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Executive Summary

The rapid development of digital technologies makes organizations rethink their business models and processes. NTNU also wants to digitize its processes as much as possible, especially its teaching processes. Even though a lot has already been digitized, we have had a look at two sub-processes we think could be improved.

Sub-process 1: Group formation

Today, when you are signing up for a group, you see a lot of different ways to do it. This can often be both confusing and frustrating. Unless the groups are going to be completely random or students enrol themselves, a NTNU employee must manually add each member to a group, which can be very time consuming. Therefore, we have discussed a new system to make this process easier for both staff and students.

We want the new system to be able to make customized groups without an instructor having to do it manually. The way we want to implement this, is by making the instructor fill out a form of how he/she would like the groups to be. Based on this form, the system creates a curated form for the students to fill out. Using this form, the system would collect information about the students and creates groups based on this information. We imagine the system being integrated in Blackboard, so when the process is done, the students are added in groups on Blackboard automatically.

Sub-process 2: Guidance

When you are stuck on an assignment and need guidance from a teaching assistant (TA), it is not always a quick process. The queue system is often just names on a sheet of paper or a blackboard, and you ought to pay close attention to know when it is your turn. We want to digitize this process.

Digitizing the process, we imagine a queue system implemented on Blackboard. The students get in line by pushing a simple button to enter the queue. The TA can see the queue and can click the next button to notify the next student that it is their turn.

The student then gets a notification on their Blackboard page and can go and get help without having to stick close to the TA or pay careful attention to their position in line.

Background

ICT in academic education has changed and is still changing, where academic education means teaching people subjects in schools, colleges and universities, and especially subjects that involve reasoning and studying¹. We can divide ICT in academic education into two categories: ICTs for education and ICTs in education. ICTs for education is the development of technology specifically for teaching and learning purposes. ICTs in education involves the adoption of technologies in the teaching learning process². Exactly what the changes are, how digital technologies are used in learning and what their effects are on academic learning is difficult to have a good understanding of. Moreover, technology develops at a rapid pace. This high rate of technological development is difficult to keep up with. However, it is possible to say something about the overall changes ICT has made in academic education. We will present some of them here.

In the last few decades we have seen a gradual shift in the understanding of learning in higher education. The focus has shifted from a teacher-centred learning towards a student-centred learning. Formerly you had to physically attend a lesson to learn, and the learning was a passive activity where knowledge was transmitted from someone who knew the subject, to someone who is learning about it. Today, learning is seen more as a constructive process, where the learner actively participates in the construction of knowledge. Early changes in lectures are mostly presentational technology, like videos and slideshows used by the teacher at first and then by the student, and lecture notes available online to stimulate student creativity and making learning more attractive.

¹ <https://www.collinsdictionary.com/dictionary/english/academic-education>

² <https://www.nyu.edu/classes/keefer/waoe/amins.pdf>

Most importantly ICT has made education more available for everyone. ICT in education opens the possibility for the students to learn anywhere in the world with lessons on video, online classes, online assignments, etc. This makes being a student more flexible, both full-time and part-time. You no longer need to be physically present at the university to get a degree. All compulsory assignments can be found online and delivered online. For some exams like home exams there is not even a need to physically visit the institution to take an exam. This unlocks possibilities for people to take education no matter what life situations they are in, for example if they are bound to a place because of family, or maybe a job on the side of their studies. We have seen a phenomenal growth of e-learning the last 20 years, partly because of the increasing demand of education and partly because of cost-cutting. It is, however, important to mention that online courses may not support an active or participatory teaching process.

The learner presently has a greater variety of sources to learn from than before. The internet has made information readily available and easy to access through articles, online courses, YouTube videos, etc. Learning new skills or learning for fun is now possible outside of traditional learning environments. This means that anyone can study almost anything at a pace suitable for them. The downside is that it can be difficult to know how reliable the obtained information is. One should be very critical to which sources to place their trust in, as fake news has become a common issue. Everyone can post new information on the internet, with no regards to whether it is accurate or not.

In conclusion, because of the easy access to informative resources online like video, audio, text and tasks, and the fact that many subjects does not require mandatory attendance, students can use ICT to learn in a way that benefits them most.

Ten years ago, we could see that ICT has changed learning, but primarily in the way of supporting existing teaching practices. ICT did not fundamentally transform the teaching process or bring any significant pedagogical changes, and the early changes are mainly seen in ICT in education and not in ICT for education. Digital technologies have the potential to support and change a pedagogy to be more

active, participatory, personalized, flexible and inclusive. It is believed that technology can improve quality in teaching if there is a better understanding of the pedagogic potentials. This way of using ICT has become more and more popular over the last ten years.

