SMACS: Modelling Urban 3D Environment

European Project Semester 2021

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ABSTRACT

OsloMet University is planning to close its campus in Kjeller in 2023 to create a new campus in the Romerike region. This change aims to improve and strengthen the synergies between the university and different companies in order to train students professionally, as well as to improve the quality of the campus in terms of accessibility and location, university life and even teaching.

Four students from the European Project semester had the opportunity to take part in this project and propose a solution to design a potential new campus of OsloMet University based on an analysis of the people's flow from an existing building.

This report shows the path followed during the whole semester, from the working methodology, the research, the contextualization and analysis of information and data to the final proposal: the creation of a tool to help in making decisions about the design and layout of the new campus to improve the people's flow and take advantage of all the available space.

A hypothetical proposal has been developed of how the new campus could be distributed, providing three factors of flexibility in terms of location, number of people and rooms and versatility in the use of the available spaces. To show this in a visual way, a 3D model has been designed that allows you to enter the building and visualise how each of the floors that make up the campus are distributed.

"If you want to go fast, go alone. if you want to go far, go TOGETHER."

1 ABSTRACT

OsloMet University is planning to close its campus in Kjeller in 2023 to create a new campus in the Romerike region. This change aims to improve and strengthen the synergies between the university and different companies in order to train students professionally, as well as to improve the quality of the campus in terms of accessibility and location, university life and even teaching.

Four students from the European Project semester had the opportunity to take part in this project and propose a solution to design a potential new campus of OsloMet University based on an analysis of the people's flow from an existing building.

This report shows the path followed during the whole semester, from the working methodology, the research, the contextualization and analysis of information and data to the final proposal: the creation of an Excel tool, *Space Management*, to help in making decisions about the design and layout of the new campus to improve the people's flow and take advantage of all the available space.

A hypothetical proposal has been developed of how the new campus could be distributed, providing three factors of flexibility in terms of location, number of people and rooms and versatility in the use of the available spaces. To show this in a visual way, a 3D model has been designed that allows you to enter the building and visualise how each of the floors that make up the campus are distributed.

2 THANKS

To begin, we would like to express our gratitude to our supervising teacher, Dr. Berthe Dongmo-Engeland. We thank her for coaching, helping and advising us at every step of our project.

Our sincere thanks go to the EPS teachers, Tengel Aas Sandtrø from the Working in Project course, and Tom Muir from the Collaboration and Communication in English course, who guided our reflections with their advice.

Furthermore, we want to thank the participants in our survey because without them, we would have very little information about people's opinions.

And lastly, many thanks to the whole university of Oslo-Met and our home universities; Universitat Politècnica de Catalunya, Universidad Politécnica de Madrid, Universidad de Cantabria and Université de Reims Champagne-Ardenne; who made this entire semester possible despite the complicated situation in 2021.

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INTRODUCTION

a General view

This report documents a project to model a potential new campus of OsloMet University based on an analysis of the people's flow from an existing building.

OsloMet (Oslo Metropolitan University) is a public university based in Oslo, Sandvika and Kjeller (Norway). It is one of the newest universities in Norway. It was established in 2018 and it evolved from Oslo and Akershus University College. According to its webpage this university has a total of 21905 students divided between 3 campuses (mentioned above), 48 bachelor's programmes, 33 master's programmes and 7 PhD programmes. (OsloMet, n.d.)

Kjeller campus is going to be closed and relocated in the near future, and this is going to be the focus of the project.

The team had the opportunity to talk to Arne-Vetle Gulliksen, program manager for OsloMet's campus development, who informed them on in which stage is this relocation at.

The location of the new campus is now being studied. As well as which departments and faculties are going to be placed there. This means they still don't know how many students nor teachers there will be in the new campus. Arne also explained how most of the people affected by this big change in the university are reluctant of the relocation. More details on this interview can be found in *Appendix1*.

Because all the uncertainty around this project the model being made is going to be as flexible as possible, so that it is easily adaptable to all options:

- Flexible in terms of location. As the final location is still unknown, the model will have to be adaptable to different places. Different parameters need to be considered when choosing the physical situation of the university. This are explained in the section *Location*.

- Flexible in terms of number of people. As stated before, the number of students or teachers is also unknown. It is very important when building a public space (as it is a university) to know how many people are going to make use of each space to calculate the capacity of the rooms, in addition to knowing which rooms and how many of them may be needed. Therefore, this team will ideate a procedure for managing flexible spaces, from which then will create a 3D model of the new campus. All of this is explained with more detail in the *design* section.

- Flexible in terms of spaces. In order to take advantage of all rooms within the campus the group has though that some spaces could have more than one use. More information is detailed in the design section.

To be able to do all this, people's flow must be studied in the university. This concept refers to people moving around, it can be across borders, around a country, around a city, within buildings, in a room...

Now, because of the Covid-19 pandemic, classes are given and taken online by students and professors and universities are mostly empty. This means that the current people flow is not a good representation of reality. To have a more accurate vision of it, a survey for professors and students has taken place asking about their routines in the university.

In addition, to study people flow within campuses this team has gone through some past data. Some documents (P35 Device Connection Data) provided by Tengel Aas Sandtrø (Senior Advisor, Section for Service Management and User Support), contain how many devices have been connected to the university network in the last years. This information comes divided by hours, floors and buildings. With this, it has been easy to predict the movement in the new campus and start to build the model around it. This is a virtual 3D model that shows the distribution of the rooms in the new building. It is a visual example of how the new campus could look like considering the *Space Management Tool*.

b SMACS modelling urban environment. Original description

SMACS modelling urban environment (MURE) is the fifth project taking place in the EPS program in OsloMet university and its original description (extracted form Oslomet website) is the following:

"Visualize building development of an urban campus through physical, mixed and virtual reality toolsets.

OsloMet campus will be transformed in the years 2021–2024, and we need simple models that communicate well for non-technical decision-makers.

A combination of mixed and virtual reality, possibly combined with physical models is suggested." (Oslo Metropolitan University Storbyuniversitetet, 2021)

From this initial description the project has been developed. A mission has been determined, goals have been set, and a scope down has been conducted, as shown below.

C Mission and goals

i. Mission

The mission for this project is to make a 3D flexible model of the OsloMet campus that will be relocated from Kjeller to Romerike.

ii. Goals

1. Analyse people's flow and search information/collect data (make a survey to know where the students and teachers spend their time in the university).

2. Create a tool to make the process of designing a flexible and equilibrated space easy.

3. Model the new campus:
   I. Decide what needs to be included in the campus.
   II. Decide how to structure the new campus.
   III. 3D modelling the campus.

iii. Scope down

Each room is not going to be designed to the smallest detail. The focus will be on people's flow, and from that it will be decided where each room of the campus should go. A real 3D model of the campus is not going to be build. A virtual model will be created; it will consist of a guide to show a visual organization of how the campus could be.

iv. Stakeholders

The stakeholders of a project are those people who are interested or involved in the project and those affected by the outcome. It is important to clarify that these are the stakeholders for the project SMACS modelling urban environment (MURE) and not for the relocation project. This second project will have other project responsible, sponsors, users, suppliers, etc.

a) Core stakeholders: People directly involved.

- Members of the project group: They will take all decisions.

b) Primary stakeholders: People directly affected and want to influence the project.

- Dr. Berthe Dongmo-Engeland: Project supervisor, and therefore the person who will help all the way.
- Arne-Vetle Gulliksen: Project manager of the new campus. The team had the opportunity to speak to him about their vision of the moving campus.
- Oslomet teachers and Oslomet students: They will be involved in this project through a survey. This survey has the aim to learn about their day-to-day life inside the university and their opinions on the relocation of the campus.

c) Secondary stakeholders: People indirectly involved.

- Oslomet staff working in Kjeller: Cleaning staff, cafeteria staff, academic management staff, reception staff, etc. All these people will be affected by the replacement of the campus as they will have their place of work changed.

- Neighbours in Kjeller: They will no longer enjoy the community that having the university there offers.

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PROJECT MANAGEMENT

a Presentations

Our team consists of four members from different nationalities. Even though three members are from Spain and only one from France, there was not a significant gap in the diverse backgrounds, attitudes, and cultures. However, we all have different ways of thinking and acting, which makes working an intriguing challenge. Besides, all of us study engineering but with different specializations, which complement each other. We can also share all of our knowledge in our field and use it to solve all the possible problems during the project as having different approaches.

i. Aina Maroto i Abril

Image 1. Aina

Aina is a 22-year-old electrical engineering student at Polytechnic University of Catalonia (Universitat Politècnica de Catalunya, UPC) - Spain. She is from Girona, a city located in the northeast part of the Iberian Peninsula (between Barcelona and France).

Even though her knowledge in the field of electricity has not been very handy, her experience on the development of many projects during her formation has been very helpful in the making of SMACS modelling urban environment.

ii. Ana Vázquez Sánchez

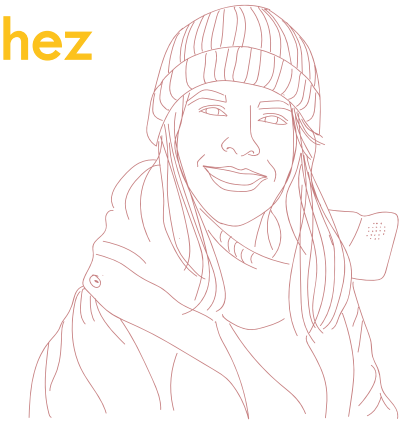


Image 2. Ana

Ana is 25 years old and studies a double bachelor's degree in Mechanical Engineering and Industrial Design and Product Development Engineering at the Polytechnic University of Madrid (Universidad Politécnica de Madrid, UPM) - Spain.

She is passionate about interior design, and her knowledge of design and ability to put ideas down on paper comes in helpful when making decisions. She enjoys working in a team, she has participated in other two international courses in Poland and in Milan and so she has experience of actively contributing ideas in a group and learning from her colleages.

iii. Estelle Annecca

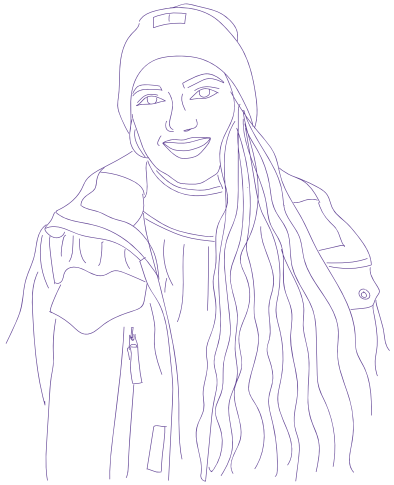


Image 3. Estelle

Estelle is 22 years old and studies Packaging Engineering at the University of Reims (Université de Reims), ESIReims - France. She studies the basic sciences but also materials and processes for packaging. She is doing the EPS program at OsloMet as her fourth year of studies to discover a different way of living and quickly deepen her English language skills, spoken and written. It has also enabled her to go outside of her comfort zones, she wanted to have a direct and concrete approach to student life in Norway, and she is very pleased to have made it despite the particular 2021 situation.

Her packaging knowledge was not that much needed for the SMACS project, but Estelle learned fast and was willing to adapt. She is giving her best regardless of the subject. She is a great worker and loves when everything is organized; she is the type of person that thinks that "the devil is in the details".

iv. Laura Haya Perez

Image 4. Laura

Laura is 21 years old and studies Industrial Electronical and Automatic Control System Engineering at the University of Cantabria (Universidad de Cantabria, UC) - Spain. She is doing the EPS program at OsloMet as her bachelor's thesis in order to improve her English and work together with international students.

The knowledge she has in electronics was not much needed, but she tried her best to adapt and bring new ideas into the project. Laura had already participated in a project when she was in High School, so her experience working with more people and under a schedule was useful.

v. Personalities: Belbin test

Knowing who you are working with is significant. Not only to distribute more properly the tasks but to try our best and have a good environment with each other. For these reasons, we selected the Belbin test in order to know more about all group members.

Results:

AINA

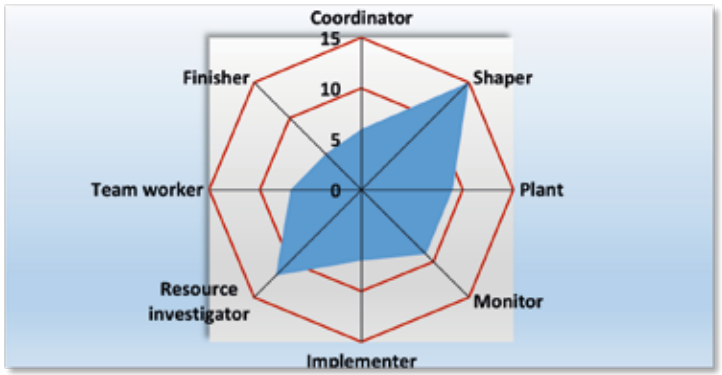


Image 5. Aina's Belbin Test

ANA

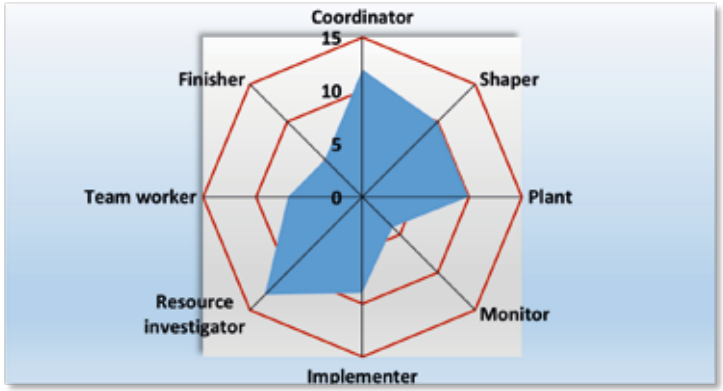


Image 6. Ana's Belbin Test

ESTELLE

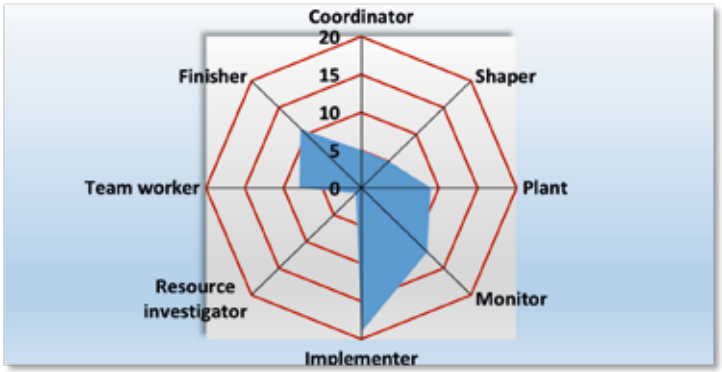


Image 7. Estelle's Belbin Test

LAURA

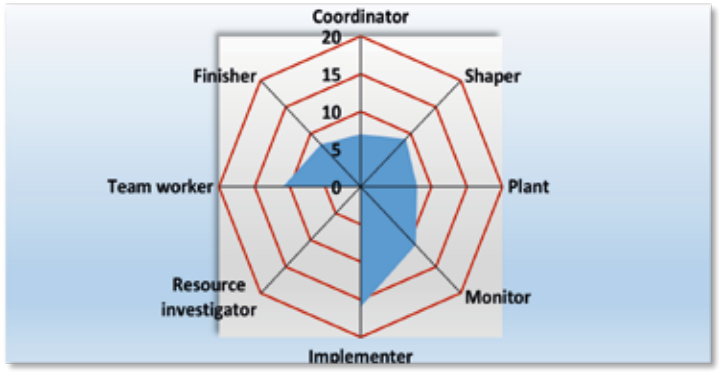


Image 8. Laura's Belbin Test

b Methodology

i. Processes used

The methodology, used during the project, consists of three parts: the Gantt diagram, our own calendar and the Hasso Plattner Institute method.

The Gantt diagram was used to organize every task that needed to be done for the project. It was organized by weeks to see how much time we have to do each task or assignment. As it can be seen, if we simplify, the research phase took up most of the first half of the project time, while the modelling phase took up the second half.

The Gantt chart is a tool used in scheduling and project management to visualise the various tasks in a project over time. The purpose of this diagram is to try to make things clearer and simpler for the people involved in the project. On a conceptual and visual level, this tool is very practical. Indeed, it encourages us to structure the project with several levels of detail, to think carefully about the dependencies between tasks, to estimate their duration, to visualise at a glance all the tasks and the progress level. We used the Gantt (initially with whiteboard/marker) as a visual breakdown, sequencing at the very beginning of the project. (association for project management, 2021)

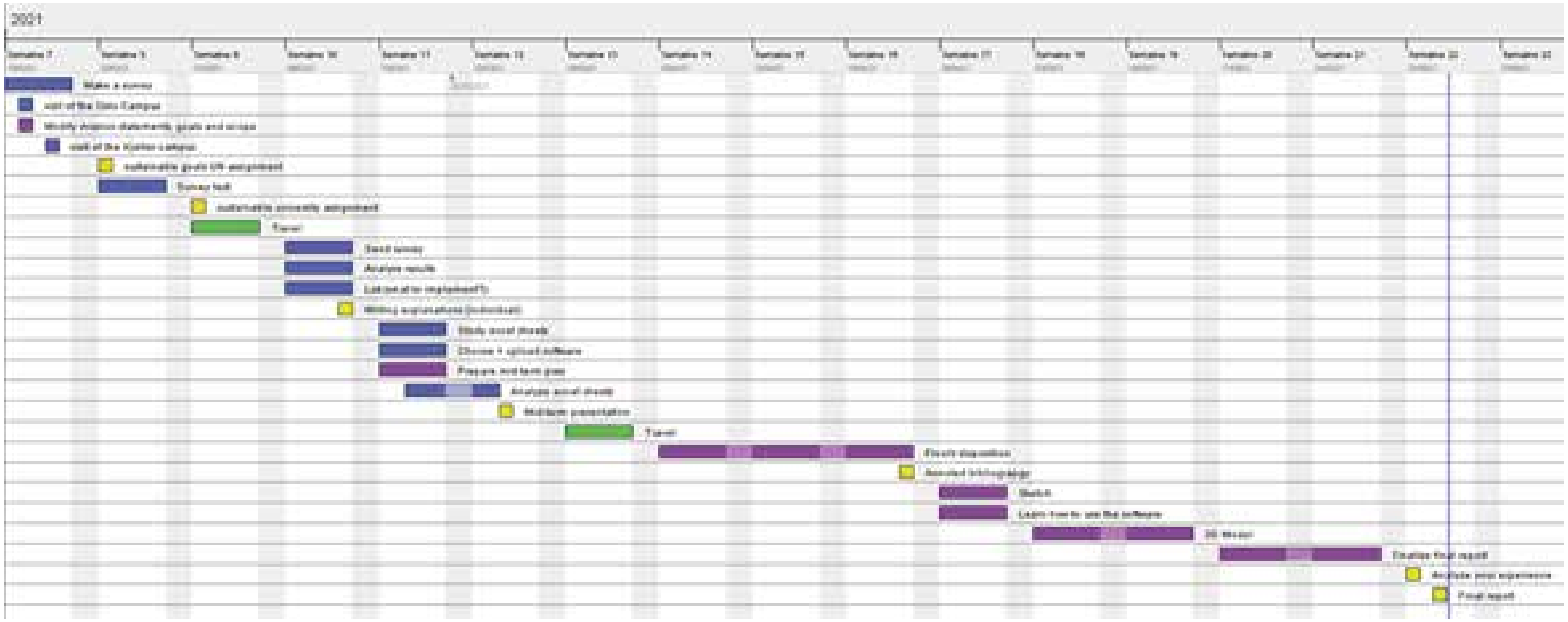


Image 9. Gantt Diagram

The calendar was used to see in a more visual way what assignments we have to do each week, meetings and when we will be doing the research. It was organized by days and weeks for the whole project's development. A colour system was also used to make it more visual and easier to understand; yellow for the assignments, pink for the meetings (between the group members and the coordinators), and blue for the research.

