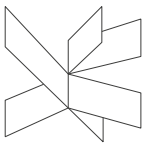
Bring ideas to life
VIA University College



Optimization of room utilization by automatic registration of students' presence in lectures

Jordi Lazo (313296),

Nils Franke (313446),

Anne Schneider (313444)

Supervised by:

Poul Væggemose (POV)

Lene Overgaard Sørensen (LEOS)

ENG-FPRPM-A21: International Project within Business and Communication (GBE)

ENG-FPRPM-A21: International Project within Software Engineering (ICT)

Semester A2021

29-09-2021

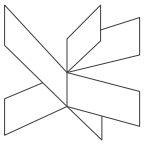
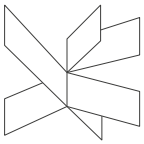
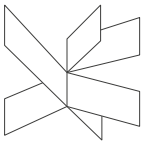


Table of content



List of tables and figures



1 Background description

VIA University College is an organization in Central Denmark Region, Denmark, established in January 2008 as a result of a number of mergers of institutions of higher education. It is present in the region with a total of eight campuses. (VIA University College, 2021)

In August 2021 VIA University College situated in Horsens, opened new facilities located in the center of the city to improve the education of its students in addition to focus on delivering an education that qualifies the work in a variety of disciplines, languages, and cultures. (VIA University College, 2021)

Moreover, the new facilities are located near the Horsens train station which allows to take advantage of new methods and technologies and reduces travel time for students to arrive to the university

To improve the education of the students it is essential that the university can verify the skills and abilities of its students and professors using all the tools and metrics possible. Being able to manage the student's attendance data with efficiency is, undoubtedly, one of the core characteristics of a successful school or university of any size. That includes internal workflows and re-designing timetables, if needed. And having knowledge of the attendance of students in class even could affects to a more positive motivating and learning environment.

With more than 2900 students at VIA University College in Horsens, the management has found a basic problem: the attendance of students in their lectures. (VIA University College, 2021)

The lack of attendance in some classes can negatively affect the academic performance of some students, questioning the quality of the university's teaching and damaging its reputation.

Handwritten absence of students is a laborious and tedious task that teachers do not have time to do that is why the implementation of a digital system to manage students' attendance helps to optimize the classroom scheduling and this focus on attendance helps to a student's culture for reaching a higher learning level.

2 Problem statement

With the move to the new facility, VIA Horsens is experiencing crucial problems with room resources balancing the limited number of available rooms with the high number of students and lectures. By now, room schedules can be planned one week in advance, at the most. To allow a valid and precise forward planning for a longer period (e.g., a semester) it is necessary to get data about the real room occupation. The question "How to automatically register students' attendance in lectures in order to optimize the utilization of room resources?" arises (see *Figure 1*).

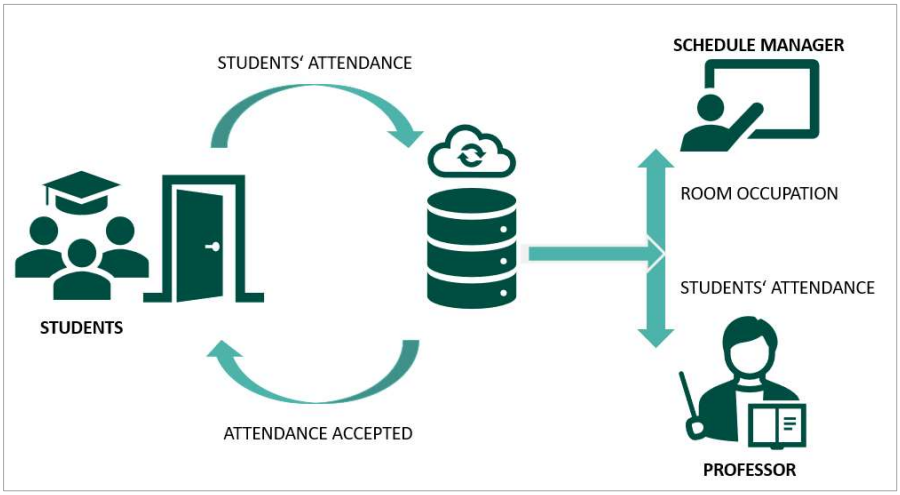
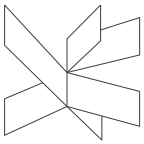


Figure 1: Scheme of problem statement



Based on this question a list of software-engineering and business-related sub-problems are generated (see chapter *2.1 Sub-problems*).

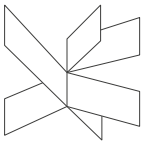
2.1 Sub-problems

To collect real-time data of room occupations a list of sub-areas needs to be addressed. In terms of IT-relations the following sub-problems may occur:

- **Type of technology**: how can the students' attendance be logged?
- **Data quality**: how to ensure real-time data collection? How to prevent attendance manipulation (real number of attending students necessary)?
- **Data security**: how to track students' presence in accordance with data security regulation (GDPR)?
- **Maintenance:** what kind of maintenance is necessary for the system?
- **Real product:** what is necessary to use the concept for potential real products in the future?
- **Performance:** how to prevent transmission interferences due to multiple end users at the same time?