As mentioned earlier, online learning may not support an active teaching process. This is where the potential of digital technology lies and where the use of ICT for education can be improved upon. It has the possibility to support a more interactive and communicative process, and an active pedagogy by supporting one-to-many and many-to-many communications. This means that students can share ideas and knowledge with their peers. They can ask questions and retrieve knowledge more easily from teachers. In addition, they can collaborate more widely, in the sense of collaborating over long distances and making collaborative text writing easier. Tools like Google Docs, Slack, GitHub, etc. are known and used for collaboration, but there are also tools like Piazza, Peergrade for peer review and GitLab that have the same functionality and are used by universities and schools like NTNU³.

ICT also makes it easy for teachers to explain complex problems and ensure student comprehension. Teachers can create a more interactive lessons and combined with the above, make learning more enjoyable through varying in the use of technologies and using technologies that are specifically made for gaining knowledge and skills. We can see that universities and schools use ICT to gather information and functionality specifically for their institution.

The main disadvantages of using ICT in academic education is that the students rely too much on the information on the internet as discussed above, the importance of privacy and security and the reliance of technology. As technology is used in a higher grade, security and privacy becomes more important and specifically when it comes to the lives of young, ignorant students. We also rely on technology to work, which means that we rarely bother to learn facts by heart and uses our memory less, making it poorer⁴.

³ <https://ajet.org.au/index.php/AJET/article/view/892/169>

⁴ <https://sites.google.com/site/eportfolioduaa/home/advantages-and-disadvantages-of-i-c-t>

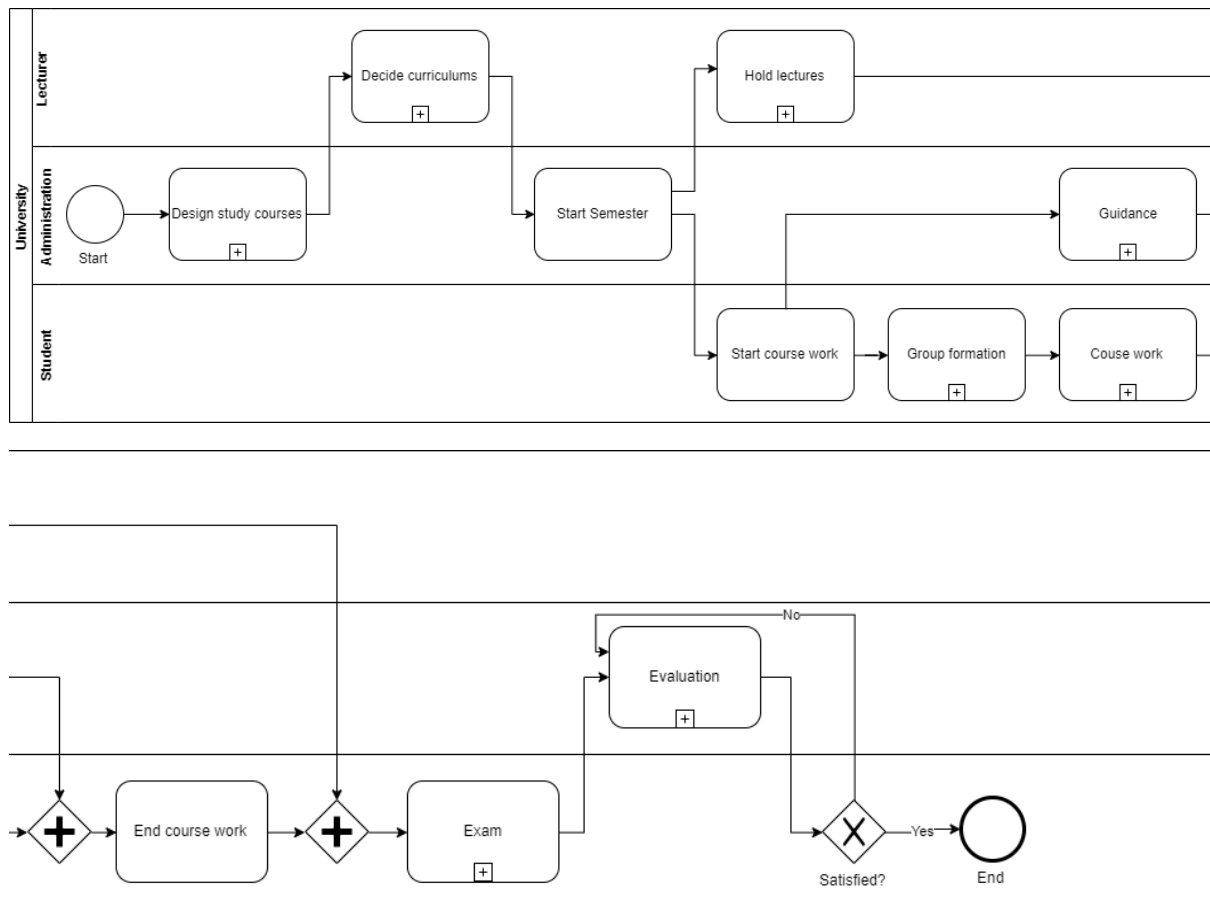
To sum up, the use of ICT in education has shifted the focus from the teacher to the student and made the pedagogy more active and personalised. The use of ICT for education has also contributed to this, but it still has the potential to make the pedagogy even more active, participatory, personalized, flexible, inclusive and improve teaching quality. As we introduce more ICT to academic education, we also have to consider the disadvantages.