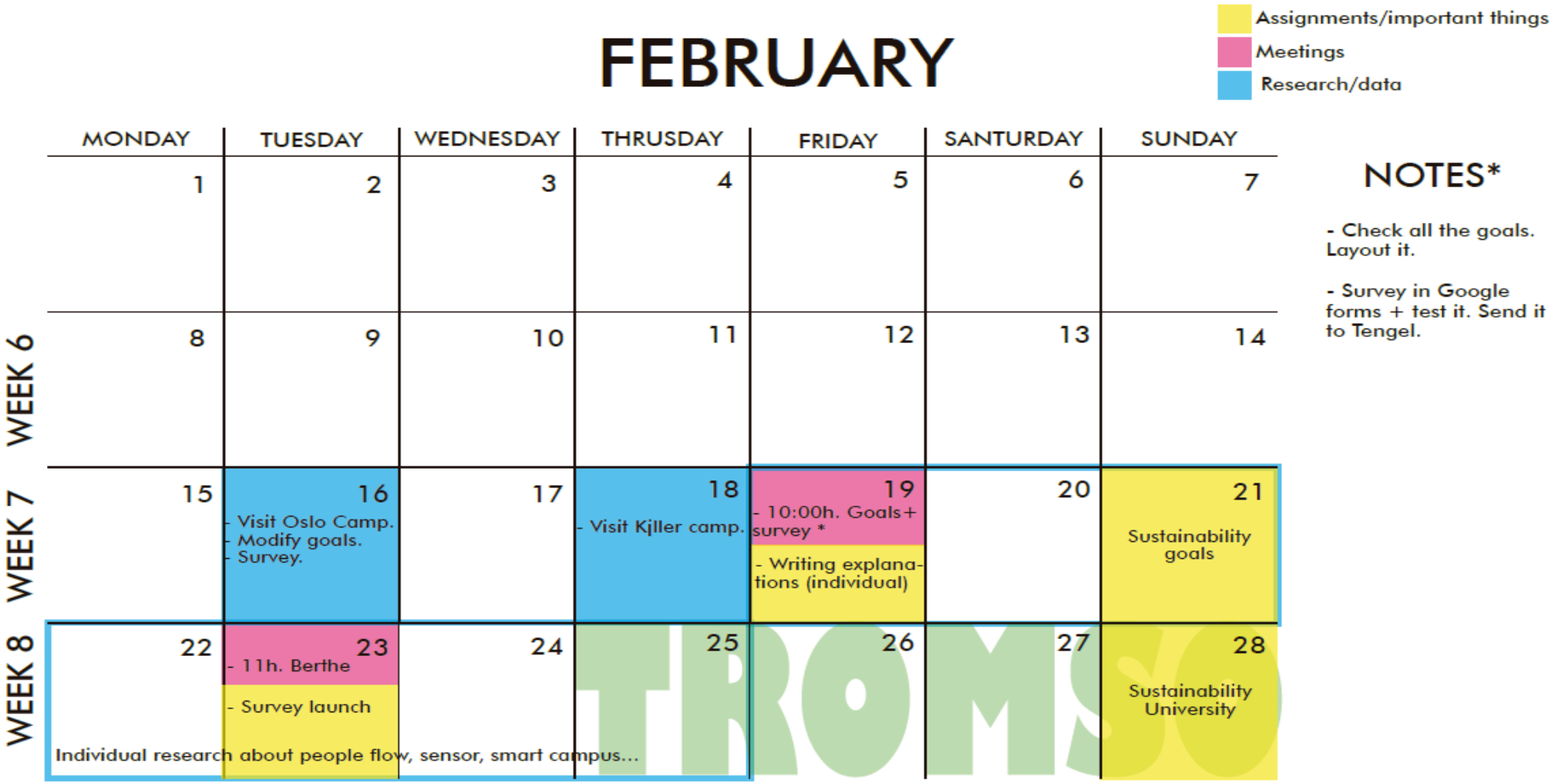


Image 10. February monthly planification

The project 5 method was created based on the Hasso Plattner Institute (HPI) method. This method was developed by the HPI in Germany. It is an approach and mindset that can be used to develop innovative solutions to solve complex problems in mixed teams. The focus is always on the human being. The first stage of this process is to gain an empathic understanding of the problem. During the Define stage, the aim is to put together the information gathered during the previous stage. In other words, analyse the observations and synthesise them in order to define the core problems. During the third stage, we start generating ideas.

Then, there is the prototype stage, the team will now produce several draft versions of the "product", so that we can see if it works well or if the product needs improvements. The final step consists in rigorously test the complete product using the best solutions identified during the prototyping phase. (Isabell Osann, 2020)

We studied several methods in class, but we chose this one because we thought it was the one that best suited our project and our way of working. Indeed, the steps and their sequence fitted perfectly with what we wanted to do, and it allowed us to have a common thread to follow throughout the project.

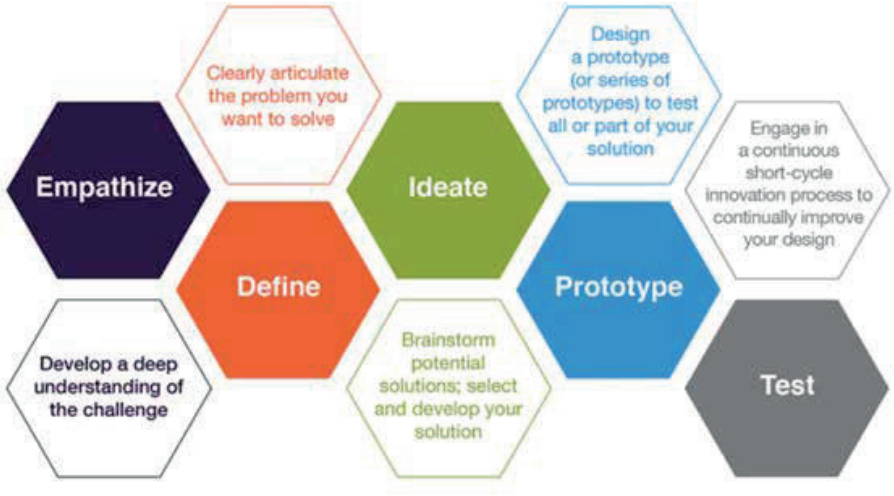


Image 11. Hasso Plattner structure (The Conversation, 2017)

Hasso Plattner	Our Methodology
- Understand	- Scope down
- Observe	- Research
- Define	- Analyse
- Ideate	- Sketch
- Prototype	- Model
- Test	- Test

Chart 1. Hasso Plattner VS our methodology

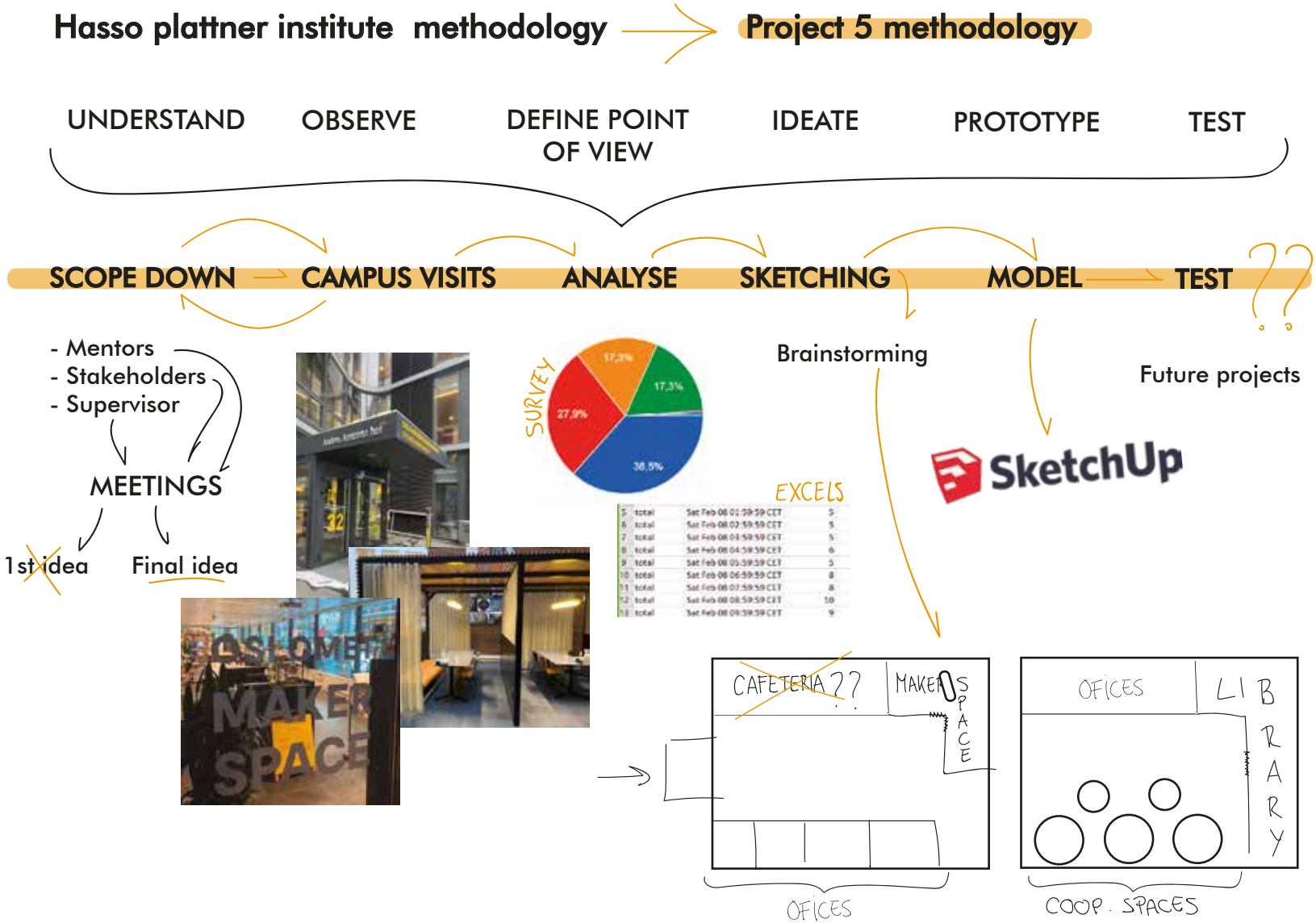


Image 12. Hasso Plattner VS. our methodology

In the two columns above, a comparison between both methods can be seen. The first one represents the six parts of our project, and the second column, the original system.

Defining and scoping down what our project is about was the first step. In order to achieve it, several meetings were made with our coordinator, supervisor, and representative of the relocation (Arne) of the new campus. The first idea that was going to be developed was turned down as soon as the campus visits made us realize what we were working with, step two. After a few more meetings, the final idea was created at the same time as the visits were over.

Step three was analysing the P35 Device Connexion Data excel tables , corresponding to the number of people connected to the Wi-Fi in P35 during 2018, 2019, and 2020, to estimate how many there are regularly at university. Due to the coronavirus situation, OsloMet has been closed, and then, open but with no face-to-face classes so the people's flow couldn't be seen during the visits. A survey, to know what people need in the new campus, was also made. Lastly, we found information about the organization of rooms and floors in P35 in order to know how to model the new building.

Brainstorming and sketching how the building would be is step four. Considering all the data in the last step, we decided what and how many rooms will fit in each floor and put our ideas on paper. At the end, a sketch of the building was draw. Modelling with the softwares SketchUp and Enscape3D is step five. After having the blueprints, we only needed to raise the walls to see our building in 3D.

Step number six would be testing what we have done in future ideas for the following SMACS projects related to this one.

ii. Working as a team

One of the team members couldn't come to Oslo because Norway's borders were closed due to the pandemic. Even though the situation of our group was not easy nor natural, working together was quite simple. The meeting schedule was two days per week, commonly on Tuesdays and Thursdays, and sometimes a few minutes after classes, merely to discuss what has to be done for the following day. Also, one day per week, a meeting with the supervisor, Berthe, was arranged.

Two methods have been used during the development of the project: divided and layered. The divided method is where everyone in the group works on a different task (or even the same one) and compares their results on an agreed meeting. The layered method is where everyone writes into the same document and can revise and edit each other's work.

From the very beginning, each one would do work on their own and put it in common later, so that the outcome would come out good and with everyone's ideas. This method is done especially when research reports are needed. The layered system was used depending on the task. One of the group members writes while everyone is giving ideas and, also, correcting the previous ones.

When it comes to decisions, there is not an evident voting system. Each group member would express their opinion about the topic and explain why their idea is the best fit. In the end, the most voted idea is the one that will be implemented.

An important part of our work as a team was how we managed to portray the ideas, through design thinking. We used the Whiteboard app and wrote everything said down in a scheme format to have a clearer vision of what we were doing as well as not forgetting information mentioned before. It was useful when deciding where to fit each room in the different floors of the new building. Some examples will be shown below.

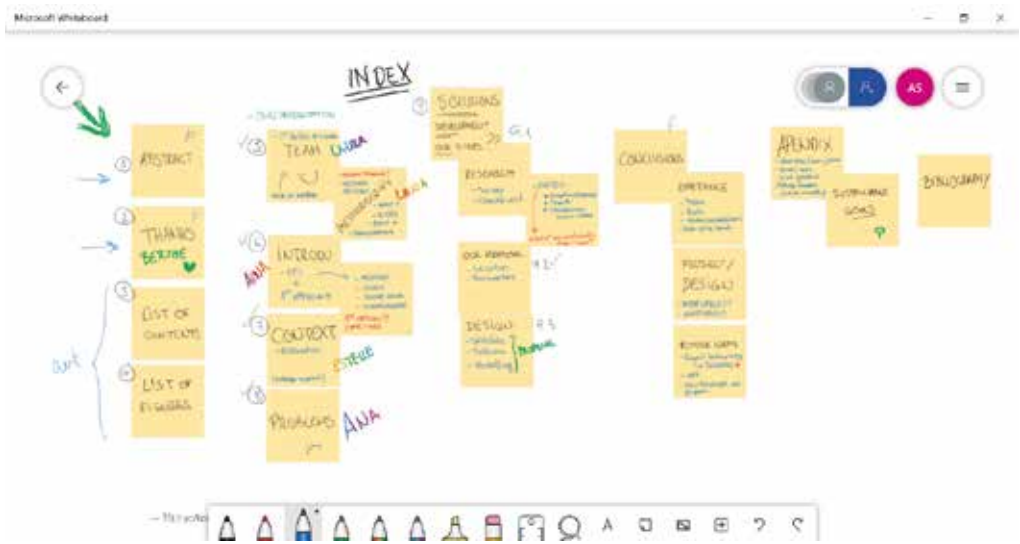


Image 13. Whiteboard design thinking 1

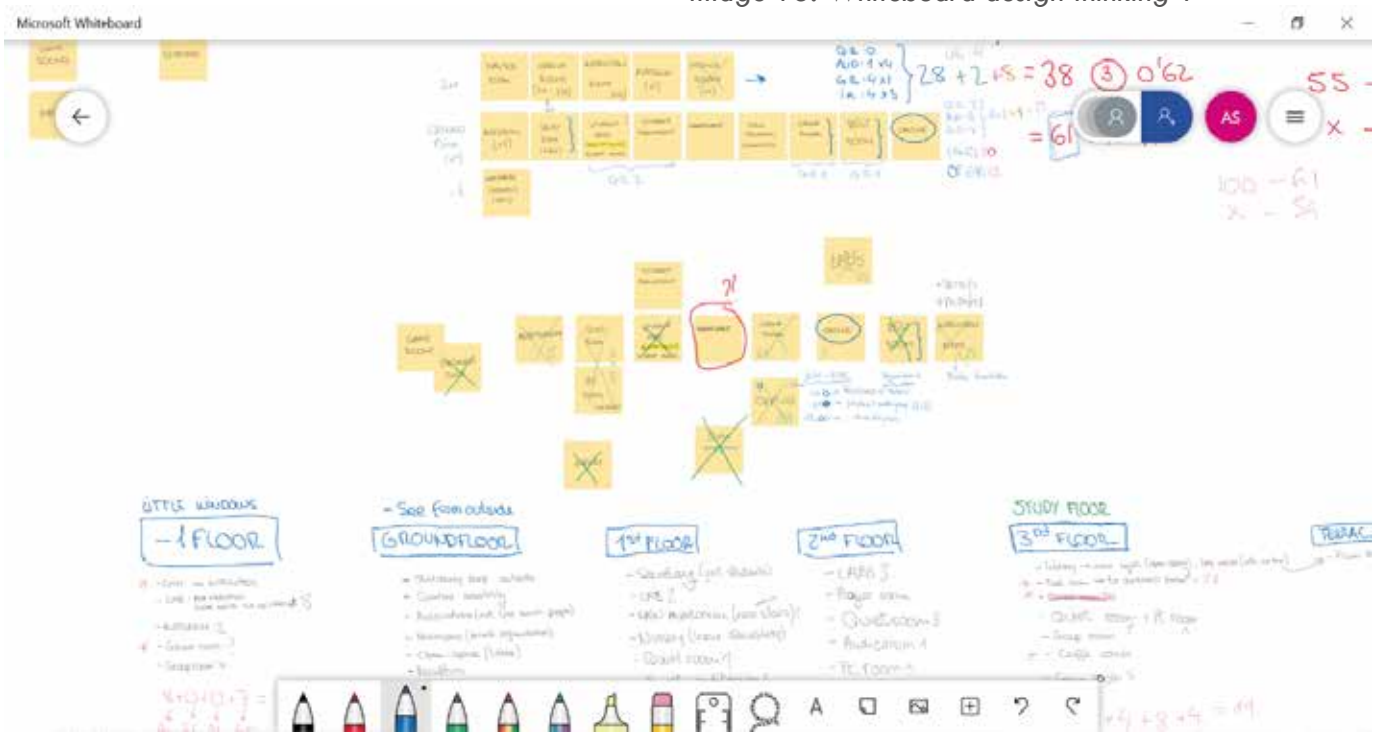


Image 14. Whiteboard design thinking 2

7

PROJECT DEVELOPMENT

Context

The main goal of our project is to visualize the building development of an urban campus of OsloMet. Indeed, the University wants to relocate one of their campus; the Kjeller campus will be shut down and moved to another place yet to be decided in Romerike. Some faculties of Pilestredet will be moved also. It will be transformed in the years 2021–2024, and our group oversees making a 3D environment of the new university building. Of course, the relocation is about the Kjeller campus which is housed in a single building that is why we choose to design only one building. Our design must represent the relocation of Kjeller campus to Romerike considering people's flow in the university building. We want to do a simple 3D model that communicates well about this relocation, and which is also adaptable to any location that will be choose. In other words, this 3D model will be an example of a lay-out. This will serve a visual representation of what is possible and what our concepts could look like in a future building.