In addition to the subproblems based in IT, further business-relation subareas need to be considered:

- **End users:** who is the target group? What are the pains and gains of the target group?
- **Useability:** how to ensure a representative amount of active end users (quality of database depends on the amount of collected data)?
- **Marketing**: how to create awareness about the product (number of potential end users)?
- **Time management:** how will the project be managed in terms of deadlines and the corresponding tasks?
- **Resources:** what external resources are necessary? Who are the key partners and what are the key resources?

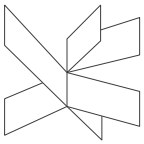


2.2 Requirements

In consideration of the evaluated subproblems, a list of requirements must be fulfilled to complete the project successfully (see *Table 1*). All requirements are prioritized with the MoSCoW method (see chapter *5 Methodology*).

ID	Description	Priority	Acceptance criteria	Sub-problem
1	mobile application for smartphones	must have	available for download in application store	type of technology
2	real-time entrance tracking (time stamp)	must have	accurate time stamp transmission to database	data quality
3	wireless communication to database	must have	no further tool for data transmission necessary	data quality
4	password protection on login	must have	password request for login	data quality
5	real-time notification on database connection error	must have	immediate pop-up on app screen	data quality
6	different end user roles & rights (log ins)	must have	different log in options on app home screen, user profile specifications	end users
7	real-time data transmission to database	must have	highest delay for data to be visible in database: 5sec	data quality
8	availability of data history	must have	logbook of past collected data	useability
9	access to timetable data (ItsLearning)	must have	real-time comparison to students' lecture registration (simulation only)	resources
10	multithreading program model	must have	simulatenous registration of attendance	performance
11	inituitive understandable GUI	should have	end user feedback: > 70% positive	useability
12	modular & scalable system	should have	system can be extended (future use)	real product
13	free of charge for end users	can have	development costs must stay in budget	useability

Table 1: Project requirements



3 Definition of purpose

The project serves the purpose to develop a tool that allows the VIA Horsens to improve its future use of room capacities by collecting data of real-time occupation of rooms by students during regular lectures. The data also can be used for future improvements of lectures quality and students' academic performance.

4 Delimitation

The project will only relate to the VIA campus in Horsens. As the problem of lack of room capacity at VIA university is well known. Also, VIA Horsens works with the portal ItsLearning. Since ItsLearning is where the app will get the data from, its necessary. Therefore, the project will not deal with other locations of VIA university.

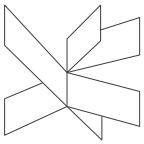
An app which analyzes the data of the end users and then evaluates it depends on the amount of data of the end users of the app. However, the project will have no review on the real end usage of the developed application.

The project scope is to create an app for real-time data collection based on the timetable data provided by ItsLearning. The analysis of the data itself and any interfaces with ItsLearning and other external systems will not be a part of the project.

The project is supposed to be a proof-of-concept only, therefore any regulations regarding GDPR will not be considered. Any data for the system development and testing will be simulation only.

Within the scope of the project, the app is programmed for the smartphone operating system Android only. There will be no app for users of an Apple device with iOS.

Attendance management focuses only on lectures and not on project work. These usually take place outside the schedule and are therefore not analyzed for the time being.



The attendance check is solely about the entrance into the classroom. It is only checked if, and when the student enters the classroom. Leaving the classroom will not be recorded.

After the project and the programming are finished, there will be no update support and no maintenance. Therefore, bugs or other errors that arise after the project will be fixed.

5 Methodology

Within the project different business and engineering related methods and models will be implemented (see *Table 2*).

Area	Subproblem	Description	Methodology
IT	type of technology	how can the students' attendance be logged?	Double Diamond
IT	data quality	how to ensure real-time data collection? How to prevent attendance manipulation (real number of attending students necessary)?	Double Diamond
IT	performance	how to prevent transmission interferences due to multiple end users at the same time?	Double Diamond
Business	useability	how to ensure a representative amount of active end users (quality of database depends on the amount of collected data)?	Use Case Diagram
Business	end users	who is the target group? What are the pains and gains of the target group?	Value Proposition Canvas
Business	marketing	how to create awareness about the product (number of potential end users)?	Customer Journey
Business	time management	how will the project be managed in terms of deadlines and the corresponding tasks?	Scrum, Double Diamond
Business	resources	what external resources are necessary? Who are the key partners and what are the key resources?	Business Model Canvas

Area	Subproblem	Description	Methodology
Business	Market opportunities	What external factors could have a positive or negative impact on the business in the future?	PESTEL

Table 2: Project methodology

For the applications' development and design, the framework of the Double Diamond model will be used (see *Figure 2*). This model represents a process of divergent and convergent thinking, where issues are explored more widely, and actions are taken focused. The model contains four phases of discover, design, develop and deliver (Design Council, 2021).