Teaching at NTNU: the AS-IS situation

In the AS-IS situation we are first describing the overall teaching process and then we distinguish the two main sub-processes both as top level process diagrams. We discuss our sub-processes and give a more detailed model of the problem we are trying to solve.

Overall teaching process

This BPMN diagram describes the overall teaching process at NTNU and distinguishes between the main sub-processes performed within a semester. The model describes everything from study course design, lectures held by the teachers, course work, evaluation and the possibility of students complaining about their evaluation. It is recommended that you open the separate files to view the BPMN diagrams, as they are hard to display properly inside of the PDF file.

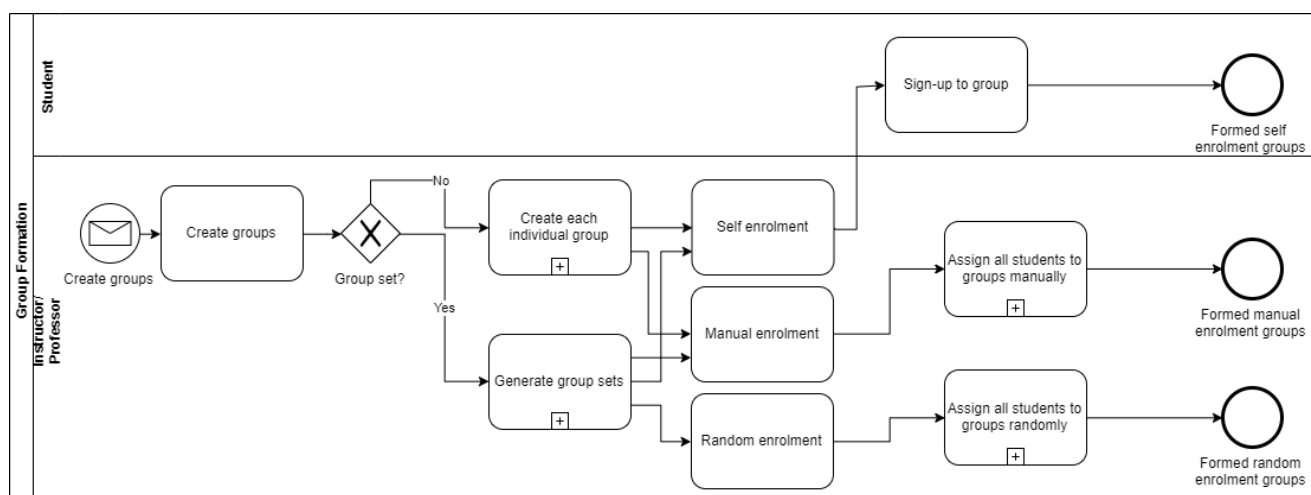


Sub-process 1: Group Formation

A Blackboard⁵ group requires at least one professor or course instructor. Both the professor and course instructors can assign new course instructors to the group.

The professor or course instructor can access the Groups tool for an already existing course from the Control Panel > Users and Groups (section) > Groups. Upon accessing the Groups page the professor or course instructor may view groups, edit existing groups and create new groups or sets of groups. Once a student first has been enrolled in a group, they will be unable to leave the group themselves.

⁵ https://help.blackboard.com/nb-no/Learn/Instructor/Interact/Course_Groups/Create_Groups



When creating a group, the course instructor is provided with two different types of groups to create. The first type of groups that can be made are single groups, which is simply creating each individual group manually. The other option are group sets, and by this option each individual group will be automatically generated by Blackboard based on the number of students OR number of groups to create.

Upon creating a group, the instructor navigates inside of the Groups page and select create, selecting an appropriate way of enrolment based on if a single group or group sets are being created. There are three ways of enrolment: Manual enrolment, random enrolment and self-enrolment.