Image 15. Distance between the current location of the Kjeller campus and the Oslo centre (Google Maps, 2021)

The red arrow points to Kjeller, as we can see, it is far from the Oslo Centre, 20 kilometres outside of Oslo. That is one of the reasons this campus is not attractive for students and teachers. Romerike is a big area as it can be seen in the following map so the new campus could be nearer of the Oslo Centre.

Image 16. Romerike area

Some figures about this Kjeller campus are useful to understand the context; there are 3 faculties which are health, education and technology and design. These three faculties count 3000 students and 200 employees in the whole building that will be relocated (OsloMet, 2018).

Currently the Kjeller campus has approximately 9,000 m2 of floor space, not counting the space for parking. In addition to this number of square meters, the height of the building, 5 floors, increases the total surface area considerably. In terms of land use the aim is to reduce the amount of floor space used in the new campus.

Image 17. Surface area of the current OsloMet

OsloMet has goals to be taken into account for this new project. There are four main objectives set for the year 2024. In objective number one: *OsloMet will be a leading provider of research-based knowledge to the welfare society* (OsloMet objectives, 2019), two subsections stand out for this proposal:

- *Develop the teacher and nursing education programmes to become the best in Norway.*
- *Offer relevant practical training of high quality in our study programmes.*

In objective number two, OsloMet will be leading in terms of introducing new technology, innovative solutions and efficient work methods (OsloMet objectives, 2019), highlights the following subsection:

- *Establish binding alliances with research communities and knowledge-intensive businesses in the region with a view to developing new technology and efficient work methods.*

Another important aspect is the fact that due to the global pandemic of Covid 19 the use of space will not be as relevant as before. For this reason, as mentioned before, it is intended to reduce the surface area, to use less space, thus obtaining the associated environmental benefits, e.g. related to energy consumption in buildings. (Larsen, 2020)

To sum up, our challenge is to design the new OsloMet campus that will be in a unique building. The lack of a definite location, in addition to the uncertainty of which faculties will this campus include and the number of students and employees it will have, makes it very difficult to create a model for the campus. Therefore, this project focuses on creating a procedure for managing flexible spaces and, afterwards, a model of the possible university. This model will be just an example of how the campus could be following the procedure. In the Design section it is explained in detail what this procedure consists of.

Problems

In order to cover the project in a satisfactory way, the first step was to locate the different problems we face. As mentioned before, the project can be very wide since at no time was it limited by the university. It has been the group that has committed itself to look for and investigate what is going wrong at the current OsloMet campuses in order to provide a solution for the new campus in Romerike.

After the research, there were 3 relevant problems to be solved:

- **Unknown building.**

In order to redesign the interior of a new building, in this case, a new OsloMet campus, it would be desirable to know from the very beginning with which building we are going to work, where exactly it is located, how many floors we have, usable surface, budget, etc.

The reality of our project is that we do not have much information. Those responsible for the relocation of the new campus do not know yet whether they will rent or build a new building or where it will be located. This makes the project even more extensive and can lead to major problems. For example, our design proposal may not be adaptable to the building that will finally be used.

For this reason, it has been decided to create a flexible project, an adaptable proposal so that, when the time comes, those in charge can extrapolate it to the final campus. This flexibility covers different approaches such as location, number of people, surface area and the possibility of using the same space for different tasks.

The team has all the freedoms to do what they want, and this can be a problem because what is done may not fit with the university's vision of the relocation.

- **No movement in the flow of people.**

We have been studying the movement of people, both students and workers, in the current campuses of OsloMet University. One of the problems that appear after analysing these flows is that the vast majority of them stay on the first floor and do not take advantage of all the space in the building. They usually prefer to be in the cafeteria and common and open areas that are located on this floor. This way they are always in contact with the "outside" and it is much easier to go home so that a university life is not enhanced. The higher floors are only used when attending mandatory classes, so all the space is unused.

Without a proper analysis of people flows, modelling could be done in a random way, which can lead to poor architecture and have the problems mentioned above.

- **Nobody wants to move there.**

There is a common problem for both students and teachers that they do not want to move to a campus in Romerike. Some of those who were already studying and working in Kjeller will simply have to move to another building, but people who are currently in the centre of Oslo do not want to have to move there on a daily commute.

Some of the reasons are:

1. Romerike is far away from their homes, and they have to travel many kilometres to get there.

2. Public transportation (right now in Kjeller) is not direct from the centre of Oslo and this makes the travel time longer.

3. They feel comfortable on the Oslo campuses.
   This new campus must be attractive so that people are willing to go and are not forced to do so. This is a big challenge when it comes to tackling the project.

C Solutions

i. Research

To achieve the goals of this project this research was done. A survey to know stakeholders opinion, campus visits to see the existing university and analising the *P35 Device Connection Data*.

1. Survey

The survey was made to get information about what people want and need in the university in order to implement it in our new campus. Their answers would give us an idea of the most used rooms and the most liked ones to be considered in our model.

Another reason is to know where people usually spend their time. Due to the pandemic, most of the classes were online, and teachers would work at home, so we couldn't see how the university functions on a regular class day.

Eleven questions, answered either test or short description, were created. The purpose of them was to obtain from what campus they belong to, which faculty, if the person doing the poll is a teacher or a student, and, as mentioned before, to know where they spend most of their time and what they would wish to have to relocate there. Even though not many students answered (26 of 212 total answers), sufficient data were obtained through teachers (186 answers).

Some relevant information retrieved from the answers is:

- Population and resources of the area.
- Public transport near and easy communication to Oslo
- Parking spaces. The campus itself won't have par king spaces to indirectly force people to use public transport but some people still will decide to come in their private car and they will need somewhere to leave the vehicle.
- Schools and hospitals. Two of the possible faculties to be included in the new campus are education and health. The students may need to do some internships during their studies in hospitals or schools.
- Green spaces around the university such as parks.
- Distance from Kjeller campus.
- Natural light.
- Offices.

To see all the results, there is more information in the *Appendix 1 , Survey*.

2. Campus visits

To improve and make more attractive theproposed new campus, we needed to know what the present one has. Due to the pandemic, visiting the campus was tough and had to be arrangedin advance. We visited the Kjeller campus, the one shutting down, and the Pilestredet campus, principally the P35 and P52 buildings, to get more ideas.

Both campuses were almost empty except for some teachers and students going to laboratory classes.

The Kjeller campus was a large building that has an enormous amount of space fitly used. By contrast, Pilestredet was tall, meaning more floors than in the other campus, and a bit intricate to walk through. Also, it was situated in the centre of the city rather than in the outskirts as Kjeller. In both, there was natural light that illuminated all the building even though we went in early February. See more photos of the visits in the *Appendix 1, Campus visits.*

Image 18. Auditorium in Kjeller campus

Image 19. Canteen and open space in Pilestredet campus, P35 building

Image 20. Open space in Pilestredet campus, P52 building

Furthermore, the visits were valuable to get maps of the buildings. In them, we had information about what rooms are on each floor and their location, besides seeing their surface.

This data will be helpful to create our model in *Design, First Step (P35), Observe the main rooms.*

Image 21. Kjeller campus map

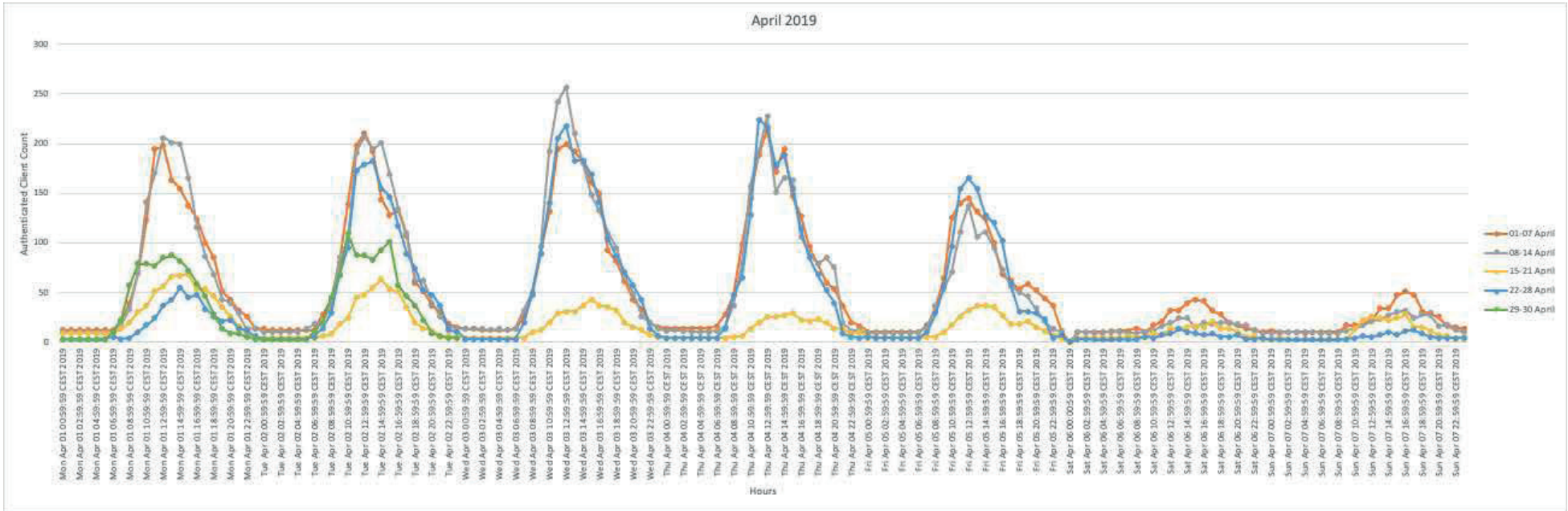
Image 22. Pilestredet campus, P35 building map

3. P35 Device Connection Data

As it was mentioned before in Problems, one of our main goals was to avoid many people being on the ground floor. For that, we needed to know the people's flow in the campuses, so P35 served us as a model. Data from the network's usage, provided by Tengel Aas Sandtrø (Senior Adviser in OsloMet University), from 2018 to 2020, was obtained and later analysed. We focused on the years 2019 and 2020 as they show a change in people's flow between before the pandemic (2019) and during the pandemic (2020).

At a first approach, we analysed the data from 2019 and 2020 to see during what months, weeks, days and hours people spend more time on the ground floor. An example, of April, can be seen in the photo below. Because we didn't have the exact number of people, but the devices connected, we approximated three devices equal to two people. The reason behind this is that many people use different electronic appliances at the same time. For more information about the excel sheets, go to *Appendix 1, P35 Device Connection Data*.

The second approach was after creating the parameters that define the people's flow (explained in the section *Design*).



Graphic 1. Connections to the P35 ground floor in April

Design

i. Introduction

In this section, our methodology for arriving at the final 3D model of the OsloMet campus is detailed. We will also outline how we managed making our model flexible. Indeed, a lot of information about the new campus in Romerike is missing now, such as its exact location, the number of students and staff that will move to the new campus, if the building is existent or not... This is why our project must be adaptable; it pushed us to create a hypothetical building that would be adjustable to any type of location. In concrete terms, our modelling is based on a certain number of people, which is not necessarily the actual number of people who will be relocated to Romerike.

We have chosen the surfaces of our building in proportion to it. After this a verification of the surface of each room was made. To make sure that the capacity of them was allowed. (CENEPRED)

To make this flexible, we have created a Space Management Tool. It is an excel spreadsheet that allows us to enter the number of people and obtain the appropriate surface of the building. Thanks to this, it will be easier to use our project once the amount of people is known. It also contains a page with the Capacity Verification calculus. In the attached *Appendix 2*, there can be found a guide on how to use this tool.

However, we want to expand that concept of flexibility. Indeed, our modelling is not only flexible in terms of surfaces, and number of people but also for the use of inner spaces. We want to use classes for something else than their usual use when they are empty. For that, it will be interesting to study the people's flow in these particular rooms and deduce at what time of the day it is empty, we explained this in the Future ideas section. Of course, we cannot use every kind of room for that point. For example, laboratories cannot be used for something else because that place is going to be used for something specific and it has specific functions with specific rules.

To summarize, we want our 3D model to be flexible and adaptable in terms of amount of people, surfaces but also to create a concept of versatile rooms in order to make the most of the space.

ii. First Step (P35)

Observe the main rooms.

The first question we asked ourselves was the following: *How should rooms be organised by floor in the new campus?* To answer this question, we have studied the flow of people in building P35 at the University of OsloMet on the Pilestredet campus. We have been able to do this by means of data about devices connected to the building's network. The aim is to link this information to the room's layout in this building P35. This information was obtained from the maps found during the campus vistis. To do this, we grouped the rooms by floor to see how they are organised in this existing building. We have extrapolated all the data from P35 and Kjeller campus's figures to know how many people approximately will be in the new campus.

Furthermore, we observed the main rooms in P35, the most recurrent ones, which are the following:

- Auditorium.
- Instruction room.
- Quiet room.
- Group room.

Assign a coefficient to the main rooms.

Then, we decided to count these rooms per floor (still in the P35 building) and assigned coefficients according to the importance of the room type. By importance, we mean the rooms that are used by the higher number of people. These coefficients will allow us to see an approximation of people's flow between floors.

We have assigned the following coefficients:

Rooms	Coefficients
Auditorium	4
Instruction room	3
Quiet room	2
Group room	1

Chart 2. Main rooms' coefficients

Once this was done, we focused on the other spaces, and we assigned coefficients to each room of the P35 building:

Rooms	Coefficients
Canteen	20
Library	4
Open spaces	15
Laboratory	/
Makerspace	/
Offices	5/2
PC room	2
Restroom	3

Chart 3. Other rooms' coefficients

***Special Cases**

An important point was to observe the offices. Indeed, P35 building was our first reference, and it was not clear. That's why, we decided to attribute the offices coefficient later on the process. As a matter of fact, we haven't been able to explore the campus as much as it was desired because of the covid situation. For this reason, we didn't know the exact number of offices. So, this is a provisional coefficient that we have thought adequate for the first approximation. In this first approximation, we divided the offices by floor and assign a number to the group of offices (for the floors 4-8, a 5 because there were more offices than in the other; and for the floors 1-3, a 2). To be more accurate, we changed it in the final model, but this will be explained later in the second step.

At this point, we didn't consider laboratories and maker space either. Indeed, these rooms are specific, and students don't spend much of their time there because they need authorization to be in the makerspace. For the laboratories, it is not used all the time. The factor of these rooms is found later on the process just as the offices.

Coefficients of each floor.

Afterwards, we established floor coefficients as well. These ones show people's flow in each floor, so we can see which floors are more used. The closer to the ground floor, the floor with the main door, the more people there will be because access is more direct.

P35 Floors	Coefficients
8th	1 - because people do not spend time on this floor, there is only quiet rooms and a personal canteen for STAFF.
7th	2
6th	3
5th	4
4th	5
3rd	6
2nd	7
1st	8
Ground floor	9 - the canteen and student areas mean that students spend most of their time on this floor.
-1	1- people do not spend time on this floor, there is only a changing room.

Chart 4. Coefficient of each floor

Then, with the number of rooms in each floor and its specific coefficient, we have obtained a number that shows approximately how much time people spend on each floor.

Floors	Coefficients	Explanation
9th	6	People do not spend time on this floor, there is only quiet rooms and a personal canteen for STAFF.
8th	29	
7th	34	
6th	28	
5th	31	
4th	41	
3rd	60	There are many group rooms where people spend a lot of time.
2nd	44	
Ground floor (1st)	61	The canteen and student areas mean that students spend most of their time on this floor.
-1	/	People do not spend time on this floor, there is only a changing room.

Chart 5. Coefficient for each floor

For a better understanding of the data, these numbers have been converted to percentages in the following table.

FLOOR	-1			
	ROOM	NUMBER	COEFFICIENT	TOTAL
	Wardrobe	1,00	0,00	0,00
	Floor factor		0,00	0,00
TOTAL WITHOUT OFFICES AND FLOOR FACTOR				0,00
TOTAL WITHOUT FLOOR FACTOR				0,00
TOTAL				0,00
PERCENTAGE (0-1)				0,00

Chart 6. Coefficient and percentage of the -1 floor

GROUND FLOOR			
ROOM	NUMBER	COEFFICIENT	TOTAL
Auditorium	2,00	4,00	8,00
Cantine	1,00	20,00	20,00
Group room	1,00	1,00	1,00
Makerspace	1,00	0,00	0,00
Oslo Terminal Comunity	1,00	0,00	0,00
Quiet room	1,00	2,00	2,00
Rest room	1,00	3,00	3,00
Student area	2,00	1,00	2,00
Student parlament	1,00	1,00	1,00
Open spaces	1,00	15,00	15,00
Floor factor		9,00	9,00
			52,00
			52,00
			61,00
			100%

Chart 7. Coefficient and percentage of the ground

2			
ROOM	NUMBER	COEFFICIENT	TOTAL
Auditorium	1,00	4,00	4,00
Group room	12,00	1,00	12,00
Instruction room	6,00	3,00	18,00
Master room	1,00	0,00	0,00
Offices		2,00	2,00
Prayer room	2,00	0,00	0,00
Floor factor		8,00	8,00
			34,00
			36,00
			44,00
			72%

Chart 8. Coefficient and percentage of the 2nd floor

3			
ROOM	NUMBER	COEFFICIENT	TOTAL
Auditorium	2,00	4,00	8,00
Group room	29,00	1,00	29,00
Instruction lab	0,00	0,00	0,00
Library	1,00	4,00	4,00
Offices		2,00	2,00
PC room	1,00	2,00	2,00
Quiet room (lesesal)	2,00	2,00	4,00
Quiet room (PC)	2,00	2,00	4,00
Floor factor		7,00	7,00
			51,00
			53,00
			60,00
			98%

Chart 9. Coefficient and percentage of the 3rd floor

4			
ROOM	NUMBER	COEFFICIENT	TOTAL
Auditorium	1,00	4,00	4,00
Computer lab	1,00	0,00	0,00
Group room	6,00	1,00	6,00
Instruction room	4,00	3,00	12,00
Master room	1,00	0,00	0,00
Network lab	1,00	0,00	0,00
PC room	3,00	2,00	6,00
Quiet room (PC)	1,00	2,00	2,00
Offices		5,00	5,00
Floor factor		6,00	6,00
			30,00
			35,00
			41,00
			67%

Chart 10. Coefficient and percentage of the 4th floor

5			
ROOM	NUMBER	COEFFICIENT	TOTAL
Auditorium	1,00	4,00	4,00
Group room	3,00	1,00	3,00
Instruction room	3,00	3,00	9,00
Material lab	1,00	0,00	0,00
Medical technology room	1,00	0,00	0,00
Optical room	1,00	0,00	0,00
PC room	1,00	2,00	2,00
Project room	3,00	1,00	3,00
Ultrasound room	1,00	0,00	0,00
Offices		5,00	5,00
Floor factor		5,00	5,00
			21,00
			26,00
			31,00
			51%

Chart 11. Coefficient and percentage of the 5th floor

6			
ROOM	NUMBER	COEFFICIENT	TOTAL
ARIS	1,00	0,00	0,00
Automation lab	1,00	0,00	0,00
Cybernetics lab	1,00	0,00	0,00
Dark room	1,00	0,00	0,00
Electro lab	2,00	0,00	0,00
Instruction room	5,00	3,00	15,00
Quiet room (PC)	2,00	2,00	4,00
Offices		5,00	5,00
Floor factor		4,00	4,00
			19,00
			24,00
			28,00
			46%

