send surveys to participants.

**FFR5** Administrators should be able to view and download the feedback from the rating system and surveys as CSV or Excel.

**ICFR1** All users of the system should be able to preform a unified search across the application.

**ICFR2** Administrators should be able to give practical information about the conference to the users of the system. *This requirement contains ambiguity in not specifying "practical information". This is done due to the different practical information encountered in different conference settings. One example of such practical information could be how to configure the WiFi.*

**GFR1** The application should utilize Gamification, this includes profiles, points, leaderboards, and achievements.

**PAFR1** The application should at least be accessible through web, and preferably exposed core functionality through an API for the creation of native/hybrid applications.

### 3.2.2 Non-functional requirements

The non-functional requirements specifies requirements to the system that are not specified by the functional requirements.

**NFR1** The application should run on all major platforms.

**NFR2** The application should be perceived as having high ease of use by its users.

**NFR3** The application should be perceived as having high usefulness by its users.

**NFR4** The application should be interoperable to support exchanging of information with other applications.

**NFR5** The application should support high modifiability.

**NFR6** The application should support high extensibility.

NFR1 states that the application should run on all major platforms. The application is developed as a web application, which will run on all platforms having a web browser. NFR2 and NFR3 are connected with usability and utility and may be examined more with the results from a acceptance evaluation. NFR4 is not considered in this project. NFR5 and NFR6 are affected by using a framework. However, they are in addition affected by the produced code.

## 3.3 Presentation of the prototype

This section first presents the selected requirements for the prototype developed in the specialization project, then it presents its different views.

### 3.3.1 Selected requirements

There are a vast set of requirements for conference applications in section 3.2. Due to time frames, only some requirements could be implemented in the prototype. From the interviews and research, important requirements were identified. This section introduces the rationale for the requirements chosen for implementation.

EventMobi has presented the results from a survey [82] including over 300 planners and 160 attendees, asking what functionality they really want in an event application. Both groups said that access to basic, critical information about the program, scheduling

and the communication were the most important features. The study points out that half of the planners said social media was important, only 35% of the attendees said the same. Private social networks was more attractive because it can provide a closed and focused community around the conference. In addition, feedback and statistics is pointed out to be important. The following functionality is the top 5 which both planners and attendees agreed at

- Access to Event Schedule.
- Access to Session Descriptions.
- Ability to Receive Updates from Organizer.
- Ability to Create a Personalized Schedule.
- Access to Maps.

In addition, this functionality was identified as the most important functionality from interviews.

Another study by Guidebook [27] discovered that the two of the top three benefits with event applications was changes can be made fairly quickly, and it is possible to send messages to the participants.

The top 5 functionalities are chosen, but do not map directly to the requirements in section 3.2. The requirements which can be associated to the different functionalities are presented next

- **Access to Event Schedule**

**PFR3** The conference program with conference activities should be accessible to all participants.

**PFR4** The program activities should at least contain the following information: title, description, time, and place.

**PFR5** The program should differentiate between session events and social events.

- **Access to Session Descriptions**

**PFR4** The program activities should at least contain the following information: title, description, time, and place.

- **Ability to Receive Updates from Organizer**

**PFR9** Changes to the session events should be automatically updated in all the personal programs they reside.

**PFR10** Participants should get a notification if one of the session events added to the personal program are changed.



**CFR3** Administrators should be able to send information through a news feed available to everyone at the conference.

**CFR4** Administrators should be able to contact specific groups (such as speakers, exhibitors, and participants signed up to specific sessions) or individual participants in a one-way communication manner.

- **Ability to Create a Personalized Schedule**

**PFR6** Participants should be able to construct a personal program for the conference.

**PFR7** Participants should be able to add sessions derived from the conference program to their personal program.

**PFR8** Participants should be able to create personal events in their personal program.

- **Access to Maps**

**NAFR1** Administrators should be able to add one or more conference facility maps available for all participants to see.

**NAFR2** Administrators should be able to insert a global interactive map so that participants can see the conference location.

**NAFR3** The map should locate the users who have accepted tracking by the application on the map.

**NAFR4** The map should be able to give directions to the users.

With regard to time, it had to be prioritized which requirements to be implemented, but still retain the essence of the above functionality.

The requirements associated with the first two functionalities are left as is. Some of the requirements associated with the last three functionalities were excluded from the prototype. More specifically PFR5, PFR8, PFR10, and NAFR2 - NAFR4, resulting in the list below. The decision was made because the requirements did not align enough with the functionality or were time expensive to implement. The requirements in the list below are the requirements for the prototype.

**PFR3** The conference program with conference activities should be accessible to all participants.

**PFR4** The program activities should at least contain the following information: title, description, time, and place.

**PFR6** Participants should be able to construct a personal program for the conference.

**PFR7** Participants should be able to add sessions derived from the conference program to their personal program.

**PFR9** Changes to the session events should be automatically updated in all the personal programs they reside.

**CFR3** Administrators should be able to send information through a news feed available to everyone at the conference.

**CFR4** Administrators should be able to contact specific groups (such as speakers, exhibitors, and participants signed up to specific sessions) or individual participants in a one-way communication manner.

**NAFR1** Administrators should be able to add one or more conference facility maps available for all participants to see.

Since the problem owners (UNINETT) goal for a conference application is to enhance the experience for participants, the prototype only has a "static administrative side". There are no functionality that supports the administrators of the prototype, only the regular participant users. The data is seeded to the database beforehand, to simulate the administrative perspective for the users during evaluation. For instance, the requirement CFR4 is solved by an inbox containing three messages from the administrator. Every user receives the same messages as a demonstration of the functionality.

### 3.3.2 Views

The prototype for the conference application was built with the Laravel framework and is a responsive web application where the layout adapts to the size of the screen. Therefore, the layout for mobile and desktop is different as shown in Figure 3.9 and 3.17.

Most of the views are presented from the mobile and uses Norwegian language to comply more with the consistency and standards heuristics from heuristic evaluation. With a more complete prototype, the users would be able to decide between Norwegian, English, or possibly other languages. All views with the exception of details about sessions is accessed through first selecting the menu. The menu can be seen in Figure 3.16.

#### Conference program view

The program from NOKIOS 2014 conference was used to create the feeling of a real conference. In the conference program shown in Figure 3.9, one can see the serial and parallel sessions. The view allows users to filter the program based on days. Each session and other events contains date, time, room (location) and a link to read a detailed description. In addition they can be added to a personal program.

#### Details about session view

The view for session details can be seen in Figure 3.13. It contains a more detailed description of the session than the conference program view.

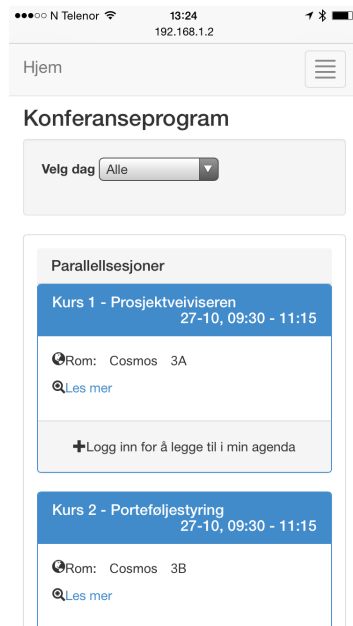


Figure 3.9: The initial prototype - The conference program view on mobile

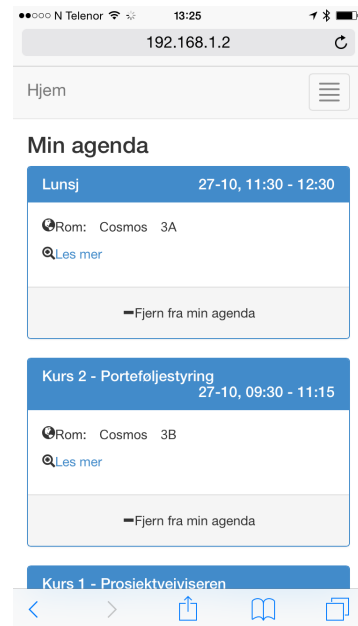


Figure 3.10: The initial prototype - The personal program view on mobile

### Personal program view

The personal program can be seen in Figure 3.10. Each session can be added to, or removed from the personal program if the user is authenticated.

### Maps view

Information about where the conference rooms were located can be seen in the map. See Figure 3.12.

### Message inbox view

The message inbox simulates one-way communication from the organiser as shown in Figure 3.11.

### Login view

To be able to add sessions to a personal program, the user must log in through the login view as seen in Figure 3.14. A username or email address in combination with a password can be used to log in.

### Create account view

If a user want to store sessions in a program, an account must be created. Username, email and password is required as seen in Figure 3.15.



Figure 3.11: The initial prototype - The message inbox view on mobile

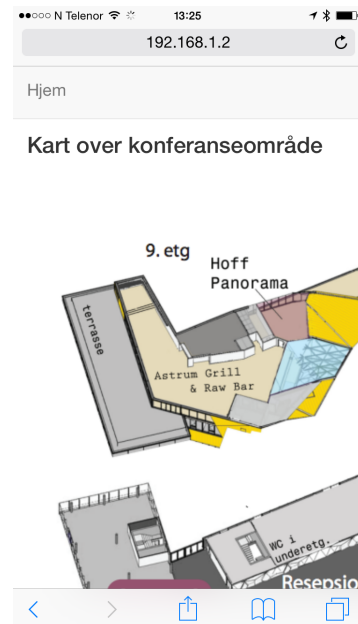


Figure 3.12: The initial prototype - The map view on mobile

### Newsfeed view

Tweets from a conference can be seen in the newsfeed. It is a view from Twitter with the hashtag nokios2014.

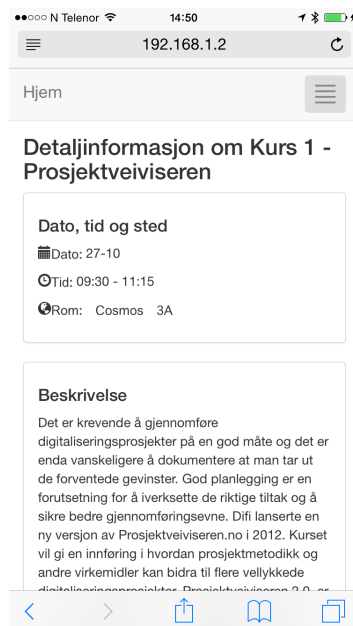


Figure 3.13: The initial prototype - Details about session view on mobile

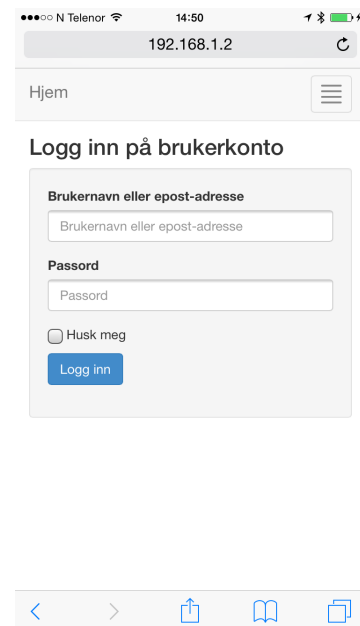


Figure 3.14: The initial prototype - The login view on mobile

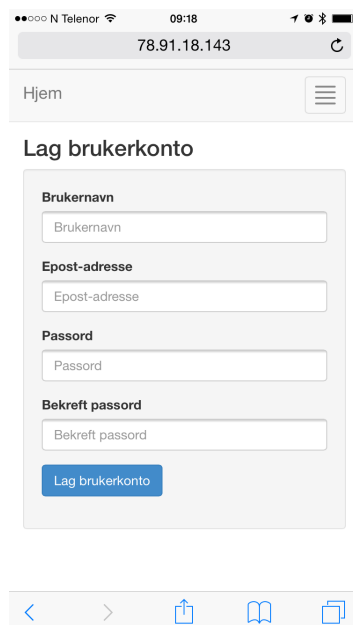


Figure 3.15: The initial prototype - Creating account view on mobile

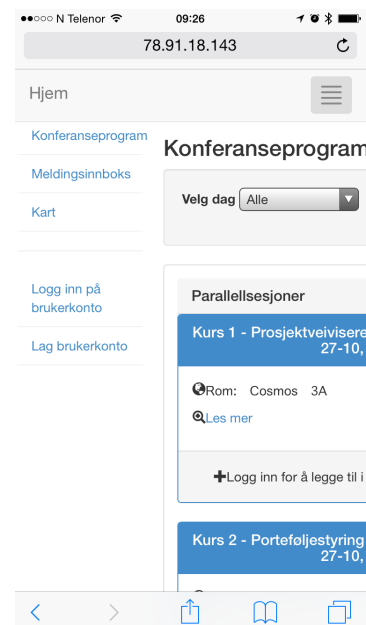


Figure 3.16: The initial prototype - Selecting the menu on mobile

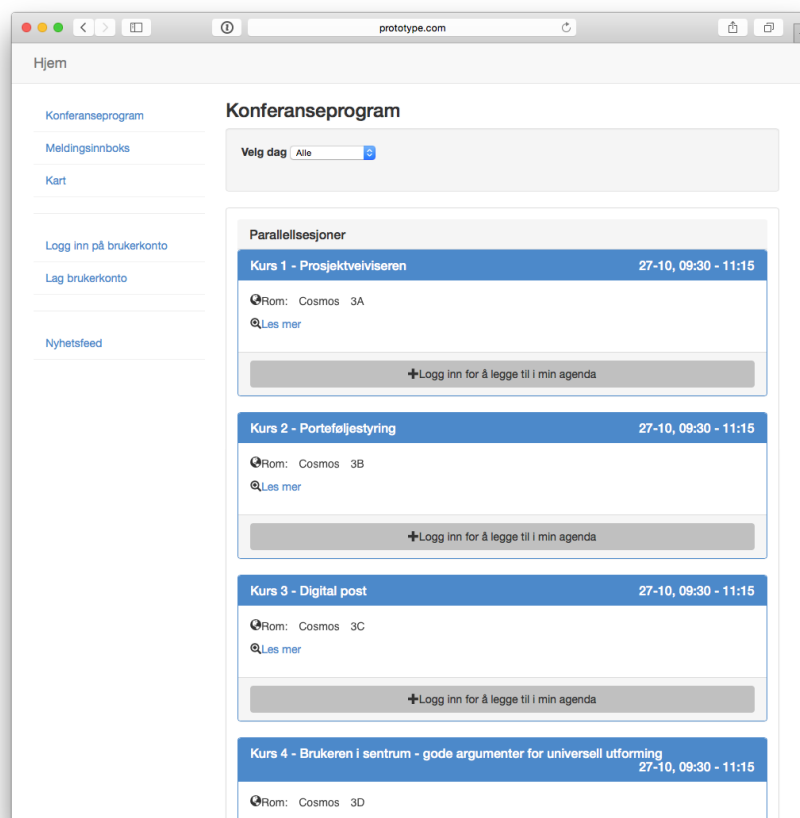


Figure 3.17: The initial prototype - The conference program view on desktop

## Chapter 4

# Literature review on research methodologies and evaluation

This chapter first presents technology acceptance theories, then it presents theory related to data collection and data analysis. Lastly, it presents usability theory.

### 4.1 Technology acceptance theories

Technology acceptance theories has been developed to predict user behavior towards an action, or more specifically their attitude and attention to adopt new technologies.

This section first presents innovation diffusion theory, then it presents theory of reasoned action before presenting the technology acceptance model.

#### 4.1.1 Innovation diffusion theory

The Innovation Diffusion Theory (IDT) was developed by E.M. Rogers in 1962 and is one of the oldest social science theories. It aims to explain how an idea or product gains momentum and diffuses through a specific population or social system [62], resulting in people adopting a new idea, behavior, or product.

Diffusion happens gradually in a social system, where some people are more receptive to new ideas or products than others. Figure 4.1 shows an estimate of the population size of the five adopter categories which is explained next

**Innovators** These people are very willing to try an innovation. They are risk takers and usually the first to develop new ideas. Very little, if anything, needs to be done to appeal to this population.

**Early adopters** These people are very comfortable adopting new ideas, while leading others. Strategies to appeal to this population include manuals and implementation information.

**Early majority** These people are no leaders like the early adopters, but they do adopt to new ideas before the average person. However, they need evidence that the innovation works before they are willing to adopt it. Strategies to appeal to this population include success stories and evidence of the innovations effectiveness.

**Late majority** These people are sceptical and usually not willing to adopt to new technology before the majority has tried it first. Strategies to appeal to this population include information on how many other people have tried the innovation and have adopted it successfully.

**Laggards** These people are conservative and very sceptical of change. Strategies to appeal to this population include statistics, fear appeals, and pressure from people in the other adopter groups.

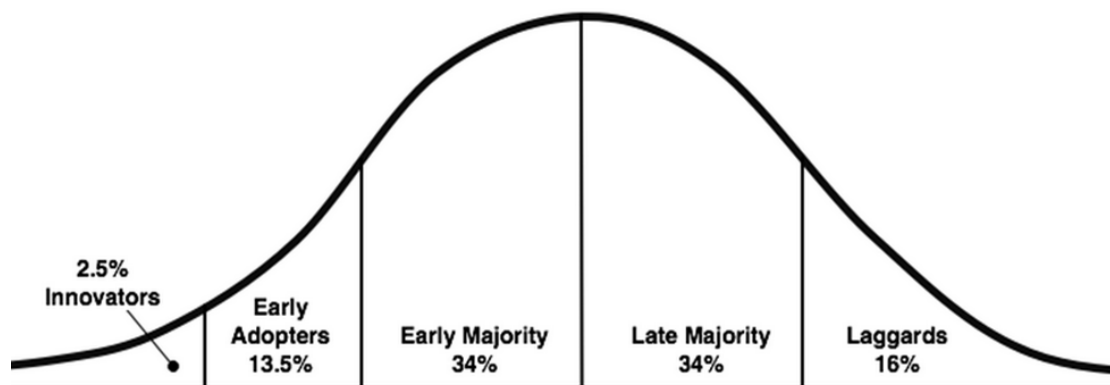


Figure 4.1: Innovation Diffusion Theory - Estimated population size of the five adopter categories [61]

For an innovation to accomplish diffusion, a population must adopt it. Klonglan and Croward (1970) [36] suggests a two phase symbolic adoption model, accepted and used by various other research contributions. They define symbolic adoption to be "*the acceptance of an idea component of an innovation, or the decision that an innovation is appropriate for the adoption unit*" [36]. The phases can be seen in Figure 4.2.

The first phase considers accepting the idea behind the innovation (symbolic adoption). The second phase is about accepting the innovation itself (use adoption). For a person to adopt the innovation, the person becomes aware of it, adopts the idea (symbolic adoption), tests the innovation through initial use, and continue to use the innovation (use adoption).

There are five main factors that influences the adoption of an innovation. The extent to which these factors influence the adoption of a person depends on the adopter categories in which that person resides. The factors are

**Relative Advantage** The degree to which an innovation is seen as better than the idea, program, or product it replaces.



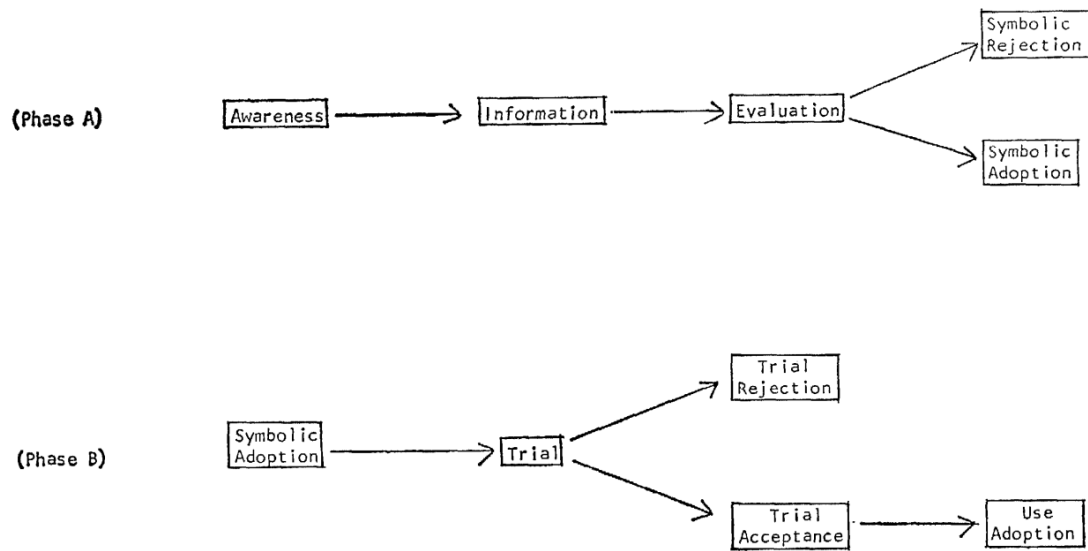


Figure 4.2: Innovation Diffusion Theory - The adoption process [36]

**Compatibility** How consistent the innovation is with the values, experiences, and needs of the potential adopters.

**Complexity** How difficult the innovation is to understand or use.

**Triability** The extent to which the innovation can be tested or experimented with before a commitment to adopt is made.

**Observability** The extent to which the innovation provides tangible results.

A limitation of IDT is that it was designed to be an analytic basis for adoption of behaviors, rather than cessation or prevention of them. Additionally it lacks some consideration of important background information about the individuals resources or social support that might affect their ability to adopt the innovation..

#### 4.1.2 Theory of reasoned action

The Theory of Reasoned Action (TRA) is a theory from social psychology for predicting actual behaviour and has been used in a variety of domains. The theory was presented in Fishbein and Ajzens book "Belief, Attitude, Intention, and Behavior: An Introduction to Theory and Research" [21]. The theory states that the most important determinant to predict actual behaviour is behavioral intentions which again can be predicted by examining ones attitude and perceived subjective norm towards that behaviour. Figure 4.3 shows the theory model and the three variables in TRA

**Attitude toward behaviour (A):** The individuals feelings toward performing the behaviour in question. The model defines attitude toward behaviour as the sum of all

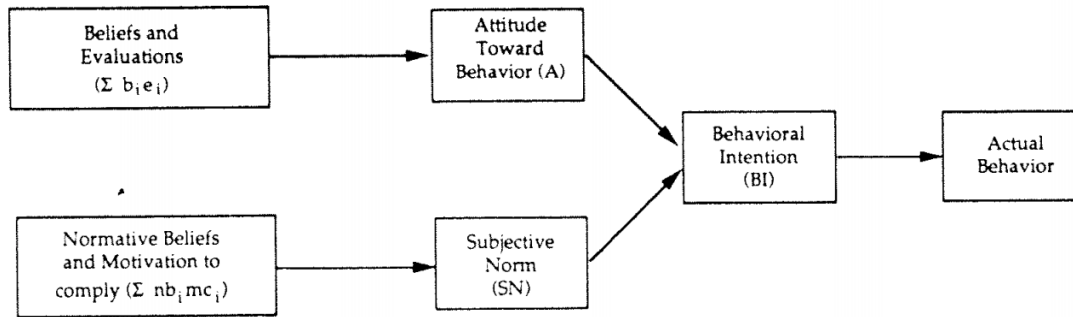


Figure 4.3: Theory of Reasoned Action [12]

positive or negative outcomes of the perceived beliefs with regard to its associated probabilities of occurrence. Or in other words: "if I do this action, or behave in this way, how will it affect me and the world around me?".

**Subjective Norm (SN):** The person's perception of whether others think he should perform the action. Subjective norm is the sum of a person believes about all referents' likelihood of approval or disapproval of performing the given behavior, with regard to the persons motivation to comply with the referent in question. Or in other words: "If I perform this action, or behave in this way, what will people around me think about me, and how much do i care?".

**Behavioral Intention (BI):** An indication of an individuals' readiness to perform a given behavior. Behavioral intention is, in its simplest form, the sum of the attitude toward behaviour and subjective norm.

Using TRA will eventually give an indication of actual behaviour. However the model is too general. Relevant beliefs will have to be elicited from a representative sample of the target population before the model can be applied to a specific setting.

#### 4.1.3 Technology acceptance model

Technology Acceptance Model (TAM) is based on the theory of reasoned action to measure the acceptance of information technology [12, 11, 37]. TAM appears to be one of the most widely accepted models for predicting behaviour and has been applied in multiple studies [9, 42, 77, 12, 13]. The model has three variables and their definitions are presented in the following list

- **Perceived Usefulness (PU):** The degree to which a person believes that using a particular system would enhance his or her job performance.
- **Perceived Ease Of Use (PEOU):** The degree to which a person believes that using a particular system would be free of effort.

- **Behavioral Intention to use (BI):** An indication of an individuals readiness to perform a given behavior.