Random enrolment is only available to group sets, as this option does not make sense should the instructor wish to create individual groups. When using random enrolment students will be automatically distributed to a group based on the restrictions set when making the group sets. It is important to note that random enrolment only works to students currently enrolled in the course, but students who enrol later can be manually enrolled to the group sets.

The self-enrolment option allows students to assign themselves to a group using a sign-up sheet, and for single groups the instructor should specify the maximum number of members in the individual group settings. If this option is selected the instructor needs to inform students to enrol to a group themselves through the

Blackboard announcement feature, and it should be noted that a student may not unenroll from a group once they are enrolled.

Given manual enrolment the instructors need to assign each individual student of the course to a group manually. This is done through the Add Users window where one can see all group members, search for students taking the course and select which ones to add to the group.

After having selected the way of creating a group a group name should be specified, but the group description is optional. Settings for group tools, group smart view and student homepage personalization can be specified by selecting the appropriate options with checkboxes. Grading of student submissions can be done with the Grade option, typing the amount of points possible for a submission given a group tool such as, but not limited to journals, blogs, files, wikis.

When the Blackboard functionality is not enough the instructors often use Google sheets or Google forms as a supplement. The example we have seen in the use of Google Sheets is where the professor or course instructor provides a spreadsheet document to the students where the students will write their names and e-mail. If they want to form a group with people themselves they can type their names in a specific group, if a student wants to join a random group they may write their name in a field for this option, if a student wants to join an already formed group with available slots they will need to ask the group members for access. When the spreadsheet option is used as an addition to creating groups on Blackboard the manual option is used by an instructor to enter members who have formed a group into a Blackboard group, and random enrolment needs to be performed for the people who have opted for this.

In the use of Google Forms the professor or course instructor creates a form using Google Form and provides the link as an announcement during the lecture and/or using the Blackboard course announcement tool. Course students will need to submit the form in a deadline to form a group, and this form typically consists of questions related to the course ambition level, experience, what people the person

wants to work with and if the user wants to request an English group or is okay working in an English-speaking group. The professor or course instructor then use the form submission data with manual enrolment to enter students into course groups based on form result and can use random enrolment as an option given parameters such as ambition or English-speaking.

It is important to note that the current use of an external information system such as Google Sheets/Form is not only flawed by making the process inefficient, but also strictly illegal. NTNU currently does not possess a data processing agreement⁶ with Google, which makes it impossible to ensure that personal information such as students name and contact details is processed according to the current legislations and supportive frameworks. Should personal information be processed incorrectly NTNU risks a loss of reputation and fines from regulators, and the use of these 3rd party systems is therefore an unnecessary risk for NTNU.

Sub-process 2: Guidance

During a semester each course have different kinds of guidance for helping the students through the course. It is possible to contact the course administration using discussion forums online inside Blackboard or in the external gathering place, Piazza. Sending emails are also one of the possible ways of communicating for more serious or complex problems. Most courses also have teaching assistants helping students on a given time at a given place during the week.

Blackboards integrated discussion forums are called "Discussion Board" and the student do not need to take any action for signing up. Within the course you find a tab for the forums and there could be multiple forums. The professor of the course often separates problems related to the exercises and questions related to the exam