Chart 12. Coefficient and percentage of the 6th floor

7			
ROOM	NUMBER	COEFFICIENT	TOTAL
Bio lab	1,00	0,00	0,00
Chemical lab	2,00	0,00	0,00
Instruction room	8,00	3,00	24,00
Quiet room	1,00	2,00	2,00
Offices		5,00	5,00
Floor factor		3,00	3,00
			26,00
			31,00
			34,00
			56%

Chart 13. Coefficient and percentage of the 7th floor

8			
ROOM	NUMBER	COEFFICIENT	TOTAL
Auditorium	1,00	4,00	4,00
Flow lab	1,00	0,00	0,00
Geometric lab	1,00	0,00	0,00
Geotecnical lab	1,00	0,00	0,00
Group room	2,00	1,00	2,00
Indoor climate lab	1,00	0,00	0,00
Master room	1,00	0,00	0,00
Microbio lab	1,00	0,00	0,00
PC room	1,00	2,00	2,00
Quiet room (PC)	1,00	2,00	2,00
Seminar room	4,00	3,00	12,00
Offices		5,00	5,00
Floor factor		2,00	2,00
			22,00
			27,00
			29,00
			48%

Chart 14. Coefficient and percentage of the 8th floor

9			
ROOM	NUMBER	COEFFICIENT	TOTAL
Instruction room	1,00	3,00	3,00
Personal cantine	1,00	0,00	0,00
Quiet room	1,00	2,00	2,00
Floor factor		1,00	1,00
			5,00
			5,00
			6,00
			10%

Chart 15. Coefficient and percentage of the 9th floor

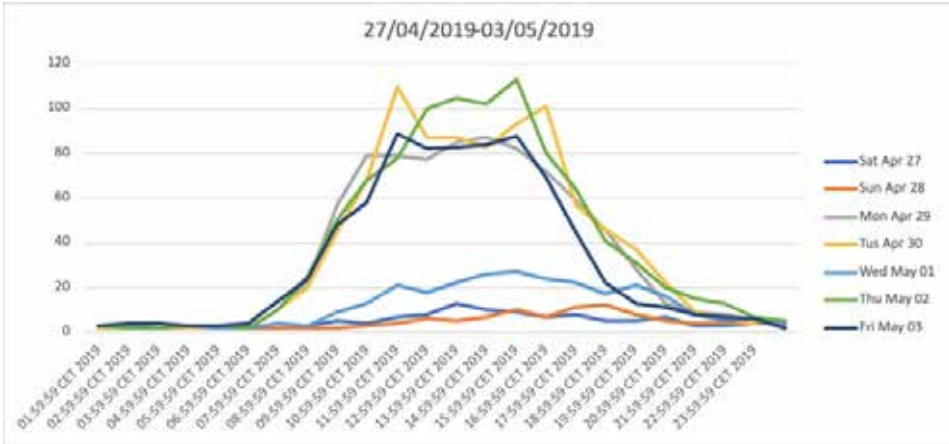
P35 data.

As mentioned above, we had access to excel sheets that represent the number of devices connected on the ground floor of OsloMet's building P35. Refer to Research, Excel to see the excel analysis. We have taken up this analysis to be able to use data about the people's flow in the P35's ground floor. Thanks to this and with the percentages of people's flow found previously, we calculate the actual number of people on each floor. Firstly, we have decided what were the most representative months (February, April and May) of the year 2019-2020 to estimate the number of people before, during and after the pandemic. We took the week with more people of each month and the day with more people of that week (Wednesday).

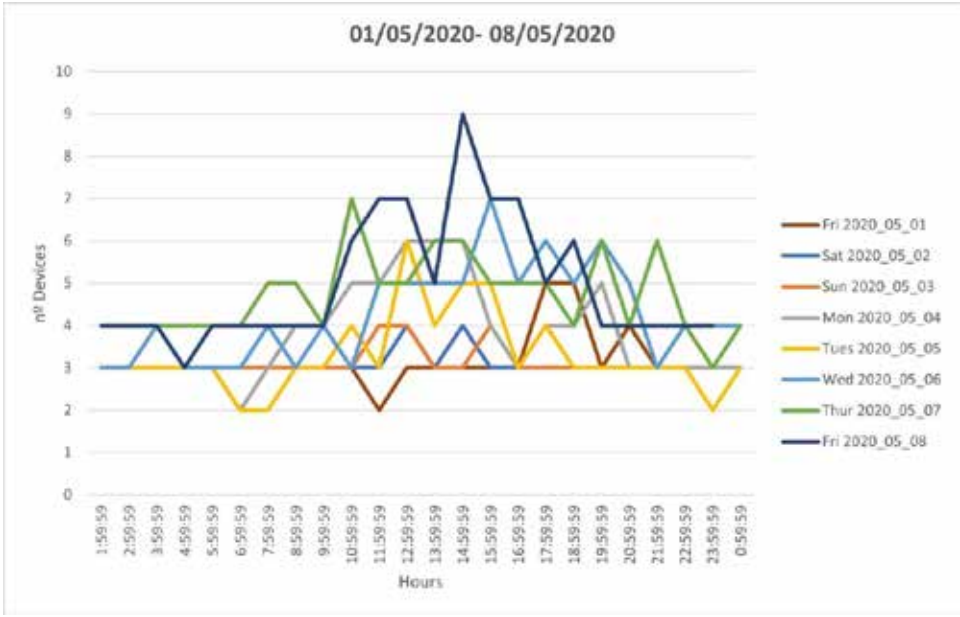
Then, we used the people's average of that day before the pandemic (average of three months in 2019), when the pandemic was coming (February 2020), and finally during the first lockdown (April 2020) and after it (May 2020).

February 2020 is the number of people we foresee to have in the future without pandemic. But we anticipate some numbers changing in the final model, as the pandemic has shown some advantages of learning and working from home. fewer rooms, therefore, will be needed. In the following graphics there is an example of how did people's flow change between years, before the pandemic and during the lockdown.

What should be remembered from this section is that there are much more people on the ground floor, and it can therefore be seen that the lowest floors are generally the most used. Finally, the top floor and basements are not used very often.



Graphic 2. End of April, beginning of May 2019



Graphic 3. May 2020

iii. Second step: New Campus, Theoretical Proposal

With the data from P35 and the number of students and employees of the new campus a theoretical proposal has been made.

Number of floors.

We have decided to make a building with a height of 4 floors because "the municipality may stipulate heights for various parts of a building in the provisions of the plan" (Norwegian Building Authority, 2017), and we want this building to be able to fit anywhere. Moreover, we want our final model to have a fluid people's flow.

Number of rooms.

The next step for us was to decide how many rooms would be incorporated into our model. The excel sheet works as a tool and has three different changeable charts. The first one named, Number of Rooms, works as when the number of desired people is entered, it automatically changes the total number of each room. To calculate this number, we did a simple rule of three. We used the number of students and teachers in P35 and on our campus.

Here is an example of the calculation: If 8 auditoriums were needed for 5000 students in P35, for 3000 students on our campus, we would need:

$$x = \frac{3000 \times 8}{5000} = 4{,}8 \approx 5$$

Here is an example of how the tool works:

Students in P35	5000
Teachers in P35	375
Students in campus	3000
Teachers in campus	200

Room	Number in P35	Number in campus	Numbers used
Auditorium	8	4,8	5
Group room	46	27,6	28
Instruc on room	22	13,2	13
Lab	21	12,6	13
Office	256	136,5	137
PC room	6	3,6	4
Quiet room	11	6,6	7
Associaions	2		2
Canteen	1		1
Infocenter	2		2
Library	1		1
Makerspace	1		1
Office (lockers)	-		1
Recep on	1		1

Image 23. Original number of students and teachers in our campus

Students in P35	5000
Teachers in P35	375
Students in campus	4000
Teachers in campus	300

Room	Number in P35	Number in campus	Numbers used
Auditorium	8	6,4	6
Group room	46	36,8	37
Instruc on room	22	17,6	18
Lab	21	16,8	17
Office	256	204,8	205
PC room	6	4,8	5
Quiet room	11	8,8	9
Associaions	2		2
Canteen	1		1
Infocenter	2		2
Library	1		1
Makerspace	1		1
Office (lockers)	-		1
Recep on	1		1

Image 24. Change in the number of students and teachers in our campus

Number of floors.

After deciding on the total number of rooms, the important thing was to know what the surface area of these rooms would be. To have an idea of the surface areas of the rooms and the building that we will model, we decided to measure the surface areas of the rooms in building P35 on the Pilestredet campus of the OsloMet's University.

Because there are some rooms with the same use, but different measures, an average of the surface was made. Therefore, we have obtained an approximation of the surfaces of each room for our own model from the surface of P35 that we measured.

Room	m² REAL	Number in P35	Room	m² REAL	Number in P35
Assossia ons	24,52	2	Library	760,46	1
Auditorium (big)	149,11		Li s (2)	10,88	
Auditorium (main)	188,30		Makerspace	185,40	1
Auditorium (second)	166,51		Office (lockers)	47,92	
Auditorium (av)	157,81	7	Office (big)	17,89	
Canteen	859,03	1	Office (medium)	17,83	
Group room (big)	40,10		Office (small)	13,81	
Group room (small)	12,77		Office (av)	16,51	137
Group room (small 2.0)	12,83		PC room (big)	122,36	
Group room (av)	21,90	43	PC room (medium)	95,05	
Infocentre 1	24,52	1	PC room (small)	89,19	
Infocentre 2	24,52	1	PC room (av)	102,20	6
Instruc on room (big)	81,38		Quiet room (big)	68,54	
Instruc on room (mediu	72,71		Quiet room (small)	30,46	
Instruc on room (small)	70,98		Quiet room (av)	49,50	10
Instruc on room (av)	75,03	24	Recepcion	24,52	1
Lab (big)	59,75		Stairs	21,31	
Lab (small)	40,26		WC (big)	19,98	
Lab (av)	50,01	21	WC (small)	3,59	

Image 25. Surface of the rooms in Pilestredet campus, P35 building

Design each floor.

After having the surface of each room, explained in the previous section, it was possible to start designing each floor considering the coefficient of the rooms. The aim was that all of it had a similar total factor. As mentioned before, some of the factors have changed. It was also considered that the surface used in each floor had to be similar. The corridors and the open spaces were useful to equilibrate the amount of squared meters.

a) Offices:

For the offices, we worked with group factors, so we changed it for an independent factor for each office. Furthermore, these offices will also be group rooms. As described earlier, for the flexibility of our model, we want to extend the usefulness of the rooms and use them for other functions that its main one. However, teachers prefer individual offices, we had this information thanks to the survey we made in the research phase of our project. Therefore, we added to our final model big offices with lockers (one big office in each floor), it allows each teacher to have a closed and personal space.

b) Laboratories:

We chose a factor one because, even though it has specific functions, it still is used by many people.

c) Open spaces:

Finally, we decided that the coefficient will be fifteen for the open spaces in the underground and the ground floor because it is in the most traversed floors and it is a place where one can find tables and benches, which makes people want to spend time on this area. Then, we chose a factor five for the open spaces in the other floors since there are only corridors and fewer benches. In the survey, both students and teachers responded that they absolutely want a lot of open spaces and also green spaces, that's why we added the terrace.

d) Boost room:

We also added boost rooms, these are the rooms that boost people's flow in floors where the amount of people was way less important than the ground floor, like the stationary shop for example. Moreover, student life is important and once again, we noticed that thanks to the survey of the research phase. So, these rooms make the building more attractive:

- Rest room
- Coffee corner
- Gym
- Secretary
- Nursery
- Stationary shop

The excel tool we have created allows us to see the equilibration between floors. Contrary to the Number of Rooms chart (the one which calculates the number of rooms), this one, Estimated Surface of the Campus (the second one in the excel), does not change automatically. It is the user who has to design each floor deciding where to put the rooms obtained by the Number of Rooms chart. It calculates the total factor of each

floor so that the balance between floors can be seen.

On the following image, we can clearly observe that the factors without this boost rooms are not equilibrated within floors (in red), on the other hand when adding this extra rooms, the coefficients are similar to each other (in green).

		ESTIMATED SURFACE OF THE CAMPUS (BEFORE SKETCHING)											
	FLOOR	-1				0				1			
		ROOM	Nº	SURFACE (m²)	COEFFICIENT	ROOM	Nº	SURFACE (m²)	COEFFICIENT	ROOM	Nº	SURFACE (m²)	COEFFICIENT
		Associa ons	0,00	0,00	0,00	Associa ons	2,00	49,03	2,00	Associa ons	0,00	0,00	0,00
		Auditorium	2,00	315,62	8,00	Auditorium	0,00	0,00	0,00	Auditorium (main)	1,00	188,30	4,00
										Auditorium (second)	1,00	157,81	4,00
		Canteen	0,00	0,00	0,00	Canteen	1,00	859,03	20,00	Canteen	0,00	0,00	0,00
		Group room	5,00	109,49	5,00	Group room	0,00	0,00	0,00	Group room	7,00	153,29	7,00
		Instruc on room	2,00	150,05	6,00	Instruc on room	2,00	150,05	6,00	Instruc on room	6,00	450,15	18,00
		Lab	8,00	400,06	8,00	Lab	0,00	0,00	0,00	Lab	2,00	100,02	2,00
		Library	0,00	0,00	0,00	Library	0,00	0,00	0,00	Library	0,00	0,00	0,00
		Makerspace	0,00	0,00	0,00	Makerspace	1,00	185,40	2,00	Makerspace	0,00	0,00	0,00
		Offices	0,00	0,00	0,00	Offices	0,00	0,00	0,00	Offices	45,00	742,98	6,75
		Offices (lockers)	0,00	0,00	0,00	Offices (lockers)	0,00	0,00	0,00	Offices (lockers)	1,00	47,92	1,00
		PC room	0,00	0,00	0,00	PC room	0,00	0,00	0,00	PC room	0,00	0,00	0,00
		Quiet room	1,00	49,50	2,00	Quiet room	0,00	0,00	0,00	Quiet room	1,00	49,50	2,00
		Recep on	0,00	0,00	0,00	Recep on	1,00	24,52	1,00	Recep on	0,00	0,00	0,00
		Secretary	0,00	0,00	0,00	Secretary	1,00	49,03	1,00	Secretary	0,00	0,00	0,00
		Game room	1,00	49,50	3,00	Open Spaces	1,00	1045,78	15,00	Nursery	1,00	12,83	1,00
		Gym	1,00	188,30	4,00	Sta onary room	1,00	40,10	2,00				
		Li s	1,00	10,88		Li s	1,00	10,88		Li s	1,00	10,88	
		Stairs	2,00	42,63		Stairs	2,00	42,63		Stairs	2,00	42,63	
		WC big	2,00	39,97		WC big	2,00	39,97		WC big	2,00	39,97	
		WC small	1,00	3,59		WC small	1,00	3,59		WC small	1,00	3,59	
SURFACE	TOTAL			1359,58				2500,00				1999,85	
2500	REMAINING			1140,42				0,00				500,15	
FACTORS	NO BOOST ROOMS				29,00				32,00				44,75
	BOOST ROOMS				36,00				49,00				45,75
										TOTAL WITHOUT OFFICES		1256,87	
										REMAINING WITHOUT OFFICES		1243,13	
										Offices		75	
										Surface		1238,29	
										Surface remaining		4,83	
										Without 500m2 (corridors)		743,13	
										Number of offices (final)		45	

Image 26. Estimated surface of the campus, before sketching

	FLOOR	ESTIMATED SURFACE OF THE CAMPUS (BEFORE SKETCHING)							
		2				3			
		ROOM	Nº	SURFACE (m²)	COEFFICIENT	ROOM	Nº	SURFACE (m²)	COEFFICIENT
		Associa ons	0,00	0,00	0,00	Associa ons	0,00	0,00	0,00
		Auditorium	1,00	157,81	4,00	Auditorium	0,00	0,00	0,00
		Canteen	0,00	0,00	0,00	Coffee corner	1,00	40,10	
		Group room	7,00	153,29	7,00	Group room	7,00	153,29	7,00
		Instruc on room	6,00	450,15	18,00	Instruc on room	0,00	0,00	0,00
		Lab	3,00	150,02	3,00	Lab	0,00	0,00	0,00
		Library	0,00	0,00	0,00	Library	1,00	760,46	4,00
		Makerspace	0,00	0,00	0,00	Makerspace	0,00	0,00	0,00
		Offices	40,00	660,42	6,00	Offices	41,00	676,93	6,15
		Offices (lockers)	1,00	47,92	1,00	Offices (lockers)	1,00	47,92	1,00
		PC room	1,00	102,20	2,00	PC room	1,00	102,20	2,00
		Quiet room	3,00	148,49	6,00	Quiet room	1,00	49,50	2,00
		Recep on	0,00	0,00	0,00	Recep on	0,00	0,00	0,00
		Secretary	0,00	0,00	0,00	Secretary	0,00	0,00	0,00
		Prayer room	2,00	27,62	0,30	Rest room	1,00	75,03	3,00
						Terrace	1,00		15,00
		Li s	1,00	10,88		Li s	1,00	10,88	
		Stairs	2,00	42,63		Stairs	2,00	42,63	
		WC big	2,00	39,97		WC big	2,00	39,97	
		WC small	1,00	3,59		WC small	1,00	3,59	
SURFACE	TOTAL			1995,00				2002,49	
2500	REMAINING			505,00				497,51	
FACTORS	NO BOOST ROOMS				47,00				22,15
	BOOST ROOMS				47,30				40,15
TOTAL WITHOUT OFFICES				1334,57				1325,55	
REMAINING WITHOUT OFFICES				1165,43				1174,45	
Offices				70				71	
Surface				1155,74				1172,25	
Surface remaining				9,69				2,20	
Without 500m2 (corridors)				665,43				674,45	
Number of offices (final)				40				41	

Image 26. Estimated surface of the campus, before sketching

In the following chart there is a detailed distribution of the campus considering all this information mentioned above. We focused on moving people from the ground floor to use all the available space and all the floors.

Floor	Rooms
4th	- Outdoor terrace
3rd	- Library (1): lighter on the last floor and less noise (nothing on top) - Rest room (1): to disconnect - Quiet room (1) - PC room (1) - Group rooms (7) - Coffee corner (1)
2nd	- Laboratories (3) - Auditorium (1) - Quiet rooms (3) - PC room (1) - Group rooms (7) - Instruction room (6) - Prayer room (2)
1st	- Secretary (1) - Laboratories (2) - Main auditorium: near the main stairs (1) - Nursery: near the elevators to be accessible from everywhere in the building. (1) - Quiet room (1) - Small auditorium (1) - Group rooms (7) - Instruction rooms (6)
Ground floor (0)	- Stationary shop: can be seen from the outside. (1) - Canteen: easy accessibility on this floor (1) - Associations (1) - Makerspace (1) - Open spaces (tables) - Reception (1) - Instruction rooms (2)
-1	- Gym: no distraction for the working rooms (1) - Laboratories (8): no vibration, people can talk on this floor without interrupting lectures. - Auditoriums (2) - Game room (1): people can talk on this floor without interrupting lectures. - Group room (7)

Chart 16. Distribution of the rooms per floor

iv. Third step: New campus, definitive proposal

First draft of the sketch.

Until now we were talking about a theoretical proposal, in this step of development of the project a definite proposal has been made. The number of rooms have to be adjusted to the shape of the hypothetical building.