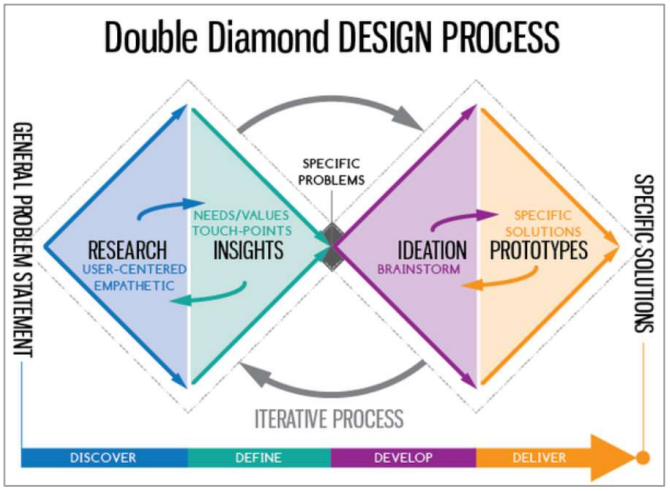


Figure 2: Double Diamond process model

The first two phases of discovery and definition (the first diamond) helps people to really understand the problem. It involves speaking to the people who are affected by the issues, and based on the gathered insights, define the challenge from different perspectives. The second diamond contains the phases of development and delivery. While developing focused on different answers to a clearly defined problem and co-designing with others, delivering is about testing out different solutions and their rejection (fail) or improvement (pass) (Design Council, 2021).

Applying this method allows to be in contact with the students who will use the application as well as the intermediaries promoting early delivery, and continual improvement, and it encourages flexible responses to changes in requirements, resource availability, and understanding of the problems to be solved.

Besides the Double Diamond model for software engineering, the project also implements business related models, especially within the ideation and initiation phase of the project. All initial ideas about the project were collected by reverse brainstorming, where ways and facts worsen the problem were identified instead of thinking about a direct solution. The ideas were then mapped into the different project elements like requirements, sub-problems, delimitations, models & methods, for example (see *Figure 3* and *Figure 4*).