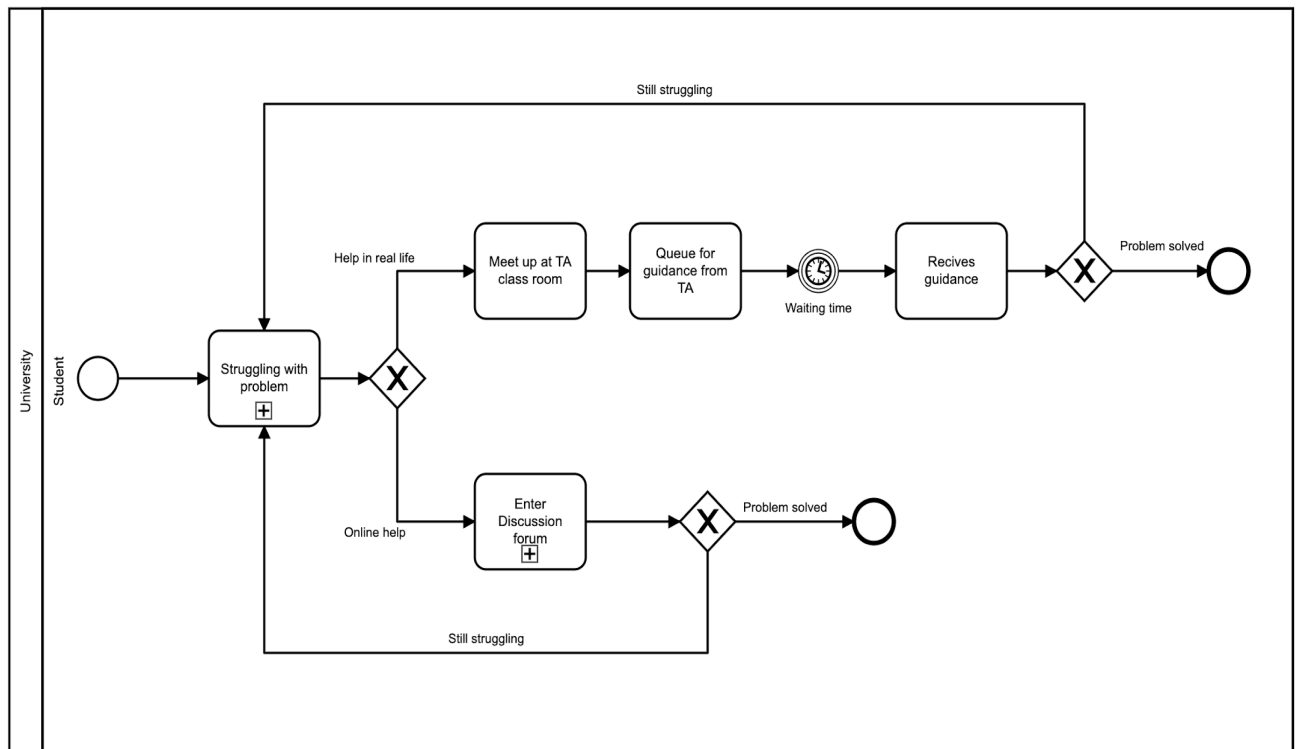
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<https://www.datatilsynet.no/rettigheter-og-plikter/virksomhetenes-plikter/databehandleravtale/databehandleravtale/>

in two forums. Within the forum students can create threads and subscribe for getting notifications.

Piazza seems to be more popular among the professors and have more functionality. The students do need a separate account and find the specific course for joining the forum. You find almost the same functionalities in Blackboard. Click “New Post” for asking a question. A more specific form for creating the question pops up and you can create a post as a regular “Question”, just a “Note” with no answering functionality, or as a “Poll/In-Class Response” for voting. It is a possibility to only ask the instructors. Piazza displays code naturally as we would see it in a code editor.

Problem solving or questions directly to the teaching assistants are taking place in open workspaces at the university. Teaching assistants create a note on their spot so students looking for them easily could find them. If there is waiting time for guidance the teaching assistant could have a waiting list where students need to sign their name on a paper. Some courses use their teaching assistants for evaluation of exercises and have a prioritized group for each assistant. Then others could get guidance in between if there is time. Close to an exercise deadline it could be a long waiting list to receive guidance.



BPMN: The current as-is for the guidance situation for a student at NTNU.

Teaching at NTNU 4.0: the TO-BE situation

Sub-process 1: Group formation

We want a process that makes it easier to form groups for all situations in subjects and reduce the time an instructor spends on adding students to groups manually. Today's process is standardized, but with minimal functionality and there are several examples where the professors uses external information systems like Google Sheets and Google Form instead. Through the description of the AS-IS situation above, we have identified the following problems:

1. Manual enrolment requires unnecessary use of time and resources.
2. There should be more options available for creating a group set like language preferences, ambition levels and what to do with late enrollers.
3. Self-enrolment on Blackboard is confusing and if the students enrol in the wrong group the teacher assistants have to unenroll them manually.

We want to create an enterprise IS to standardise the process:

The new system would start when the instructor decides that he/she wants a group project and fills out a form on Blackboard. We have chosen to implement the system on Blackboard because this is where projects are delivered, and course related information is found. We believe that integrating everything in the same place would make things more straightforward and easier to use.