As said earlier in the second step, some of the number of rooms has changed and therefore is not the same in the drafts. Due to the Covid-19 pandemic and the implementation of flexible and versatile spaces fewer rooms are needed.

Before starting the sketch, we had to decide on the shape of the building. A rectangular one was chosen because they are easier, faster and more economical to build out of ordinary materials. With this shape most of the space is used and there is usually less waste. They are also easier to design. This shape is very strong structurallyand spatially. Electrical and water installation are easy to incorporate. Air circulation and temperature regulation are better controlled. (Whittaker, 2019)

On the right side it can be seen how all the rooms have been organised:

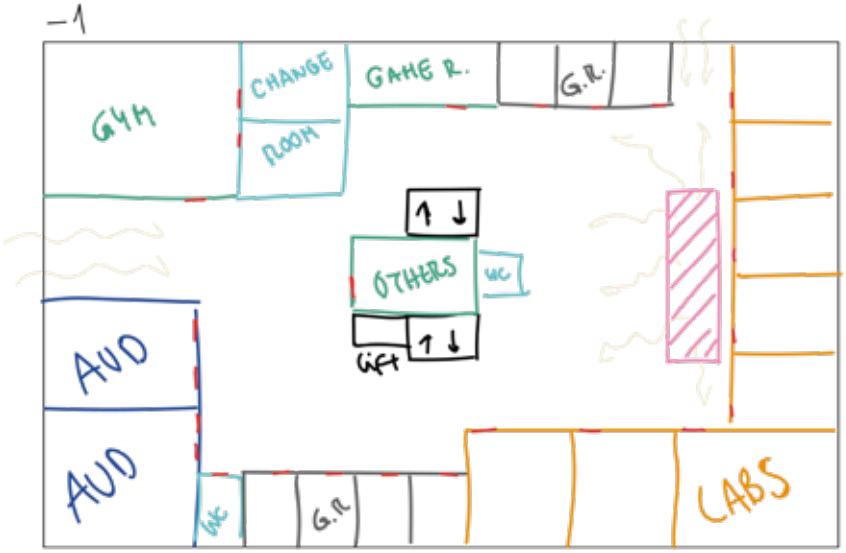


Image 27. Our campus sketch, -1 floor

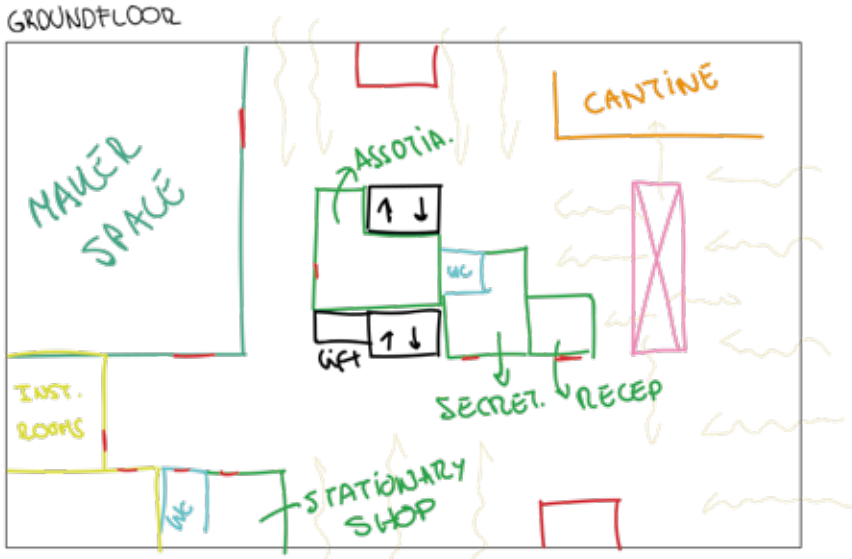


Image 28. Our campus sketch, ground floor

Image 29. Our campus sketch, 1st floor

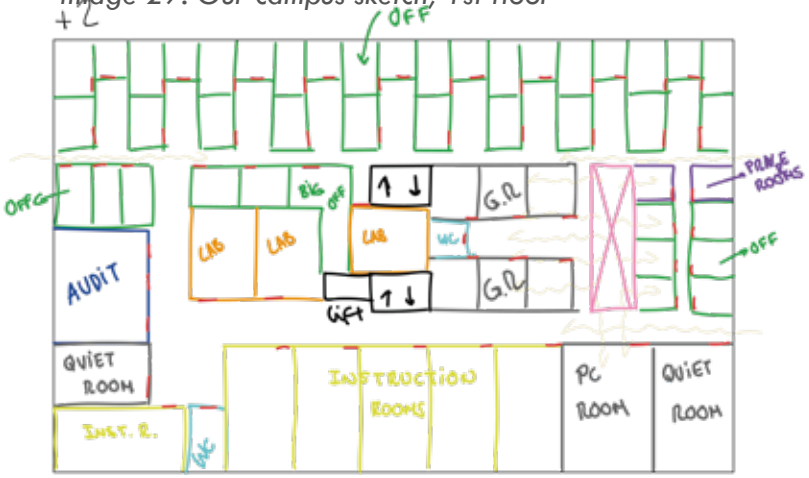


Image 30. Our campus sketch, 2 nd floor

Image 31. Our campus sketch, 3 rd floor

Floor plan with real measures in SketchUp.

In this section, all the constrained floor plans can be seen.

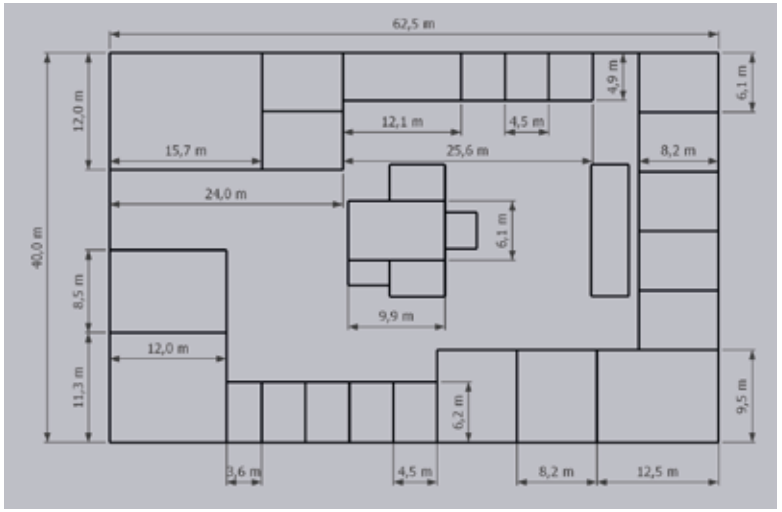


Image 32. Floor plan, -1

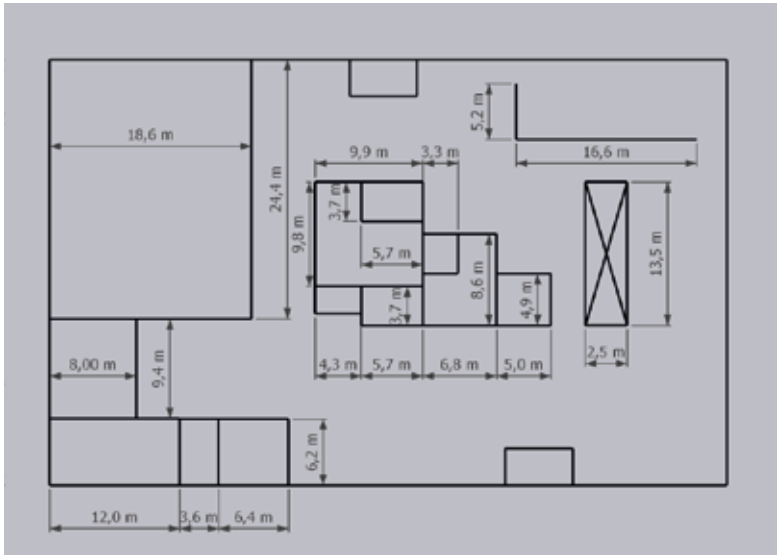


Image 33. Floor plan, ground floor

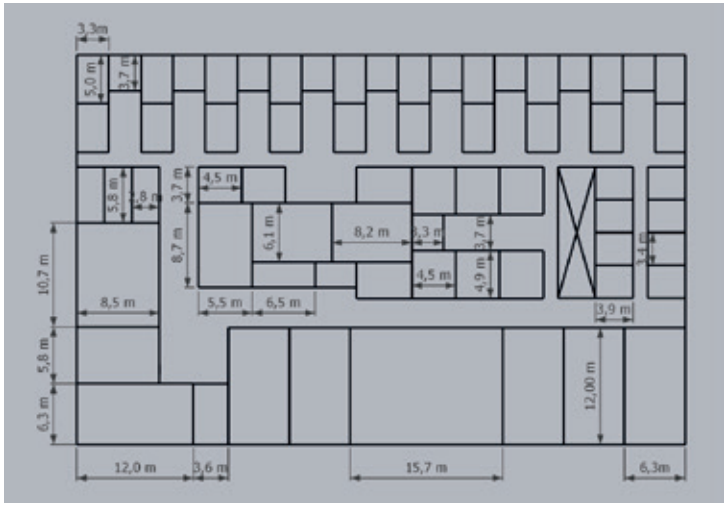


Image 34. Floor plan, 1st floor

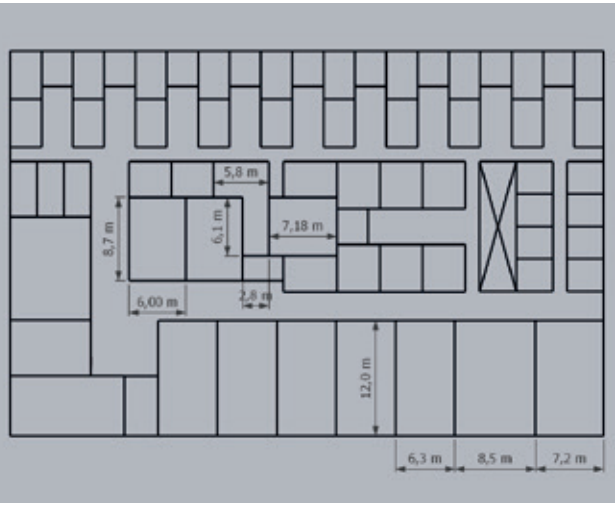


Image 35. Floor plan, 2nd floor

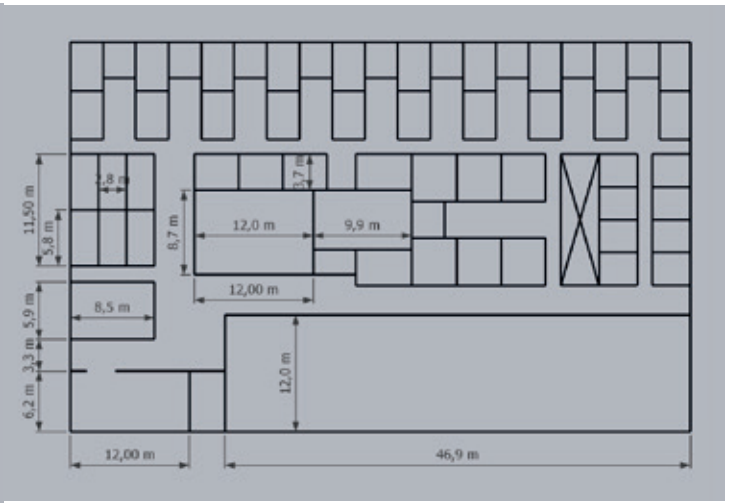


Image 36. Floor plan, 3rd floor

Definitive coefficients.

Having the first theoretical draft we have entered all these data in the excel tool, floor by floor, in the Real Surface of the Campus chart (the third one in Excel). The total factor of every floor is balanced in order to take advantage of all the space. The perk of this tool is that it can be changed in the future. When you change the amount of people, it is programmed to modify the number of rooms and the surface.

Rooms	Coefficients
Canteen	20
Library	4
Open spaces	15 (big) / 5 (small)
Secretary	1
Nursery	1
Prayer room	0,15
Associations	1
Coffee corner	3
Game room	3
Gym	4
Laboratory	1
Makerspace	2
Offices	0,15 / 1 (lockers)
PC room	2
Reception	1
Rest room	3
Stationary room	1
Terrace	15

Chart 17. Definitive coefficients of each room

REAL SURFACE OF THE CAMPUS (AFTER SKETCHING)															
FLOOR		-1				0					1				
	ROOM	NUMBER	SURFACE (m²)	TOTAL	COEFFICIENT	ROOM	NUMBER	SURFACE (m²)	TOTAL	COEFFICIENT	ROOM	NUMBER	SURFACE (m²)	TOTAL	COEFFICIENT
	Associations	0,00	0,00	0,00	0,00	Associations	1,00	76,37	76,37	1,00	Associations	0,00	0,00	0,00	0,00
	Auditorium (big)	1,00	135,19	135,19	4,00	Auditorium (big)	0,00	0,00	0,00	0,00	Auditorium (main)	1,00	188,00	188,00	4,00
	Auditorium (small)	1,00	102,00	102,00	4,00	Auditorium (small)	0,00	0,00	0,00	0,00	Auditorium (second)	1,00	90,75	90,75	4,00
	Canteen	0,00	0,00	0,00	0,00	Canteen	1,00	146,18	146,18	20,00	Canteen	0,00	0,00	0,00	0,00
	Group room (big)	4,00	28,01	112,04	4,00	Group room (big)	0,00	0,00	0,00	0,00	Group room (big)	6,00	22,00	132,00	6,00
	Group room (small)	3,00	22,00	66,00	3,00	Group room (small)	0,00	0,00	0,00	0,00	Group room (small)	0,00	0,00	0,00	0,00
	Instruction room	0,00	0,00	0,00	0,00	Instruction room	2,00	75,00	150,00	6,00	Instruction room	6,00	75,00	450,00	18,00
	Lab (big)	1,00	118,65	118,65	1,00	Lab (big)	0,00	0,00	0,00	0,00	Lab	2,00	50,00	100,00	2,00
	Lab (medium)	2,00	77,87	155,74	2,00	Lab (medium)	0,00	0,00	0,00	0,00	Lab (big)	0,00	0,00	0,00	0,00
	Lab (small)	5,00	50,00	250,00	5,00	Lab (small)	0,00	0,00	0,00	0,00	Lab (small)	0,00	0,00	0,00	0,00
	Library	0,00	0,00	0,00	0,00	Library	0,00	0,00	0,00	0,00	Library	0,00	0,00	0,00	0,00
	Makerspace	0,00	0,00	0,00	0,00	Makerspace	1,00	453,90	453,90	2,00	Makerspace	0,00	0,00	0,00	0,00
	Offices (big)	0,00	0,00	0,00	0,00	Offices (big)	0,00	0,00	0,00	0,00	Offices (big)	25,00	16,50	412,50	3,75
	Offices (medium)	0,00	0,00	0,00	0,00	Offices (medium)	0,00	0,00	0,00	0,00	Offices (medium)	8,00	13,00	104,00	1,20
	Offices (small)	0,00	0,00	0,00	0,00	Offices (small)	0,00	0,00	0,00	0,00	Offices (small)	9,00	12,16	109,44	1,35
	Offices (lockers)	0,00	0,00	0,00	0,00	Offices (lockers)	0,00	0,00	0,00	0,00	Offices (lockers)	1,00	48,00	48,00	1,00
	PC room	0,00	0,00	0,00	0,00	PC room	0,00	0,00	0,00	0,00	PC room	0,00	0,00	0,00	0,00
	Quiet room (big)	0,00	0,00	0,00	0,00	Quiet room (big)	0,00	0,00	0,00	0,00	Quiet room (big)	1,00	49,50	49,50	2,00
	Quiet room (small)	0,00	0,00	0,00	0,00	Quiet room (small)	0,00	0,00	0,00	0,00	Quiet room (small)	0,00	0,00	0,00	0,00
	Reception	0,00	0,00	0,00	0,00	Reception	1,00	24,50	24,50	1,00	Reception	0,00	0,00	0,00	0,00
	Secretary	0,00	0,00	0,00	0,00	Secretary	1,00	46,60	46,60	1,00	Secretary	0,00	0,00	0,00	0,00
	Others	1,00	60,61	60,61											
	Game room	1,00	59,29	59,29	3,00	Game room	0,00	0,00	0,00	0,00	Game room	0,00	0,00	0,00	0,00
	Gym	1,00	188,00	188,00	4,00	Gym	0,00	0,00	0,00	0,00	Gym	0,00	0,00	0,00	0,00
	Changing room	1,00	99,49	99,49		Changing room	0,00	0,00	0,00		Changing room	0,00	0,00	0,00	
	Nursery	0,00	0,00	0,00	0,00	Nursery	0,00	0,00	0,00	0,00	Nursery	1,00	17,00	17,00	1,00
	Open Spaces	1,00	1065,56	1065,56	15,00	Open Spaces	1,00	1441,22	1441,22	15,00	Open Spaces	1,00	659,36	659,36	5,00
	Prayer room	0,00	0,00	0,00	0,00	Prayer room	0,00	0,00	0,00	0,00	Prayer room	0,00	0,00	0,00	0,00
	Rest room	0,00	0,00	0,00	0,00	Rest room	0,00	0,00	0,00	0,00	Rest room	0,00	0,00	0,00	0,00
	Stationary room	0,00	0,00	0,00	0,00	Stationary room	1,00	40,10	40,10	2,00	Stationary room	0,00	0,00	0,00	0,00
						Indoor balcony	1,00	33,7	33,7		Indoor balcony	1,00	52,02	52,02	
	Lifts	1,00	11,00	11,00		Lifts	1,00	11,00	11,00		Lifts	1,00	11,00	11,00	
	Stairs	2,00	21,00	42,00		Stairs	2,00	21,00	42,00		Stairs	2,00	21,00	42,00	
	WC big	1,00	22,30	22,30		WC big	1,00	22,30	22,30		WC big	1,00	22,30	22,30	
	WC small	1,00	12,13	12,13		WC small	1,00	12,13	12,13		WC small	1,00	12,13	12,13	
SURFACE	TOTAL			2500,00					2500,00					2500,00	
2500															
FACTORS	NO BOOST ROOMS				23,00					31,00					43,30
	BOOST ROOMS				45,00					48,00					49,30