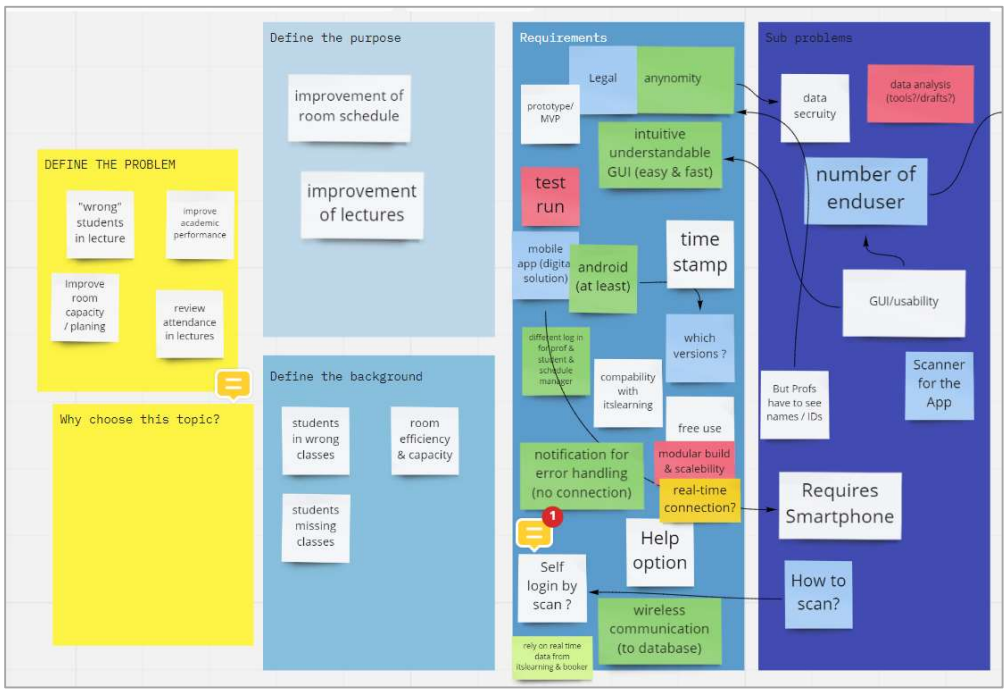


Figure 3: Idea collection (reverse brainstorming), part 1

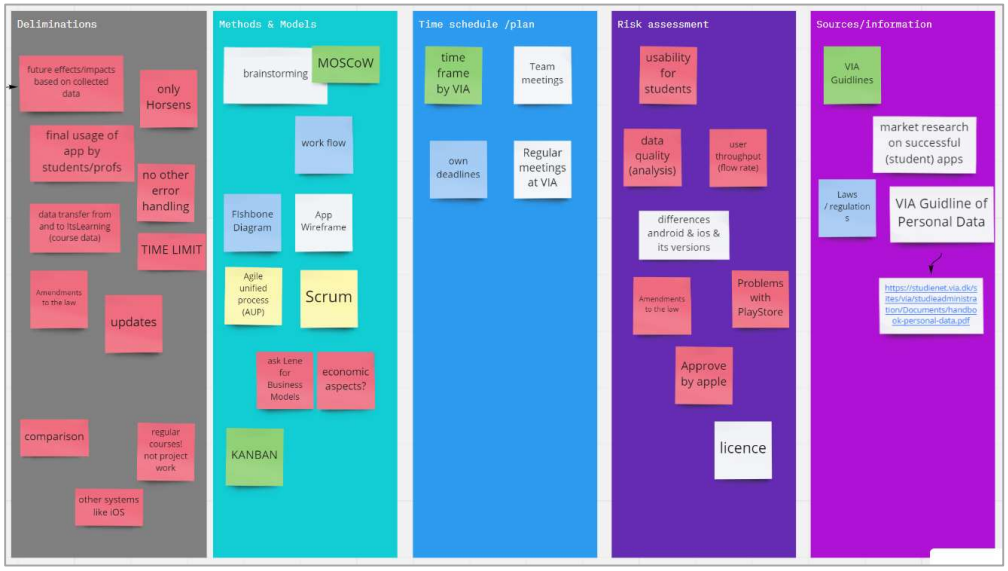


Figure 4: Idea collection (reverse brainstorming), part 2

Potential relationships between the idea are shown by connecting arrows. All identified requirements were prioritized with the MoSCoW[1] technique (see also chapter *2.2 Requirements*).

In addition to the mapping, customer requirements were evaluated using the innovative approach of Values Proposition Canvases (VPC, see appendix, *Figure A - 1*, *Figure A - 2* and *Figure A - 3*). The customer journey is a method used in a marketing context. It refers to the customer`s path via touchpoints connecting their decisions. This means mapping out all the different behaviour scenarios by using existing data to help to understand the customers travel through an organisation, website, or application. This method allows the decision-makers to stay focused on their customers as well as to improve the journey steps and the potential experience (Ryte, n.d.).

Under consideration of the evaluated customer profiles the first draft of Osterwalder's Business Model Canvas (BMC) was established (see *Figure 5*).

[1] *MoSCoW: requirement analysing system, categorizing requirements into four categories of initiatives (must-have, should-have, could-have and won't-have) (Nicholls, 2021)*

The BMC is a management tool identifying nine business model key elements (key resources, key partners, value propositions, channels and more) and mapping them into a canvas (Adam J. Bock, Gerard George, 2018). So far, the project is limited to the development of a mobile application (channel) offering students, professors, and the schedule manager (customer segments) collected data about students' attendance.
The key activities will be the development, and future maintenance of the application, which will also be the main costs of the project. As the application is supposed to be free of charge, there is no revenue stream planned yet.