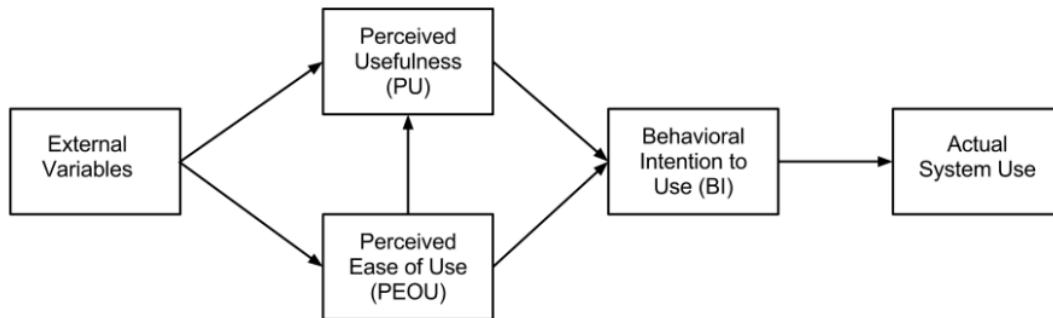


Figure 4.4: Technology Acceptance Model (TAM)

Figure 4.4 shows the model and relationships of the variables. The external variables may include a whole range of factors, such as age, domain, and technological experience, which can affect both the measures of PU and PEOU. TAM has the following three hypotheses, shown by the arrows in Figure 4.4

**H1:** PEOU has a positive impact on PU.

**H2:** PEOU has a positive impact on BI.

**H3:** PU has a positive impact on BI.

TAM is criticized for having limited extensibility and explanatory power [3, 1]. A study found that the hypothesis H2 decrease with time for a specific system because people adopt and learn the user interface [12]. Researchers states that extending TAM with additional variables is necessary to provide a stronger model [42, 77, 78].

A lot of extensions to TAM exists today, the most popular of them being Technology Acceptance Model 2 (TAM2) [77], Unified Theory of Acceptance, and Use of Technology (UTAUT) [78]. TAM is a good model due to its paucity nature. Extending TAM with more variables will increase its accuracy but also increase its complexity, making it more difficult to take practical advantage of it. Finding the balance between complexity and accuracy dependent on the situation is important for a good evaluation. Both UTAUT and TAM2 are complex compared to TAM.

## 4.2 Data collection

According to Seaman & Allen [64], data collected from surveys are grouped into a four level hierarchy. Data types in higher level in the hierarchy can be seen as more powerful than data in lower levels

**Nominal data** The weakest level of measurement representing categories without numerical representation.

**Ordinal data** Data in which an ordering or ranking of responses is possible but no measure of distance is possible.

**Interval data** Generally integer data in which ordering and distance measurement are possible.

**Ratio data** Data in which meaningful ordering, distance, decimals and fractions between variables are possible.

Ideally, the data should be at least interval, since distance measure is possible. Strictly, data from a Likert-scale are ordinal. However, sets of Likert-items can be combined to form indexes or constructs, then the data may be used as interval data. The Likert-scale should be at least five and preferably seven point, and pass Cronbach's alpha or the Kappa test of intercorrelation and validity [64]. This is covered in Section 4.3.

#### 4.2.1 Characteristics of a Likert-scale

Uebersax [44] has defined the characteristics/features of a Likert-scale to be

1. The scale contains several items.
2. Response levels are arranged horizontally.
3. Response levels are anchored with consecutive integers.
4. Response levels are also anchored with verbal labels which connote more or less evenly spaced gradations.
5. Verbal labels are bivalent and symmetrical about a neutral middle, and
6. In Likert's usage, the scale always measures attitude in terms of level of agreement/disagreement to a target statement.

He also mention that feature 1-4 comprise the main requirements for a Likert-scale. Likert-scales are sometimes modified to be anchored with labels in the endpoints. In that case, the scale should actually be called a Discrete Visual Analog Scale (DVAS). See Section 4.2.2 for labeling of Likert-scales.

#### 4.2.2 Labeling of Likert-scales

Krosnick & Berent found in a study [39] indications that fully labeled scales enhances reliability. However, Jamieson [34] claims that researches frequently assume that the distance between the response levels are interpreted to be equal by the respondents.

Agree and slightly agree might be interpreted differently, because the interpretation is associated with feelings. Hence the response may become very subjective. Another study [8], states that a fully labeled scale was least accurate, while the unlabeled scale was most accurate. According to [57], it is a common convention in market and social research interviews to use Likert-scales which is modified to be anchored with labels in the endpoints to remove possible misinterpretation.

## 4.3 Data analysis

### 4.3.1 Structural Equation Modelling

Structural Equation Modeling (SEM) consists of different multivariate statistical analysis techniques used to analyze structural relationships. By using SEM, it is possible to answer a set of interrelated research questions in a single, systematic, and comprehensive analysis [24]. A SEM-analysis assesses

#### **The structural model**

Also known as the inner model. It specifies the relationships between the latent variables.

#### **The measurement model**

Also known as the outer model. It relates responses or indicators to latent variables.

The assessment can be conducted with different techniques. Two of the most widely used techniques are Covariance-Based SEM (CB-SEM) and Partial Least Square (PLS). Their differences can be seen in Table 4.1. According to Wong [83], PLS analysis is useful for research projects where the data sample is small and the distribution is skewed.

Research from Westland [81] indicates disagreement among researchers about the sample size required to run a SEM analysis so it is representative to its intended population. Gefen et al. [24] suggests that the required minimal sample should be at least 10 times the number of items in the most complex construct.

#### 4.3.1.1 Assessing the measurement model

The results from a PLS analysis can be used for the assessment of reliability and validity in the measurement model. Before conducting an analysis, the structural model is first created and the latent variables are connected to reflect the research model, then the respective indicators are connected to each latent variable.

#### **Reliability**

Cronbach's alpha is a measure of reliability for a set of two or more construct indicators. Higher values indicates higher reliability among the indicators, with 1.0 being the highest value. It should be above 0.60 for exploratory research and above 0.70 for confirmatory research [24]. According to [38], 0.6 is the lowest acceptable alpha for exploratory research. However, it is also pointed that a score of 0.6 is generally acceptable.

Issue	PLS	CB-SEM
Objective of Overall Analysis	Reject a set of path specific null hypotheses of no effect.	Show that the null hypothesis of the entire proposed model is plausible, while rejecting path specific null hypotheses of no effect.
Objective of Variance Analysis	Variance explanation (high R-square)	Overall model fit, such as insignificant $\chi^2$ , or high AGFI.
Required Theory Base	Does not necessarily require sound theory base. Supports both exploratory and confirmatory research.	Requires sound theory base. Supports confirmatory research.
Assumed Distribution	Relatively robust to deviations from a multivariate distribution.	Multivariate normal, if estimation is through ML. Deviations from multivariate normal are supported with other estimation techniques.
Required Minimal Sample Size	At least 10 times the number of items in the most complex construct.	At least 100-150 cases.

Table 4.1: Structural model equation techniques [24]

### Convergent validity

Convergent validity is established by assessing the average variance extracted (AVE) value. AVE is a measure of the variance that is captured by a construct and is accepted if it is higher than 0.5 [23, 83].

### Discriminant validity

Research suggest different methods for the assessment of discriminant validity [30]. SmartPLS allows assessing with different techniques, while the heterotrait-monotrait ratio of correlations technique seems to give the most accurate results [30]. In addition, the SmartPLS documentation recommends this technique [67]. The different techniques and its criteria is shown in Table 4.2.

#### 4.3.1.2 Assessing the structural model

T-statistics and the p-value is examined when assessing if the hypotheses are statistically significant or not. For a two-tailed test, a hypothesis is significant if  $T > 1.960$  and  $p < 0.05$  or  $T > 2.576$  and  $p < 0.01$  or  $T > 3.291$  and  $p < 0.001$  [80, 10].

Technique	Criteria
The Fornell-Larcker criterion	The square root of AVE of each latent variable is greater than the correlation among the latent variables, then discriminant validity is established.
Cross-loadings	Each indicator has higher loading on its assigned latent variable, than on the other latent variables [24].
The heterotrait-monotrait ratio of correlations	Value must be below 0.9 to establish discriminant validity [30].

Table 4.2: Discriminant validity - Techniques, description, and criteria

## 4.4 Usability

### 4.4.1 Definitions of usability

Jakob Nielsens definition of usability is "*usability is a quality attribute that assesses how easy user interfaces are to use*" [54]. It is defined by the following five quality components

**Learnability** How easy is it for users to accomplish basic tasks the first time they encounter the design?

**Efficiency** Once users have learned the design, how quickly can they perform tasks?

**Memorability** When users return to the design after a period of not using it, how easily can they reestablish proficiency?

**Errors** How many errors do users make, how severe are these errors, and how easily can they recover from the errors?

**Satisfaction** How pleasant is it to use the design?

Another definition of usability comes from the ISO specification 9241-11 1998. It defines usability as "*extent which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use*" [68]. Some of the definitions are presented in the following list.

**Effectiveness** Accuracy and completeness with which users achieve specified goals.

**Efficiency** Resources expended in relation to the accuracy and completeness with which users achieves goals.

**Satisfaction** Freedom from discomfort, and positive attitudes towards the use of the product.

**Context of use** Users, tasks, equipment (hardware, software and materials), and the physical and social environments in which a product is used.

**Work system** System, consisting of users, equipment, tasks and a physical and social environment, for the purpose of achieving particular goals.

Jakob Nielsen seems to have a narrow focus on the user interfaces, while the ISO definition has a wider focus that includes the context of use. Combined, both definitions supports the process of developing a more usable application, both in the early and late stages.

#### 4.4.2 Designing for usability

Gould & Lewis [26] suggests three principles of system design which seems to produce an easy to use and useful application. The approach is different because it does not rely on design guidelines to achieve an easy to use and usable application in one iteration. The principles are presented together with a short explanation.

**Early focus on users and tasks** The first principle is concerned with understanding who the users will be, and how they accomplish the relevant, and potentially new tasks.

**Empirical measurement** The second principle suggests that during the early development of the application, the intended users should be able to do realistic tasks with simulations or a prototype. Data about their reactions and performance should be recorded and analyzed.

**Iterative design** The third principle suggests repeating cycles of iterative design. As the requirements are implemented and the application is designed, it will then be tested by the intended users. If usability problems are found, they must be fixed.

Users conduct tasks differently, which could make the prototype less intuitive. By following these principles it is easier to identify the different ways to conduct user tasks, thus making the prototype more intuitive and ensuring a more pleasant experience.

#### 4.4.3 Heuristic evaluation

Heuristic evaluation (HE) is an informal discount usability engineering method developed by Jakob Nielsen [52]. It was originally developed to be performed by users with some knowledge about usability, however not necessarily experts. It has received its name because the evaluation is conducted with only 10 heuristics which is more broad and general, compared to other evaluation methods which may have hundreds of rules that must be followed.

This type of evaluation is conducted individually. The evaluators are given a list of the 10 heuristics presented in Appendix B, together with the application to identify violated heuristics. They may communicate after all evaluations is finished. A general



recommendation is that the evaluators does at least two iterations. The first iteration should give the evaluator a feeling and the general scope of the system. On the second iteration they go through each heuristic and compare it with the available views in the application. However, the approach must not be strictly followed. Evaluators may do as they like. The evaluators does not necessary need to be domain experts. Non-domain experts may have questions about the domain and these should be answered. This evaluation method gives an output which is a list of usability violations with references to the heuristics. By following a less complicated method, there is a larger chance for it being successful [50].

#### 4.4.4 Testing usability

Jakob Nielsen [53] mention that it is enough to conduct usability testing with no more than five persons and running many small tests. If the system is to be tested by different target groups, each target group should conduct the same test because the results could be very different. However, if there are more than one target group, each group does not necessarily need to have five members.

As the number of evaluators in a test increase, they begin to report the same findings. The percentage of usability problems discovered by increasing the number of test users can be seen in Figure 4.5. Another study by Robert A. Virzi [79] confirms that 80% of usability problems are discovered with four or five evaluators.

Nielsen does not mention anything about the evaluators being non-specialists, specialists or double-specialists. In one of his studies [49] three different groups of evaluators did Heuristic Evaluation (HE) on the same interface. One group did not have any usability expertise, another group were regular usability specialists, and the last group were double usability specialists, which means they also had experience with that particular kind of interface. The group without usability expertise found only 22% of the usability problems, while the group of usability specialists found 41%, and the double specialists found 60%. This indicates that HE could be conducted with users without much knowledge about usability, but it would be less effective than conducting it with experts or double experts. When evaluating with double specialists which has experience on the particular type of interface that is to be evaluated, using as little as two or three evaluators could be enough. If the evaluators are non-specialists, they will only find about 51% of the usability problems. This indicates that the expertise does matter, and "using no more than five evaluators" does not necessarily hold as can be seen in Figure 4.5.

#### 4.4.5 System usability scale

John Brooke mentions "*The System Usability Scale (SUS) is a simple, ten-item scale, giving a global view of subjective assessments of usability*" [6]. It was developed by John Brooke in 1986 and have been widely used in evaluation of different systems. SUS is a Likert-scale, which is the sum of the responses received on Likert items. A Likert item is a positive or negative statement. The range of the scale is usually 5 or 7. The points in the 7 point Likert-scale is defined as: strongly disagree (1), disagree (2), slightly

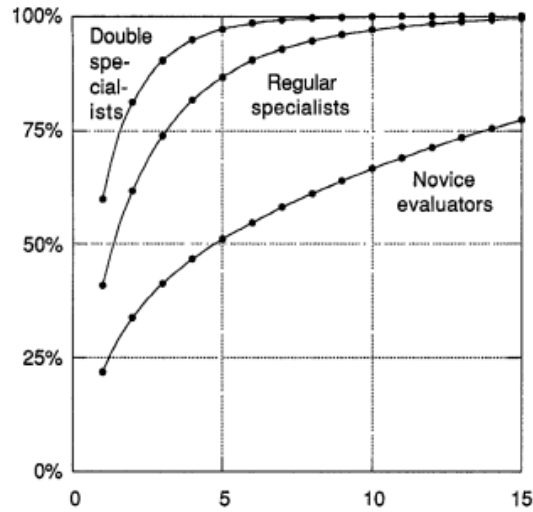


Figure 4.5: Evaluation - The percentage of usability problems discovered by increasing the number of test users [49]

disagree (3), neither agree nor disagree (4), slightly agree (5), agree (6), strongly agree (7). Slightly disagree, and slightly agree are excluded from the the 5 point Likert-scale.

In John Brookes paper from 2013, he mentions that SUS is both reliable and valid [7]. This is in agreement with another prior study [43] where it also was discovered that SUS has the two factors usability (8 items) and learnability (2 items) with a coefficient alpha of 0.91 and 0.70 respectively. However, in Brooke's paper there is only one learnability item and the rest is usability. Either way, SUS can be used as it originally was created.

Because SUS cover a variety of aspects of system usability, the validity is high [6]. The scale and its items can be found in Appendix C.

If a user cannot decide what to choose, "Neither agree nor disagree" should be chosen. SUS is to be used after a evaluator have tried the system. The evaluators should record the immediate response, rather than start to think about it. The items are selected carefully. To calculate the score from SUS, John Brooke explains how to do it based on the 5 point Likert-scale: "*SUS yields a single number representing a composite measure of the overall usability of the system being studied. Note that scores for individual items are not meaningful on their own. To calculate the SUS score, first sum the score contributions from each item. Each item's score contribution will range from 0 to 4. For items 1,3,5,7,and 9 the score contribution is the scale position minus 1. For items 2,4,6,8 and 10, the contribution is 5 minus the scale position. Multiply the sum of the scores by 2.5 to obtain the overall value of SU. SUS scores have a range of 0 to 100*" [6]. How to determine if a score is acceptable or not, can be seen in figure 4.6.

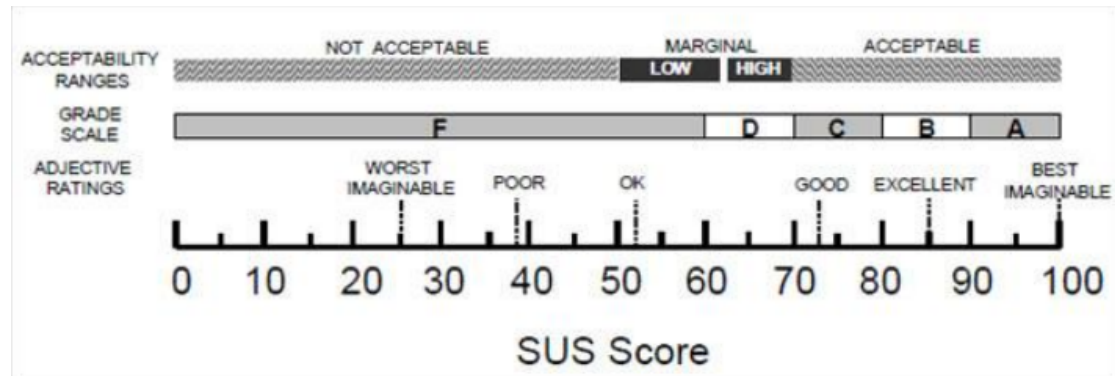


Figure 4.6: Evaluation - Grading SUS scores [7]

#### 4.4.6 Software for testing usability

Datalogger is a free Excel spreadsheet that was first created in 2002 and have then received improvements from many usability researches [84]. The book "Practical Usability testing" [76] suggests using this tool for starters and intermediates that wishes more structure on their data.

In addition to lists of recorded observations from all participants sorted on tasks, it is possible to generate diagrams of task performance, task completion, task confidence, time spent per task, and system usability scale chart which also calculates the score automatically.



## Chapter 5

# The conference application

This chapter first presents the chosen requirements for the conference application. Then, it presents the domain model which explains some concepts in conferences and how they relates to each other. In addition, it is currently used database schema in the conference application. The last section presents the conference application.

### 5.1 Selected requirements

This section presents the functional and non-functional requirements, partially or fully implemented in the conference application. They are selected and prioritized from the requirements list presented in Chapter 3.2.

#### 5.1.1 Functional requirements

The functional requirements specifies what the conference application should be able to do.

There are no interfaces for the administrative perspective, resulting in manually inserting or seeding the database with data to simulate the administrative perspective during evaluation. In a complete solution, these requirements should be managed through a user interface such as an administration panel, thus the requirements that are partly implemented is annotated with an asterisk.

**PFR3** The conference program with conference activities should be accessible to all participants.

**PFR4** The program activities should at least contain the following information: title, description, time, and place.

**PFR5** The program should differentiate between session events and social events.

**PFR6** Participants should be able to construct a personal program for the conference.

**PFR7** Participants should be able to add sessions derived from the conference program to their personal program.

**PFR9** Changes to the session events should be automatically updated in all the personal programs they reside.

**SMFR1** Participants should be able to share content on the following social media sites: Facebook, Twitter, and LinkedIn.

**FFR1** Participants should be able to rate the individual sessions, exhibitions and social events.\*

**CFR3** Administrators should be able to send information through a news feed available to everyone at the conference.\*

**CFR4** Administrators should be able to contact specific groups (such as speakers, exhibitors, and participants signed up to specific session) or individual participants in a one-way communication manner.\*

**NAFR1** Administrators should be able to add one or more conference facility maps available for all participants to see.\*

**PAFR1** The application should at least be accessible through web, and preferably exposed core functionality through an API for the creation of native/hybrid applications.

Explanation to requirements annotated with an asterisk

**FFR1** It is not possible to rate exhibitors since it is not possible to add exhibitors.

**CFR3** It exists functionality in the API to add messages in a newsfeed. There are no user interface for the administration.

**CFR4** Groups are not utilized in the solution. However, the database schema accounts for groups.

**NAFR1** It exists functionality in the API for conference maps in the API. There are no user interface for the administration.

### **5.1.2 Non-functional requirements**

The non-functional requirements specifies requirements to the system that are not specified by the functional requirements.

**NFR1** The application should run on all major platforms.

**NFR2** The application should be perceived as having high ease of use by its users.

**NFR3** The application should be perceived as having high usefulness by its users.

**NFR5** The application should support high modifiability.

**NFR6** The application should support high extensibility.

NFR1 states that the application should run on all major platforms. The application is developed as a web application, thus it can be accessed from all platforms having a modern web browser. NFR2 and NFR3 are connected with usability and utility and may be examined more with the results from a acceptance evaluation. NFR4 is not considered in this project. NFR5 and NFR6 are affected by using a framework, and by the produced code.

## 5.2 Domain model

This section presents a domain model for conferences that serves as a basis for the database schema, and aims to explain the relationship between them. The model shown in Figure 5.1 addresses the selected requirements and in addition addresses a broader range of requirements than the application as a whole. The model is extracted and depicted through MySQL Workbench, and modified to enhance readability. Third-party specific tables are excluded from the model. The table attributes are excluded from the figure, however they are presented later in this section. Explanations to the colors in the model are presented next

**Blue:** These tables have their own model and controller class as known from the MVC pattern [41]. However, there are no views since this solution is in the API.

**Green:** Pivot tables, a many to many relationship between tables.

**Red:** Polymorphic pivot tables. Polymorphic relations allow a table to be associated to multiple tables, on a single association, by referring to logical models in the code base instead of foreign keys in the database. For instance, a ratings table can refer to a conference with id 1, or a session with id 1. The polymorphic relations are represented in Figure 5.1 by red lines.

All the models have the `created_at` and `updated_at` attributes, and all with the exception of the pivot and polymorphic pivot tables has a unique id as the primary key.

Table 5.1 describes in which sub-system context each of the different domain model parts belong, and should be read from left to right. For instance, the conferences table is directly under the conference system, and the groups table is directly under the group system, which is under the user system, which is under the conference system.

This section presents the domain tables in the order described in Table 5.1 while describing the concept and intention to the sub-systems housing each table. The conference system is at the top of the hierarchy with the table conferences, and maps directly under it. The conference system represents the application as a whole.

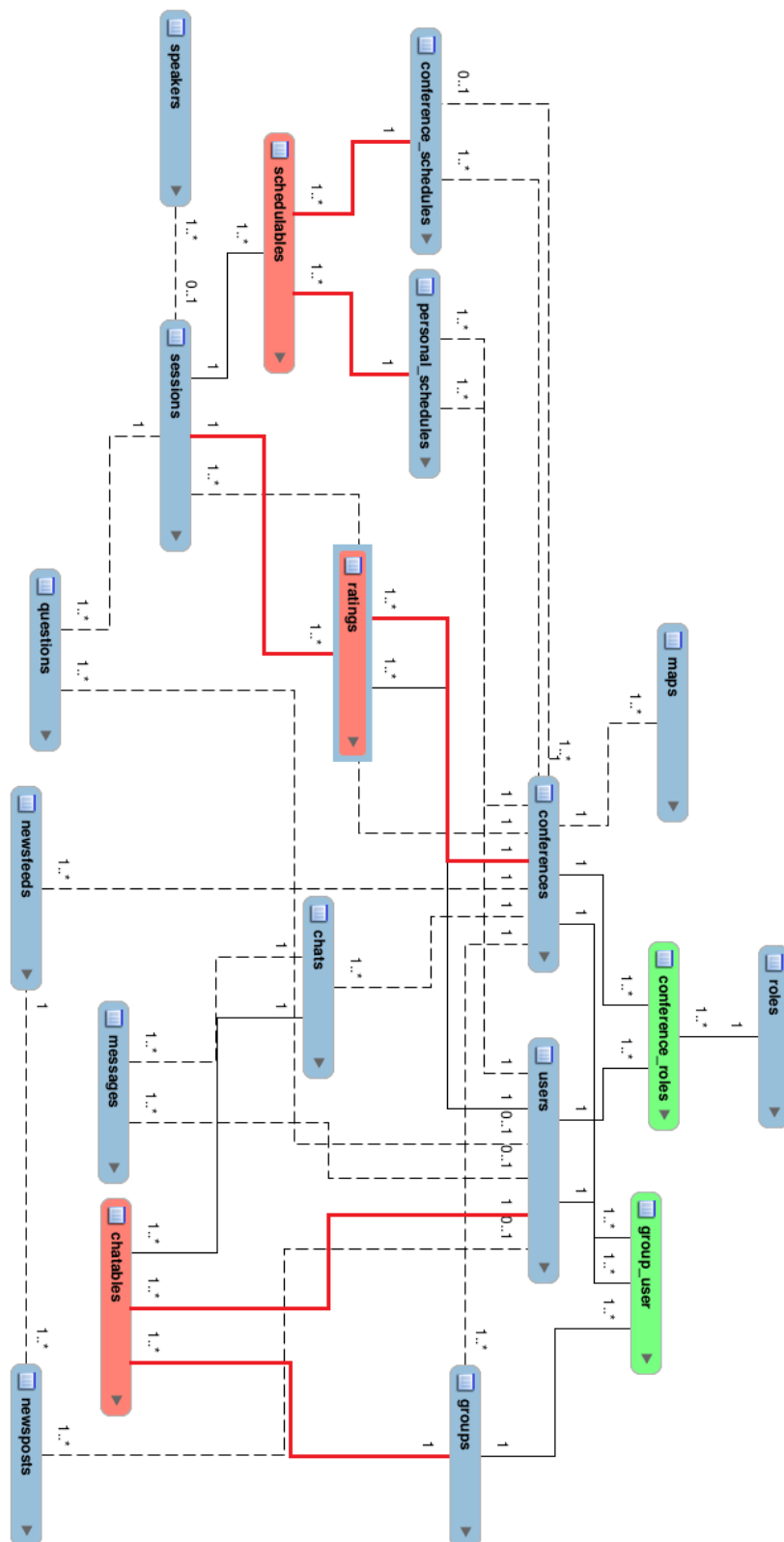


Figure 5.1: Conference application - Domain model



Conference system			conferences
			maps
			users
	User system		group_user
		Group system	groups
		Authorization system	conference_roles
	Schedule system		roles
			conference_schedule
			personal_schedule
			schedulables
			sessions
	Rating system		speakers
			questions
			ratings
Newsfeed system		newsfeeds	
Chat system		newsposts	
		chats	
		messages	
		chatables	

Table 5.1: Domain - System overview

## Conferences

Every resource belongs to a conference with the exception of users, which can traverse different conferences. By defining a conference table, the application can support more than one conference. Figure 5.2a shows the attributes for the conference table. The banner attribute describes the path to a banner for the conference. The active\_schedule\_id attribute is a foreign key to the main conference\_schedules table for the conference. The domain model was designed to let users make their own conferences at will.