Image 37. Real surface of the campus, after sketching

		REAL SURFACE OF THE CAMPUS (AFTER SKETCHING)									
	FLOOR	2					3				
		ROOM	NUMBER	SURFACE (m²)	TOTAL	COEFFICIENT	ROOM	NUMBER	SURFACE (m²	TOTAL	COEFFICIENT
		Associations	0,00	0,00	0,00	0,00	Associations	0,00	0,00	0,00	0,00
		Auditorium (big)	1,00	90,75	90,75	4,00	Auditorium (big)	0,00	0,00	0,00	0,00
		Auditorium (small)	0,00	0,00	0,00	0,00	Auditorium (small)	0,00	0,00	0,00	0,00
		Canteen	0,00	0,00	0,00	0,00	Coffee corner	1,00	27,75	27,75	3,00
		Group room (big)	6,00	22,00	132,00	6,00	Group room (big)	6,00	22,00	132,00	6,00
		Group room (small)	0,00	0,00	0,00	0,00	Group room (small)	0,00	0,00	0,00	0,00
		Instruction room	6,00	75,00	450,00	18,00	Instruction room	0,00	0,00	0,00	0,00
		Lab	0,00	0,00	0,00	0,00	Lab (big)	0,00	0,00	0,00	0,00
		Lab (big)	2,00	52,00	104,00	2,00	Lab (medium)	0,00	0,00	0,00	0,00
		Lab (small)	1,00	43,77	43,77	1,00	Lab (small)	0,00	0,00	0,00	0,00
		Library	0,00	0,00	0,00	0,00	Library	1,00	563,00	563,00	4,00
		Makerspace	0,00	0,00	0,00	0,00	Makerspace	0,00	0,00	0,00	0,00
		Offices (big)	25,00	16,50	412,50	3,75	Offices (big)	29,00	16,50	478,50	4,35
		Offices (medium)	6,00	13,00	78,00	0,90	Offices (medium)	8,00	13,00	104,00	1,20
		Offices (small)	9,00	12,16	109,44	1,35	Offices (small)	9,00	12,16	109,44	1,35
		Offices (lockers)	1,00	38,40	38,40	1,00	Offices (lockers)	1,00	60,60	60,60	1,00
		PC room	1,00	102,00	102,00	2,00	PC room	1,00	104,20	104,20	2,00
		Quiet room (big)	1,00	86,00	86,00	2,00	Quiet room (big)	1,00	50,00	50,00	2,00
		Quiet room (small)	1,00	49,50	49,50	2,00	Quiet room (small)	0,00	0,00	0,00	0,00
		Reception	0,00	0,00	0,00	0,00	Reception	0,00	0,00	0,00	0,00
		Secretary	0,00	0,00	0,00	0,00	Secretary	0,00	0,00	0,00	0,00
		Game room	0,00	0,00	0,00	0,00	Game room	0,00	0,00	0,00	0,00
		Gym	0,00	0,00	0,00	0,00	Gym	0,00	0,00	0,00	0,00
		Changing room	0,00	0	0,00		Changing room	0,00	0	0,00	
		Nursery	0,00	0,00	0,00	0,00	Nursery	0,00	0,00	0,00	0,00
		Open Spaces	1,00	638,19	638,19	5,00	Open Spaces	1,00	656,42	656,42	5,00
		Prayer room	2,00	13,00	26,00	0,30	Prayer room	0,00	0,00	0,00	0,00
		Rest room	0,00	0,00	0,00	0,00	Rest room	1,00	74,64	74,64	3,00
		Stationary room	0,00	0,00	0,00	0,00	Stationary room	0,00	0,00	0,00	0,00
							Terrace	1,00	2174,78	2174,78	15,00
		Indoor balcony	1,00	52,02	52,02		Indoor balcony	1,00	52,02	52,02	
		Lifts	1,00	11,00	11,00		Lifts	1,00	11,00	11,00	
		Stairs	2,00	21,00	42,00		Stairs	2,00	21,00	42,00	
		WC big	1,00	22,30	22,30		WC big	1,00	22,30	22,30	
		WC small	1,00	12,13	12,13		WC small	1,00	12,13	12,13	
SURFACE	TOTAL				2500,00					2500,00	
2500											
FACTORS	NO BOOST ROOMS					44,00					24,90
	BOOST ROOMS					49,00					29,90

Image 37. Real surface of the campus, after sketching

Image 38. 3D model, -1 floor, open space

Image 39. 3D model, -1 floor, game room

3D Model.

The main goal of the project, SMACS: modelling an urban environment (MURE), is to create and model the new University campus for OsloMet.

Building a 3D model of the campus has been challenging firstly because we had to choose the software without knowing a lot about 3D modelling and design. For this reason, several software options have been considered to carry it out. Some examples are Sketchup, AutoCAD, SolidWorks, and Inventor. After giving it some thought, the best solution was working with Sketchup. (Autodesk Inc., 2021) (Dassault Systèmes SolidWorks Corporation, 2021)

Sketchup is an easy-to-use software, available online and free. AutoCAD has however a major drawback; textures can't be added, giving an unfinished look. Moreover, the versatility of Sketchup for all types of users convinced us, 3D visualisation is very good, and it has a clear communication of design and detailing. (Trimble, 2020)

Enscape3D is an extension that plugs directly into Sketchup giving us an integrated visualization and design workflow and it allows us to make 3D renders. (Enscape 3D, 2021)

Image 41. 3D model, ground floor, entrance

Image 42. 3D model, ground floor, cafeteria

Image 43. 3D model, ground floor, makerspace

Image 44. 3D model, first floor, group room

Image 45. 3D model, first floor, nursery

Image 46. 3D model, second floor, offices

Image 47. 3D model, second floor, auditorium

Image 48. 3D model, third floor, library

Image 49. 3D model, third floor, coffee corner and quiet room

Image 50. 3D model, third floor, rest room

To conclude, we created a tool that allows us to find the right number of rooms for the number of students and employees. This aspect of adaptability was very important to us given the limited information we had about the relocation of the campus. Thanks to this aspect, our project can be used regardless of the number of faculties that will be transferred and regardless of the future location.

Furthermore, we created a 3D model on SketchUp, which will allow to visualise the result of our research. With Enscape 3D we could go inside the model and record a tour through all the floors of the building. This video can be found in the attached fiile, Appendix 3. Enscape3D has allowed us to make a realistic representation and add more details to our model. But it also has had some malfunctions such as the blinking signage.

8

FUTURE IDEAS

In this part we will detail ideas and thoughts for next EPS groups who could continue our project.

We believe that this project still has a lot of potential, and it can be very interesting to continue with it, to complete and add information so that the final set is gradually refined.

The main concept of the project has been to create a flexible campus. This flexibility encompasses both the final location of the future campus, the number of people it will include, the number of rooms and floor space it occupies as well as the versatility between the different spaces within the building.

During this spring term we have focused on the first features, but the versatility of the spaces is still open to further improvements.

The idea of designing a hybrid space can be very useful given the current times and the new ways of studying and working that will be implemented on a daily basis. For this reason, different possibilities are presented below, which are considered appropriate to expand this project.

Design Flexible and Versatile spaces

As a first option, it has been proposed that some of the rooms that are used as teachers' offices could also be used by students during the hours when teachers are not using them. Of the 8 hours of a teacher's working day, almost half of the time is dedicated to teaching, which means that the offices are free. In addition, the situation with Covid has made many teachers prefer to telework and change their office at the university for one at home. In this case, being small rooms, but with enough space to be able to work in them, they could be used as group rooms for 2 or 3 people and thus make the most of them throughout the day.

In the same way, there are other types of rooms that can have dual uses. Having proposed a first option, it opens up the possibility for the next group to explore this field and design new hybrid rooms, e.g., instruction rooms as public spaces, auditoriums as master's rooms etc.

Thanks to the creation of such spaces, the total area required for the campus can be smaller as the number of rooms will decrease. Thus, the total rental or construction cost and the impact on the land will be lower.

Room management

The second option that arises is the management of this type of space, because for such a large-scale project, exclusive design can be limited. For a room to operate as a hybrid, it is very important that it is well organized. In this way, those who are going to use it will know when they can and cannot use it. Creating software to manage public and restricted use times would be a good way to coordinate the rooms.

There will be spaces that need to be booked in advance in order to be used. The times of use can be displayed visually in each of the classrooms and in a simple application that allows the desired space to be reserved on a given day for the required time.

There will be other spaces that, for example, have certain hours when they can be used publicly. This application will be responsible for announcing them and managing their occupation in coordination with the school administration.

People's flow

It would also be interesting to continue working on the people's flow at the university. Indeed, we had the idea to put smart technology like sensors in the new campus that would count the number of people entering/leaving a space. These sensors would be linked to an application on the phone, and this application would show the number of people in a room in real time. In this way, students could see whether a room is full or not. This could be very useful in times of pandemic, as the administrator could choose the maximum number of people allowed in a room and then the application would show "full" if this number is reached.

In addition, we talked about making some spaces flexible by using one room for several functions. These sensors could be useful in this case as well. Indeed, we could study the people's flow in a day and see if rooms are empty at certain times and if so, these rooms could be used for another function.

9

CONCLUSIONS

Project

After researching and learning about the existing Oslo-Met campus, asking for students and employees needs and analysing people's flow in the P35 building; we were able to create the Space Management Tool that allowed us to, with very little information, create a flexible model of the campus university.

This project can be defined as a procedure for managing flexible spaces. The Space Management Tool designed after analysing all the existing data will allow anyone who follows the guide to learn how many rooms of each type are necessary for a campus depending on the number of students and employees desired. From that it will be very easy to distribute these rooms between the wanted floors, taking into the account the coefficients previously given. Finally, the only thing left to do would be the 3D model.

In the making of this project, it has been given a lot of importance to the flexibility. This is because the original information given was very little, and the entire project was depending on that: number of people the campus would contain, placement of the new campus, which faculties would be affected... So, it was decided to make a model that could be useful independently of all this information.

Finally, it was also decided to create a model as a form of example following the procedure. This model is a visual representation of a hypothetical university campus. The number of students and employees taken were also hypothetical, as well the surface and the number of floors of the building. It was thought that making this model would show how the procedure created works and it would be also a prove of its effectiveness.

b Experience

i.Team

Our project experience this semester was unusual. Indeed, covid-19 changed our plan and one of the team members, Ana, got stuck in Spain... We thought at first that she would join us during the semester and then we realised that it was not going to happen because Norway's borders remained closed. So, we took measures to make sure that our project would run as smoothly as possible even though Ana was more than 2000 kilometres away. We decided to do all our meetings on zoom or teams so that Ana would not miss any information. We had to make sure that we had a good WIFI connection, we had some issues with this at the beginning but then everything went well, and we always managed to communicate well. Refer to the Risks section in the Appendix 1 to know more about it and how the problem was handled.

Despite this major setback, we all enjoyed the experience and learned a lot, especially working in a multicultural team. For some of us, we had never worked on a project with people from other countries, other universities and other specialities. During this semester, we have learned a lot from each other.

At the beginning of the project, we did the Belbin test to find out our team roles but finally we chose not to assign roles to the people in the group, we worked as follows: we had a meeting and then divided the work into four, once or twice a week. This organisation suited us perfectly. Of course, there were times when we disagreed. So, in this case, the discussions should be solved like in a democracy therefore we took a vote, and the majority chose. That's how we worked, and it was very efficient. Moreover, we used a Gantt diagram and a calendar to make sure we did not miss any important dates. Thanks to this, we never had to work under pressure.

10

APPENDIX 1

Initial idea

The first weeks of the project the idea to be developed was another one. The mission has not been changed but the goals and the scope down have.

The intention was, in order to make the new campus attractive, to focus on three different rooms in the campus and design them to the last detail. The rooms where: a co-working hybrid space, a smart-library and classes with smart technology. The approach was changed because this idea was too precise and there would have not been time to make it possible. However, with the new idea to model the whole campus deciding what rooms should be included and where to place them we had time to complete and make a good project.

All these changes were informed to the project supervisor, Dr Berthe Dongmo-Engeland, who helped us to finish shaping and scooping down the project.

b Interview

On the 8th of February the team had the opportunity to interview Arne-Vetle Gulliksen. The goal of this meeting was to find out more information on OsloMet's project of relocating the campus. Arne-Vetle is the program manager for OsloMet's campus development, so he was the right person to ask.

Some of the questions were: "what is your vision on the relocation?", "where is the new campus going to be located", "which departments are going to be relocated and how many people?" and "what is the general opinion on the relocation?". From this it was found out that the relocation was still in a very early stage. The final and new location was yet to be decided and the faculties included in the new campus were still unknown. It was said that the campus should be located in the area of Romerike, probably in Lillestrøm or Lørenskog (near Ahus – University Hospital of Akershus) and that it would likely include faculties that are now in the Kjeller and in the Pilestredet campus.

It was also mentioned that the popular feeling about this relocation was negative and that many people were against it, so it was important to make the new campus attractive.

Arne also emphasised on the fact that the new campus must cooperate with companies around the whole region, and, also with the municipalities of the cities affected by the relocation. He also said that the purpose was to use this relocation as a development of the university campus and to stablish a connection between the real state and the improvement of education.

Survey

SMACS: Modeling urban environment

We are a group of international students who are taking part of the EPS (European project semester) project this semester. Our project is based in the relocation of the Kjeller campus in Romerike, to make it more appealing for both, teachers and students. Our main goal is to implement Smart technology using sensors to analyze the flow of people. This will permit the constant improvements of the facilities in the campus as well as the energy savings.

Our first step is to know more information about the OsloMet campuses. Can you help us? It will take you only 1 minute! 😊

Image 51. Survey

These were the questions asked in the survey with their responses. For the short answer's questions, we will include photos of the most common or repetitive one.