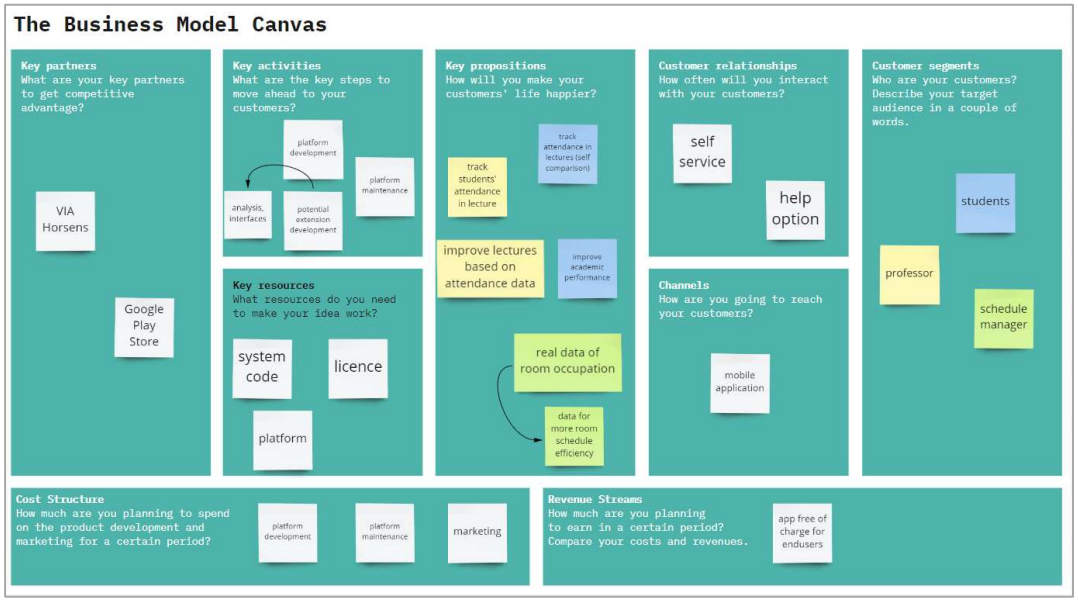


Figure 5: Business Model Canvas

The app development within the project will be a proof-of-concept only. However, for any potential business in the future, the possible external factors impacting the business and its market opportuinities in a positive and negative way needs to be evaluated. Therefore, the PESTEL analysis will be implemented, which allows to identify all challenges in terms of Political, Economic, Social, Technological, Environmental and Legal (PESTEL) matters. (Oxford College of Marketing, n.d.)

Next to software and business-related models and methods, Scrum will be implemented (see *Figure 6*). Scrum is a framework for developing, delivering, and sustaining products in a complex environment. It is designed for teams of ten or fewer members, who break their work into goals that can be completed within time-boxed iterations, called sprints, no longer than one month and most commonly two weeks. The Scrum team assesses progress in time-boxed daily meetings of 15 minutes or less. At the end of the sprint, the team holds two further meetings: the sprint review which demonstrates the work done to stakeholders to elicit feedback, and sprint retrospective which enables the team to reflect and improve (Scrum, 2021). The Scrum team is formed by the Product Owner Nils, the Scrum Master Anne and the Developer Jordi. Given the short amount of project time, the sprint period is set to 7 days.

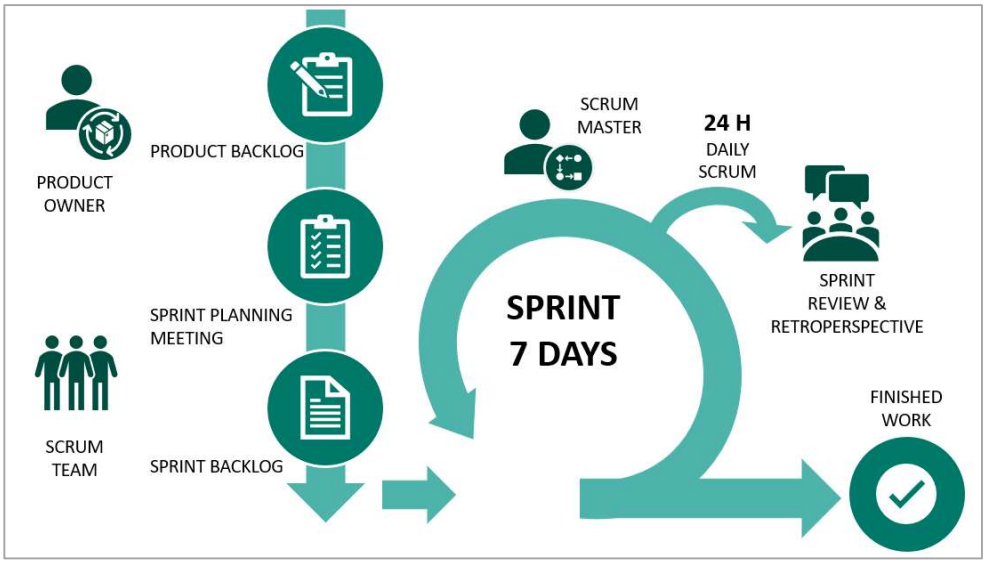
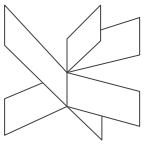


Figure 6: Scrum process (own figure based on (Javapatel, 2016))

For a project that complex and time sensitive, Scrum is used before Kanban in order to keep transparency about all work to be done and issues need to be addressed. (Landau, 2017)



6 Time schedule

The project is considered with a total workload of 413 hours per student (1239 hours in total) and will cover five phases: initiation, analysis, design, coding, testing, and closing (see *Figure 7*). The project itself and its initiation phase starts with the group formation and topic selection, on Monday September 13th. During the initiation phase the project team will hold its first meeting with the project supervisor, on September 29th (first milestone) and will work continuously on the project description. This phase will be completed with the final approval of the project description on October 27th (2nd milestone). The analysis phase is used to outline the understanding of the problem and the stakeholders' expectations.

With the help of Use Case Diagrams the Domain Model of the application will be evaluated, which finish the analysis phase (3rd milestone). Based on the Domain Model all other models will be evaluated during the design phase. The finalizing of the applications blueprint (4th milestone) on November 19th ends the design phase. The coding phase focuses on the code writing based findings and outcomes of the previous phases. This phase will also include a wireframe draft for the application. Both, the code and the wireframe will form the prototype (as MVP, 5th milestone), which is to be released on December 3rd. With the release of the prototype the testing phase starts. During the testing phase the product will run through different test based on test specifications. All findings will be document. The final testing report (6th milestone) ends the testing phase on December 15th. During the closing phase the final project and process report will be written. The hand in of both reports on December 17th (7th milestone) defines the end of the project.