## Maps

Conference participants may need maps to guide them around potentially vast conference areas. These areas can be in close vicinity, across multiple floors or buildings, or even across town. As such, the participants may need multiple detailed maps to successfully find their way around. The maps table is connected to the conferences table in a many to one fashion to support for multiple maps. The uri attribute contains a hyperlink for the map resource and is shown in Figure 5.2b.

### 5.2.1 User system

The domain model was designed to support grouping and authorization of users. The grouping and authorization systems are subsystems of the user system.

## Users

User management information such as credentials are stored in the users table which can

conferences	
id	INT(10)
name	VARCHAR(255)
description	LONGTEXT
banner	VARCHAR(255)
active_schedule_id	INT(10)
start_date	DATETIME
end_date	DATETIME
country	VARCHAR(255)
city	VARCHAR(255)
created_at	TIMESTAMP
updated_at	TIMESTAMP
Indexes	

(a) Conferences table

maps	
id	INT(10)
conference_id	INT(10)
uri	VARCHAR(255)
description	VARCHAR(255)
created_at	TIMESTAMP
updated_at	TIMESTAMP
Indexes	

(b) Maps table

Figure 5.2: Domain model - Conference system

be seen in Figure 5.3. The confirmation\_code and confirmed attributes safeguard against email hijacking by forcing users to activate their account through the confirmation code sent to their email when registering. When the email is confirmed, the confirmation\_code is set to null, and confirmed changed from false to true.

users	
id	INT(10)
email	VARCHAR(255)
password	VARCHAR(255)
confirmed	TINYINT(1)
confirmation_code	VARCHAR(255)
created_at	TIMESTAMP
updated_at	TIMESTAMP
Indexes	

Figure 5.3: Domain model - User system, User table

#### 5.2.1.1 Group system

The group system was designed to group users for quick messaging purposes through the newsfeed or chat system. For instance, a conference administrator could create a group for all participants, and another one for all speakers of the conference.

Although the domain model is designed to facilitate grouping of users within conferences, the application as a whole does not utilize this functionality.

group_user	
group_id	INT(10)
user_id	INT(10)
created_at	TIMESTAMP
updated_at	TIMESTAMP
conferences_id	INT(10)
Indexes	

(a) Group\_user table

groups	
id	INT(10)
conference_id	INT(10)
name	VARCHAR(255)
created_at	TIMESTAMP
updated_at	TIMESTAMP
Indexes	

(b) Groups table

Figure 5.4: Domain model - Group system

conference_roles	
role_id	INT(10)
conference_id	INT(10)
user_id	INT(10)
created_at	TIMESTAMP
updated_at	TIMESTAMP
Indexes	

(a) Conference\_roles table

roles	
id	INT(10)
name	VARCHAR(255)
created_at	TIMESTAMP
updated_at	TIMESTAMP
Indexes	

(b) Roles table

Figure 5.5: Domain model - Authorization system

### Group\_user

The group\_user is a pivot table seen in Figure 5.4a. It connects a user to a group within a conference.

### Groups

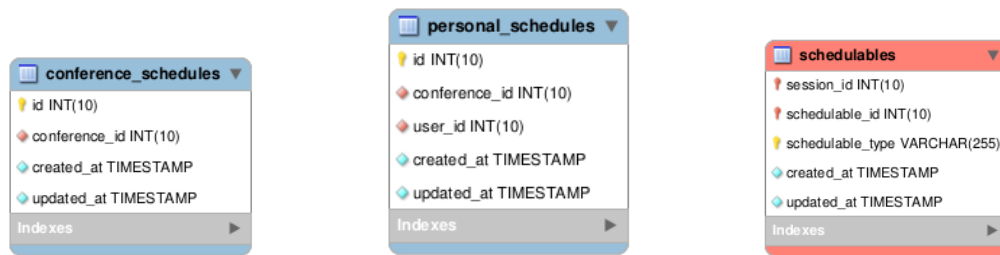
The groups table seen in Figure 5.4b is simplistic as it only contains a descriptive name for a group within a conference.

#### 5.2.1.2 Authorization system

The domain model was designed to accommodate the administrative side of a conference. For this purpose, the authorization system was designed to be able to distinguish administrators from regular participants of a conference.

### Conference\_roles

The conference\_roles table seen in Figure 5.5a is a pivot table connecting a user to a role within a conference.



(a) Conference\_schedules table (b) Personal\_schedules table (c) Schedulables table

Figure 5.6: Domain model - Schedule system 1

## Roles

To distinguish between administrators and participants of a conference, roles must be defined. Initially there was a need for three separate roles: administrators, co-administrators, and participants. One user within a conference should have the role of administrator, which would have full control of the conference resources, including giving other users the role of co-administrators. The administrator would be the user whom created the conference. Co-administrators would have the same control as the administrator within the conference with the exception of modification of roles and deleting the whole conference.

Instead of defining one single enum attribute in the `conference_roles` table to account for the roles, there is a whole table in the domain model allocated to store the different roles, shown in Figure 5.5b. The design choice was made to potentially accommodate more future roles if needed.

## 5.2.2 Schedule system

The schedule system contains data about the conference schedules, personal schedules, sessions and the sessions related questions, and speakers.

### Conference\_schedules

A conference can according to the domain model have zero or more `conference_schedules`. The idea is that administrators can create drafts of the conference schedules, by creating and rearranging the sessions within it, before deciding upon an active schedule. The `conference_schedules` table can be seen in Figure 5.6a.

### Personal\_schedules

A user can according to the domain model have zero or more `personal_schedules`. Users should be able to create drafts of their own personal schedule. However, they can not create custom sessions directly in their own personal schedule. The sessions must derive from the conferences' session pool.

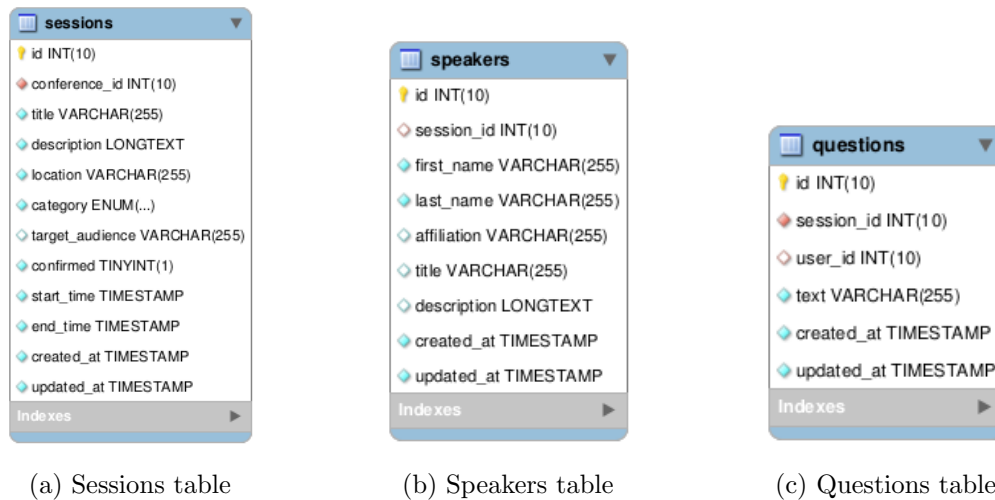


Figure 5.7: Domain model - Schedule system 2

In spite the drafting freedom in the domain model, the application does not implement drafting of personal schedules, but forces the user to have one active schedule.

The program\_schedules table can be seen in Figure 5.6b.

### Schedulables

The schedulables table shown in Figure 5.6c is a polymorphic pivot table which provides a many to many relationship between the sessions and conference\_schedules table, or the sessions and personal\_schedules table.

### Sessions

The sessions table shown in Figure 5.7a contains a title, description, location, target audience, start\_time, and end\_time attribute. It has a category which can be break, professional, social, or other. Additionally it has a boolean confirmed attribute. If true, the session is confirmed, otherwise the session is canceled.

### Speakers

The speaker table shown in Figure 5.7b contains all the necessary information about a sessions' speakers. The speakers do not have to be users with an active account in the application.

### Questions

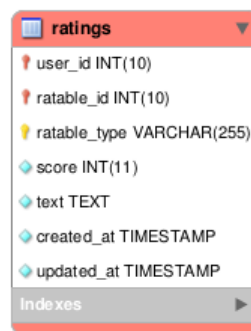
The ability for users to ask questions directed at specific sessions is implemented through the questions table shown in Figure 5.7c. The idea is that a session leader can access a feed of all the questions asked during the session, prioritize them, and ask the relevant questions to the speakers in an orderly fashion. This could also potentially lower the threshold for asking questions.

### 5.2.3 Rating system

The rating system is about giving criticism and praise to the session speakers and conference administration.

#### Ratings

The ratings table shown in Figure 5.8 is a polymorphic table. It connects a user to a session or a conference resource, by allowing the user to give a score, and option to add a comment towards that resource. The ratings table is however not just a polymorphic table, it also has its own model in the application as indicated by its blue border in the domain model in Figure 5.1. This results in the restriction that a user may only rate a session or conference once. The application restricts the users to rate sessions and conferences only when the session or conference in question is over.



ratings	
user_id	INT(10)
ratable_id	INT(10)
ratable_type	VARCHAR(255)
score	INT(11)
text	TEXT
created_at	TIMESTAMP
updated_at	TIMESTAMP
Indexes	

Figure 5.8: Domain model - Rating system, Ratings table

### 5.2.4 Newsfeed system

One of the main challenges of a conference is the flexibility to change after it has begun. The difficult part is to effectively deliver a message to all participants in time. The newsfeed system is one such way to do that.

#### Newsfeeds

The newsfeed system is designed so that a conference may have multiple newsfeeds. The idea is to be able to group the newsfeeds into a hierarchy of different themes. However, although the domain model account for this flexibility, the application does not. At the time of this writing, the application does only support one newsfeed for each conference. The newsfeed table seen in Figure 5.9a is a container for newsposts.

#### Newsposts

Through the newspost table seen in Figure 5.9b, a user, usually an administrator, can post news to a newsfeed.

newsfeeds	
id	INT(10)
conference_id	INT(10)
user_twitter	VARCHAR(255)
created_at	TIMESTAMP
updated_at	TIMESTAMP
Indexes	

(a) Newsfeeds table

newsposts	
id	INT(10)
newsfeed_id	INT(10)
user_id	INT(10)
title	VARCHAR(255)
body	TEXT
created_at	TIMESTAMP
updated_at	TIMESTAMP
Indexes	

(b) Newsposts table

Figure 5.9: Domain model - Newsfeed system

chats	
id	INT(10)
conference_id	INT(10)
name	VARCHAR(255)
created_at	TIMESTAMP
updated_at	TIMESTAMP
Indexes	

(a) Chats table

messages	
id	INT(10)
chat_id	INT(10)
user_id	INT(10)
text	TEXT
created_at	TIMESTAMP
updated_at	TIMESTAMP
Indexes	

(b) Messages table

chatables	
chat_id	INT(10)
chatable_id	INT(10)
chatable_type	VARCHAR(255)
created_at	TIMESTAMP
updated_at	TIMESTAMP
Indexes	

(c) Chatables table

Figure 5.10: Domain model - Chat system

### 5.2.5 Chat system

The chat system opens up the ability to chat to other users of the application. However, the application does not utilize this feature.

#### Chats

The chats table shown in Figure 5.10a contains the name of the chat, and acts as a container for the recipients and messages of the chat.

#### Messages

The messages table can be seen Figure 5.10b contains the message a user has sent to the chat. The idea is for the application to restrict reading and writing capabilities to users in the recipients list.

### Chatables

The chatables table in Figure 5.10c acts like the chats recipients list. It is a polymorphic pivot table between a chat and users or groups. The idea is that users can be added by linking to the users table directly or indirectly added through groups to the recipients list.

## 5.3 The conference application

It was necessary to install and configure three servers for hosting the conference application. The study of Linux, Apache, DNS, certificates, and other required technology are not included. Instead, Appendix E includes a few technical notes that may be practical for future developers. This section first presents an overview of the servers that are connected. Next, it presents the conference API, and lastly the conference web application.

### 5.3.1 Overview of the network solution

This section illustrates the whole conference application solution and how they are connected. In addition, it illustrates how hybrid and native applications would be used with the conference application solution. The solution is hosted on UNINETT's NOVA-platform where it is possible to create and manage virtual machines.

Connections to the database are restricted to only allow the IP-address of the server that hosts the API, and the local machine. The connection between the API and conference web application, and conference web application and potential clients uses HTTPS since passwords and access tokens are transferred over the internet.

### 5.3.2 The conference API

During the project, there were conducted research on REST APIs and related technologies, presented in Appendix D. The conference API is a REST API, which is developed with the Laravel framework.

#### 5.3.2.1 Request handling

Figure 5.12 shows the happy path for a protected route, which is the most complex sequence of a request. Only the applied concepts in the development are shown, and not parts of the internal framework.

Throughout this section, the notation (number) will refer to the individual sequences in Figure 5.12, i.e. (1) refer to the sequence between client and OAuth.

If the resource is protected by OAuth, an access token is required for authorization the request. If it is valid, it is processed by the controller (2).

The controllers responsibility is to initialize the commands through the command bus (3), prepare output through the transformer (12), and respond through the responder (14).



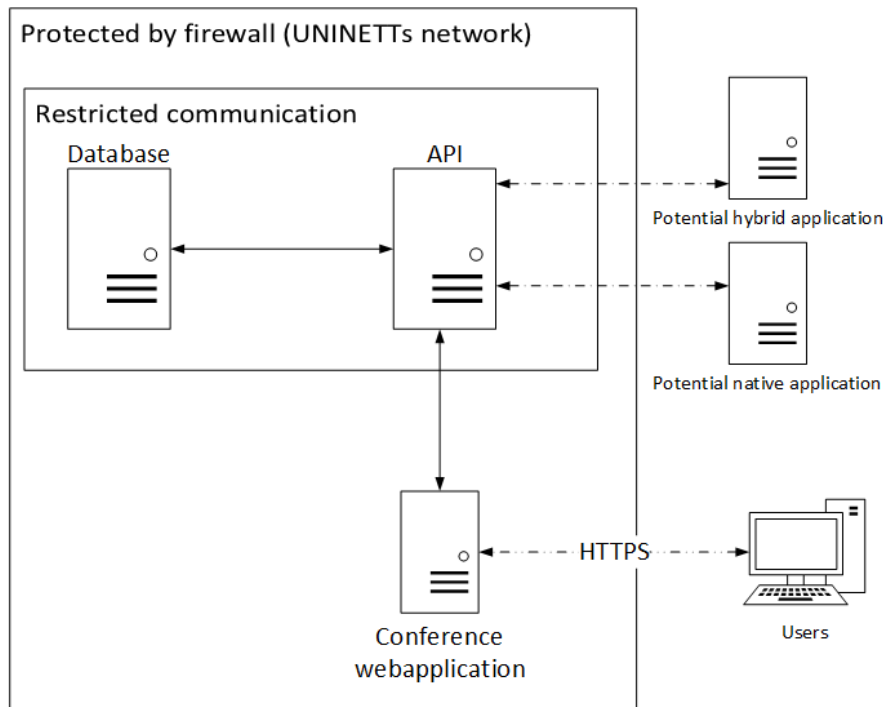


Figure 5.11: Conference application - Overview of the conference application network solution

The command bus forwards the request through a validator (4). The validator ensures that all the required data is present, and in some cases that the data is of the correct type. Should the validation fail, it notifies the controller, which respond with an error message. However if the validation is successful (5), the command bus proceed to run the command (6).

The commands' responsibility is to request data from one or more repositories (7 and 10) to build an array of necessary request data, which is returned to the controller (11). In addition, it has the responsibility to execute internal API command events raised from the repositories (not depicted in Figure 5.12).

Repositories are logical layers that depend on the underlying database model. Its task is to request or manipulate the necessary data from the database (8) and return it to the command (9). It queries the database through different models shown in section 5.2. In addition it raises events of the performed tasks, which prepares the functionality for extension while still closing it for modification.

When the controller receives its response from the command, the structure of the data mirrors the database schema. A transformer is requested by the controller to prepare the data (12) by renaming, reordering, and excluding irrelevant or secret fields before forwarding the response to the controller.

The controller forwards the refined set of data to the responder (14) which transforms

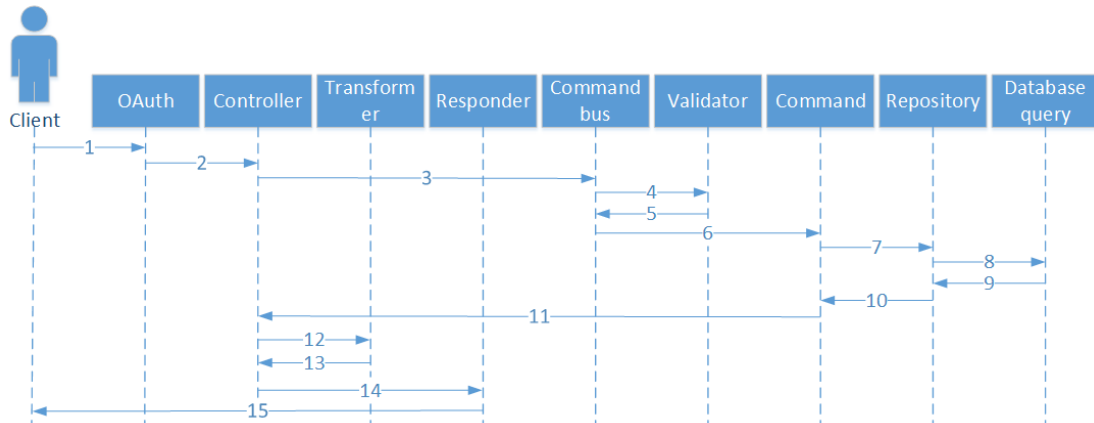


Figure 5.12: Conference application (API) - Sequence diagram for a request

the response into JSON with a standard output format before responding the client (15).

To read more about the technical aspects of the API see Appendix E.3.2.

### 5.3.3 The conference web application

The application is built with the Laravel 4.2 framework, and much time has been spent on ensuring cross-browser compatibility. The front-end is developed with the grid system and other functionality in the mobile-first and responsive Bootstrap framework version 3.3.4. It officially supports all the newest browsers on Windows, Mac OSX, iOS, and Android, with the exception of opera on mobile, some exceptions for Internet Explorer and Safari on Windows. Unofficially, it is claimed that it should work well enough in Chromium and Chrome for Linux, Firefox for Linux, and beginning with Internet Explorer 7 and newer versions [4].

The functionality are explained in Section 5.3.3.1. Most of the views are presented from the mobile version, and the application uses Norwegian language to comply more with one of the heuristics for evaluation. See Figure 5.14, 5.15, 5.16, and 5.17 for mobile views, and Figure 5.13 for a tablet view. Since the application may not be available in the future, multiple images of the views are provided.

#### 5.3.3.1 Views

This section explains the different views and the tasks that can be executed. Due to legal reasons, the first time a user access the application, a notification about information collected by the application is shown. It may be dismissed, or it is possible to click on a link and read more. This information can be accessed at any time by a hyperlink in the application, located in the footer.

#### Menu

The menu adjusts according to the device. It is always located in the top right corner on

mobile, while it is collapsed on tablets, as shown in Figure 5.13 and 5.14b. All items are visible on the navigation bar when the application is accessed from a desktop computer or laptop.

The last visited conference is remembered. Links behind the items in the menu will change when another conference has been visited.

One can see authenticated status by looking at the color of the house to the far left of the navigation bar. It will be red if not authenticated and green otherwise. The language can be changed from Norwegian to English.

### **Log in**

The login view shown in Figure 5.14d allows users to authenticate, and require a valid email and password. This menu item is not available when authenticated.

### **Register**

The register view allows registering a new account. This menu item is not available when authenticated and shown in Figure 5.14c.

### **Schedule**

The first time a user visit the schedule, the user receives a notification about adding the application as a bookmark on the homescreen, shown in Figure 5.17c.

The schedule is composed of events. An event can be of the type professional, social, break, or other. Each type uses a different color, which makes it easier to differentiate between the events. It is possible to view the schedule using a calendar or traditional layout shown in Figure 5.15c and 5.15b respectively.

The calendar layout is minimal compared to the traditional layout, but it is easier to identify parallel events. The information available in the calendar layout are time, location, speakers, and title. However, the fields may not be possible to display on a specific device due to their length. In these cases, it will only be possible to read some of the text. One can click on the event to access the details view as shown in Figure 5.3.3.1, or use the traditional layout to view the full details about the event.

By using the traditional layout, there are access to more options. The schedule can be filtered and searched through by free-text, and days. It may be searched for specific words anywhere in the schedule, or selected specific days, and then searched for words in the schedule for that day. It is shown in Figure 5.15c.

Events have a read more button which removes the need to navigate to a new web page to read the full description about the event, and a link for rating the event. It can be seen in Figure 5.17a. To be able to rate an event, the user must be authenticated, not previously rated the event, and the event must be finished.

Sharing to social networks is also integrated. All events can be shared on Twitter, Facebook and LinkedIn.

### **Maps**

This view contains the maps relevant for a conference and is shown in Figure 5.16a.

### **Newsfeed**

The newsfeed view contains messages sent by the conference administration and is visible for everyone. The view can be seen in Figure 5.16c.

### **My schedule**

This view removes the need for scrolling through the conference program to see the events added to My schedule. The view is shown in Figure 5.16b and requires being authenticated.

### **Details about an event**

This view contains the event as seen in the traditional layout of the schedule. The event description is expanded by default, and information about the speakers, and the possibility to rate the event.

Information about speakers consists of a title, affiliation, and a possible description about the speakers.

### **Read about the application**

This view is shown in Figure 5.17b and serves as a short introduction to the application. It contains information about the application, such as it is developed during the master thesis, and its features.

### **See application guidelines**

The application stores data about its users to function properly. The view informs about the use of cookies, data storage, and how the stored data will be used. Cookies are used to remember language settings, determine if the user previously has visited the web site, and the preferred layout of the schedule.

Some data may be linked to the actual user. For instance, to ensure that a specific person only rates an event once, the user id must be stored together with the score and optional comment. The view can be seen in Figure 5.17d. This is the same view as linked to in the notification when first visiting the web site.

### **Help**

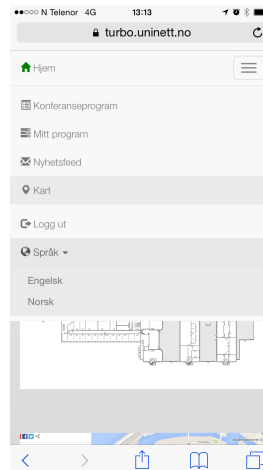
This view has explanations for the menu and the conference schedule.