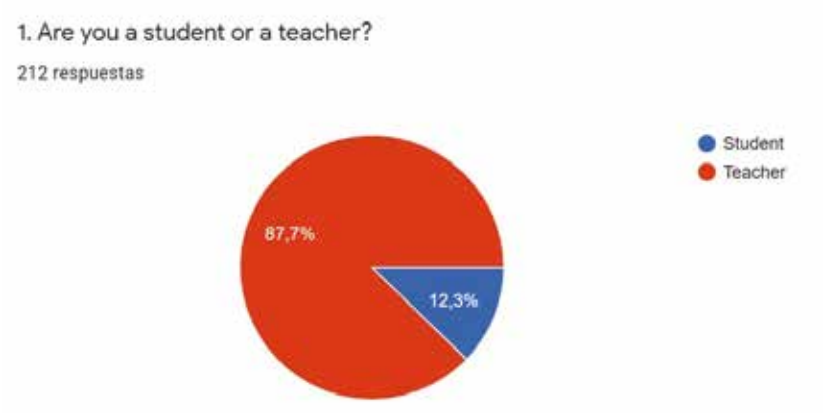


Image 52. Survey, first question

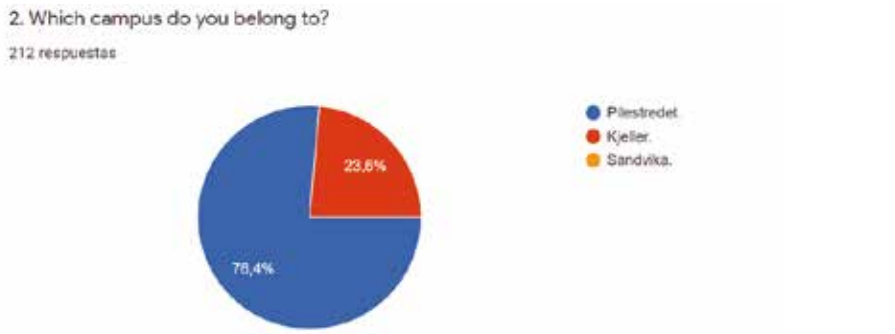


Image 53. Survey, second question

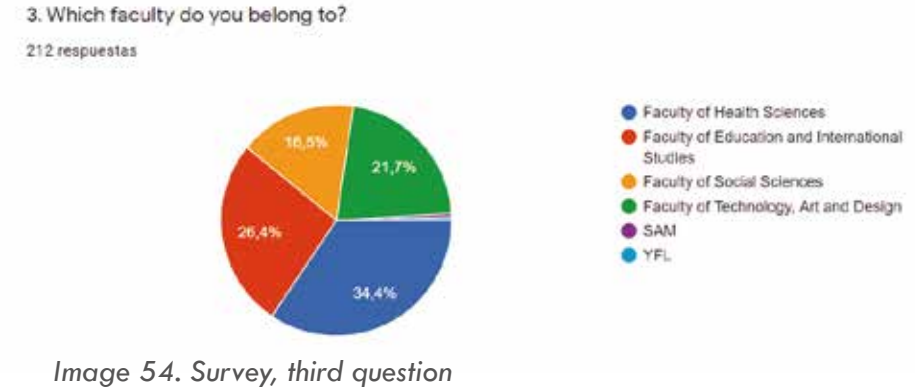


Image 54. Survey, third question

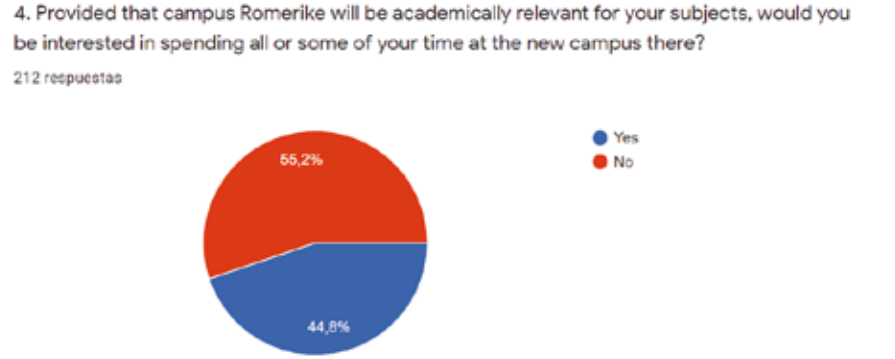


Image 55. Survey, fourth question

5. What must the campus have to make you move there? (Wanted for you).

212 respuestas

Will never move there

Active social and cultural offer on the campus

Trafical options, facilities for training

Easy transportation

Good facilities and car parking

nærhet til jernbanestasjon

Frequent and fast public transport

Image 56. Survey, fifth question

6. What should the new campus have for you to be more comfortable there? (Necessary for you).

212 respuestas

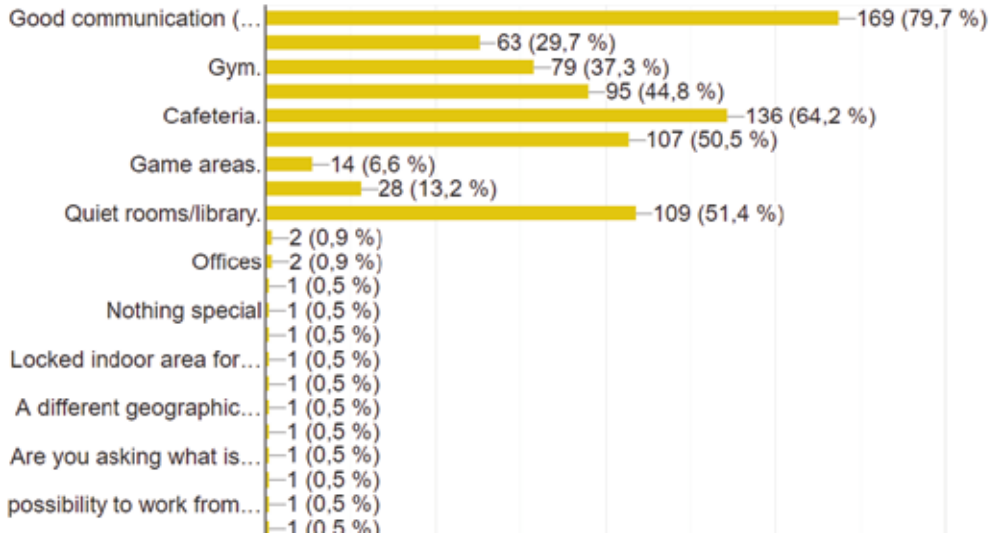


Image 57. Survey, sixth question

7. How would you go there?

212 respuestas

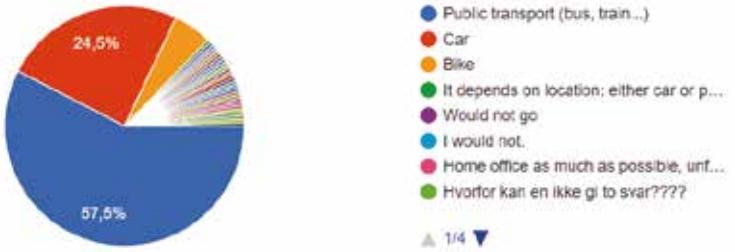


Image 58. Survey, seventh question

8. Would it be interesting to have a student housing in Romerike near the new campus?

212 respuestas

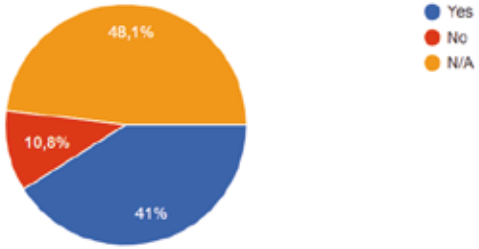


Image 59. Survey, eight question

9. How much time do you spend at University per day?

212 respuestas

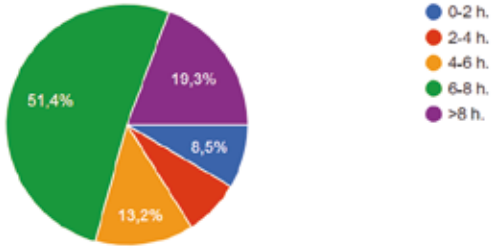


Image 60. Survey, nineth question

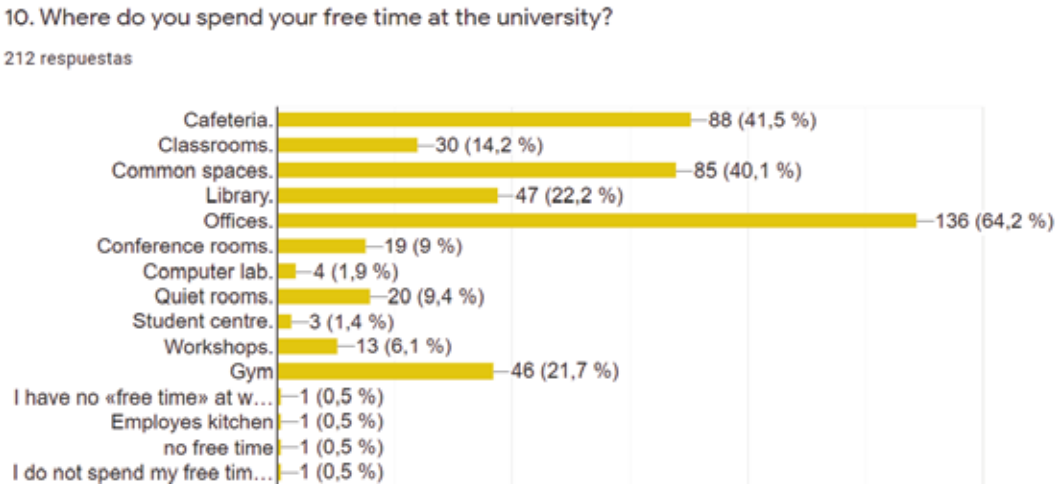


Image 61. Survey, tenth question

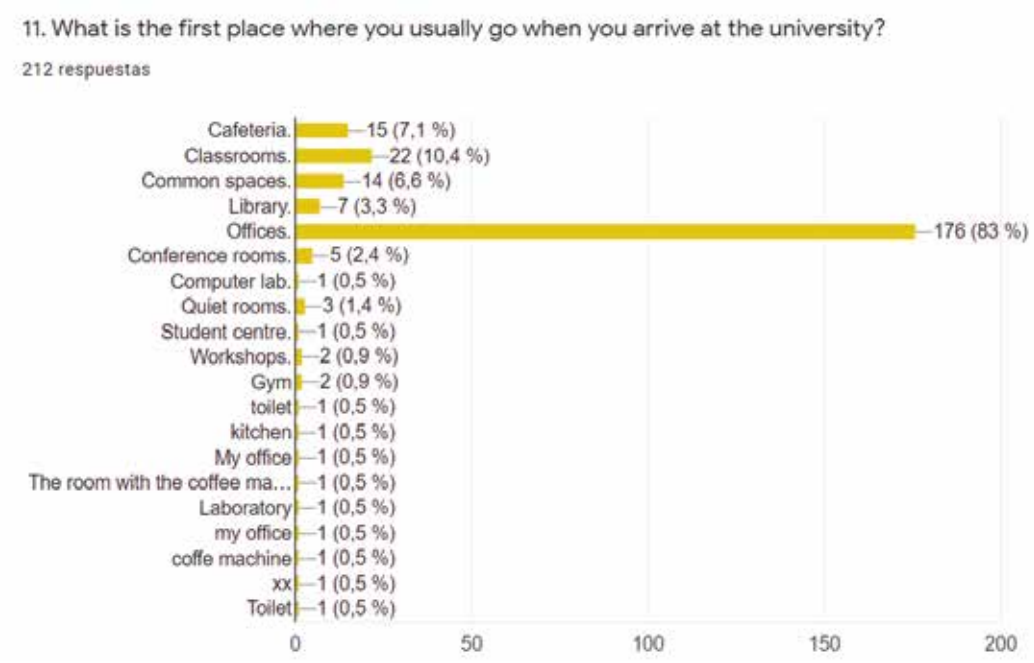


Image 62. Survey, eleventh question

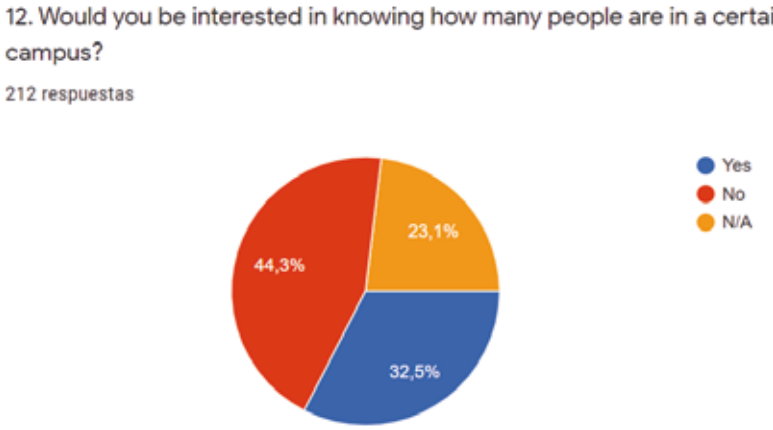


Image 63. Survey, twelveth question

P35 Device Connection data

These excels were provided to us by Tengel Aas Sandtrø, corresponding to the years 2018, 2019 and 2020 and the number of devices connected to the network on the ground floor in P35. In them, we can see which building and floor it belongs to, the date, the connection protocol and the reporting period. Also, a chart with the number of Associated Client Count and Authenticated Client Count as well as the time (per hours, starting at 00:59:59 and finishing at 23:59:59). The whole process will be explained with an example to be better understood. For that, the data from April 2019 will be used.

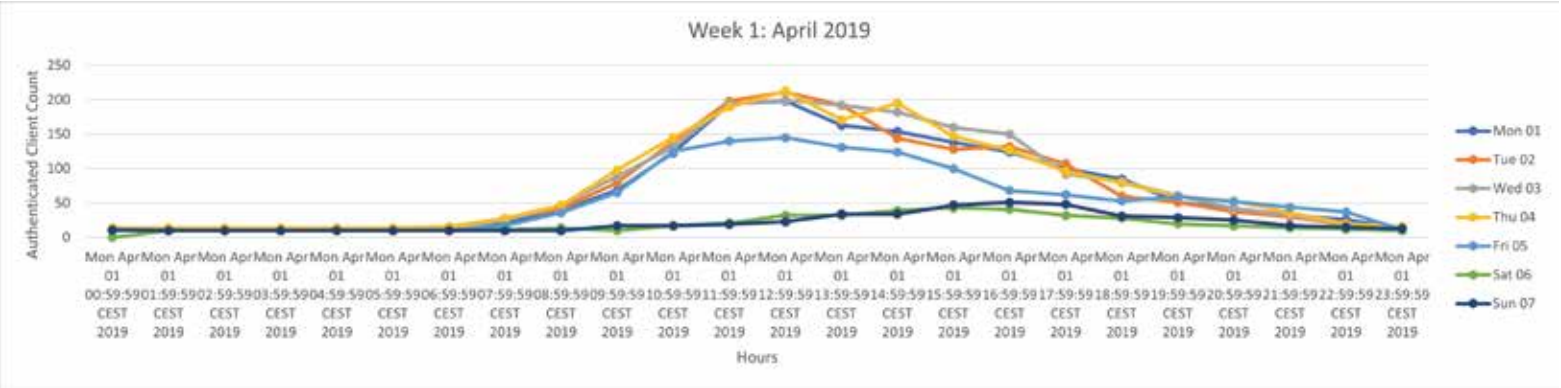
Total Count	Event Time	Associated Client Count	Authenticated Client Count
total	Wed Apr 22 11:59:59 CEST 20	4	4
total	Wed Apr 22 12:59:59 CEST 20	6	6
total	Wed Apr 22 13:59:59 CEST 20	4	4
total	Wed Apr 22 14:59:59 CEST 20	3	3
total	Wed Apr 22 15:59:59 CEST 20	4	4
total	Wed Apr 22 16:59:59 CEST 20	3	3
total	Wed Apr 22 17:59:59 CEST 20	3	3
total	Wed Apr 22 18:59:59 CEST 20	3	3
total	Wed Apr 22 19:59:59 CEST 20	3	3
total	Wed Apr 22 20:59:59 CEST 20	3	3
total	Wed Apr 22 21:59:59 CEST 20	3	3
total	Wed Apr 22 22:59:59 CEST 20	3	3
total	Wed Apr 22 23:59:59 CEST 20	3	3
total	Thu Apr 23 00:59:59 CEST 202	3	3
total	Thu Apr 23 01:59:59 CEST 202	3	3
total	Thu Apr 23 02:59:59 CEST 202	3	3
total	Thu Apr 23 03:59:59 CEST 202	3	3
total	Thu Apr 23 04:59:59 CEST 202	3	3
total	Thu Apr 23 05:59:59 CEST 202	3	3
total	Thu Apr 23 06:59:59 CEST 202	3	3

Image 64. Associated Client Count and Authenticated Client Count Excel

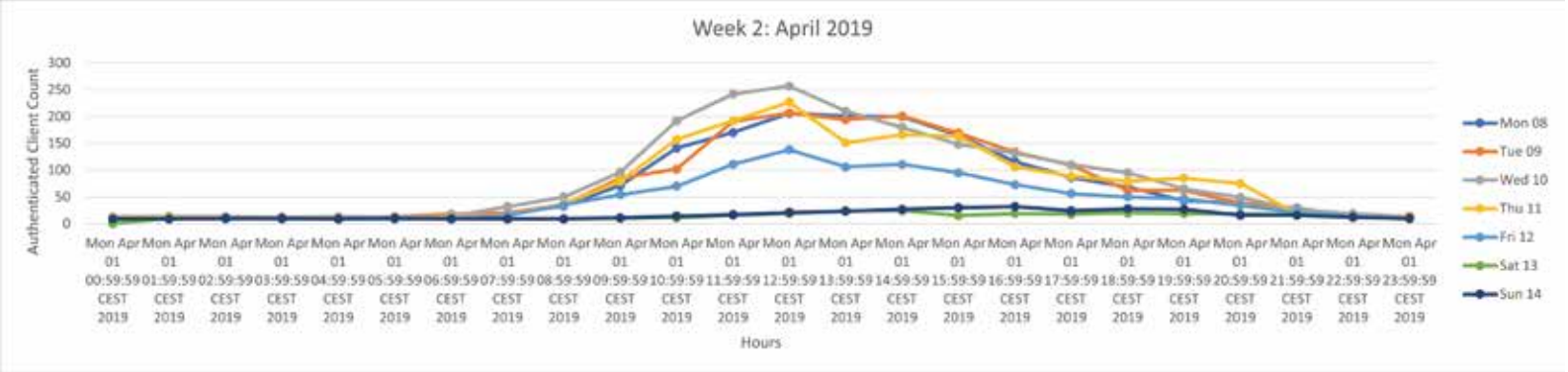
The first thing decided to do was a quick scan of all the data in order to obtain more helpful information. So we discarded the year 2018 as it was not too recent and because we wanted to see the impact the pandemic had on university life. In a near future many people will want to work from home as it is more comfortable and classes will be hybrid (some students will go to class and some other will stay home), so the number of people in the university will not be the same as it was before the pandemic.

In the second step, we analysed more in detail both years. Then, we made graphics to understand better the people's flow on the ground floor, what the peak times were, and when people go the most.

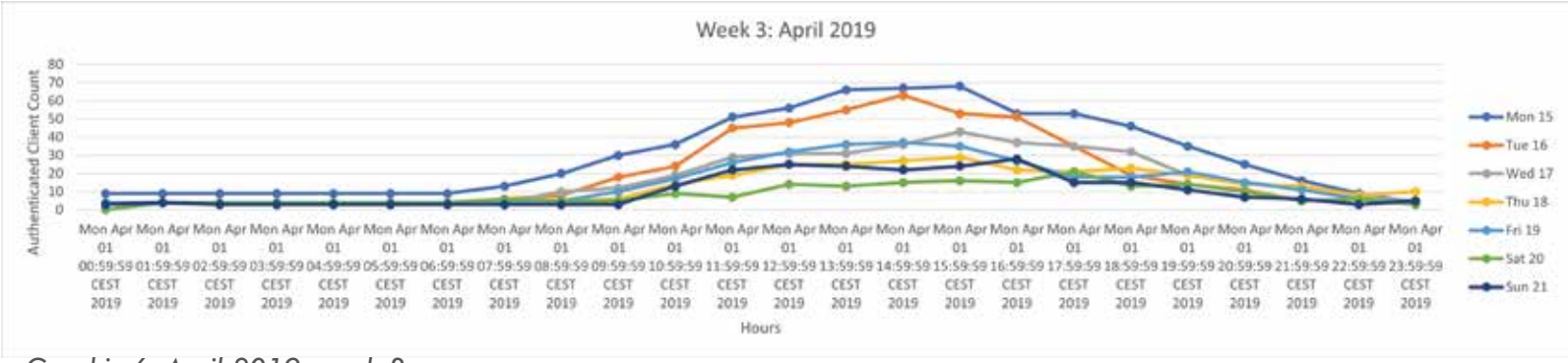
As seen in the graphics below, the peak is usually around 13:00-15:00. Furthermore, we can see the opening hours: the curve starts going up around 8:00-9:00 and going down at 15:00 and reach the minimum around 19:00-20:00. Lastly, it can be seen that the devices counted at night are not cero. That is because some computers are left open in the university.



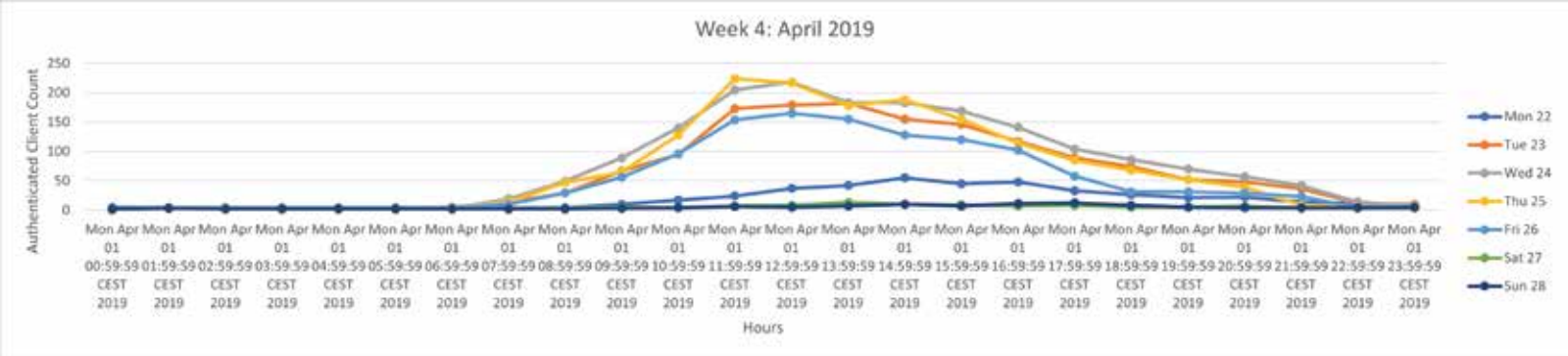
Graphic 4. April 2019, week 1



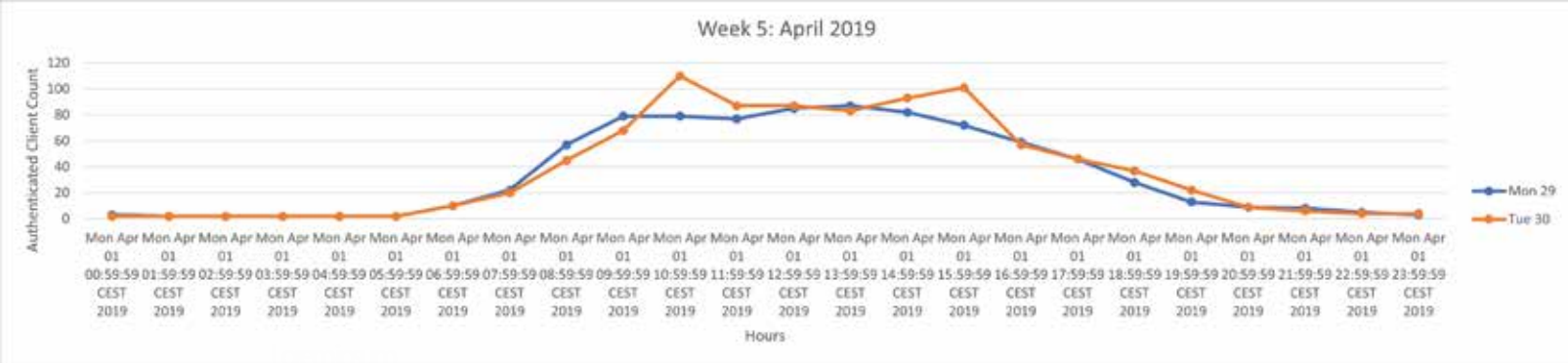
Graphic 5. April 2019, week 2



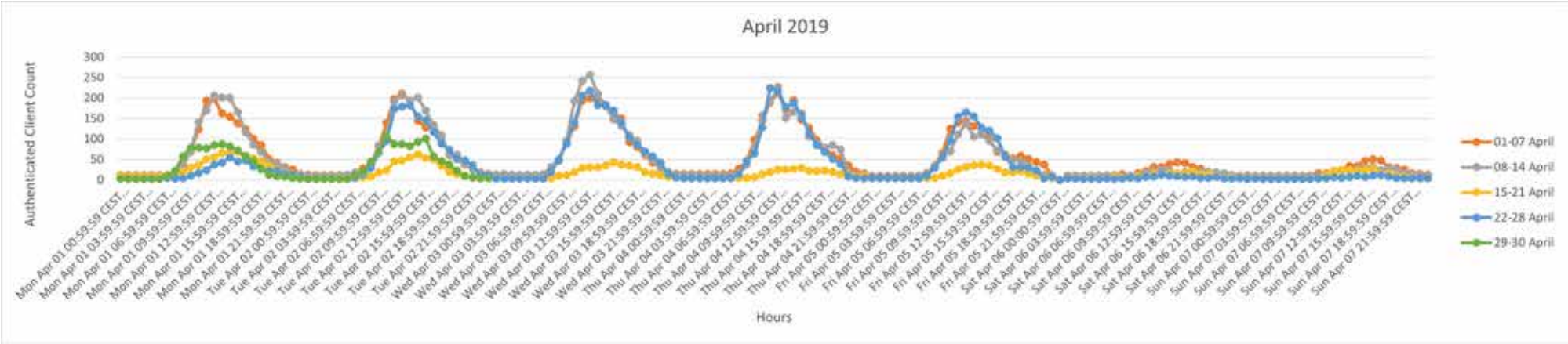
Graphic 6. April 2019, week 3



Graphic 7. April 2019, week 4

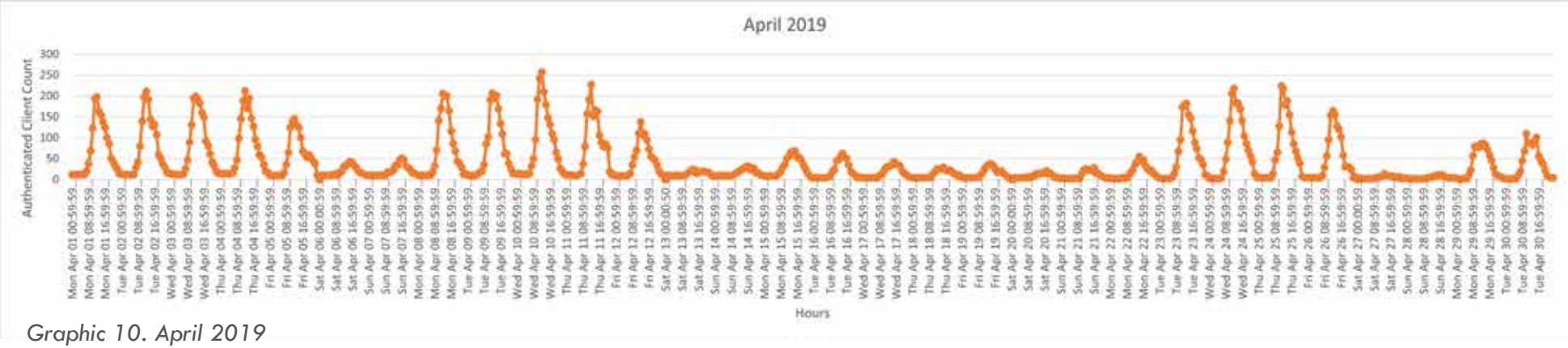


Graphic 8. April 2019, week 5



Graphic 9. April 2019, comparison of the weeks

And we represented the month in only one graphic.