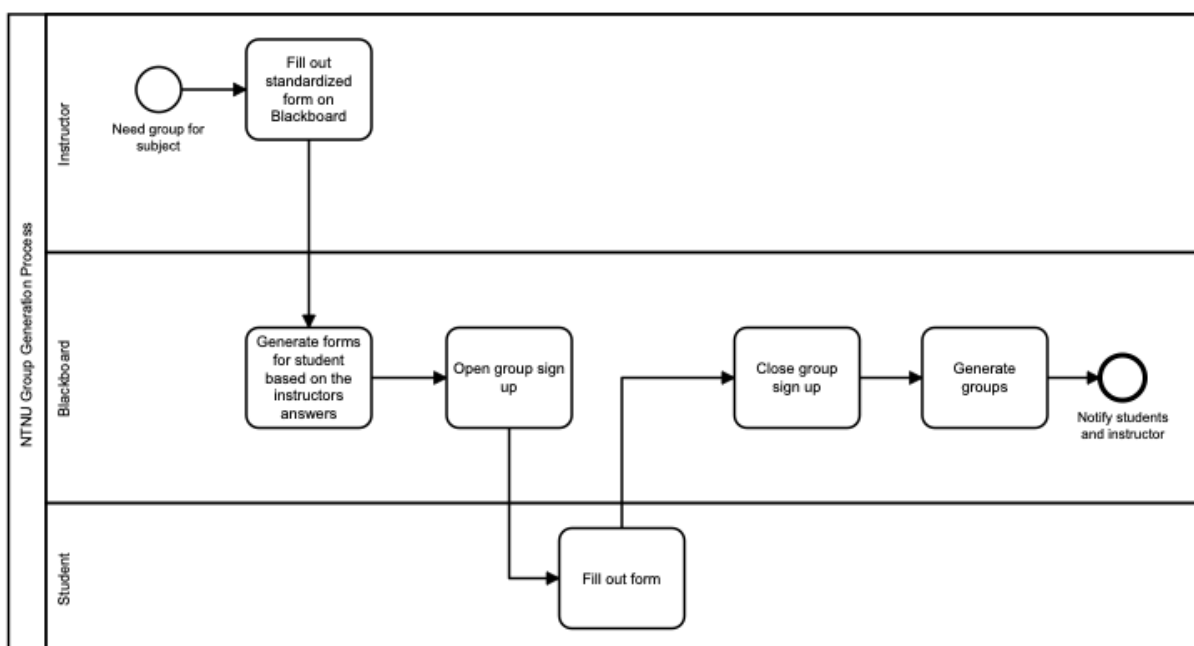
In this form you can choose between several options for how the group should be formed. Some of the options will be a deadline for answering, group size, if the students can name people they want to work with for self-enrolment, random selection, ambition levels and language specifications. He/she will also be able to decide some rules for handling of exceptions, e.g. uneven group sizes. We want to have a customizable form, because different subjects might need different types of groups.

When the choices have been made, Blackboard will generate a form and notify the students that the group registration is open. The students then must fill out the form before the deadline. After the deadline has expired, Blackboard generates groups based on the information from the forms and notifies the instructor and the students when this is done.

The new process solves the following problems:

1. It can often be difficult to make the numbers add up, with late enrolments, wrong enrolments or when the students assign themselves to groups. The new system will make sure that all the groups will be filled with the right number of members and handle how to fill up all the groups automatically through the rules specified by the professor. For example, one group with four members, or two groups with two if the ideal number was three.

2. Today, if students wish to be in a group with students they know, the instructor have to add this manually or they have to self-enrol which does exception handling hard. With the new system, this will all be handled by Blackboard.
3. Currently the group formation process uses many different systems to make groups (different methods on Blackboard, Google Forms, Google Sheets, etc), and this can be both confusing and inefficient. With the new system, the students (and instructor) only need to deal with one standardized system.
4. Often it is a lot of work for the instructor to make groups. With the new system the workload will be reduced.



BPMN of the new group formation system.

Sub-process 2: Receive guidance from TA - Teaching Assistant

We want to digitize the process of receiving guidance from a teaching assistant (TA). Today, if you want to receive help, you either need to write your name down on a paper list, or just sit and wait until you see that the TA is finally free. You must pay a lot of attention to the TA to know when it is your turn to get guidance, and this can

make the waiting time terribly unproductive. The system used today is a manual IS, but we want to make it a computer-based IS.

The system will be a personal IS, because it will improve productivity by reducing the waiting time, and time wasted on finding out whose turn it is. We hope that the system will give the student an assurance that they will be notified when it is their turn, and that this will make the waiting time more productive.