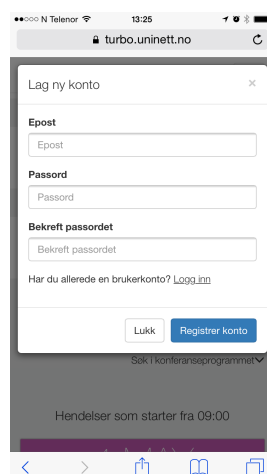
Figure 5.13: Conference application - Schedule view on tablet



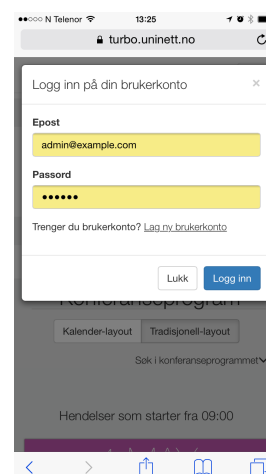
(a) Conference application - Home screen on mobile



(b) Conference application - The menu on mobile

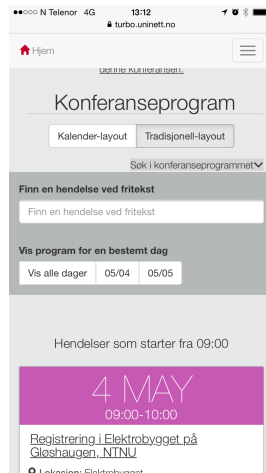


(c) Conference application - Register view on mobile

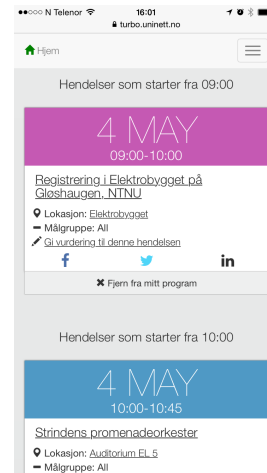


(d) Conference application - Log in view on mobile

Figure 5.14: Conference application - Different views on mobile 2



(a) Conference application - Schedule view with filter options on mobile



(b) Conference application - Schedule view on mobile

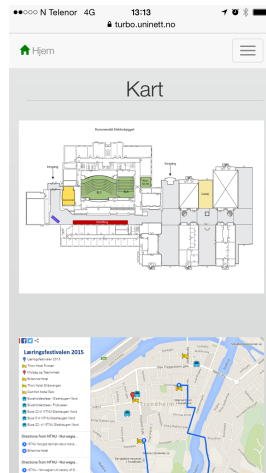


(c) Conference application - Schedule view with calendar layout on mobile

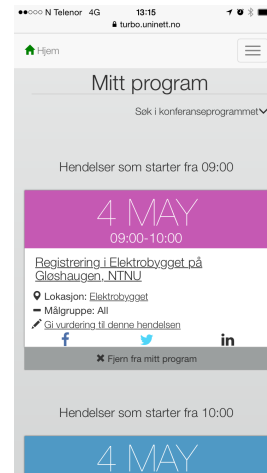


(d) Conference application - Schedule view and read more on mobile

Figure 5.15: Conference application - Different views on mobile 1



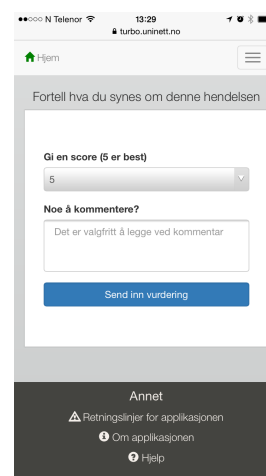
(a) Conference application - Maps view on mobile



(b) Conference application - My schedule view on mobile



(c) Conference application - Newsfeed view on mobile



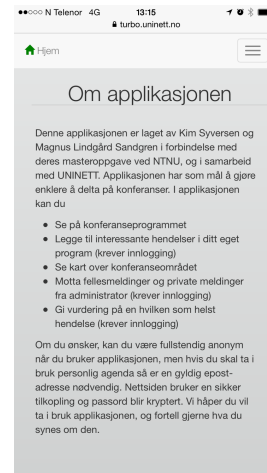
(d) Conference application - Rate a event on mobile

Figure 5.16: Conference application - Different views on mobile 3

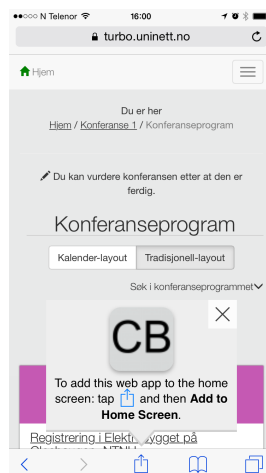




(a) Conference application - Details about event view on mobile



(b) Conference application - About the application view on mobile



(c) Conference application - Add to home-screen on mobile



(d) Conference application - Guidelines view on mobile

Figure 5.17: Conference application - Different views on mobile 4



## Chapter 6

# Evaluation

The preparation for acceptance evaluation consisted of two usability tests, preparation and hosting of the application to ensure that participants could securely use the solution, and stress testing. Also the project had to be reported to the Norwegian social science data services [55].

It was conducted two usability tests to to improve the user interface, resulting in bugfixes and improvements which are presented in section 6.3. The 10 heuristics from heuristic evaluation was kept in mind and violations were mitigated during the development.

The application had to be available on the internet, and should be able to use the application without exposing passwords or any personally identifying data. The application is hosted on UNINETT's NOVA platform, certificates were ordered and applied to ensure a secure connection.

Then, the application was stress tested to ensure that it did not crash when it was tested at a real conference. The solution was stress tested with up to 1000 simulated concurrent connections with loader.io [66]. Neither the web application, API, nor database crashed during the tests.

Research which collects and stores, directly or indirectly, personally identifying details, such as email addresses, must be reported to the Norwegian social science data services in accordance to Norwegian laws and regulations. Since both the surveys and the conference application could contain such identifying material, an application was sent, and approved, granting this research permission to conduct its research.

This chapter first presents the settings and instrument used for the evaluation, second it presents results from usability testing, third some usage statistics of the application, and finally the descriptive statistics, and statistical analysis.

## 6.1 Settings

### 6.1.1 Research questions

Two questions guides this research

1. Is there an interest for a conference application in the university and college sector?
2. How applicable is the technology acceptance model for responsive platform independent conference applications in the university and college sector?

When examining the interest for conference applications, it is differentiated between mobile, tablet, and pc to see if it is more desirable to use a conference application on one platform rather than another.

By the second question, the relationships between the constructs in the technology acceptance model is examined. The model is criticized for having limited extensibility and explanatory power [3]. Other research indicates that perceived usefulness affects the intention to use more than that of perceived ease of use [28, 77, 37].

### 6.1.2 Research model

This research applies the technology acceptance model, presented in Section 4.1.3, as its research model. It has the constructs Perceived Ease Of Use (PEOU), Perceived Usefulness (PU), and Behavioral Intention to use (BI). The model is presented in Figure 6.1 along with a annotation of its hypothesis

- H1: Perceived ease of use positively affects perceived usefulness.
- H2: Perceived ease of use positively affects behavior intention to use.
- H3: Perceived usefulness positively affects behavior intention to use.

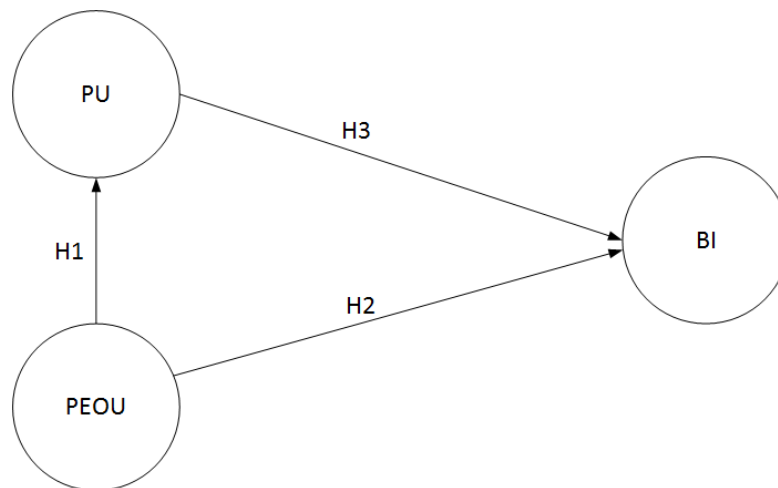


Figure 6.1: Research model

## 6.2 Instrument

Two electronic surveys were used to measure the constructs in the research model. A conference survey targeted participants at the Læringsfestivalen 2015 conference, and a web survey was sent out by email, targeting a larger audience not attending to the conference.

The surveys were almost equal. The web survey considered which sector the respondent had experience from, and expanded one question with an additional option. To reach a wider audience, the surveys were translated to both Norwegian, and English. Surveys in both languages can be found in Appendix A, and Table 6.1 shows the mapping of questions to items. Both surveys are based on a 7-point Likert-scale which is modified to be anchored with labels in the endpoints to remove misinterpretation. The left end is labeled with Strongly disagree, while in the right is labeled with Strongly agree. The surveys were divided into six tasks

**Task 1** Watch an optional video about the application. Particularly necessary if the respondent did not try the application.

**Task 2** Provide background information: Gender, age, experience with conference and technology, experience with similar applications, and the type of device used. In addition it had control questions used to decide if the response should be considered valid.

**Task 3** Five questions for perceived usefulness.

**Task 4** Five questions for perceived ease of use.

**Task 5** Six questions for Intention to use, where the first two are related to mobile, the next two related to tablet, and the last two questions related to pc.

**Task 6** The respondents could leave their thoughts and comments. This task was optional.

### 6.2.1 Response criteria

Four criteria were defined to account for quality management of the responses.

1. The participant must have an assessment basis of the application. If the participant neither tried the application, nor watched the video, the response is thrown.
2. The participant must have experience within the university and college sector. This criterion is applicable to the web survey.
3. Only one response per person. If two responses have the same email the first response is thrown.

Construct	Item	Question
PU	PU1	By using the conference application I can quickly find and understand the conference schedule for my conference.
	PU2	By using the conference application I can decide which event I want to attend quickly and without hassle.
	PU3	By using the conference application I do not need the paper program.
	PU4	I think my conference experience would be enhanced by using the conference application.
	PU5	Overall, I find the conference application useful.
PEOU	PEOU1	The conference application is easy for me to understand.
	PEOU2	Using the conference application does not require much concentration.
	PEOU3	I think it is easy to get the conference application to do what I want it to do.
	PEOU4	The conference application behaves as I expect.
	PEOU5	Overall, I find the conference application easy to use.
BI	BI1	I would like to use the conference application, if accessible to me on a smart phone.
	BI2	I am going to use the conference application, if accessible to me on a smart phone.
	BI3	I would like to use the conference application, if accessible to me on a tablet.
	BI4	I am going to use the conference application, if accessible to me on a tablet.
	BI5	I would like to use the conference application, if accessible to me on a laptop / desktop.
	BI6	I am going to use the conference application, if accessible to me on a laptop / desktop.

Table 6.1: Survey - Items mapped to questions

4. All the required questions of the survey must be answered. The electronic survey enforced that policy, by not allowing submission before all the required questions were answered. This criteria is therefore only applicable to surveys given to participant on paper.

## 6.3 Results from usability testing

Knowledge in usability issues gathered from the specialization project were a key asset in preparing the conference application for usability testing. The issues found in the specialization project were mitigated before conducting usability testing in this project. The usability testing performed in this project found different bugs that has been removed, and resulted in different improvements to the user interface. This section presents the system usability scale scores, and the main issues and solution from two usability tests conducted to prepare for acceptance evaluation. The main issues are presented in bold text, together with its solution on the next line.

The application received a SUS-score of 92 at the first test, and 81.5 and the second test. See Figure 6.2 and 6.3 respectively. Both tests had different evaluators. Although there is a difference of 10.5 between the SUS evaluations, the score is acceptable.

### 6.3.1 Issues and mitigations

**The home-link in the menu was inconsistent. It changed relative to the last visited conference. This turned out to be confusing for the evaluators.**  
 Solution: The home-link was changed to always be the web page with all conferences.

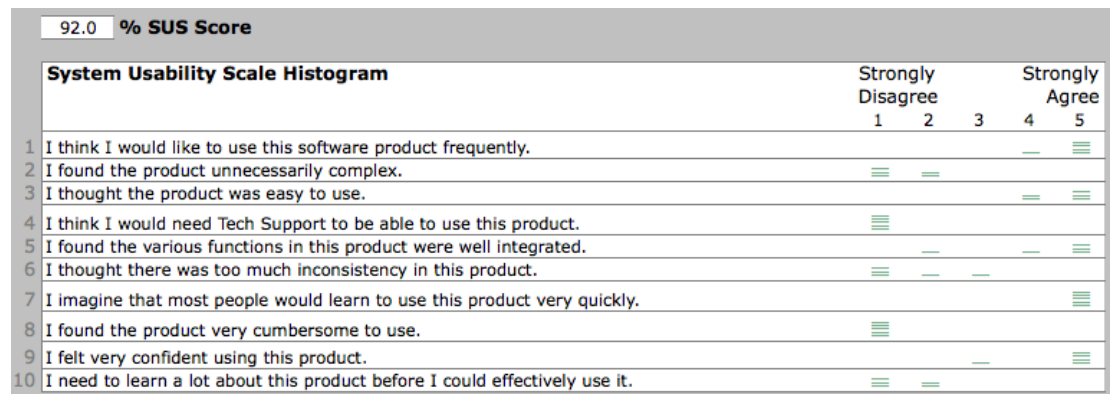


Figure 6.2: Usability testing - First test

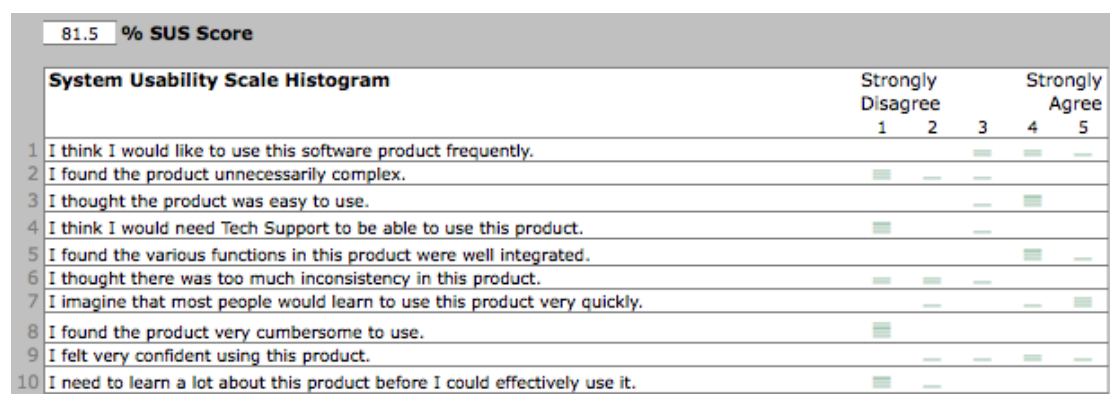


Figure 6.3: Usability testing - Second test

**When browsing the conference program, the evaluators often tried to click on the location name and expected to see something.**

Solution: The location was changed from plain text, to be a hyperlink, which allows navigation to the map.

**It was not very visible that it was possible to rate events. Most evaluators were not sure where to find it, and was surprised when they found it.**

Solution: Each event-element contains a text that explicitly says it is possible to give a rating.

**Messages in the newsfeed are not sorted in descending order by time. It was a bit confusing to find the latest message after scrolling through old messages.**

Solution: The messages are sorted in descending order by time.

**The events in the schedule is not sorted alphabetically.**

Solution: The events are sorted alphabetically.

Many of the evaluators tried to add events such as lunch, registration, and breaks to their personal schedule. Only the main events had a "add to schedule" button.

Solution: Users now have the freedom to add everything to their personal schedule.

## 6.4 Results from usage at the conference

This section presents and discusses the statistics collected from the usage of the conference application during the Læringsfestivalen 2015 conference. The conference had 300 participants from the university and college sector. It was held in the electro building and had a maximum of two parallel events. Participants could access the application at <https://turbo.uninett.no> during the conference.

Function	Hits
All conferences	1267
Schedule	676
Personal schedule (authenticated)	505
Events	752
Events (authenticated)	1036
Ratings (events)	162
Maps	2
Newsfeed	18

Table 6.2: The conference application - Usage statistics at Læringsfestivalen 2015

74 people that chose to create an account during the conference, and at least 24.7% of the conference participants chose to test the application.

Table 6.2 is a summation of the usage statistics in the period from 4. May 2015 08:00:00 to 6. May 2015 22:00:00. The function column represent a use case, and the hits column represent the total number of requests for that function. Hits may not be very accurate since multiple hits can be generated by refreshing the web page, and it could be kept open without any navigation to other pages or reloadings.

The least used functionalities are maps and newsfeed. Hits could be low since the conference area was not very large. It may not be much need for a map since the two auditoriums used was next to each other, and the lunch was very close to those rooms. The conference application was announced just a few days before the conference started, at which point the participants may already have seen the map over the area.

Only a few important messages had to be announced during the conference. The conference had its own chat room on an external third-party service where a few important messages were sent. In addition, Twitter was to some degree used.

The most used functionality was the schedule (requested 676 times), events, personal schedule, and ratings. There were 752 non-authenticated and 1036 authenticated requests for different events. When these numbers are added, they are high compared



to the schedule. A user could open the schedule once, then opening some events and reloading those web pages, or the events could be accessed from the personal schedule. The personal schedule requires being authenticated and was requested 505 times. It is created for a user if the user requests the web page from the menu or add an event to the schedule. 58 (78.37%) of the registered users created a personal schedule, however only 37 of them used the feature actively. It can not be said anything about how many times the users added and removed an event to the schedule since this is not logged. Best case, a user requested personal schedule approximately 8 times.

Ratings seemed to be popular. The results can be seen in Table 6.3. It was posted in total 162 event ratings from 34 unique users. The ratio is calculated based on the 34 unique users. The table contains two rows for each type that could be rated. Ratings with a comment is differentiated from those that did not have comments. A possible reason for the popularity could be that the conference did not have a system for posting ratings on single events during the conference. The application accepted ratings for the events immediately after they ended.

The rating of the conference was not very popular. The application started accepting ratings on the conference two hours before the conference ended. However, only four ratings for the conference were received. The conference administration used a survey given electronically at the end of the conference to accept ratings. This is something the participants are used to, and could be a reason for only four ratings.

Rating	Total	Ratio
Event	105	3.1
Event with comment	53	1.6
Conference	4	0.1
Conference with comment	0	0

Table 6.3: The conference application - Rating statistics from Læringsfestivalen 2015

## 6.5 Descriptive statistics

Both summary and frequency statistics are presented for all items. The summary tables includes the question in the survey, represented by an item, number of responses (N), mean, median, standard deviation, minimum (min) and maximum (max) values. The frequency table presents the distribution of responses. The score 1 to 3 is intended as the negative side of the scale, 4 as the neutral, and 5 to 7 as the positive side of the scale.

It should be noted that due to the way SPSS presents rounded numbers when displaying percentages with one decimal, they do not always sum up to 100%. However, despite the way SPSS presents the resulting data output, its calculations is with six decimals. For the summary tables, an asterisk marks some modes. It means multiple modes

exists for the item, but the lowest is presented in the table. The descriptive statistics are produced with IBM SPSS Statistics 21.

### **6.5.1 Conference survey**

The authors were present at the conference to provide support related to the application, or survey whenever needed. The participants received information about the survey when registering at the conference, some speakers mentioned the application in their session, and it was a notice in the conference application. However, only a few people actually had questions about the survey, mostly not related to the survey questions themselves, but rather such things as privacy issues concerning anonymity of the responses.

All participants except two responded to this survey directly on the internet. The last two responded by paper where they got some assistance in the form of clarification on survey questions. There are both possible positive and negative effects of the clarification the respondents received, such as the responses could be biased by the way in which the clarification was stated. Of the 300 participants at the conference, 70 responded to the survey, giving a response rate of 23.3%. There was 1 response to the English survey and 69 to the Norwegian. Only two people responded that they had not actually tried the application, however they chose to watch the presentation video. One person did not try the application nor watch the video, violating criteria 1 of Section 6.2.1. Therefore, the response is deemed invalid, making the valid response rate of the survey 98.6%. The summary statistics are presented in Table 6.5 and the distribution of responses in Table 6.6.

#### **6.5.1.1 Demographic variables**

The respondents represents the university and college sector and consisted of 49.3% females and 50.7% males, where most of them were between 30 and 59 years old. The results show 58% did use a smartphone when using the application, while 21.7% used a computer, and 17.4% used a tablet. Responses related to technological and conference experience are mostly medium to high, only 24.6% had experience with similar systems. However, they rarely knew the name of the application or had tried festival applications which may be similar in some ways. Only a few of them had used an actual conference application. Those that did not explore the application could choose to watch a short video that presented the conference application for the response to be deemed valid. Of the 2.9% that did not explore the conference application, one person did not watch the video. Even if the respondents examined the application with a device, they had the possibility to watch the video, which 82.6% did. The demography statistics can be seen in Table 6.4.

#### **6.5.1.2 Perceived usefulness**

The mean varies from 5.16 to 5.70, while the median for all items were 6, except for PU4 where it was 5. The modes were either 6 or 7. The responses range in the values from

Variable	Item	N	Percent
Gender	Female	34	49.3
	Male	35	50.7
Age	20-29	9	13.4
	30-39	17	24.6
	40-49	28	40.6
	50-59	13	18.8
	60-69	2	2.9
Technological experience	Low	3	4.3
	Medium	26	37.7
	High	40	58
Conference experience	Low	5	7.2
	Medium	24	34.8
	High	40	58
Experience with similar systems	Yes	17	24.6
	No	52	75.4
Device used to examine the conference application	Mobile	40	58
	Tablet	12	17.4
	Computer	15	21.7
	None	2	2.9
Saw the video about the application	Yes	57	82.6
	No	12	17.4

Table 6.4: Descriptive statistics - Conference survey - Demography

1 to 7 for the items PU1, PU2, and PU3, while it were 2-7 for PU4 and PU5.

Overall, the majority seems to found the conference application useful. By summarizing the percentages of respondents giving at least a score of 5 in PU5, 85.5% of the responses are on the positive side of the scale. From the distribution of responses in item PU1, it seems to mostly be easy to find and understand the conference program since there are 79.6% responses on the positive side of the scale, 11.6% neutral, and 8.6% at the negative side of the scale.

The responses in PU4 stands out and indicates that not everyone believed that the conference application would enhance their conference experience. 68.1% of the responses were positive on this account, however, 23.2% of the responses had the score of 4, and 23.2% had the score of 5, indicating some uncertainty about the usefulness.

### 6.5.1.3 Perceived ease of use

The mean varies from 4.97 to 5.44. Median and mode varies from 5 to 6, and the range of responses varies from 1 to 7.

From the responses in PEOU1, the application seems mostly to be easy to understand. However, the distribution of responses in PEOU3 are mixed with 10.1% of score 3, 26.1% of score 4, and 18.8% score 5, indicating it was not easy for all the evaluators to get the application to do what they want. In addition, the application did not always seem behave as the evaluators expected. In PEOU4, 17.4% of the responses were neutral, 34.8% had the score 5, 23.2% had the score 6, while only 11.6% had the score 7.

Item	N	Mean	Median	Mode	Standard deviation	Min	Max
PU1	69	5.42	6	6	1.29	1	7
PU2	69	5.48	6	6*	1.37	1	7
PU3	69	5.74	6	7	1.54	1	7
PU4	69	5.16	5	6	1.27	2	7
PU5	69	5.70	6	6	1.22	2	7
PEOU1	69	5.43	6	5	1.30	1	7
PEOU2	69	5.29	6	6	1.44	1	7
PEOU3	69	4.97	5	6	1.40	1	7
PEOU4	69	4.97	5	5	1.33	1	7
PEOU5	69	5.36	6	6	1.36	1	7
BI1	69	5.74	6	7	1.42	1	7
BI2	69	5.57	6	6*	1.47	1	7
BI3	69	5.14	5	7	1.64	1	7
BI4	69	4.80	5	4	1.79	1	7
BI5	69	4.43	4	4	1.91	1	7
BI6	69	4.25	4	4	1.97	1	7

Table 6.5: Descriptive statistics - Conference survey - Summary

### 6.5.1.4 Behavioral intention to use

The items BI1 and BI2 have overall better responses than the rest of the items, indicating that mobile is possibly more preferred. Next comes tablet, and lastly laptop/desktop.

## 6.5.2 Web survey

The web survey was sent by email to people at various colleges, universities, and companies in Norway. Roughly estimated it is believed that the email reached out to 500 people, while 132 responded, which give a response rate of 26.4%. For a response to be considered as valid, the respondent needed at least experience with conferences in the university and college sector, and the video about the application had to be watched. It

	1		2		3		4		5		6		7	
Item	N	%	N	%	N	%	N	%	N	%	N	%	N	%
PU1	1	1.4	0	0	5	7.2	8	11.6	19	27.5	21	30.4	15	21.7
PU2	1	1.4	0	0	6	8.7	8	11.6	16	23.2	19	27.5	19	27.5
PU3	1	1.4	2	2.9	5	7.2	6	8.7	9	13.0	15	21.7	31	44.9
PU4	0	0	2	2.9	4	5.8	16	23.2	16	23.2	21	30.4	10	14.5
PU5	0	0	1	1.4	5	7.2	4	5.8	12	17.4	29	42.0	18	26.1
PEOU1	1	1.4	0	0	4	5.8	10	14.5	19	27.5	18	26.1	17	24.6
PEOU2	2	2.9	1	1.4	6	8.7	7	10.1	15	21.7	26	37.7	12	17.4
PEOU3	2	2.9	0	0	7	10.1	18	26.1	13	18.8	20	29.0	9	13.0
PEOU4	2	2.9	0	0	7	10.1	12	17.4	24	34.8	16	23.2	8	11.6
PEOU5	2	2.9	0	0	3	4.3	12	17.4	15	21.7	23	33.3	14	20.3
BI1	1	1.4	2	2.9	3	4.3	6	8.7	9	13.0	23	33.3	25	36.2
BI2	1	1.4	2	2.9	4	5.8	9	13.0	9	13.0	22	31.9	22	31.9
BI3	2	2.9	2	2.9	8	11.6	12	17.4	12	17.4	14	20.3	19	27.5
BI4	5	7.2	3	4.3	5	7.2	18	26.1	11	15.9	11	15.9	16	23.2
BI5	6	8.7	8	11.6	6	8.7	16	23.2	8	11.6	13	18.8	12	17.4
BI6	9	13.0	7	10.1	6	8.7	17	24.6	7	10.1	12	17.4	11	15.9

Table 6.6: Descriptive statistics - Conference survey - Frequency

were 32 responses, which was deemed invalid, causing a valid response rate of 75.75%. The summary statistics are presented in Table 6.8 and the distribution of responses in Table 6.9.