A general overview over the project phases, the including work packages and milestones, the chosen methods and models as well as the potential sources of information can be found in the appendix (see *Figure A - 4*).

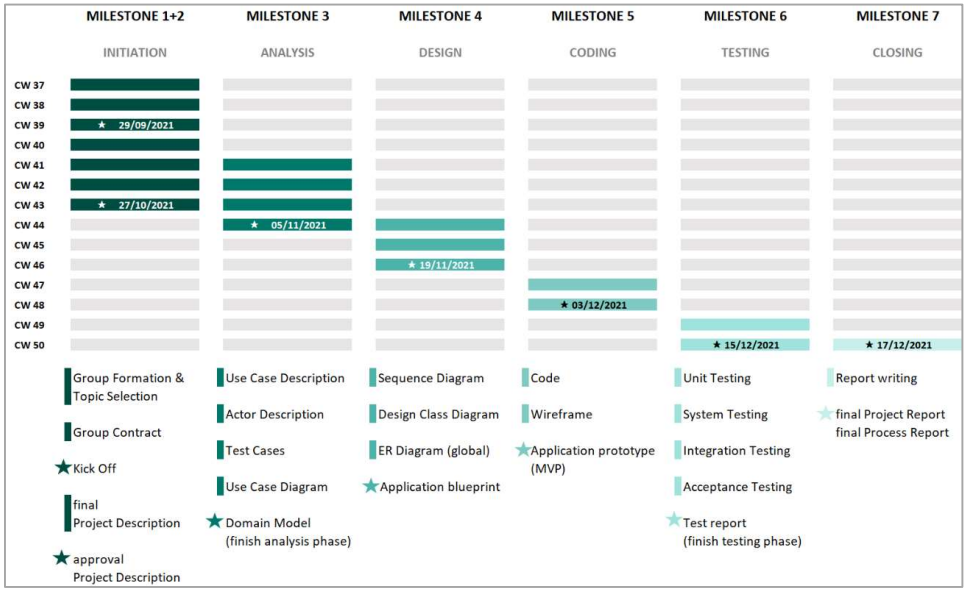


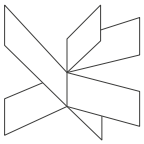
Figure 7: Project timeline including milestones

7 Risk assessment

According to requirements and the sub problems, a list of risks could be identified (see *Table 3*). All risks were assessed, categorized, and valued individually. Both, likelihood (L) and servity (S) follow a scale from 1-5, 1 being low risk, 5 being high risk. To end value for this risk is calculated by the product of two former characteristics.

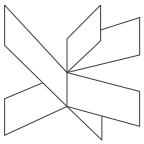
In addition, identifiers were defined which can be used to detect the risks when they occur. For every risk a countermeasure is specified.

Risk #	Description	L	S	L x S	Countermeasures	Identifiers
1	Low quality of data	**4**	**5**	**20**	Encourage users to use the app more	no useful data, no significant analysis
2	Poor usability for students	**2**	**4**	**8**	Improve usability, improve GUI	less end users, numbers of downloads



Risk #	Description	L	S	L x S	Countermeasures	Identifiers
3	Small number of end users	**3**	**2**	**6**	Review of usability, marketing	Not enough data, empty Database
4	No approval from Google Playstore	**1**	**5**	**5**	Work on datasecurity, cooperate with Google Play Store	app not available in Google Play Store
5	Attendments to the law	**2**	**1**	**2**	Work on data security	difficulties with app approval by Google Play Store

Table 3: Risk assessment



8 Sources of information

Adam J. Bock, Gerard George, 2018. *The Business Model Book - Design, Build And Adapt Business Ideas that Thrive.* s.l.:Pearson Education Limited.

Agile, 2001. *Manifesto for Agile Software Development.* [Online]
Available at: https://agilemanifesto.org/

Design Council, 2021. *What is the framework for innovation? Design Council's evolved Double Diamond.* [Online]
Available at: https://www.designcouncil.org.uk/news-opinion/what-framework-innovation-design-councils-evolved-double-diamond

Edeki, C., 2013. Agile Unified Process. *International Journal of Computer Science and Mobile Applications,* Sep, 1(3), pp. 13-17.

Javapatel, 2016. *Javapatel.* [Online]
Available at: https://javapatel.wordpress.com/2016/12/31/scrum-agile-methodology/
[Accessed 14 Oct 2021].

Landau, P., 2017. *PROJEKTMANAGER.* [Online]
Available at: https://www.projectmanager.com/blog/kanban-vs-scrum-better

Nave, 2017. *The Kanban Method: The Ultimate Beginner's Guide!.* [Online]
Available at: https://getnave.com/blog/what-is-the-kanban-method/
[Accessed 10 Oct 2021].