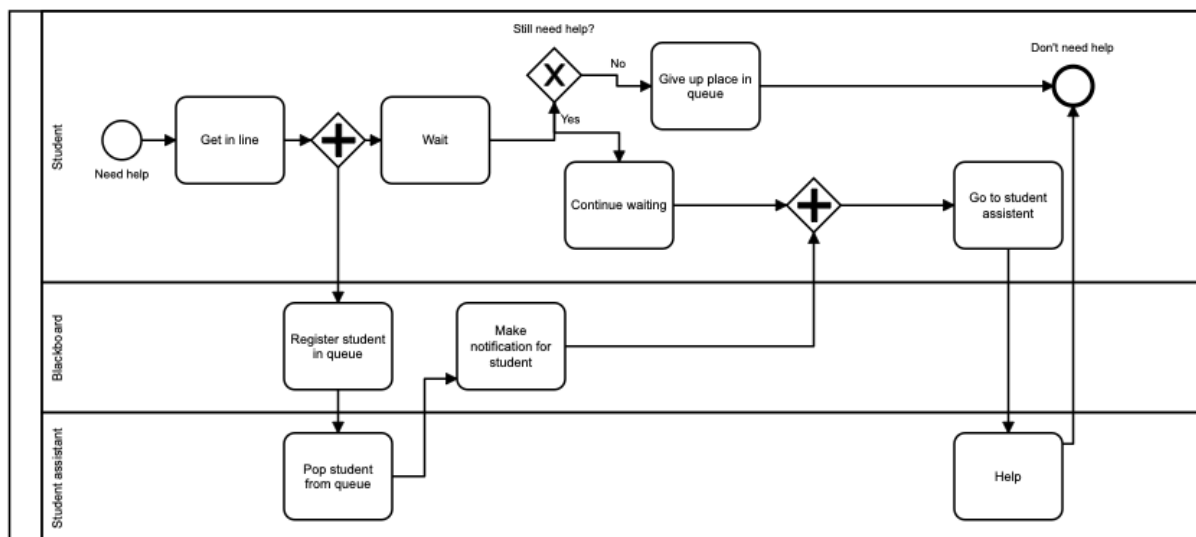
The new process would start when the TA presses a button to start the help session. Blackboard then opens a queue where students can join. We have chosen to implement the system on Blackboard because this is where you find a lot of the other tools concerning schoolwork. It is also easier because all students have an account on Blackboard, so you don't have to sign up anywhere to use the system. This also makes it easier when the students are going to receive notifications, because many already have the Blackboard app or is actively checking the Blackboard web page.

The students can then write their names and the problem they need help with to join the queue. The TA presses a button to notify the first student in line. The student receives a notification on blackboard on both the app and webpage. If the student does not show up the TA can go to the next student in line. This is up to the TA to decide, but the time period should be relatively short. We have chosen to skip to the next in line manually, because this gives the TA better control, e.g. it can be nice if the TA wants to take a bathroom break.

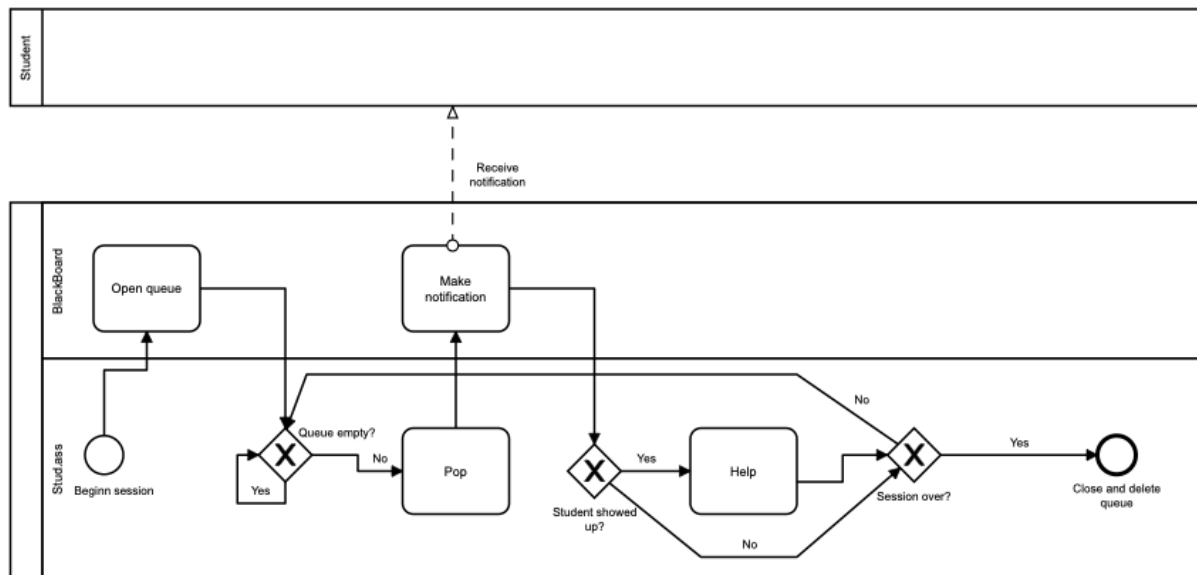
If the student does show up, the student receives help. Everyone can during the session see the waiting line. The TA can then make decisions on how long he or she can help each student, and the students can see how fast the queue moves and which number they are in the line. They can also see what kind of problem the current one is and listen when the TA helps the current student if they have the same kind of problems. We hope that this will reduce the line. The students can at any time get out of the line. They will also receive a notification when they are number two and one in line, which gives them time to prepare for their turn and there is no time

wasted waiting on the student. When the session is over the queue closes and gets deleted. We have chosen not to save the queue, because it complicates the next session, e.g. if there are a lot of students that are in line but doesn't show up.