#### 6.5.2.1 Demographic variables

The respondents consisted of 33% females and 67% males, with the mode age range of 50-59 (27%). However, there were 25% between 20-29, 21% between 30-39, and 22% between 40-49. Their technological and conference experience were mostly medium and high, with high as the mode on both. It were 27% of the respondents that had experience with different conference and somewhat similar applications, while others did not remember the name of the application. There were 64% that never had used a similar system, and 9% were not sure what to respond. A computer was the most popular device to examine the application. Only 3% used a tablet, while 20% used mobile, and 49% used computer. The rest 28% chose to only watch the video about the application. The demography are presented in Table 6.7.

#### 6.5.2.2 Perceived usefulness

The lowest mean is 5.18 for PU4, while the highest is 5.93 for PU1. Overall, most of the respondents seem to find the application useful in PU5. However, the distribution of responses in PU4 indicates that the conference experience would not always be enhanced

Variable	Item	N	Percent
Gender	Female	33	33
	Male	67	67
Age	10-19	1	1
	20-29	25	25
	30-39	21	21
	40-49	22	22
	50-59	27	27
	60-69	4	4
Technological experience	Low	1	1
	Medium	19	19
	High	80	80
Conference experience	Low	6	6
	Medium	30	30
	High	64	64
Experience with similar systems	Yes	27	27
	No	64	64
	Not sure	9	9
Device used to examine the conference application	Mobile	20	20
	Tablet	3	3
	Computer	49	49
	None	28	28
Saw the video about the application	Yes	100	100

Table 6.7: Descriptive statistics - Web survey - Demography

the same degree. At the negative side of the scale, there are 12% of the responses, 19% neutral, and 20% with the score of 5. In addition, it seems to be some uncertainty about the need of a paper program. There are 21% responses at the negative side of the scale and 11% neutral.

### 6.5.2.3 Perceived ease of use

The intervals between the responses are mostly 3 to 7, while it is 2 to 7 for the item PEOU4. However, 17% gave the score 7, 34% score 6, 25% score 5, and 18% score 4. It seems like the application did not always behave as expected.

The application mostly seems to be easy to use and understand in PEOU1, while PEOU2 indicate it do not require much concentration to use it. However, the results from item PEOU3 indicates not everyone think it is easy to make the application do

Item	N	Mean	Median	Mode	Standard deviation	Min	Max
PU1	100	5.93	6	6	0.99	2	7
PU2	100	5.58	6	6	1.22	1	7
PU3	100	5.28	6	7	1.92	1	7
PU4	100	5.18	5	6	1.47	1	7
PU5	100	5.76	6	6	1.15	1	7
PEOU1	100	5.79	6	6*	1.06	3	7
PEOU2	100	5.75	6	6	1.04	3	7
PEOU3	100	5.42	6	6	1.09	3	7
PEOU4	100	5.37	6	6	1.17	2	7
PEOU5	100	5.70	6	6	1.06	3	7
BI1	100	5.77	6	7	1.50	1	7
BI2	100	5.45	6	7	1.67	1	7
BI3	100	4.76	5	7	2.06	1	7
BI4	100	4.49	5	7	2.13	1	7
BI5	100	5.01	5	7	1.80	1	7
BI6	100	4.78	5	6	1.87	1	7

Table 6.8: Descriptive statistics - Web survey - Summary

	1		2		3		4		5		6		7	
Item	N	%	N	%	N	%	N	%	N	%	N	%	N	%
PU1	0	0	1	1	1	1	6	6	18	18	44	44	30	30
PU2	1	1	1	1	3	3	13	13	21	21	38	38	23	23
PU3	4	4	10	10	7	7	11	11	10	10	17	17	41	41
PU4	1	1	6	6	5	5	19	19	20	20	29	29	20	20
PU5	1	1	1	1	1	1	7	7	28	28	32	32	30	30
PEOU1	0	0	0	0	2	2	10	10	26	26	31	31	31	31
PEOU2	0	0	0	0	3	3	9	9	24	24	38	38	26	26
PEOU3	0	0	0	0	2	2	23	23	24	24	33	33	18	18
PEOU4	0	0	1	1	5	5	18	18	25	25	34	34	17	17
PEOU5	0	0	0	0	3	3	12	12	21	21	40	40	24	24
BI1	3	3	2	2	5	5	4	4	19	19	25	25	42	42
BI2	4	4	4	4	5	5	10	10	20	20	21	21	36	36
BI3	11	11	6	6	11	11	15	15	12	12	15	15	30	30
BI4	13	13	10	10	11	11	14	14	10	10	17	17	25	25
BI5	4	4	7	7	13	13	12	12	15	15	22	22	27	27
BI6	5	5	11	11	13	13	11	11	13	13	26	26	21	21

Table 6.9: Descriptive statistics - Web survey - Frequency

what they want. Item PEOU4 has 18% neutral responses and 25% with score 5, which could indicate that it did not always behave as the respondents expected. Item PEOU5 indicates that not everyone found the application equally useful, where 12% gave the score of score 4, 25% score 5, 40% score 6, and 24% of score 7.

#### **6.5.2.4 Behavioral intention to use**

The results indicates that computer is more popular than tablet, while mobile is the most popular platform. The distribution of responses are visually presented in Table 7.1.

## **6.6 Statistical analysis**

The statistical analysis is conducted with SmartPLS version 3.2.1. The assessment of reliability and validity are performed with a partial least square analysis, while the significance of the hypothesis are determined with bootstrapping. This section first presents the results from the assessment of reliability and validity for both surveys, then significance of the hypothesis are assessed with the results from bootstrapping.

### **6.6.1 Results from the assessment of the measurement model**

This section presents the assessment of the measurement model for both surveys. It shows that the data can be considered reliable and valid.

#### **Reliability**

The reliability is assessed by examining Cronbach's alpha. Table 6.10 shows the alpha value for all constructs on both surveys. The lowest observed alpha for the conference survey is 0.846, and 0.857 for the web survey. This is well above the minimum requirement of 0.6, and shows that the data can be considered reliable.

#### **Convergent validity**

Table 6.10 shows the AVE number for both surveys. The lowest observed AVE is 0.621 in the conference survey, and 0.640 in the web survey. This is higher than the requirement of 0.5. Hence, convergent validity is established.

#### **Discriminant validity**

Discriminant validity has been assessed by evaluation with Fornell-Larcker criteria, cross loadings, and the heterotrait-monotrait ratio of correlations technique (HTMT). Results from Fornell-Larcker and HTMT are shown in Table 6.11 and 6.12, while cross-loadings can be found in Appendix F.1. The results shows that discriminant validity is established with all three techniques by the different criteria in Table 4.2.



Platform	Construct	Conference survey		Web survey	
		Cronbach's alpha	AVE	Cronbach's alpha	AVE
Mobile	BI	0.964	0.965	0.899	0.908
	PEOU	0.923	0.766	0.925	0.771
	PU	0.846	0.622	0.857	0.641
Tablet	BI	0.915	0.921	0.942	0.945
	PEOU	0.923	0.766	0.925	0.771
	PU	0.846	0.622	0.857	0.641
Computer	BI	0.957	0.958	0.940	0.944
	PEOU	0.923	0.766	0.925	0.771
	PU	0.846	0.621	0.857	0.640

Table 6.10: Statistical analysis - Cronbach's alpha and AVE numbers

Platform	Construct	Fornell-Larcker			HTMT		
		BI	PEOU	PU	BI	PEOU	PU
Mobile	BI	0.982	-	-	-	-	-
	PEOU	0.563	0.875	-	0.587	-	-
	PU	0.710	0.763	0.789	0.780	0.840	-
Tablet	BI	0.960	-	-	-	-	-
	PEOU	0.349	0.875	-	0.368	-	-
	PU	0.491	0.762	0.789	0.554	0.840	-
Computer	BI	0.979	-	-	-	-	-
	PEOU	0.298	0.875	-	0.311	-	-
	PU	0.263	0.767	0.788	0.284	0.840	-

Table 6.11: Statistical analysis - Conference survey - Assessment of discriminant validity using Fornell-Larcker Criterion and HTMT

## 6.6.2 Results from the assessment of the structural model

Figure 6.4 shows the structural model for the conference survey, and Figure 6.5 shows the structural model for the web survey. They contain values for path coefficients next to the arrows and T-values in parenthesis, while  $R^2$  values are shown in the circles. They are presented for the different platforms mobile, tablet and pc respectively.

### 6.6.2.1 Conference survey

H1 was significant on all platforms, while H2 was not significant on any platform. H3 was significant on mobile with a significance level of 0.001, and 0.01 for tablet. Overall, the research model is able to explain 50.5%, 24.2%, and 9.2% of the variance for mobile, tablet, and pc respectively.

Platform	Construct	Fornell-Larcker			HTMT		
		BI	PEOU	PU	BI	PEOU	PU
Mobile	BI	0.953	-	-	-	-	-
	PEOU	0.535	0.878	-	0.586	-	-
	PU	0.676	0.657	0.801	0.770	0.732	-
Tablet	BI	0.972	-	-	-	-	-
	PEOU	0.343	0.878	-	0.367	-	-
	PU	0.454	0.661	0.800	0.497	0.732	-
Computer	BI	0.971	-	-	-	-	-
	PEOU	0.387	0.878	-	0.413	-	-
	PU	0.478	0.661	0.800	0.516	0.732	-

Table 6.12: Statistical analysis - Web survey - Assessment of discriminant validity using Fornell-Larcker Criterion and HTMT

#### 6.6.2.2 Web survey

H1 were significant for all platforms, while H2 were not significant on any platform. H3 was significant on mobile with the significance level of 0.001, and significant for tablet and computer with 0.01. Overall, the research model is able to explain 47.2%, 20.9%, and 23.7% of the variance for mobile, tablet, and pc respectively.

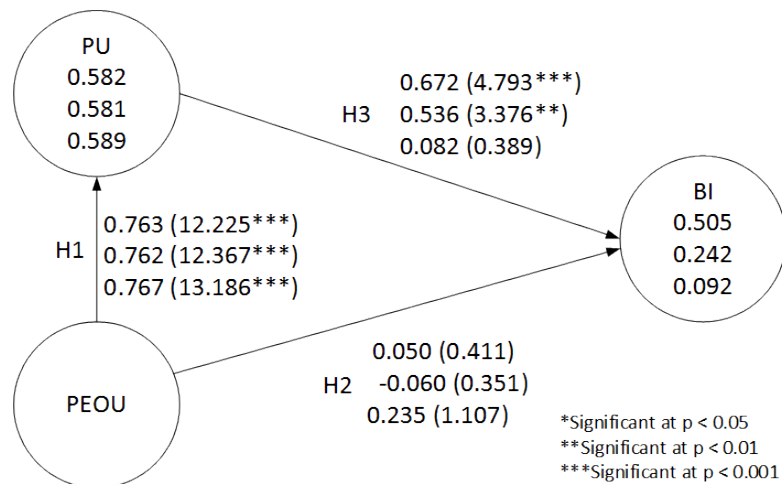


Figure 6.4: Statistical analysis - Conference survey - The structural model

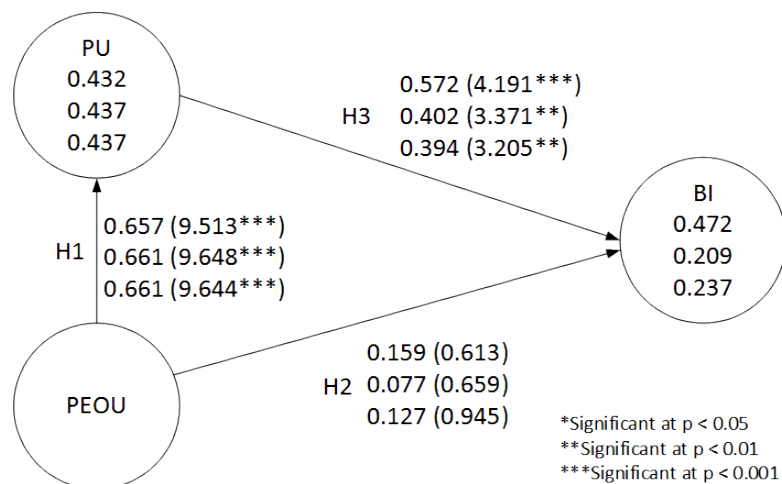


Figure 6.5: Statistical analysis - Web survey - The structural model



## Chapter 7

# Discussion

This chapter first discusses the research questions and results, and then it presents theoretical and practical implications from this study, and last limitations of this study.

Hypothesis	Platform	Conference survey		Web survey	
		Path coefficient	Significant at	Path coefficient	Significant at
H1 $PEOU \rightarrow PU$	Mobile	0.763	$p < 0.001$	0.657	$p < 0.001$
	Tablet	0.762	$p < 0.001$	0.661	$p < 0.001$
	Computer	0.767	$p < 0.001$	0.661	$p < 0.001$
H2 $PEOU \rightarrow BI$	Mobile	0.050	Not significant	0.159	Not significant
	Tablet	-0.060	Not significant	0.077	Not significant
	Computer	0.235	Not significant	0.127	Not significant
H3 $PU \rightarrow BI$	Mobile	0.672	$p < 0.001$	0.572	$p < 0.001$
	Tablet	0.536	$p < 0.01$	0.402	$p < 0.01$
	Computer	0.082	Not significant	0.394	$p < 0.01$

Table 7.1: Discussion - Assessment of hypotheses

### 7.1 Technology acceptance model for responsive conference applications in the university and college sector

Intention to use on the mobile platform in both the conference and web survey could explain 50.5% and 47.2% which are good compared to the other studies that were able to explain 35.2% to 73% of the variance of intention to use [29, 28, 32, 38, 12]. However, the  $R^2$  values for computer and tablet in both surveys fall short of this range. The research model were able to explain 24.2% and 20.9% of the variance on intention to use tablet, while only 9.2% and 23.3% of the variance to use computer.

H1 was significant on all platforms in both surveys and had the strongest path coefficients, indicating that perceived ease of use had a good effect on perceived usefulness

throughout both surveys. In the conference survey the  $R^2$  values for perceived usefulness were 58.2%, 58.1%, and 58.9%, while it were 43.2%, 43.7%, and 43.7% in the web survey for mobile, tablet and computer respectively. These results seems good when compared to the other studies, which have been able to explain 10% to 66.3% of the variance in perceived usefulness.

The results in both surveys rejects H2 which could be due to high expectations of user interfaces, or the fact that the users care more for the functionality than the user interface. Davis et al. has found that the strength of the relationship between PEOU and BI decreases with time for a specific system [12], however it has also been found to increase over time [77]. It stands to reason that previous applications, both directly and indirectly related to the application in question, lays the foundation for the expectations for future applications. In addition, 64% and 75.4% of the respondents in both surveys did not have experience with similar systems, but they had good technological experience. If the study from Davis et al. holds for applications in general, it could be due to advances in technology and changes in the society. However, this indirectly states that conducting additional analysis will still reject H2. In fact, it would give a worse result for H2. The survey results indicates issues related to the user interface or possibly user experience, sometimes supported by the comments in Appendix G. The issues may be rooted in the available resources to design the user interface. More time were spent on learning different tools and frameworks for designing web interfaces than on the design. The conduction of usability testing had an exclusive focus on the mobile platform, due to the assumption that people would prefer to use their smart phone on the conference. The exclusive focus could have caused a less effective and efficient user interface, and possibly other challenges with the user interface. This again could indicate that there is a need for major improvements of the user interface for perceived ease of use to directly positively affect intention to use. However, other acceptance studies sometimes show a weaker or non-significant relationship between perceived ease of use and intention to use, while the relationship between perceived usefulness and intention to use is significant [28, 29, 69, 32], which seems to be true for this study as well. Kozar et al. [37] reviewed 101 articles published by leading IS journals and conferences, and found that only 58 of those studies showed a significant relationship between perceived ease of use and dependent variables. They further argue that perceived ease of use might be an unstable measure in predicting intention to use. Subramanian [69] states that a possible reason for the unstable measure is that systems which are relatively easy to use due to expectations set by previous systems, perceived usefulness has less or no impact on the intention to use. This could indicate that the research model is not adequate for acceptance testing and that perceived ease of use have no direct positive effect on intention to use on platform independent conference applications in the university and college sector.

In the conference survey, H3 was rejected for the computer platform. This indicates that, even though the application could be seen as useful, it may not be used on a computer. This could be due to such a simplicity as compared to a smart phone or tablet, a laptop may be seen as cumbersome to carry around on conferences. When attending a conference, one might need to access the application immediately, regardless

of time and place, which may partially explain the increase in perceived usefulness and thus its implication on intention to use for mobile and tablet, and the rejection of H3 for computer. However, this was not the case in the web survey where H3 was significant on the computer platform. One might argue that the respondents' state of mind had an impact on the results in that the conference survey respondents had an accurate conference context in mind, while the web respondents did not. In addition, the results of the web survey are based on a larger data set that might have affected the outcome. The analysis of subgroups indicates that respondents, regardless of the device they used to examine the application, were most positive to the mobile platform. However, even though they were often close to be deemed valid, validity tests were inconclusive making the results questionable. The summary of the analysis can be seen in Appendix F.2.

One might question if the technology acceptance model is too simplistic in this case. The model is criticized for having limited extensibility and explanatory power [3, 1]. It might be that peoples' expectation of applications has grown out of the model's explanatory boundaries, which may be a possible reason for the weak or non-significant relationship between perceived ease of use and intention to use in our results. However, other studies again shows a significant relationship between these constructs [38, 72, 73, 47, 13]. In addition, acceptance studies tends to focus on one platform and not consider differences between multiple platforms [29, 38, 42, 37]. There might be a need to consider extending the research model with additional variables, or another research model all together, to account for such variables as platform.

## 7.2 The interest for conference applications in the university and college sector

The distribution of responses are visually presented in Figure 7.1. A positive response is defined as a response with a score from 5 to 7. In the conference survey, the items BI1 and BI2 received 84.5% and 76.8% positive responses respectively. The same items received 86% and 77% positive responses in the web survey. The interest for using tablets, measured by BI3 and BI4 received 65.2% and 55% positive responses respectively in the conference survey, while they were 57% and 52% in the web survey. The interest for using computers, measured by BI5 and BI6 received 46.3% and 43.4% positive responses respectively in the conference survey, while they were 64% and 60% in the web survey.

The results indicate that BI questions starting with "I would like to use..." scored better than questions starting with "I am going to use...". There is a possibility that the first statement may be interpreted as wider and less specific than the latter. By following this logic, the results are not surprising. The statements can be mapped to Rogers innovation diffusion theory's symbolic adoption and use adoption [62]. "I would like to use..." is accepting the idea, while "I am going to use..." is accepting the innovation itself. Thus, the result show that the idea of a conference application is good and the diffusion of the conference application follows closely behind.

In addition, the results indicate that the most preferred device in both surveys are mobile. However, the participants in the web survey are more positive to computer

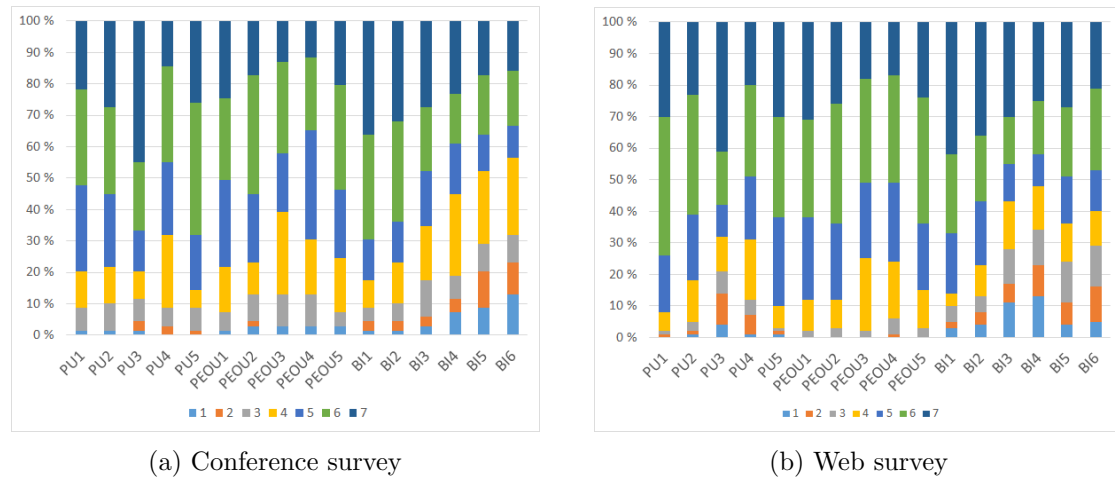


Figure 7.1: Discussion - The distribution of responses in the surveys

than tablet, unlike the participants in the conference survey. The  $R^2$  values from the structural model in both surveys supports these results.

## 7.3 Implications of this research

The results indicate that perceived usefulness has a strong positive effect on the intention to use on the mobile platform, and a low to mild effect on intention to use on the tablet and computer platforms. Perceived ease of use seems to have no direct effect on intention to use. However, it has an indirect effect on intention to use through a strong positive effect on perceived usefulness. Together with the developed application, this has several practical implications for both marketers and institutions considering the development of conference applications. In addition, it has some theoretical implications.

### 7.3.1 The technology acceptance model

The theoretical implications of the technology acceptance model can be found in Section 7.1.

### 7.3.2 The innovation diffusion theory

According to the innovation diffusion theory, technology gains momentum and diffuses through five different adopter groups. Some of those groups are generally more skeptical and do not choose to adapt the technology before the majority has tried it first. Based on this theory and the surveys response rate, it seems that innovators, early adopters and parts of the early majority responded to the surveys. In addition, in the conference and web survey, there were 52% and 64% respondents respectively that did not have any experience with similar systems beforehand. This further supporting the hypothesis



that innovators, early adapters and some of the early majority were the ones testing, and providing feedback on the application due to their willingness to test innovations. If the conference application had been used for a longer period, it could gain a larger momentum, implying other groups would possibly provide more critical feedback to the surveys, and in addition increasing the sample size.

### **7.3.3 The usability principles of Gould & Lewis**

The principles suggested by Gould & Lewis has been followed in this project [26]. Through the iterative design cycles, it has been an exclusive usability focus on the mobile platform. The results for the mobile platform were improved for each iteration. In addition, the results from usability testing in Chapter 6.3 shows that the improved properties is common on each platform. Consequently, the user interface seems to have successfully been improved with the use of the principles suggested by Gould & Lewis independent on the platform.

### **7.3.4 Marketing of the conference application solution**

The solution combines multiple third-party packages, and a framework released under a permissive license such as MIT which allows the commercialization of the software. In today's society, applications are expected to be available on multiple platforms such as pc, mobile, and tablet. The developed conference application accounts for the expectation due to its platform independence, and allows adding other web, native or hybrid applications. If the application is further developed and reaches its vision, giving everyone the possibility to self-manage conferences, this can be seen as a good argument for the commercialization.

The results would seem to indicate that when developing or marketing conference applications one should focus on the functionality that improves its usefulness as the main priority. Investing time to improve or market the ease of use would enhance peoples' perceived usefulness and thus intention to use. However, since no direct positive correlation were found between perceived ease of use and intention to use, the ease of use should be considered less important than the usefulness.

### **7.3.5 Development of the conference application solution**

Developers share some of the implications of the results as seen in Section 7.3.4, while concrete suggestions are presented in Chapter 8.3. In addition, Appendix E contains various technical details and tips.

#### **7.3.5.1 The web application**

What type of application that should be developed depend on the requirements [71]. While the web application is developed with technology that normally require little time and cost, it may fall short when there is a need to utilize specific functionality such as offline technology, push notifications, and integration with the calendar on the

respective device. Technology such as offline functionality is possible to realize, however its implementation may be cumbersome if one is to support multiple browsers since they tend to be slow in supporting new APIs in the W3C specification.

The developed web application can not be said to necessarily be a good starting point. For a more complex solution, it might be better alternatives that would make requirements such as applying different themes easier, and provide complex functionality out of the box. Anyway, the web application contain multiple concepts and principles that can be used in further work and a web application should definitely be available. While a web application is useful, a native application for mobile and tablet should be developed to cope with challenges related to offline capabilities, push notifications, and calendar integration.

#### **7.3.5.2 The API**

The API was developed for the conference application solution as suggested in the specialization project [71]. The Laravel framework that has proven itself be easy to modify and extend. However, while the suggestion still is to use an API, it does not necessarily have to be restricted to the specific framework used in this study. Concepts seen in the sequence diagram in Figure 5.12 are applied. They allow the placement of responsibility more correctly, while retaining loose coupling and high cohesion. Thus, the concepts, and the API can be said to be a decent basis for further development.

#### **7.3.5.3 The domain model**

The domain model is partly built upon results from the specialization project [71] where it was collected information about the conference domain. The domain model shown in Figure 5.1 reflect and relates concepts in the conference domain. The usage of polymorphic relations reduces the complexity and increases its extendability. However, this may be a feature specific for the chosen framework, while it should be possible to develop similar solutions if using a different framework. Overall, the model can be said to be a starting point for further development.