Graphic 10. April 2019

The last step was to calculate the total number of devices and the total number of people. For that, we made an approximation of three devices equals to two people. This is because many people use more than one device at a time. Then rounded the number; as we are counting people, the number cannot be with decimals.

	TOTAL DEVICES	TOTAL PEOPLE
WEEK 1 (1-7)	9277	6185
WEEK 2 (8-14)	8996	5998
WEEK 3 (15-21)	2725	1817
WEEK 4 (22-28)	6815	4544
WEEK 5 (29-30)	1735	1157
TOTAL	29548	19699

Chart 18. Total devices and total people

Also, we calculated the average devices connected by hours, day and week and the same for the people considering the chart above.

	AVERAGE DEVICES CONNECTED BY HOUR	AVERAGE DEVICES CONNECTED BY DAY	AVERAGE DEVICES CONNECTED BY WEEK	AVERAGE PEOPLE CONNECTED BY HOUR	AVERAGE PEOPLE CONNECTED BY DAY	AVERAGE PEOPLE CONNECTED BY WEEK
WEEK 1	56	1344	9408	38	896	6272
WEEK 2	54	1296	9072	36	864	6048
WEEK 3	17	408	2856	12	272	1904
WEEK 4	41	984	6888	28	656	4592
WEEK 5	37	888	6216	25	592	4144
APRIL	42	1008	7056	28	672	4704

Chart 19. Average connections by hour, day and week of devices and people

The question now is for what we needed all these numbers and information. After creating all the parameters and obtaining the percentage of the floor's occupancy, we calculated the number of people on each floor and the total amount.

We also wanted to compare the difference between before the pandemic and during and after the lockdown. Continuing with April's 2019 example, we will add April's 2020 in order to see the differences. The chart below is the number of devices and people in both years by hours, the total during the day and the average number of people per hour.

	DEVICES		PEOPLE	
HOURS	February 2019	February 2020	February 2019	February 2020
8:00	36	27	24	18
9:00	55	48	37	32
10:00	103	58	69	39
11:00	118	124	79	83
12:00	197	184	132	123
13:00	218	177	146	118
14:00	190	144	127	96
15:00	184	137	123	92
16:00	158	123	106	82
17:00	126	103	84	69
18:00	101	68	68	46
19:00	88	58	59	39
20:00	64	53	43	36
21:00	46	43	31	29
22:00	30	42	20	28
		TOTAL	1148	930
		AVERAGE PEOPLE/HOUR	76,53	62

Image 65. Comparison April 2019 and 2020

To see the number of people on each floor in P35, we multiplied the percentages obtained in section *Design, First step, Floor coefficients*, by the number corresponding to the ground floor. As seen in the chart on the next page, we calculated the total people per floor and the total amount (in yellow) for both years.

All the months were not fully provided with all its data, so we choose February, April and May as our references to calculate the average number of people.

BEFORE PANDEMIC	Average of people in 2019	1059,67
BEFORE LOCKDOWN	Average of people in February 2020	930
DURING LOCKDOWN	Average of people in April 2020	44
AFTER LOCKDOWN	Average of people in May 2020	138

Image 66. Average of people before pandemic and before, during and after lockdown

FEBRUARY 2019									
HOURS	GROUND FLOOR	2ND FLOOR	3RD FLOOR	4TH FLOOR	5TH FLOOR	6TH FLOOR	7TH FLOOR	8TH FLOOR	9TH FLOOR
8:00	24	15	24	17	12	12	14	12	3
9:00	37	23	36	25	19	18	21	18	4
10:00	69	43	67	47	34	32	39	33	7
11:00	79	49	77	53	39	37	45	38	8
12:00	132	82	129	89	65	61	74	63	14
13:00	146	91	142	98	72	68	82	69	15
14:00	127	79	124	86	63	59	72	60	13
15:00	123	77	120	83	61	57	69	58	13
16:00	106	66	103	72	52	49	60	50	11
17:00	84	53	82	57	42	39	48	40	9
18:00	68	43	66	46	34	32	39	32	7
19:00	59	37	58	40	29	28	34	28	6
20:00	43	27	42	29	22	20	25	21	5
21:00	31	20	31	21	16	15	18	15	4
22:00	20	13	20	14	10	10	12	10	2
TOTAL	1148	718	1121	777	570	537	652	547	121
								TOTAL 2019	6191

FEBRUARY 2020									
HOURS	GROUND FLOOR	2ND FLOOR	3RD FLOOR	4TH FLOOR	5TH FLOOR	6TH FLOOR	7TH FLOOR	8TH FLOOR	9TH FLOOR
8:00	18	12	18	13	9	9	11	9	2
9:00	32	20	32	22	16	15	18	16	4
10:00	39	25	38	27	20	18	22	19	4
11:00	83	52	81	56	41	39	47	40	9
12:00	123	77	120	83	61	57	69	58	13
13:00	118	74	115	80	58	55	67	56	12
14:00	96	60	94	65	48	45	54	46	10
15:00	92	58	90	62	46	43	52	44	10
16:00	82	51	80	55	41	38	46	39	9
17:00	69	43	67	47	34	32	39	33	7
18:00	46	29	45	31	23	22	26	22	5
19:00	39	25	38	27	20	18	22	19	4
20:00	36	23	35	25	18	17	21	17	4
21:00	29	18	29	20	15	14	17	14	3
22:00	28	18	28	19	14	13	16	14	3
TOTAL	930	585	910	632	464	435	527	446	99
								TOTAL 2020	5028

Image 67. Average of people per hours and floors, February 2019 and 2020

d Campus visits

Kjeller Campus

Image 68. Kjeller campus, open spaces

Image 69. Kjeller campus, library

Image 70. Kjeller campus, lab

Image 71. Kjeller campus, lab

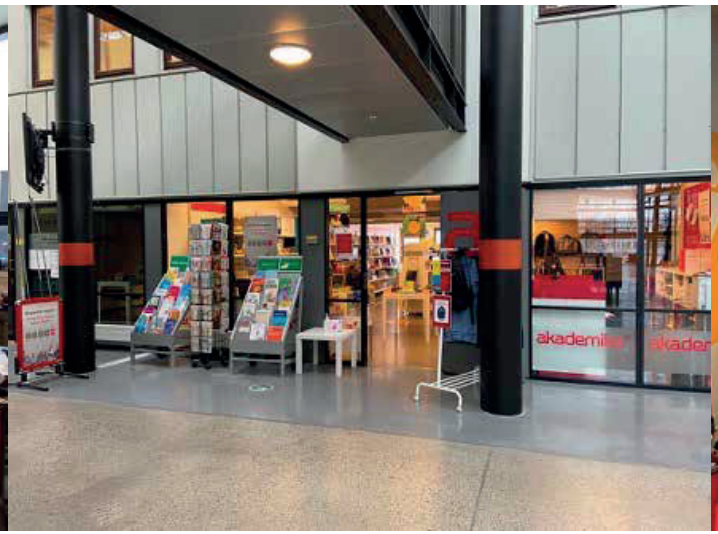


Image 72. Kjeller campus, stationary shop

Image 73. Kjeller campus, gym

P32 Building

Image 74. Pilestredet campus, P32, open spaces

Image 75. Pilestredet campus, P32, group room

P35 Building

Image 76. Pilestredet campus, P35, open spaces

Image 77. Pilestredet campus, P35, arquitecture

Image 78. Pilestredet campus, P35, open spaces

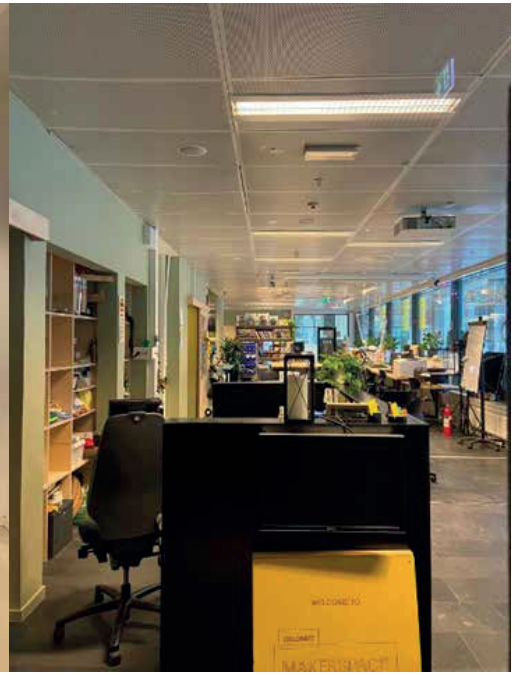


Image 79. Pilestredet campus, P35, makerspace

P52 Building

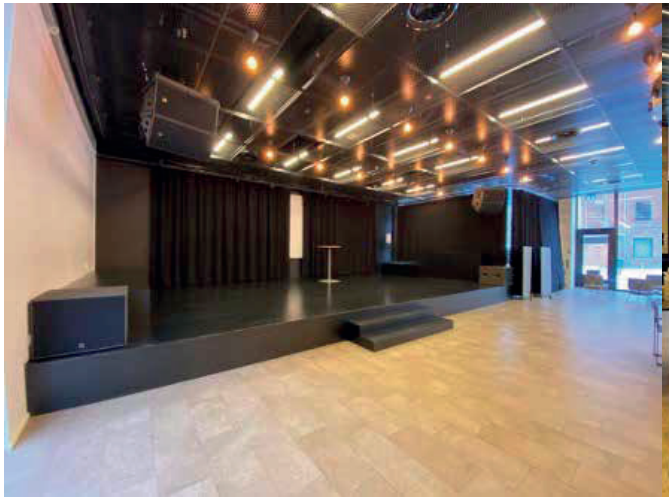


Image 80. Pilestredet campus, P52, open spaces

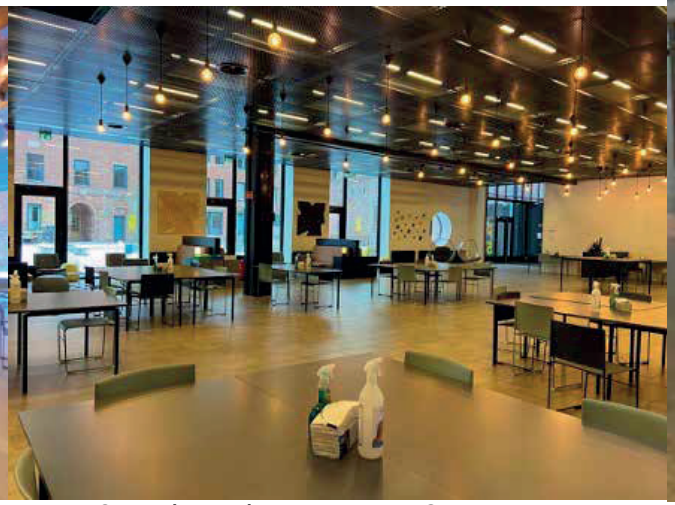


Image 81. Pilestredet campus, P52, open spaces

Image 82. Pilestredet campus, P52, instruction room

Risks

Before starting the project, a list of risks that could happen during the process was made to be prepared and not losing time thinking about the solutions. There is a total of six:

1. Not having enough time to do everything as wanted.

The project is broad and, as said before, in the methodology steps, the plan was to research people flow at university and then a 3D model of the building design. These steps could take a long time, so following the planning could be challenging. Moreover, there is a possibility, as well, to run out of time for the second part (modelling).

2. Software/report: not saving the modelling properly.

Not saving up properly and, therefore, losing the work would be dramatic. It usually happens and, it will be necessary to think about possible solutions to this common problem.

3. Having too much information.

It is possible to lose time analysing all the information.

4. Having too little information from the surveys.

Unfortunately, this year's health situation does not allow us to get a concrete approach of the number of people at the University. There is no one on the premises, so that is why the survey is a good alternative. Besides, not having enough information from the survey could be a problem due to not having another source to collect data about people flow at university.

5. One of the group members could not come to Oslo.

Indeed, Ana is still in Spain. So far, it has not been too much of a problem as everything has been by videoconferencing. However, it could become a problem later if something more concrete has to be done. An example is that Ana was not able to visit the campus with the group. An alternative to the problem was: to send her photos of what the other members of the group saw.

Alternatives are always found, but it will be more disabling in the future compare to other groups that can work by seeing each other face-to-face.

6. Bad connection.

Sometimes it is difficult to talk with the group due to connection problems. It could cause misunderstandings.

RISK	Consequence	Likely	LEVEL (1-6)
Time	2	3	5
Not saving	3	1	4
Too much info	1	1	2
Too little info	2	3	5
Group's member	3	2	5
Connection	3	3	6

Image 82. Pilestredet campus, P52, instruction room

Sustainability Goals

In 2015 the UN set 17 Sustainable Development Goals. The most related goals to this project have been selected and down below is explained how they will affect in the decision-making process.

This process was part of the Sustainability workshop given by Professor Dimitrios Kraniotis where we learned more about them and how those goals can interact with our project.

First of all, we can say that our project, being related to education, since it is about redesigning a new university, is strongly linked to **objective number 4: *Quality education.***

When the essential conditions and context for learning are not brought together, teaching itself is doomed to failure. Indeed, poor quality education equals to no education at all. What is the advantage of enrolling a student in school if the quality of education is so poor that they don't not attend regularly, and if they do, they do not assimilate the practical skills they will need later?

This project is about designing a new campus for OsloMet University, therefore is directly linked to the education theme. The SMACS: modelling urban environment project will ensure spacious and attractive working spaces. It has the aim to study the people's flow inside the university in order to propose a 3D model of the campus and organisation in the building that is suitable for students and employees so that they don't have

In a second time, the project is linked to the **goal number 11: *Sustainable cities and communities.***

The world is becoming increasingly urbanized. Since 2007, more than half the world's population has been living in cities, and that share is projected to rise to 60 per cent by 2030. It is true that metropolitan areas are the nerve centres of economic growth, but nevertheless, these places present a level of CO2 emissions of around 70 per cent worldwide and over 60 per cent of resource use.

In relation to our project, one of the OsloMet campuses will be relocated to Romerike, which is not as populated as Oslo is. This encourages the population to spread out and not accumulate so many people in the same point, stimulating the decrease of resource use.

Additionally, knowing that construction is the main problem of this large percentage of emissions, it will be tried, as far as possible, not to build a new building from scratch in Romerike. Existing buildings in the district will be sought, creating a new campus with full use of resources. In this way, the economy is strengthened and one of the objectives set out at this point: "support positive economic, social and environmental links between urban, peri-urban and rural area."

On the other hand, this objective refers to the fact that only half of the world's population has convenient access to

public transport (between 500 and 1000m). It is known that the relocation of the campus means an increase in the number of people who must travel. It will be tried that the campus will be near some public transport service.

Finally, the last point to be discussed in this goal would be the poor air quality in cities caused by the large percentage of emissions previously mentioned. These emissions caused 4.2 million premature deaths in 2016. To reduce this amount, strengthen efforts to protect and safeguard the world's natural heritage have been suggested. Extrapolating the problem to our project, the new campus will promote the use of green spaces to improve air quality. The necessary data will be collected from the flow of people who use them to reinforce measures of use, implement new spaces and encourage both students and teachers to use them daily.

As a final sustainable goal, **objective number 12** has been taken into account: ***Responsible consumption and production.***

Many natural resources have been provided to us by our planet. But they have not been utilized responsible and, currently, they have been consumed far beyond what the planet can provide. How to use and produce in sustainable ways, that will reserve the harm that has been inflicted on the planet, must be learnt.

The following eleven targets need to be used in order to create action to achieve the goal:

1. Implement the 10-year sustainable consumption and production framework.
2. Sustainable management and use of natural resources.
3. Halve global per capita food waste.
4.Responsible management of chemicals and waste.
5. Substantially reduce waste generation.
6. Encourage companies to adopt sustainable practices and sustainability reporting.
7. Promote sustainable public procurement practices.
8. Promote universal understanding of sustainable lifestyles.
9. Support developing countries' scientific and technological capacity for sustainable consumption and production.
10. Develop and implement tools to monitor sustainable tourism.
11. Remove market distortions that encourage wasteful consumption.

Not all of these proposals appear as the main aim of this project as this phase focuses exclusively on the redesign of the university campus. However, of great importance is the fact that the amount of floor space used will be less than what currently exists on the Kjeller campus. This reduces the consumption of natural resources. Furthermore, since the campus will most likely be built from an existing building, the impact on nature will be much smaller.

11

Attached file:

a. Space Management Tool Guide

b. Space Management Tool

APPENDIX 2

12

Attached file:

- Campus Tour

APPENDIX 3

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