Nicholls, J., 2021. *The Everyday Project Manager.* 1st ed. Boca Raton: Routledge.

Oxford College of Marketing, n.d.. *What is a PESTEL analysis?.* [Online]
Available at: https://blog.oxfordcollegeofmarketing.com/2016/06/30/pestel-analysis/
[Accessed 02 Nov 2021].

Ryte, n.d.. *Ryte Wiki.* [Online]
Available at: https://en.ryte.com/wiki/Customer_Journey
[Accessed 13 Oct 2021].

Scrum, 2021. *What is Scrum?.* [Online]
Available at: https://www.scrum.org/resources/what-is-scrum

VIA University College, 2021. *About VIA.* [Online]
Available at: https://en.via.dk/about-via

VIA University College, 2021. *Campus Horsens.* [Online]
Available at: https://en.via.dk/life-at-via/campuses/horsens

VIA University College, 2021. *VIA University College.* [Online]
Available at: https://en.via.dk/life-at-via/campuses/horsens

9 Appendices

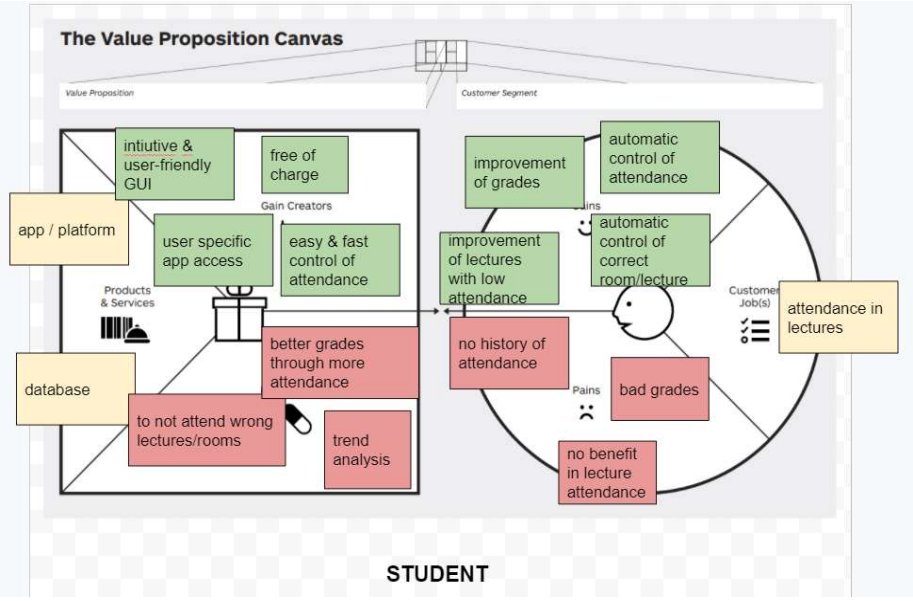


Figure A - 1: VPC end user: student

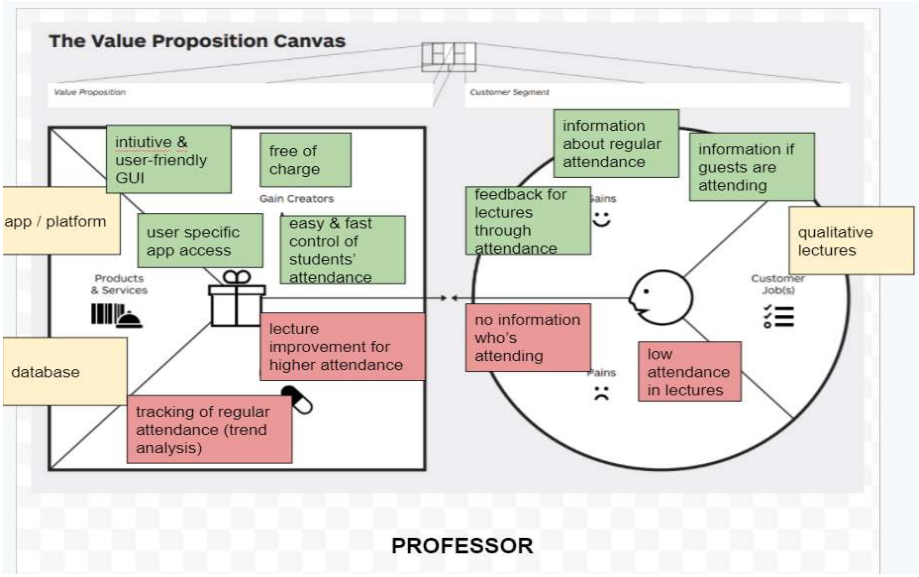


Figure A - 2: VPC end user: professor

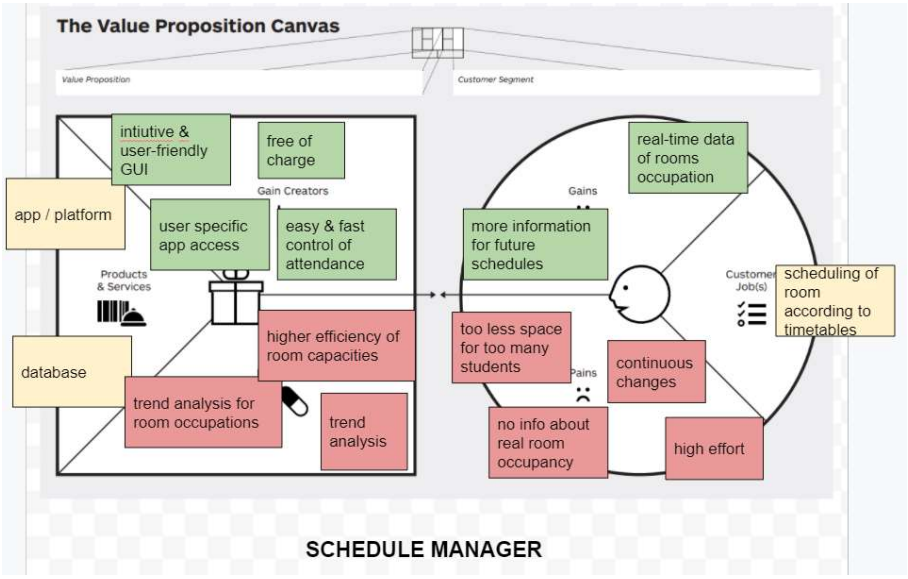


Figure A - 3: VPC end user: schedule manager

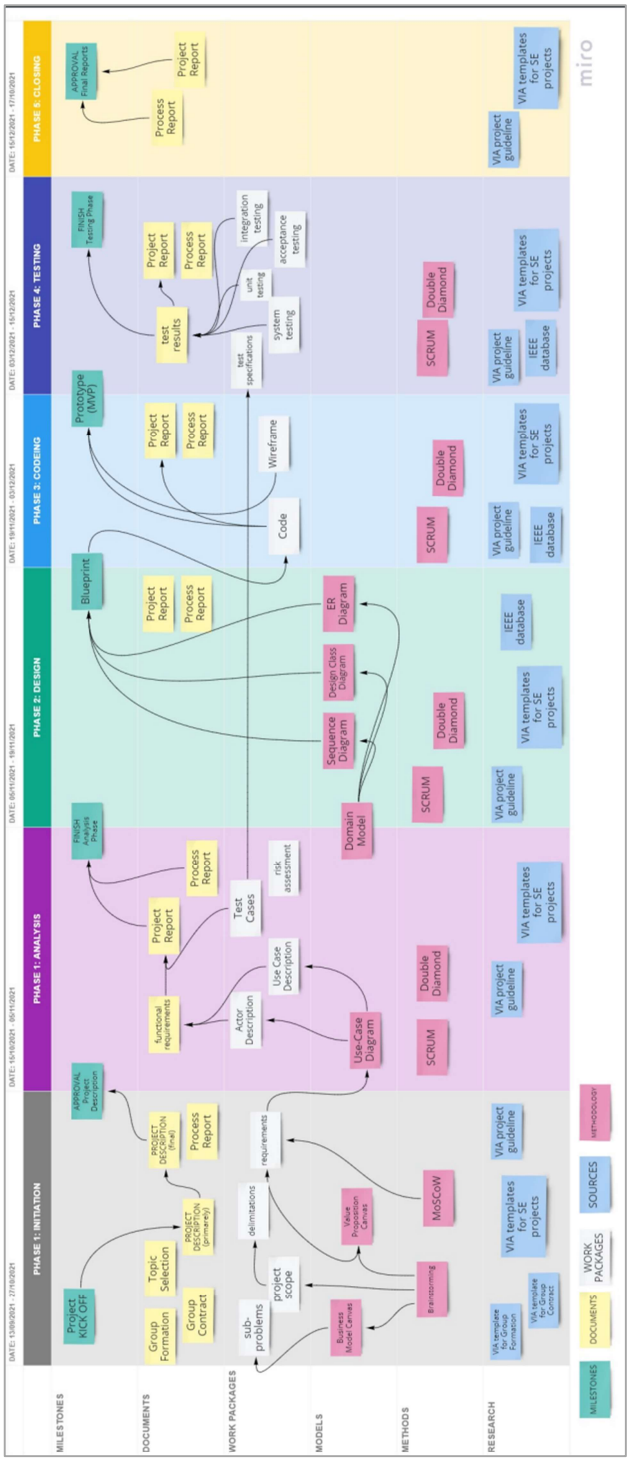


Figure A - 4: Project phases and work packages