### **7.4 Limitations**

#### **7.4.1 The use of a modified Likert-scale**

While the scale used in this study is common in market and social research interviews, there are research that indicates the choice of scale affects the result [57, 39]. This study used labels only in the endpoints, and may have affected the results.

#### **7.4.2 One survey and multiple platforms**

By giving the respondents an option between three different platforms, might unintentionally have affected the results. If a respondent have the option to choose between

platforms, the respondent may favor one platform over others. Thus, the results may not necessarily be independent of each other. By limiting the study to one platform at a time, the results might differ. It would be interesting to conduct multiple studies, each restricted to one platform, to see if it would show results where the hypothesis can not be rejected. However, one could argue that due to the application's platform independent nature, people should have the ability to choose the platform themselves, which is reflected in the survey.

#### **7.4.3 The sample size**

The size of the data sets can be questioned. The sample size from the conference survey was 69, while 100 from the web survey. Gefen et al. [24] states that the data set should be at least 10 times the number of items in the most complex construct. However, the required size is debated and too often found to be inadequate according to [81]. H3 was significant for all platforms in the web survey, while not for computer in the conference survey. There is a possibility that the results from both surveys would be different with a larger sample size.



## Chapter 8

# Conclusion and further work

### 8.1 Conclusion

The objective in this project was to investigate the user acceptance of a responsive and platform independent conference application, and investigate the interest of such an application in the university and college sector.

Two surveys were used to collect data for the evaluation. The first survey targeted participants of a real conference in the university and college sector, while the other targeted people not attending to that specific conference.

The data analysis was performed with structural equation modeling and partial least square analysis intended to answer the two research questions which has guided the project

1. Is there an interest for a conference application in the university and college sector?
2. How applicable is the technology acceptance model for responsive platform independent conference applications in the university and college sector?

The results show that there is an interest for conference applications in the university and college sector. In addition, it shows that mobile is the most preferred device to use. However, the results from the two surveys contradicts each other on the second and third most preferred device. The results also show that perceived usefulness is the major determinant for intention to use, while perceived ease of use indirectly affects intention to use.

### 8.2 Further research

#### 8.2.1 Longitudinal study

The majority of the evaluators did not have experience with conference applications or similar applications. In addition, they did not use the application over a longer period. The respondents in the conference survey may have used the application of a maximum of

two days. The respondents in the web survey barely examined the application, however, everyone saw the video. By conducting a longitudinal study and collect data from the same subjects to investigate the intention to use the application and see how it may change over time.

### 8.2.2 Research model

Simplicity, rejected hypothesis, and contradicting results show that it may be a need to add other variables to the research model. While the research model is able to explain much of the variance for intention to use, further research should extend the technology acceptance model with additional variables, or apply a different research model to investigate how other variables would affect the intention to use conference applications.

## 8.3 Further work with the conference application solution

The solution is not a complete system based on the requirement list. There are requirements in the list that would be interesting to implement and evaluate. For instance, a requirement that has in particular been found interesting by administrators is PFR2, which is related to an automatic program scheduling tool.

While it is clearly important, there is no interface for the administration of a conference. The administrator of a conference should be able to create programs, surveys, post messages in the newsfeed, send messages to specific users, and access different statistics.

In addition, some specific improvements was identified during the project, but was not dealt with due to limited time. These improvements are presented next

**API** The error message format of the API can be improved. By mapping error codes to specific errors, it may be easier to implement translation between languages and the meaning of an error if the implementation is to be conducted at the client side.

**API** The API should be documented and a system for documentation should be implemented.

**Web application** If one is to be able to self-manage a conference from the web application, it should be easy to create a program and customize the design in a user friendly manner. This should be investigated closer to ensure that a decent solution is applied.

**Web application** To comply with the laws in a respective country, the application need a system that ensures that the visitors are informed about details such as cookies and the information the application will store.

**The solution as whole** Depending on how the web solution is hosted and implemented, requirements related to scaling should be considered. The users expect the application to be fast, and do not want to wait.

**Domain model** There is no such requirement to account tracks in a conference program, and there is no such requirement to account for that one session in a program may consist of multiple small sessions. In addition, having target groups related to a session were discovered as a useful functionality during the project. These are requirements that at least should be added and implemented in both the requirement list and domain model.





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# Appendix A

## Surveys

The surveys were labeled in the endpoints. The labels are placed inside parenthesis.

### A.1 Conference survey

#### A.1.1 English version

##### About you

Gender

- ☐ Male ☐ Female

Age

- ☐ 10-19 ☐ 20-29 ☐ 30-39 ☐ 40-49 ☐ 50-59 ☐ 60-69 ☐ 70-79

Technology experience. How would you rate your skills with computers / smart phones / tablets?

- ☐ 1 (Low) ☐ 2 ☐ 3 (High)

Conference experience. How would you rate your conference experience?

- ☐ 1 (Low) ☐ 2 ☐ 3 (High)

Do you have experience with other similar applications?

- ☐ Yes ☐ No

If you answered yes on the previous question, what was the name of the application?

What type of device did you mainly use at the conference?

- ☐ Smartphone ☐ Tablet ☐ Computer ☐ I did not test the application

Did you watch the video about the conference application?

- ☐ Yes ☐ No

By participating in this survey and submitting your email, you have a chance to win a price. The email address will not be used for other purposes other than to contact you if you win.

### Perceived Usefulness

Please consider the conference application as a whole while answering the following statements:

By using the conference application I can quickly find and understand the conference schedule for my conference.

- ☐ 1 (Strongly disagree) ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 (Strongly agree)

By using the conference application I can decide which event I want to attend quickly and without hassle.

- ☐ 1 (Strongly disagree) ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 (Strongly agree)

By using the conference application I do not need the paper program.

- ☐ 1 (Strongly disagree) ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 (Strongly agree)

I think my conference experience would be enhanced by using the conference application.

- ☐ 1 (Strongly disagree) ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 (Strongly agree)

Overall, I find the conference application useful.

- ☐ 1 (Strongly disagree) ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 (Strongly agree)

### Perceived Ease Of Use

Please consider the conference application as a whole while answering the following statements:

The conference application is easy for me to understand.

- ☐ 1 (Strongly disagree) ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 (Strongly agree)



Using the conference application does not require much concentration.

- ☐ 1 (Strongly disagree) ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 (Strongly agree)

I think it's easy to get conference application to do what I want it to do.

- ☐ 1 (Strongly disagree) ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 (Strongly agree)

The conference application behaves as I expect.

- ☐ 1 (Strongly disagree) ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 (Strongly agree)

Overall, I find the conference application easy to use.

- ☐ 1 (Strongly disagree) ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 (Strongly agree)

### **Intention To Use**

Please consider the conference application as a whole while answering the following statements:

I would like to use the conference application, if accessible to me on a smart phone.

- ☐ 1 (Strongly disagree) ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 (Strongly agree)

I am going to use the conference application, if accessible to me on a smart phone.

- ☐ 1 (Strongly disagree) ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 (Strongly agree)

I would like to use the conference application, if accessible to me on a tablet.

- ☐ 1 (Strongly disagree) ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 (Strongly agree)

I am going to use the conference application, if accessible to me on a tablet.

- ☐ 1 (Strongly disagree) ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 (Strongly agree)

I would like to use the conference application, if accessible to me on a laptop / desktop.

- ☐ 1 (Strongly disagree) ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 (Strongly agree)

I am going to use the conference application, if accessible to me on a laptop / desktop.

- ☐ 1 (Strongly disagree) ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 (Strongly agree)

### Your thoughts (voluntary)

Please share your thoughts. Is there anything you want to share with us after using the conference application? Some relevant information you feel that the evaluation did not cover? Do you have any ideas?

### A.1.2 Norwegian version

#### Litt om deg

Kjønn

- ☐ Mann ☐ Kvinne

Alder

- ☐ 10-19 ☐ 20-29 ☐ 30-39 ☐ 40-49 ☐ 50-59 ☐ 60-69 ☐ 70-79

Teknologisk erfaring. Hvordan vil du vurdere dine ferdigheter med datamaskiner / smarttelefoner / nettbrett?

- ☐ 1 (Lav) ☐ 2 ☐ 3 (Høy)

Konferanseerfaring. Hvordan vil du vurdere din konferanseerfaring?

- ☐ 1 (Lav) ☐ 2 ☐ 3 (Høy)

Har du erfaring med andre lignende systemer?

- ☐ Ja ☐ Nei

Hvis du svarte ja på forrige spørsmål, hva var navnet på systemet?

Hvilken type enhet har du hovedsakelig brukt for å undersøke applikasjonen?

- ☐ Smarttelefon ☐ Nettbrett ☐ Datamaskin ☐ Jeg har ikke undersøkt applikasjonen

Har du sett videoen om konferansen applikasjonen?

- ☐ Ja ☐ Nei

Ved å delta i denne undersøkelsen, og oppgir din epost-adresse, har du en sjanse til å vinne en iPad mini 3 Wi-Fi 16 GB – stellargrå! Epostadressen vil ikke bli brukt til andre formål enn å kontakte deg dersom du vinner.

### Opplevd nytteverdi

Vennligst vurder konferanseapplikasjonen i sin helhet mens du svarer på påstandene nedenfor.

Ved å bruke konferanseapplikasjonen kan jeg raskt finne og forstå konferanseprogrammet.

- ☐ 1 (Helt uenig) ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 (Helt enig)

Ved å bruke konferanseapplikasjonen kan jeg raskt bestemme meg for hvilke hendelser jeg ønsker å delta på.

- ☐ 1 (Helt uenig) ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 (Helt enig)

Ved å bruke konferanseapplikasjonen har jeg ikke behov for papirprogrammet.

- ☐ 1 (Helt uenig) ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 (Helt enig)

Jeg tror konferanseapplikasjonen vil forbedre min konferanseopplevelse.

- ☐ 1 (Helt uenig) ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 (Helt enig)

Alt i alt synes jeg at konferanseapplikasjonen er nyttig.

- ☐ 1 (Helt uenig) ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 (Helt enig)

### Opplevd brukervennlighet

Vennligst vurder konferanseapplikasjonen i sin helhet mens du svarer på påstandene nedenfor.

Konferanseapplikasjonen er lett for meg å forstå.

- ☐ 1 (Helt uenig) ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 (Helt enig)

Å bruke konferanseapplikasjonen krever ikke mye konsentrasjon.

- ☐ 1 (Helt uenig) ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 (Helt enig)

Jeg synes det er lett å få konferanseapplikasjonen til å gjøre det jeg vil den skal gjøre.

- ☐ 1 (Helt uenig) ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 (Helt enig)

Konferanseapplikasjonen oppfører seg som jeg forventer.

- ☐ 1 (Helt uenig) ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 (Helt enig)

Alt i alt synes jeg at konferanseapplikasjonen er enkel å bruke.

- ☐ 1 (Helt uenig) ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 (Helt enig)

## Brukerintensjon

Vennligst vurder konferanseapplikasjonen i sin helhet mens du svarer på påstandene nedenfor.

Jeg kunne tenkt meg å bruke konferanseapplikasjonen, om den er tilgjengelig for meg på en smarttelefon.

- ☐ 1 (Helt uenig) ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 (Helt enig)

Jeg kommer til å bruke konferanseapplikasjonen, om den er tilgjengelig for meg på en smarttelefon.

- ☐ 1 (Helt uenig) ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 (Helt enig)

Jeg kunne tenkt meg å bruke konferanseapplikasjonen, om den er tilgjengelig for meg på et nettbrett.

- ☐ 1 (Helt uenig) ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 (Helt enig)

Jeg kommer til å bruke konferanseapplikasjonen, om den er tilgjengelig for meg på et nettbrett.

- ☐ 1 (Helt uenig) ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 (Helt enig)

Jeg kunne tenkt meg å bruke konferanseapplikasjonen, om den er tilgjengelig for meg på en desktop/laptop.

- ☐ 1 (Helt uenig) ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 (Helt enig)

Jeg kommer til å bruke konferanseapplikasjonen, om den er tilgjengelig for meg på en desktop/laptop.

- ☐ 1 (Helt uenig) ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 (Helt enig)

## Dine tanker (frivillig)

Del dine tanker med oss. Er det noe du ønsker å dele med oss etter bruk av konferanseapplikasjonen? Noen relevant informasjon du føler at evalueringen ikke dekker? Har du noen ideer?

## A.2 Web survey

In addition to the questions in the conference survey, the web survey had one additional question related to demography where the respondents responded which sector their experience came from. In addition, there was one question that were expanded with an "I don't know" option. These two questions are presented.

### A.2.1 English version

I have attended conferences within...

- ☐ The college / university sector ☐ The private sector ☐ I have never attended any conferences ☐ Other

Do you have experience with other similar applications?

- ☐ Yes ☐ No ☐ I don't know

### A.2.2 Norwegian version

Jeg har deltatt på konferanser innen...

- ☐ Høgskole- og universitetssektoren ☐ Privat sektor ☐ Jeg har aldri deltatt på konferanser ☐ Annet

Har du erfaring med andre lignende systemer?

- ☐ Ja ☐ Nei ☐ Vet ikke



## Appendix B

# Jakob Nielsen's 10 usability heuristics

The following list describes the usability heuristics suggested by Jakob Nielsen [51].

**Visibility of system status** The system should always keep users informed about what is going on, through appropriate feedback within reasonable time.

**Match between system and the real world** The system should speak the users' language, with words, phrases and concepts familiar to the user, rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order.

**User control and freedom** Users often choose system functions by mistake and will need a clearly marked "emergency exit" to leave the unwanted state without having to go through an extended dialogue. Support undo and redo.

**Consistency and standards** Users should not have to wonder whether different words, situations, or actions mean the same thing. Follow platform conventions.

**Error prevention** Even better than good error messages is a careful design which prevents a problem from occurring in the first place. Either eliminate error-prone conditions or check for them and present users with a confirmation option before they commit to the action.

**Recognition rather than recall** Minimize the user's memory load by making objects, actions, and options visible. The user should not have to remember information from one part of the dialogue to another. Instructions for use of the system should be visible or easily retrievable whenever appropriate.

**Flexibility and efficiency of use** Accelerators – unseen by the novice user – may often speed up the interaction for the expert user such that the system can cater to both inexperienced and experienced users. Allow users to tailor frequent actions.

**Aesthetic and minimalist design** Dialogues should not contain information which is irrelevant or rarely needed. Every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility.

**Help users recognize, diagnose, and recover from errors** Error messages should be expressed in plain language (no codes), precisely indicate the problem, and constructively suggest a solution.

**Help and documentation** Even though it is better if the system can be used without documentation, it may be necessary to provide help and documentation. Any such information should be easy to search, focused on the user's task, list concrete steps to be carried out, and not be too large.



## Appendix C

# The system usability scale

1. I think that I would like to use this system frequently.
2. I found the system unnecessarily complex.
3. I thought the system was easy to use.
4. I think that I would need the support of a technical person to be able to use this system.
5. I found the various functions in this system were well integrated.
6. I thought there was too much inconsistency in this system.
7. I would imagine that most people would learn to use this system very quickly.
8. I found the system very cumbersome to use.
9. I felt very confident using the system.
10. I needed to learn a lot of things before I could get going with this system.



## Appendix D

# Technology for conference applications

This section presents the practical part of the research, essential for the back-end development. It presents some parts of Hypertext Transfer Protocol, Application Programming Interfaces and Representational State Transfer, and serving data with APIs.

### D.1 Hypertext transfer protocol

Hypertext Transfer Protocol (HTTP) is a stateless request-response protocol used in a client-server architecture [60] on the internet. It is currently in version 1.1. Version 2.0 is in development at the time of writing.

#### D.1.1 HTTP messages

A HTTP-message shown in Figure D.1 can be either a request or a response. It consists of

1. A start line which is used to differ between a request and response.
2. Zero or multiple header fields in the header section. An excerpt of the information available in some fields are presented later.
3. A Carriage Return and Line Feed (CRLF) is used to indicate the end of the header section.
4. A message-body carrying the actual payload of the message. Its presence depends on the request method and response status code.

```

1      start-line
2      *( header-field CRLF )
3      CRLF
4      [ message-body ]

```

Figure D.1: HTTP - A HTTP message [17]

### D.1.2 Status-codes

Status-codes shall provide useful and correct information about the result of a request, and range from 1xx to 5xx with wide gaps between. The range and a short description can be seen in Table D.1 and the details at [60, 56].

Status-code	Description
1xx	Indicates that a request was received and is being processed.
2xx	Indicates that some action taken by a request was executed successfully.
3xx	Indicates redirection.
4xx	Indicates errors at the client side.
5xx	Indicates errors at the server side.

Table D.1: HTTP - Status-codes and description

### D.1.3 Methods

The protocol has several methods, often referred to as verbs [60] which indicates the action that is to be performed on a resource. The methods are listed in Table D.2.

### D.1.4 Media types

The Content-Type field in the header is used to set information about the media type, also known as MIME-type [60]. A media type allows interpretation of the format of the data in the body, and the request of data in a certain format. Internet Assigned Numbers Authority (IANA) has the official registry of the supported media types [33].

### D.1.5 Cache

Caching is the storage of data to reduce access or calculation times. The benefit of caching is improved user-perceived performance and reduced load on the API and web-server. The Cache-Control field in the header is used to enable or disable if a client is allowed to cache the resource. It must obey the requirements of the directives specified in [19]. The Expires field contains a date defining when the resource is considered as stale.

Method	Purpose
GET	Retrieve a resource.
POST	Store a resource.
PUT	Update a resource, if it does not exist, create and store it.
DELETE	Delete a resource.
TRACE	Can be sent together with a particular response to the server, to see if any intermediate servers have made changes to the response.
PATCH	Partial modifications to a resource.
CONNECT	Used to request that a proxy shall establish a tunnel connection on its behalf. Also used with HTTPS.
OPTIONS	Used to see the available methods for a resource.

Table D.2: HTTP - Methods and purposes

Conditional requests enables the client to ask the server for an updated copy of a resource [20]. There are two fields in the header used for conditional requests: Last-Modified and Entity Tag (ETag). Last-Modified contains a date that defines when the resource was last modified. The ETag contains a hash value of a resource. A client may send a hash of its cached resource to the server and receive a 304 NOT MODIFIED status if the resource is up-to-date.

By including fields in the header containing preconditions, which is tested before performing an action on a resource, the performance is improved.

### D.1.6 Securing the Hypertext Transfer Protocol

HTTP is not concerned with encryption of data. Encryption is a necessity when transporting sensitive data over HTTP. Therefore, the communication should be secured by using HTTP on the top of the SSL/TLS protocol. This is known as HTTP Secure (HTTPS).

## D.2 Application programming interfaces

Application Programming Interface (API) enables data retrieval and data storage through defined interfaces. This section looks at the concepts behind the REST style, together with advantages and disadvantages.

### D.2.1 Representational state transfer

Representational State Transfer (REST) is an architectural style and a simpler alternative to SOAP and WSDL-based services, developed by Roy Thomas Fielding in his dissertation in 2000 [18]. Because of its simplicity, it has become common to use REST when developing APIs.

#### Building the rest architecture

The architecture is built by applying several concepts/constraints: client-server architecture, stateless communication, caching, uniform interfaces between components, layered system, and an optional code on demand. The concepts are shortly explained together with more practical advantages and disadvantages, rather than abstract. These constraints must be adhered to if one shall have a truly restful API.

The essence of a client-server architecture is separation of concerns. By separating the user interface and data storage, it improves scalability and portability. It may then be developed multiple clients that can communicate with a common server to balance the load on each client. The client and server may also evolve independently.

Stateless communication implies that the responsibility of storing state is placed at the client. For each request, a client must provide all the information the server need to understand what to do with it. Scalability is improved since the server implementation becomes simpler. It does not need to store state or manage usage of resources across multiple requests at the server. However, it could possibly decrease performance because it may be a necessity to execute multiple requests for accomplishing a task.

Caching can improve the performance. The data in a response may explicitly or implicitly be labeled as cacheable or non-cacheable. If the response is cacheable, a client does not need to send a request to the server in order to produce a response. However, this assumes that the data is up-to-date. If poorly implemented, it could decrease the performance or showing the wrong data.

The concept of uniform interfaces applied in REST is the same as in object-oriented programming. Interfaces decouple implementation from dependencies and results in a simplification of the architecture by restricting how components communicate and behave. It acts as a contract, which must be adhered to, resulting in changes to the contract belong in a different version of the API, allowing the API and clients to evolve independently. The four constraints are

**Identification of resources** A resource is identified by an URI, conceptually separated from its possible representations, and stored in a database. A client may ask the resource and specify the representation, such as XML or JSON.

**Manipulation of resources** When REST is used with HTTP, the HTTP methods such as GET, POST, PUT, and DELETE defines what action to be taken.

**Self descriptive messages** A request or response message includes enough information to describe what to do with it. For example, a response which has the

Content-Type field in the HTTP header, would be set to the application type "application/json" if the body contains data represented in JSON.

**Hypermedia as the engine of application state (HATEOAS)** The essence is to decouple the client from application specific URI structure, provide links to related resources for a resource, and allowing the client to perform further actions. A practical example is when the API is returning a response. It might include the field email address, and one array containing absolute URIs to threads related to the email address. When the client receives the response, it is easy to iterate through that array and generate links to the threads that are associated with that email address.

A layered system may be composed of multiple components, and each component only "see" its first neighbor. The rationale for creating such a system is to improve scaling. For instance, a possible component could have the sole responsibility to act as a cache. Other possible responsibilities are load balancing, and encapsulation of legacy services. However, a deep layer may result in lower performance because each layer introduces overhead.

Code on demand is optional. Client functionality can be extended by downloading and executing code. This simplifies the creation of clients and the number of features that must be implemented. In an ideal world where all clients are developed using the same language, this may be beneficial. However, this is often not the case and thus optional.

### D.2.2 Common mistakes

When implementing a REST API, there are common mistakes that should be avoided. However, some of those may be less important in some cases.

- Using the wrong HTTP status-codes. The API should return semantic correct status-codes. One example of wrong use is returning the "200 OK" status-code when a resource is created. The status-code 201 CREATED is more appropriate and informative in this case.
- Ignoring caching: HTTP has caching features that can be used to improve the performance.
- The API is not truly result if not HATEOAS is implemented correctly.
- Ignoring use of media types and HTTPs content negotiation. Client should be able to ask for content of a specific media type, this is often not the case.

### D.2.3 Representation of data

The served data format should be the same as specified in the Content-Type field in the HTTP header. Data is typically represented by using the Extensible Markup Language

(XML) or Javascript Object Notation (JSON). There is no rule defining which format that the API must be able to represent, however it is common to represent at least JSON. JSON is a data interchange format which is language independent, text-based, and lightweight [74]. The Twitter API for instance, only use JSON [75].

### **D.3 Open authorization 2.0**

Open Authorization 2.0 (OAuth2) is an authorization framework [15], often used in combination with APIs to protect resources.

Giving away credentials to third-party applications introduce problems and limitations, which are addressed by OAuth. Instead of giving away the typical username and password and storing them on a third-party application, one now asks for an access token from the authorization server and use that for subsequent requests for resources. This removes the need to store username and password in third-party applications and increases the security. For instance, the problem with compromised third-party applications and passwords going astray is eliminated.

An access token represents the username, password, lifetime of the token, and possible access restrictions, known as scopes, issued to the client.



# Appendix E

## Technical notes

### E.1 Development tools

Development of the API and web application was conducted with PHPStorm 8, which is a integrated development environment that increase the productivity [35].

Modeling of the database schema was conducted with MySQL Workbench [48]. Sequel Pro has also been a good tool when studying the contents of the database [65].

Git was used to structure and develop the conference application [25].

All tools except Sequel Pro are available on Linux, OSX and windows. Sequel Pro is OSX only.

### E.2 Installation and configuration of servers

While developing the application it was practical to have notes of the configuration in case the servers had to be moved due to downtime or other reasons. These guides are rough notes of how the servers were configured and may be helpful in the future. The guide in Section E.2 was used on both servers, however the details in default-ssl.conf depends on the server.

All servers were installed with Ubuntu 14.04. Two of them used PHP/Apache in combination with tools like Git, while the third was only installed with MySQL.

#### E.2.1 Servers

##### Install Apache

```
sudo apt-get install apache2
```

##### Enable SSL module and restart Apache

```
sudo a2enmod ssl
sudo service apache2 restart
```

**Create folder for certificate, add certificates and configure default-ssl.conf**

```
sudo mkdir /etc/apache2/ssl
sudo nano /etc/apache2/sites-available/default-ssl.conf
```

**Modify the default-ssl.conf**

```
ServerAdmin km.ntnu.masterprosjekt@gmail.com
ServerName shadowcat.uninett.no
DocumentRoot /var/www/html
SSLCertificateChainFile /etc/apache2/ssl/chain-5949-shadowcat.uninett.no.pem
SSLCertificateFile /etc/apache2/ssl/cert-5949-shadowcat.uninett.no.pem
SSLCertificateKeyFile /etc/apache2/ssl/shadowcat.uninett.no.privkey.pem
```

**Also, enable using .htaccess in Laravel**

```
<Directory /var/www/html/laravel/public>
    AllowOverride All
</Directory>
```

**Disable HTTP**

```
sudo vim /etc/apache2/ports.conf
```

**Remove Listen 80**

```
#Listen 80
```

```
root@shadowcat:/etc/apache2/ssl# apachectl graceful
```

**Installation of PHP 5.6**

```
sudo apt-get install software-properties-common python-software-properties
sudo add-apt-repository ppa:ondrej/php5-5.6
```

Do (chose none when postfix configuration pops up)

```
sudo apt-get update && sudo apt-get upgrade
sudo apt-get install php5 php5-cli php5-mysql \
php5-mssql php5-mcrypt php5-dev mcrypt php5-curl
```

Install git and curl

```
sudo apt-get install curl git
```

Install composer

```
curl -sS https://getcomposer.org/installer | php
mv composer.phar /usr/local/bin/composer
```

## E.2.2 Configuration of MySQL

```
sudo apt-get update
sudo apt-get install mysql-server
```

```
root@shadowcat:~# sudo mysql_install_db
Installing MySQL system tables...
150225  9:35:37 [Warning] Using unique option prefix key_buffer
instead of key_buffer_size is deprecated and will be removed
in a future release. Please use the full name instead.
OK
Filling help tables...
150225  9:35:38 [Warning] Using unique option prefix key_buffer instead
of key_buffer_size is deprecated and will
be removed in a future release. Please use the full name instead.
OK
```

To start mysqld at boot time you have to copy  
support-files/mysql.server to the right place for your system

PLEASE REMEMBER TO SET A PASSWORD FOR THE MySQL root USER !  
To do so, start the server, then issue the following commands:

```
/usr/bin/mysqladmin -u root password 'new-password'
/usr/bin/mysqladmin -u root -h shadowcat password 'new-password'
```

Alternatively you can run:  
`/usr/bin/mysql_secure_installation`

which will also give you the option of removing the test databases and anonymous user created by default. This is strongly recommended for production servers.

See the manual for more instructions.

You can start the MySQL daemon with:  
`cd /usr ; /usr/bin/mysqld_safe &`

You can test the MySQL daemon with `mysql-test-run.pl`  
`cd /usr/mysql-test ; perl mysql-test-run.pl`

Please report any problems at <http://bugs.mysql.com/>

```
root@shadowcat:~# sudo mysql_secure_installation
```

NOTE: RUNNING ALL PARTS OF THIS SCRIPT IS RECOMMENDED FOR ALL MySQL  
SERVERS IN PRODUCTION USE! PLEASE READ EACH STEP CAREFULLY!

In order to log into MySQL to secure it, we'll need the current password for the root user. If you've just installed MySQL, and you haven't set the root password yet, the password will be blank, so you should just press enter here.

Enter current password for root (enter for none):  
OK, successfully used password, moving on...

Setting the root password ensures that nobody can log into the MySQL root user without the proper authorisation.

You already have a root password set, so you can safely answer 'n'.

Change the root password? [Y/n] n  
... skipping.

By default, a MySQL installation has an anonymous user, allowing anyone to log into MySQL without having to have a user account created for

them. This is intended only for testing, and to make the installation go a bit smoother. You should remove them before moving into a production environment.

```
Remove anonymous users? [Y/n] Y
... Success!
```

Normally, root should only be allowed to connect from 'localhost'. This ensures that someone cannot guess at the root password from the network.

```
Disallow root login remotely? [Y/n] Y
... Success!
```

By default, MySQL comes with a database named 'test' that anyone can access. This is also intended only for testing, and should be removed before moving into a production environment.

```
Remove test database and access to it? [Y/n] Y
- Dropping test database...
ERROR 1008 (HY000) at line 1: Can't drop database 'test'; \
database doesn't exist
... Failed! Not critical, keep moving...
- Removing privileges on test database...
... Success!
```

Reloading the privilege tables will ensure that all changes made so far will take effect immediately.

```
Reload privilege tables now? [Y/n] Y
... Success!
```

Cleaning up...

All done! If you've completed all of the above steps, your MySQL installation should now be secure.

Thanks for using MySQL!

## Change config

```
root@shockwave# vim /etc/mysql/my.cnf
```

```
bind-address          = 158.38.213.35
```

```
local-infile=0
```

```
log=/var/log/mysql-logfile
```

```
mysql -u root -p '*****';
```

### **Add user and allow connections from the API**

```
CREATE USER 'laravel'@'localhost' \
IDENTIFIED BY '*****';
GRANT ALL ON laravel_api.* TO laravel@'158.38.213.36' \
IDENTIFIED BY ' '*****';';
GRANT ALL ON laravel_api.* TO laravel@'localhost' \
IDENTIFIED BY ' '*****';';
FLUSH PRIVILEGES;
```

Restart mysql-server

```
root@shockwave:~# sudo service mysql restart
mysql stop/waiting
mysql start/running, process 50244
```

## **E.3 The conference application system**

### **E.3.1 Web application**

The source code is available at [70].

CSS code is written in SASS and further manipulated with Gulp, which handles minimization and concatenation. Gulp is also used for managing Javascript code. In addition, it uses different libraries and frameworks which are managed through composer and bower. See Appendix E for more information. The logic can be found in Gulpfile.js, and self produced SASS code can be found in app/assets/sass.

#### **E.3.1.1 Testing**

It is not 100% test coverage. The available acceptance tests can be found in the tests folder. Different scenarios such as login, registering, and the available links found in the application are tested.

### E.3.1.2 Optimization

The fastclick framework removes a 300ms delay between the tap and firing of a click event on mobile devices.

By minifying and concatenating CSS and Javascript files, the browser needs to load and interpret less files, thus increasing the performance.

## E.3.2 Conference API

The source code is available at [45].

### E.3.2.1 Routes

Table E.1 shows the API resources, their routes and a description, excluding user registration, activation, login, and logout. The protected column of the table differentiates between routes protected by OAuth (see Section D.3), and those that are not. In other words, if the column is yes for a specific route, the user must be authorized by OAuth to access that route. However, if the column is no, the route is open to all. The routes represent all the functionality of the conference application API.

All the routes have a prefix of `api/v1` to account for future versions of the API while still being backwards compatible. The routes are relative to the API domain. The route to retrieve all the conferences would be `https://domain/api/v1/conferences`.

### E.3.2.2 Testing

The API does not have 100% automatic test coverage. The tests perform checks on the route level by requesting a route and checking its output. The tests can be seen in the `app/tests/ConferencesTest.php` and `tests/integration` folder of the API source code.

## E.3.3 Third-party packages

Third party packages are mainly installed through dependency management tools like `bower` and `composer`. The advantage of this approach is that required packages can be installed and updated with one command, and the files does not need to be tracked in version control systems.

`Composer` is a dependency management tool for PHP and is the preferred way to work with third-party packages. This section contains a excerpt of the `composer.json` file. Further information about the packages can be found at the `packagist` website [58]. Packages inside *require* contains packages the application need in order to function properly. Packages inside *require-dev* is only needed during development and does not need to be installed when the application is deployed to production.

`Bower` is one of multiple dependency management tools for front-end related packages. More information about the packages can be found at [5].

### E.3.4 Data storage

MySQL is used to store data, and is hosted on a separate server. Notes from installation can be seen in Section E.2.

#### E.3.4.1 Web application

##### Composer

```
1  "require": {
2      "laravel/framework": "4.2.*",
3      "guzzle/guzzle": "3.9.*@dev",
4      "davejamesmiller/laravel-breadcrumbs": "2.*",
5      "laracasts/validation": "~1.0",
6      "laracasts/utilities": "~1.0",
7      "hieu-le/active": "~1.0"
8  },
```

```
1  "require-dev": {
2      "codeception/codeception" : "~2.0",
3      "barryvdh/laravel-ide-helper": "1.*@dev",
4      "way/generators": "~2.0",
5      "barryvdh/laravel-debugbar": "~1.8",
6      "panique/laravel-sass": "1.0",
7      "laracasts/testdummy": "~2",
8      "mockery/mockery" : "0.9.*@dev",
9      "rap2hpoutre/laravel-log-viewer": "0.2.*"
10 },
```

##### Bower

```
1  "dependencies": {
2      "jquery": "~2.1.3",
3      "bootstrap": "~3.3.4",
4      "animate-css": "~3.2.6",
5      "add-to-homescreen": "~3.1.1",
6      "lato": "~0.3.0",
7      "lato-font": "~1.1.0",
8      "world-flags-sprite": "*",
9      "font-awesome": "~4.3.0",
10     "moment": "~2.10.2",
11     "jquery-cookie": "~1.4.1",
```



```

12     "jStorage": "~0.4.12",
13     "fastclick": "~1.0.6",
14     "fullcalendar": "~2.3.1"
15 }

```

### E.3.4.2 API

```

1     "require": {
2         "laravel/framework": "4.2.*",
3     },

1     "require-dev": {
2         "barryvdh/laravel-debugbar": "~1.8",
3         "codeception/codeception" : "~2.0",
4         "laracasts/testdummy": "~2.0",
5         "barryvdh/laravel-ide-helper": "1.*@dev",
6         "zircote/swagger-php": "0.9.*@dev",
7         "way/generators": "~2.0",
8         "xethron/migrations-generator": "1.2.*",
9         "codeception/codeception" : "~2.0"
10    },

```

### E.3.5 Third-party services

Mandrill [46] is an email infrastructure service which easily integrates with Laravel. It is free to use if you send less than 12 000 emails per month. The service has a interface that provides different statistics, and more control over sent emails. Mandrill was very useful when users at the conference had entered wrong email when trying to register.

### E.3.6 For future developers

Update Laravel. In the time of writing, version 5.1 is soon released with long term support and improvements. See [40] for information about upgrading.

The preferred way to work with the application is to use Laravel Homestead [40], which is a virtual machine configured specially for Laravel. It removes the need for a specific platform for development and eliminates problems such as "it works on my machine", and a new development environment can be installed everywhere in just a few minutes.

When working with the CSS and Javascript, it is required installing node. When node is installed, the packages found in Gulpfile.js must be installed. Finally one can execute the command *gulp watch* in the project root directory and gulp will automatically compile the files when they are changed.

When conducting this thesis the servers was configured from a fresh install. Using a virtual machine from Digital Ocean [14] together with Laravel Forge [22] makes deployment much easier. However, it costs money. The GitHub education pack gives you 100 USD in credit on Digital Ocean if you are a new user and a student [25].

During the evaluation of the application at the conference, Mandrill was very valuable. When someone tries to register and 'never receive the email', they will sometimes tell you. The interface in Mandrill let you see if they typed the wrong email or not, and if it was sent.

Resource	Method	Route	Description	Protected
Conferences	GET	conferences	Returns all the conferences.	No
Conference schedules	GET	conferences/{conferences}/schedule	Returns the active conference schedule.	No
	GET	conferences/{conferences}/schedule/authenticated	Returns the active conference schedule. Information about which of the sessions is in the personal schedule is included.	Yes
	GET	conferences/{conferences}/schedule/authenticated	Returns the personal schedule	Yes
Personal schedules	POST	conferences/{conferences}/schedule/personal	Adds a new session to the personal schedule.	Yes
	DELETE	conferences/{conferences}/schedule/personal/{session}	Remove a session from the personal schedule.	Yes
Sessions	GET	conferences/{conferences}/sessions/{sessions}	Returns a session.	No
	GET	conferences/{conferences}/sessions/{sessions}/authenticated	Returns a session. Information about the session being in the personal schedule is included.	Yes
	GET	conferences/{conferences}/sessions/{sessions}/ratings/create	Checks to see if a session can be rated.	Yes
Session ratings	POST	conferences/{conferences}/sessions/{sessions}/ratings	Rates a session.	Yes
Conference ratings	GET	conferences/{conferences}/ratings/create	Checks to see if a conference can be rated.	Yes
	POST	conferences/{conferences}/ratings	Rates a conference.	Yes
Questions	GET	conferences/{conferences}/sessions/{sessions}/questions/create	Checks to see if a question can be posted to a session.	Yes
	POST	conferences/{conferences}/sessions/{sessions}/questions	Posts a question to a session.	Yes
Maps	GET	conferences/{conferences}/maps	Returns all the maps of a conference.	No
Newsfeeds	GET	conferences/{conferences}/newsfeeds	Returns the active newsfeed for a conference.	No
	GET	conferences/{conferences}/chats	Returns all the chats within a conference where the user is a member of the chat.	Yes
	GET	conferences/{conferences}/chats/{chats}	Returns all the messages of a chat.	Yes

Table E.1: API - Resources and routes



## Appendix F

# Statistical analysis

### F.1 Cross loadings

This section presents the cross loadings in the conference and web survey analysis. Tables F.1, F.2, and F.3 show the cross loadings in the conference survey, and tables F.4, F.5, and F.6 show the cross loadings in the web survey for mobile, tablet, and computer, respectively.

#### F.1.1 Conference survey

Construct/ Item	BI	PEOU	PU
PU1	0.559	0.781	<b>0.842</b>
PU2	0.476	0.580	<b>0.818</b>
PU3	0.474	0.555	<b>0.664</b>
PU4	0.573	0.423	<b>0.766</b>
PU5	0.698	0.617	<b>0.841</b>
PEOU1	0.599	<b>0.809</b>	0.757
PEOU2	0.438	<b>0.868</b>	0.597
PEOU3	0.427	<b>0.890</b>	0.604
PEOU4	0.454	<b>0.682</b>	0.656
PEOU5	0.503	<b>0.940</b>	0.681
BI1	<b>0.984</b>	0.554	0.729
BI2	<b>0.981</b>	0.551	0.663

Table F.1: Statistical analysis - Conference survey - Cross loadings for mobile

Construct/ Item	BI	PEOU	PU
PU1	0.332	0.781	<b>0.840</b>
PU2	0.268	0.580	<b>0.815</b>
PU3	0.317	0.553	<b>0.665</b>
PU4	0.520	0.424	<b>0.770</b>
PU5	0.497	0.618	<b>0.841</b>
PEOU1	0.384	<b>0.806</b>	0.756
PEOU2	0.191	<b>0.864</b>	0.596
PEOU3	0.316	<b>0.894</b>	0.604
PEOU4	0.340	<b>0.867</b>	0.656
PEOU5	0.260	<b>0.939</b>	0.680
BI3	<b>0.968</b>	0.363	0.512
BI4	<b>0.952</b>	0.302	0.423

Table F.2: Statistical analysis - Conference survey - Cross loadings for tablet

### F.1.2 Web survey

## F.2 Summary of different statistical analysis

The conference and web survey are the main analysis of this research and explained in detail in Chapter 6 and 7. It could be interesting to analyse data from different demography attributes. However, both surveys usually have a low sample size if one is to analyse intention to use of subgroups by the demographic data. Therefore data from both survey were concatenated and divided by different criteria, before performing a PLS analysis. In addition, results from the full conference and web survey are added to ease comparison.

Table F.7 and F.8 summarizes the result of the different analyses. The sample set column shows the subgroup, including the sample size in parenthesis. Many validity tests were inconclusive, marked by the yellow cells in the valid column. The valid column contain annotations for the establishment of both convergent and discriminant validity. When convergent validity is established, this is annotated by an A. Three different techniques for the establishment of discriminant validity is performed. When discriminant validity is established with the Fornell-Larcker technique, F annotates this, while H for the HTMT test, and C for cross loadings. See Section 4.3.1.1 for more information. If the column does not have annotation, but a Yes, it means that validity is established with all tests, while No means that no test could establish validity.

The asterisk in the significance column indicates which significance level the P value adhere to (\* $P < 0.05$ , \*\* $P < 0.01$ , \*\*\* $P < 0.001$ ).

Construct/ Item	BI	PEOU	PU
PU1	0.201	0.781	<b>0.853</b>
PU2	-0.002	0.781	<b>0.853</b>
PU3	0.121	0.511	<b>0.665</b>
PU4	0.270	0.421	<b>0.753</b>
PU5	0.405	0.615	<b>0.836</b>
PEOU1	0.190	<b>0.799</b>	0.760
PEOU2	0.248	<b>0.868</b>	0.607
PEOU3	0.200	<b>0.894</b>	0.613
PEOU4	0.349	<b>0.869</b>	0.662
PEOU5	0.310	<b>0.942</b>	0.689
BI5	<b>0.984</b>	0.322	0.281
BI6	<b>0.974</b>	0.255	0.277

Table F.3: Statistical analysis - Conference survey - Cross loadings for pc

Construct/ Item	BI	PEOU	PU
PU1	0.489	0.607	<b>0.797</b>
PU2	0.487	0.544	<b>0.838</b>
PU3	0.493	0.356	<b>0.661</b>
PU4	0.618	0.517	<b>0.789</b>
PU5	0.609	0.578	<b>0.900</b>
PEOU1	0.490	<b>0.855</b>	0.555
PEOU2	0.427	<b>0.891</b>	0.584
PEOU3	0.426	<b>0.863</b>	0.555
PEOU4	0.493	<b>0.846</b>	0.575
PEOU5	0.506	<b>0.932</b>	0.613
BI1	<b>0.955</b>	0.498	0.667
BI2	<b>0.950</b>	0.521	0.621

Table F.4: Statistical analysis - Web survey - Cross loadings for mobile

Construct/ Item	BI	PEOU	PU
PU1	0.352	0.609	<b>0.806</b>
PU2	0.331	0.545	<b>0.845</b>
PU3	0.245	0.355	<b>0.640</b>
PU4	0.448	0.516	<b>0.785</b>
PU5	0.410	0.578	<b>0.902</b>
PEOU1	0.268	<b>0.853</b>	0.560
PEOU2	0.352	<b>0.895</b>	0.589
PEOU3	0.274	<b>0.865</b>	0.561
PEOU4	0.282	<b>0.842</b>	0.574
PEOU5	0.325	<b>0.931</b>	0.615
BI3	<b>0.970</b>	0.351	0.422
BI4	<b>0.974</b>	0.317	0.459

Table F.5: Statistical analysis - Web survey - Cross loadings for tablet

Construct/ Item	BI	PEOU	PU
PU1	0.382	0.609	<b>0.813</b>
PU2	0.439	0.544	<b>0.856</b>
PU3	0.202	0.354	<b>0.628</b>
PU4	0.343	0.514	<b>0.771</b>
PU5	0.484	0.578	<b>0.905</b>
PEOU1	0.389	<b>0.858</b>	0.562
PEOU2	0.344	<b>0.895</b>	0.591
PEOU3	0.305	<b>0.863</b>	0.563
PEOU4	0.260	<b>0.838</b>	0.570
PEOU5	0.392	<b>0.932</b>	0.615
BI5	<b>0.973</b>	0.381	0.482
BI6	<b>0.969</b>	0.371	0.446

Table F.6: Statistical analysis - Web survey - Cross loadings for computer



Sample set	Platform	Valid	Reliable	PU $R^2$	BI $R^2$	Hypothesis	Path coefficient	Significance
Conference survey (69 samples)	Mobile	Yes	Yes	0.582	0.505	$PEOU \rightarrow BI$	0.050	0.411
						$PEOU \rightarrow PU$	0.763	12.225***
						$PU \rightarrow BI$	0.672	4.793***
	Tablet	Yes	Yes	0.581	0.242	$PEOU \rightarrow BI$	-0.060	0.351
						$PEOU \rightarrow PU$	0.762	12.367***
						$PU \rightarrow BI$	0.536	3.376**
	PC	Yes	Yes	0.589	0.092	$PEOU \rightarrow BI$	0.235	1.107
						$PEOU \rightarrow PU$	0.767	13.186***
						$PU \rightarrow BI$	0.082	0.389
Web survey (100 samples)	Mobile	Yes	Yes	0.432	0.472	$PEOU \rightarrow BI$	0.159	0.613
						$PEOU \rightarrow PU$	0.657	9.513***
						$PU \rightarrow BI$	0.572	4.191***
	Tablet	Yes	Yes	0.437	0.209	$PEOU \rightarrow BI$	0.077	0.613
						$PEOU \rightarrow PU$	0.661	9.648***
						$PU \rightarrow BI$	0.402	3.371**
	PC	Yes	Yes	0.437	0.237	$PEOU \rightarrow BI$	0.127	0.945
						$PEOU \rightarrow PU$	0.661	9.644***
						$PU \rightarrow BI$	0.394	3.205**
Respondents with high conference experience (104 samples)	Mobile	A,F, H	Yes	0.434	0.440	$PEOU \rightarrow BI$	0.085	0.927
						$PEOU \rightarrow PU$	0.658	8.509***
						$PU \rightarrow BI$	0.604	4.583***
	Tablet	A,F, H	Yes	0.438	0.225	$PEOU \rightarrow BI$	-0.144	1.367
						$PEOU \rightarrow PU$	0.662	8.412***
						$PU \rightarrow BI$	0.557	5.002***
	PC	A,F, H	Yes	0.452	0.139	$PEOU \rightarrow BI$	0.148	0.909
						$PEOU \rightarrow PU$	0.672	9.647***
						$PU \rightarrow BI$	0.257	1.755
Respondents with medium conference experience (54 samples)	Mobile	No	Yes	0.602	0.615	$PEOU \rightarrow BI$	0.070	0.563
						$PEOU \rightarrow PU$	0.776	16.094***
						$PU \rightarrow BI$	0.729	6.246***
	Tablet	No	Yes	0.605	0.238	$PEOU \rightarrow BI$	0.096	0.457
						$PEOU \rightarrow PU$	0.778	16.209***
						$PU \rightarrow BI$	0.410	2.300*
	PC	No	Yes	0.608	0.207	$PEOU \rightarrow BI$	0.156	0.909
						$PEOU \rightarrow PU$	0.779	16.563***
						$PU \rightarrow BI$	0.323	1.837
Respondents with high technology experience (119 samples)	Mobile	Yes	Yes	0.412	0.415	$PEOU \rightarrow BI$	0.065	0.672
						$PEOU \rightarrow PU$	0.642	9.595***
						$PU \rightarrow BI$	0.601	4.787***
	Tablet	A,F, H	Yes	0.416	0.215	$PEOU \rightarrow BI$	0.126	1.194
						$PEOU \rightarrow PU$	0.645	9.843***
						$PU \rightarrow BI$	0.372	3.349**
	PC	A,F, H	Yes	0.419	0.187	$PEOU \rightarrow BI$	0.193	1.634
						$PEOU \rightarrow PU$	0.647	9.922***
						$PU \rightarrow BI$	0.282	2.475*
Respondents with medium technology experience (45 samples)	Mobile	A,H	Yes	0.665	0.526	$PEOU \rightarrow BI$	0.110	0.823
						$PEOU \rightarrow PU$	0.815	20.497***
						$PU \rightarrow BI$	0.633	3.584***
	Tablet	A,H	Yes	0.666	0.233	$PEOU \rightarrow BI$	-0.224	0.941
						$PEOU \rightarrow PU$	0.816	20.568***
						$PU \rightarrow BI$	0.648	2.968**
	PC	A,H	Yes	0.665	0.256	$PEOU \rightarrow BI$	0.028	0.121
						$PEOU \rightarrow PU$	0.815	20.852***
						$PU \rightarrow BI$	0.483	1.990*

Table F.7: Statistical analysis - Results from analysis of with subgroups 1

Sample set	Platform	Valid	Reliable	PU $R^2$	BI $R^2$	Hypothesis	Path coefficient	Significance
Respondents whom used mobile to examine the application (60 samples)	Mobile	No	Yes	0.657	0.744	$PEOU \rightarrow BI$	0.289	2.111*
						$PEOU \rightarrow PU$	0.811	13.658***
						$PU \rightarrow BI$	0.611	4.453***
	Tablet	A,F, H	Yes	0.655	0.218	$PEOU \rightarrow BI$	0.116	0.545
						$PEOU \rightarrow PU$	0.810	13.691***
						$PU \rightarrow BI$	0.368	1.837
	PC	F, H	Yes	0.657	0.136	$PEOU \rightarrow BI$	0.221	0.982
						$PEOU \rightarrow PU$	0.810	13.541***
						$PU \rightarrow BI$	0.166	0.861
Respondents whom used tablet to examine the application (15 samples)	Mobile	F, H	Yes	0.316	0.171	$PEOU \rightarrow BI$	-0.162	0.410
						$PEOU \rightarrow PU$	0.562	1.295
						$PU \rightarrow BI$	0.482	1.140
	Tablet	F, H	Yes	0.270	0.433	$PEOU \rightarrow BI$	ERROR: Too few observations	
						$PEOU \rightarrow PU$		
						$PU \rightarrow BI$		
	PC	H	Yes	0.432	0.242	$PEOU \rightarrow BI$	0.518	1.169
						$PEOU \rightarrow PU$	0.658	1.468
						$PU \rightarrow BI$	-0.041	0.075
Respondents whom used computer to examine the application (64 samples)	Mobile	F, H	Yes	0.420	0.431	$PEOU \rightarrow BI$	0.134	1.116
						$PEOU \rightarrow PU$	0.648	7.165***
						$PU \rightarrow BI$	0.561	4.293***
	Tablet	F, H	Yes	0.438	0.099	$PEOU \rightarrow BI$	-0.028	0.143
						$PEOU \rightarrow PU$	0.661	7.513***
						$PU \rightarrow BI$	0.332	1.752
	PC	F, H	Yes	0.440	0.098	$PEOU \rightarrow BI$	-0.039	0.174
						$PEOU \rightarrow PU$	0.664	7.574***
						$PU \rightarrow BI$	0.338	1.459
Respondents without experience with similar systems (116 samples)	Mobile	A,F, H	Yes	0.463	0.437	$PEOU \rightarrow BI$	0.093	1.010
						$PEOU \rightarrow PU$	0.681	13.300***
						$PU \rightarrow BI$	0.594	4.489***
	Tablet	A,F, H	Yes	0.463	0.187	$PEOU \rightarrow BI$	0.042	0.334
						$PEOU \rightarrow PU$	0.680	13.193***
						$PU \rightarrow BI$	0.403	3.252**
	PC	A,F, H	Yes	0.468	0.277	$PEOU \rightarrow BI$	0.257	2.195*
						$PEOU \rightarrow PU$	0.684	14.080***
						$PU \rightarrow BI$	0.262	2.369*
Respondents with experience with similar systems (44 samples)	Mobile	No	Yes	0.579	0.675	$PEOU \rightarrow BI$	0.088	0.460
						$PEOU \rightarrow PU$	0.761	6.458***
						$PU \rightarrow BI$	0.752	4.220***
	Tablet	A,F, H	Yes	0.585	0.253	$PEOU \rightarrow BI$	-0.086	0.405
						$PEOU \rightarrow PU$	0.765	6.616***
						$PU \rightarrow BI$	0.565	3.137**
	PC	A,F, H	Yes	0.586	0.102	$PEOU \rightarrow BI$	-0.157	0.478
						$PEOU \rightarrow PU$	0.766	6.555***
						$PU \rightarrow BI$	0.422	1.532

Table F.8: Statistical analysis - Results from analysis of with subgroups 2

## Appendix G

# Received comments to the application

Some participants added their comments when responding to the surveys. The comments are mostly presented exactly as they were given, but a few of them are anonymized.

### G.1 The conference survey

- På nettbrett er dette nettstedet et nettsted og ikke en app, i alle fall dersom man følger instruksjonene og går til webben. Greit nok konferansewebsite, men rotete fargebruk og inkonsekvens i formattering gjør det bare greit nok.
- Det er flott at noen har laget en konferanseapplikasjon. Det har virkelig potensialet til å forbedre en konferansedeltakelse. Jeg tror likevel at applikasjonen trenger mer arbeid når det gjelder universell utforming og i særdeleshet gjelder det den grafiske. Jeg tror også at applikasjonen kunne forholdt seg mer og bedre til min kontrast, bl.a lokasjon og tid. Lykke til med videreutviklingen!
- Bruker papirutgaven til å notere litt og kommer derfor til å fortsette med den.
- Zoom på kartet er nødvendig. Ønsker at hendelsene jeg lagrer til mitt program skal komme inn i min egen Outlook kalender. Dersom du legger til sesjoner i 'mitt program' som krasjer med hverandre, bør det komme opp en beskjed. Hvor kan du se det som blir skrevet om sesjonene? (Når folk har vurdert dem). Hadde vært kjekt for foreleser å se, pluss alle andre. Ville hatt bilder av foreleser og hvor de kommer fra (instutisjon). Instutisjon forteller meg mye om foredraget kan være aktuelt. Stor forskjell på om de er fra IT, lærested eller kommersiell aktør feks. Programmet bør også alltid være oppdatert (romendringer osv) Ps: har svart før, men kom på litt mer :) lykke til! Mvh Cecilie Haraldseid
- For brukervennligheten sin skyld hadde det kanskje vært fint om parrallellbolkene var skilt med forskjellige farger. Ved å bruke appen på mobilen slet jeg også litt

med å få kalenderen som jeg får opp på datan. Men veldig fint at man kan bytte mellom å ha det som en kalender og som en "tradisjonell-layout".

- Savner mulighet for å redigere kommentarer. Tror ikke den husker mine valg (åpner alltid i fellesprosjekt.)
- Registrering av konto er for tungvint. Blir fanget av spamfilteret og må frigis av dette. I vårt system kan det først gjøres neste dag. Trenger man registrering??
- Litt sein oppdatering av neewsfeeden
- Konferanse-appen er mye bedre enn hjemmesidene til konferansen.
- Menysystem noe uryddig. Liker ideen og mulighet for kontinuerlig tilbakemelding etter hver sesjon. Noe sånt savner vi ofte! Her var terskelen for å komme i gang for høy (forvirrende å komme i gang), men i bruk framstår det høyst brukbart, men LITT hjemmelaget. Ennå.
- Det var kjekt å kunne gi fortløpende vurderinger på de ulike foredragene. Det burde kommet tydelig frem i hvilken grad de vurderingene var anonyme, eller om de skulle publiseres noe sted. Jeg likte totaloversikten av programmet best. For en liten konferanse med 2 spor var det ikke så hensiktsmessig å "lage eget program" gjennom den andre funksjonen. Da var det bedre å kunne ha alt samlet på ett sted, slik at man slapp å scrolle i evigheten for å få med seg alt. På større og mer "uoversiktelige" konferanser ville dette derimot vært helt genialt (for eksempel på NMD, Nordiske mediedagene som pågår i Bergen akkurat nå). På denne måten ville kart-delen av applikasjonen også kommet til sin rett. På et spredt område er det en genial funksjon, men i denne sammenheng trengte jeg ikke bruke den i det hele tatt. Jeg var veldig fornøyd med appen. Å ha konferanseprogrammet "i lomma" til en hver tid var veldig kjekt. Fint også med informasjon om hvert enkelt foredrag og foredragsholder. Newsfeeden brukte jeg heller ikke, men ser i ettertid at det ligger nyttig info der. Den fikk man også andre steder, så føler ikke at jeg gikk glipp av noe. Dere kunne kanskje hatt et slags forum for app-brukerene. Det hadde vært kult. Det er ikke alle som har Twitter og bruker #hashtags. Det hadde senket terskelen for å delta i "nettdiskusjonen", siden det ble veldig lite tid til faktisk (analog) diskusjon under konferansen. Jeg har troen på appen deres og håper å kunne bruke den ved kommende konferanser. Lykke til!
- Konferanseapplikasjonen mangler tilbakemelding på koordinering/administrering av konferansen. Det er bare mulig å gi tilbakemelding på de ulike presentasjonene. Læringsfestivalen hadde noen koordineringsproblemer den første dagen. Også manglende info om lunsjen på nettsidene. Konferanseapplikasjonen oppleves bra. Kunne vært en mulighet å fått "ditt program" i kalendermodus. Lettere å se helheten.
- Ønsker at kartet skulle vært større. Ønsker å kunne soome på kart. Ønsker å se en full oversikt over dagsprogrammet en plass, (på en side). Fant ikke dette (?)

- Flott applikasjon, lykke til!
- Brukte den på mobil. Tror det raskt ville blitt veldig uoversiktlig med flere spor.
- Irriterende at du må lage egen bruker for å kommentere innlegg. Tok litt tid å lage bruker. Når det er kjappe skift mellom tema, gidder jeg ikke å opprette egen bruker og dropper da også å kommentere innlegg. Det blir for tungvint.
- 1. Videoen var altfor rask. Jeg fikk ikke sukk for meg før ting forsvant. Ble litt stressa av tempoet i videoen. 2. Ved stor skjerm ble konferanseprogrammet en smule bredt. Kunne vært smalere eller lagt opp på en måte som ikke lagde så mye luft-hull i horisontalen. 3. Jeg syntes "Hendelser som starter fra 09:00" og de nedover var mer rotete enn noe særlig annet. Det kunne kanskje vært gjort på en annen måte, men de fremsto mest som unaturlige pauser i contentet. 4. Jeg skulle ønske det ikke var så obvious at det var brukt bootstrap gjennom siden. Modal-dialogen er ren bootstrap uten noe særlig customisering? Man ønsker gjerne at en applikasjon skal være litt mer særegen. 5. Når man trykker på "Les mer" skulle jeg ønske at det var en liten animasjon for å ikke miste flyten. 6. Når man er inne på en hendelse ser jeg ikke poenget med "Les mer". Da burde jeg bare se hele uansett. Hva er poenget med knappen der inne? (skjønner at det er gjenbruk, men kanskje skru av den knappen der?) 7. Det er alt for mye som er sentrert (breadcrumb, mellomtitler osv). Flyten mangler litt. Kanskje dette kan hjelpe: <http://www.smashingmagazine.com/2015/04/29/design-principles-compositional-flow-and-rhythm/> Appen virker veldig nyttig, men det burde vært en UX-designer på banen :)
- jeg synes app'en er veldig bra. Dere spør tilogmed om vurdering av pauser og kveldsarrangement, noe som kan gi et inntrykk av konferansen som helhet.
- Likte app'en og synes det ville vært veldig greit om jeg hadde en slik på de konferansene jeg deltar på. Ikke minst fordi den var veldig enkel å forstå og bruke - raskt.
- Jeg måtte gå tidlig andre dag, men har fulgt konferansen streamet. Det hadde vært en fordel om det var en link til streaming i applikasjonen.
- Ikke bra at man er nødt å registrere bruker for å vurdere punkter i konferanseprogrammet. Bra med webapp, heller enn native app. Mvh, Magnus Rom Jensen
- Kjempebra tskjorter dere brukte under festivalen for å vise tilstedeværelse! Selve appen er fin, den. :)
- Appen har for lite nytt til at jeg vil bruke den. Hvis den kunne legges inn i min kalender eller lastes ned som en app så kanskje jeg ville brukt den.
- Fikk ikke sett videoen da jeg ikke fikk skrudd ned lyden og jeg nå sitter på et foredrag (og ikke har hodetelefoner..). Får ikke gjort slik tilbakemelding i pausene. Ellers likte jeg den veldig godt

- Internett fungerer ikke på konferansen, og da blir svarerne deretter.
- Bra og nyttig applikasjon. Litt forvirrende ved oppstart da jeg leita etter en meny og ville bruke den. Skjønnte fort at man måtte klikke i kalender. Undersøkte ikke om den funker offline, det bør den. Enkel integrasjon med egen kalenderapp kan være ønskelig.
- Flott konsept. Hadde vært gull å fått samlet alle de norske konferansene rettet mot utdanning på ett sted gjerne sortert etter målgruppe. Gjerne også et kart som viser hvor i landet de holdes.
- Jeg ble litt forvirret av dette. Er det utviklet en Smart phone app eller ikke? Så langt har jeg kun sett en nettbasert tjeneste jeg har logget meg inn i. Den ser ut til å fungere bra. Jeg fikk et spørsmål på telefonen min om jeg ville installere en snarvei på telefonen, men noe skjedde slik at jeg ikke fikk gjort dette og etter dette har jeg ikke klart å gjenskape denne situasjonen. Aktiveringsmailen må dere gjør noe med. Den så ganske luguber ut. Legg til litt informasjon om hvilken tjeneste denne aktiveringen gjelder. Nå ser det ut som en svindelmail.
- Bra app, men litt for mye scrolling for å se gjennom alt i den ene visningen. Med bedring i grensesnittet så hadde jeg mer fornøyd.
- Kanskje ha muligheten til å legge inn notater til seg selv ? prøvde bare på pc laptop, men siden batteriet mitt er dårlig og det ikke var strømuttak i salen, fikk jeg ikke prøvd appen så mye
- Dårlig nett tilgang når flere bruker mobilen. Behov for flere ladepunkter på campus / forelesningssaler for pc og nettbrett hvis man går bort fra papirversjon.
- Det hadde vært fint om lenkene det vises til i nyhetsfeeden var klikkbare og om det hadde vært mulig å få lagt konferanseprogrammet inn i Outlookalender. Bra app!
- Godt grensesnitt, lettfattelig å bruke. Mye bedre enn papirprogram. Gikk litt lang tid for å kunne bekrefte registrering. En ide for fremtiden er at man kan legge hele bolker, som "Spor 1" eller "alle pauser og lunsj" inn i sitt personlige program med et trykk istedenfor enkeltaktiviteter. Gratulerer med lovende app!
- Et utbedringdforslag er at pausene komme automatisk inn i " mitt program". Da slipper man legge til alle som egen hendelse og kun legge til hvilke foredrag man vil følge. Drre kunne evt. Beholde fjern fra mitt program for de som ikke har tenkt å delta på lunsjer mm. Ellers er jeg veldig begeistret for appen :)
- PC ikke aktuelt for app for min del. Smart telefon og nettbrett er tilstrekkelig.
- Bra utgangspunkt. Veldig hands-on ift hva man trenger. Flott med tilpasning av egen kalender når det er flere spor. (PS: dere burde brukt den i kartleggingen av

hvilke spor som var mest etterspurt før konferansen. Mandagen drev vi og byttet Aud hele tiden!) Slet noen ganger med treg oppdatering ifm påmelding/avmelding, men det skyldtes gjerne min link (3G på bussen). Kunne tenkt meg at gjennomførte aktiviteter kollapset / ble minimert automatisk og at aktuell hendelse / neste hendelse ble dyttet opp slik at man slapp å scrolle seg frem til denne.

- En utmerket idé. Særlig på store konferanser hvor det er mange parallellsesjoner.

## G.2 The web survey

- Denne så veldig bra ut, men jeg har ikke testet den - derfor bare score 4 på noen av spørsmålene. Jeg bruker heller ikke nettbrett. Om den virker som vist på videoen og uten feil kommer jeg nok til å benytte appen om jeg får mulighet. Lykke til! :-)
- Flott applikasjon :-)
- Nå når "alle" har fått relativt store smart-telefoner eller nettbrett er en slik app helt super. Jeg har savnet enkel tilgang til programmet på konferansen på en app, en app hvor også interaksjon legges inn, hvor alt er oppdatert osv. Håper en reel test kommer på neste NOKIOS!
- Jeg synes dette er en super ide! Ting som er viktige for meg: Kart og beskrivelse av hvor konferansen holdes. Kart og oversikt over hvor de enkelte foredragene holdes. Når jeg leser om et firedrag, bør det være enkelt å komme tilbake til programmet derifra. Lukk kan kanskje likegodt gå tilbake til programmet? Parallellsesjoner!? Lykke til!
- Jeg har ikke Smartphone!
- Clean design og UX
- Tror det kommer an på størrelsen på konferansen - desto større konferanse, jo større sjanse for at jeg vil bruke konferanseapplikasjonen. Grunnen til at jeg er såpass skeptisk er at jeg misliker at folk sitter med laptop/nettbrett/smartphones på konferanser, både når jeg selv presenterer og når jeg er tilhører. Det er rett og slett uhøflig å dukke ned bak en skjerm eller fikle med nettbrett/smartphone, selv om det er for å ta notater eller annet relevant. Bedre å ta notater på papir/oversikt som deles ut på konferansen. Jeg merker også at synet mitt blir dårligere av å bruke smartphone for mye, men laptop er ok - til nød.
- Ville vurdert en allerede eksisterende app, som er brukt på flere konferanser nasjonalt og internasjonalt. Ville trolig ikke lastet ned en egen app for en spesifikk konferanse.
- For å lukkast er det viktig at ein slik app vert "pusha" av konferansearrangøren. Då er eg som brukar meir trygg på at alt som er viktig faktisk er der. Filmen var

litt rask, men det er viktig at det er eit godt brukargrensesnitt og at den snakkar med min kalender + evt push-varslar. Lukke til :-)

- Kalender-layout bedre enn tradisjonell layout. Litt vanskelig å få oversikt på tradisjonell layout - kanskje vurdere litt design-endringer. Kort forklaring av fargekoder på sidene der det brukes hadde også vært en fordel. Men alt i alt veldig bra :)
- Har ikke prøvd applikasjonen, den ser ut som et meget nyttig verktøy for de som deltar mye på konferanser og da gjerne konferanser som ofte overlapper eller foregår i samme tidsrom. Jeg drar ikke på konferanser for tiden, men om jeg hadde ville jeg benyttet meg av denne applikasjonen på mobiltelefon eller datamaskin. Den ser også enkel ut å bruke, men har ikke brukt den personlig, derfor litt varierende svar. Jeg kommer ikke til å benytte applikasjonen, men det er kun fordi jeg ikke går på konferanser.
- Må jobbe litt med designet..
- En slik app må også fungere off-line, med evt. oppdateringer når det kommer online (ved evt. tilbakemelding på konferansen/foredrag). App'en bør også kunne ha direkte valg mot Facebook, Twitter, Instagram o.a.
- Erfaringsmessig holder det helt fint med en nettside med alle de forskjellige presentasjonene og et kalenderlignende view der. Ofte, om du er på multitrackkonferanser, kan det hende du bytter track spontant fordi andre anbefaler det noen minutter før. Følgelig blir det nesten mer overhead å si hvilke talks du skal på, fordi de ofte byttes nogenlunde spontant. Virker hendig for å gi feedback til de individuelle presentasjonene, men for å gi feedback til konferansen i seg selv er det oftest lettere å sette opp en survey som du sender ut på epost i etterkant.
- Denne undersøkelsen henvender seg kun til bruker. Som avsender vil det være en del spørsmål man ønsker å få svar på som er veldig relevante i dag; Hva koster det å bruke en slik app, snakker den med egne systemer for registrering? Dette er avveininger vi har gjort som har resultert i at vi ikke benytter oss av konferanseapper da vi tror e-post kombinert med brukervennlig nettsider gir brukeren samme opplevelse. Det er en kost/nytte vurdering. Men hadde vi hatt tilgang på et rimelig Open Source verktøy som kan tilpasses til egne systemer for registrering og egne systemer for evaluering (Questback) vil det være et godt alternativ.
- Det at filmen går så fort, gjør at det er vanskelig å vurdere nytte og funksjonalitet. Men Bra jobba! Mvh Jens
- Tjenesten er for lite utviklet/for lite tilgjengelige konferanser til at jeg kan undersøke tjenesten godt nok akkurat nå, men om tjenesten er like enkel å bruke som presentasjonsfilmen ga inntrykk av, er jeg ikke i tvil om at den vil bli populær. Pro's: Enkel å bruke, strømløst design, overførbar til alle mulige duppedingser



(ipad,iphone,pc etc). Cons: Litt kjedelig design. Kunne vært mer kreativ i utforming av knapper, valg etc. Farger skaper ofte større engasjement. Dette er jo mulig å videreutvikle. Godt jobba :-)

- Er koblingen deres mot twitter slik at man kan få twitterstrøm med dertilhørende hashtag til hvert foredrag? Kunne vært nyttig (mulig dere har dette, jeg har ikke undersøkt applikasjonen så veldig nøye). Kobling mot streaming vil også være aktuelt for de som sitter andre steder enn på konferansen (der konferansene gjør dette selvfølgelig).
- En (uvesentlig) anbefaling: litt mindre masete musikk på youtube-video :-)
- Jeg lurer litt på hvordan det vil fungere dersom man er på flere ulike konferanser, organisert av ulike organisasjoner både i Norge og i andre land. Hvordan sikrer jeg at disse konferansene er mulige å laste inn i appen? Dvs. må de organisatørene være compatible med appen for at det skal fungere?
- Jeg tror denne applikasjonene er nyttig. Jeg har deltatt på veldig mange konferanser i mange forskjellige fagmiljøer. Det jeg har savnet i de mange konferansene har vært en enkel måte å se hvem andre som er tilstede, og en enkel måte å ta kontakt med de på, f.eks. avtale at man møtes ved kaffebaren e.l. Er det mulig å inkludere noe slikt i app'en?
- Alt i alt veldig bra! På store konferanser med flere haller/bygg er det ofte uoversiktlig når man skal bevege seg mellom. En ide er å fremheve hvilke bygg/lokasjon de forskjellige hendelsene er når man trykker på "Lokasjon". Det kan løses f.eks. ved at alt annet blir grått, mens den lokasjonen du skal til fremhevet med en farge etc.
- Det med evaluering er en viktig del som burde vært med. Altfor mange dårlige og lite effektive/nyttige konferanser og for lite evaluering
- Synes appen både ser og fungerer veldig bra! For meg vil bruk på mobil være #1 og viktig at appen fungerer godt på mindre skjerm. Når det er sagt har jeg brukt den aller mest på laptop ifm testing. Støtte for notifications (nye varsler, påminnelse om sesjoner, etc) er noe appen vil dra nytte av. Veldig bra jobba!!
- En android app som viser nettsiden (der selve nettsiden er lagret internt i appen) og informasjon caches når man er koblet på nett kunne vært nyttig, slik at man kan se gjennom ting på flyet etc.
- Det må være en mulighet å trykke "jeg vet ikke" eller noe i den duren! Forsøkte på mobil (iPhone 69). Synes ikke jeg fikk noen god totaloversikt over konferansen og de enkelte sporvalg (hvis det da var sporvalg). Og designet manglet vel litt på å være responsivt.
- Bra tenkning, god ide og virker som gode løsninger.

- Synes nettsiden på pc ser og føles ut som en side laget for ipad. Så jeg er ikke fan riktig enda. Ideen er ikke så dum. Kalender-layout fikk jeg ikke til å funke.
- Applikasjonen kan gjerne ha funksjonalitet for presentasjon/beskrivelse av utstillere, slik at man kan vurdere hvilke man evt ønsker å besøke. Funksjonalitet for å se hvilke virksomheter deltakerne kommer fra hadde vært nyttig. Funksjonalitet for "behovstorg" der deltakere kunne poste behov/ønsker om samarbeid hadde vært fint. Ideelt sett burde applikasjonen ha funksjonalitet som bidrar til at du som deltaker får mer ut av deltakelsen, kommer i kontakt med nyttige folk, iverksetter samarbeid, ny viten og erfaringsdeling mellom folk.
- Litt lite info om app'ens funksjoner m.v. før man svarer slik at svarene på spørsmålene kan bli litt \*"som man roper i skogen får man svar". I tillegg kunne det vært interessant om det fantes en komprimert månedsoversikt o.l.
- Veldig kult! :) Likte det oversiktlige konferanse kalenderen, men kunne likt at jeg kunne importere den i min egen kalender, alá Google Kalender eller Mac Calendar. Også hadde det vært smud med en "Kalender-layout" under "Mitt program", og ikke bare "tradisjonell-layout". Klarte å legge til to hendelser til "Mitt program" som overlappet hverandre, her burde det være et varsel.
- Mulighet for å laste ned presentasjoner/materiell direkte fra sesjonene hadde vært nyttig
- Det kunne ha vært greit å ha muligheten for å svare "vet ikke" på noen spørsmål.
- Ønsker mulighet for å skrive ut \*mitt\* program. Det er tungvindt å måtte sjekke en app (eller en elektronisk dings), blant annet pga batteribruk, papir er nyttig ennå i 2015! Liker ellers mest mulig generiske ting - en app per konferanse blir for dumt, så noe som funker på en nettside og lar meg legge det inn i egen kalender samt lage et eget stykke papir er fint..
- Er det mulig å søke i programmet uten å utvide hver eneste post, uten å være logget inn? Relevant hvis man har lyst til å se over programmet før man bestemmer seg for om man skal melde seg på og dra. Er det en god ide å la brukerne skrive anmeldelser av pauser som ikke har videre innhold eller beskrivelser? Man kan sikkert anta at folk oppfører seg voksent og profesjonelt i en slik setting hvis de må oppgi fult navn, men igjen så er de i praksis blitt forumbrukere i en tråd uten videre føringer på innhold. På workshops er det alltid interessant å vite hvem det er som er arrangøren, da det ikke nødvendigvis er gitt at det er konferansearrangøren og ikke en kommersiell tredjepart. Kan komme an på konferansen, men som en som ikke vet noe mer om den enn at det kanskje kan være saklig å gå på den er det relevant informasjon. Tilsvarende på paneldebatter/debatter er det interessant å vite hvem det er som kommer til å være ordstyrer/moderator. I en faglig sammenheng kan ordstyreren i seg være en interessant grunn til å oppsøke debatten, eller hvis arrangementet går over fler dager/uker kan det hende man

liker stilen til ordstyreren så godt at man har lyst til å besøke flere av debattene han modererer.

- Har ikke prøvd app'en. Synes det er enklere å lese program, kart etc. på papir eller større skjerm.
- Høres ut som en veldig bra applikasjon som mange kommer til å bruke. Hadde jeg gått mer på konferanser selv ville jeg helt klart brukt den.
- Føler jeg burde brukt konferanseappen litt med før jeg svarer på spørsmålene, men ser veldig nyttig ut!
- Det virker som om kalendervisningen går til dagens dato. Det ville kanskje gi litt mer mening om den gikk til dagens dato hvis konferansen pågår, og utenom det tidsrommet til første eller siste dag.
- I did not actually use it, with the video it seemed easy to use, but my answers would be right if i had actually tried it!
- Federated authentication (via Feide / eduGAIN / Kalmar2) would greatly increase adoption. People hates opening accounts and having one account for every single app they use. With federated authentication more people would be glad to use the app, specially in the education sector.
- I think this might be mostly useful in the academia environment rather than professional.



## Appendix H

# Digital Attachments

The report is delivered with some digital attachments in the file attachments.zip.

### H.1 Source code

Source code for both API and the conference web application are attached in the file source-code.zip

### H.2 Video

The video used along with the surveys in the file Video.mp4.

### H.3 The collected data

Consisting of three files

**Raw\_data.xlsx** Contains the raw data from the conference and web survey.

**Web\_and\_conference\_concatenated.xlsx** Contains both surveys concatenated and divided into subgroups.

**Web\_and\_conference\_concatenated\_pls\_results.xlsx** Contains the results from partial least square analysis of the data from the Web\_and\_conference\_concatenated.xlsx file.