We have decided to show the process for when the TA begins the help session and helps the students in the queue, and the process for when a student needs help and joins the queue to describe both perspectives properly. This is because for a student the process ends when the student has gotten the help he/she needs, but for the TA the process loops until the help session is over.



BPMN 2: Student perspective



BPMN 1: Teaching assistant perspective

This new process solves the following problems:

1. The queues not being properly followed.
2. The TAs don't have to yell to alert the next one in line, this is very helpful as some do not dare to yell out a name in a large crowd of people.
3. The students do not have to wonder whether there is a queue or not.
4. The students can easily work on their problems while following the queue on Blackboard and does not have to be in the same room as the TA. Sometimes it is a problem that the room where the TA is helping students is full, and you are force to sit elsewhere.
5. The queues might get smaller if the students can pay attention when another student gets help with a similar issue.

From AS-IS to TO-BE | Implementation

We look at our project as a Sustaining (Incremental) Innovation, which will result in enhancements to existing services and ways of operating. It will involve some

re-engineering, which will lead to a redesign of the organizational structures and information systems. As we have pointed out, there is some serious problem with the group generating method that is used today, where students end up being confused by all the diverse approaches to this process. Also, we have found a lack of structure around the guidance in practice hours, where students and TAs deal with an ambiguous approach to the queuing process for help.

We will take strong action to solve these serious problems, and in the coming sections, we will discuss how these changes to the current NTNU information system will affect different stakeholders. We will discuss this using diverse models and theories, and lastly, we will point out some potential risks that may be caused by these changes.

Change Management Model

To complete the implementation plan, we will use a Change Management Model, specifically Lewin's Change Model. By using this model, we can carefully plan the three stages that include preparing for change (Unfreezing), making the change (Moving), and finally institutionalizing the change (Refreezing). For each stage, we will go into the most crucial points that need to be taken into consideration.

Unfreezing

Communicate

Communicate with employees and students about the change, so that they are prepared for an incoming change. As humans, we are constructed in a way that we fear change because we can't anticipate the outcome⁷, which makes this step a vital one to start with, and to do correctly.

Involve stakeholders

Ask for input. This mainly accords to the staff, but it can also include students.

⁷

<https://www.psychologytoday.com/us/blog/the-adaptive-mind/201809/how-overcome-the-fear-change>

A solution which has become increasingly popular for dealing with resistance to change is to get people involved to participate in making the change⁸. But participation is not something that can be conjured or created artificially, and one can obviously not buy it. Most of all, it is not something that can be forced upon someone, or at least with resulting in a positive and valuable outcome.

According to Paul R. Lawrence, a Harvard Business Review author, the key to the problem is to understand the nature of resistance, which is *social change*. It is the change in employees/users human relationships that generally accompanies *technical change*. Without going too deep into this research, we can conclude that the management can take concrete steps to deal with the attitudes, such as:

- emphasizing new standards of performance for staff specialists and encouraging them to think in different ways.
- meetings with staff, operating groups, and potentially even students, that encourage healthy discussions for change.

Schedule, Budget, Scope

There are several types of change which may be requested and considered for the IS Project⁹. Some of them may be:

Scheduling Changes

As we have included several stakeholders as contributors to the change of the processes, more detailed and strict scheduling needs to be in place.

Budget Changes

The project may require changes to the cost baseline and will require adding funding to project reserves.

Scope Changes

Unforeseen changes in scope may occur due to some requirements that were not considered early in the process. These changes will lead to changes in schedule, budget, and other necessary project documentation.

⁸ <https://hbr.org/1969/01/how-to-deal-with-resistance-to-change>

⁹ <https://www.projectmanagementdocs.com/template/project-planning/change-management-plan/>

Moving

Motivate

Some people will be harmed by the change, especially those who benefit from the status quo. Others may take a long time to recognize the benefit that change brings. It is important to motivate these people to see the light at the end of the tunnel by describing the benefits and explain exactly how changes will affect everyone.

Train

Providing support and training is crucial. Everyone should be informed and supported, during this and the coming (refreezing) stage.

Manage and lead

One should empower action by e.g. providing lots of opportunities for employee involvement and having line managers provide day-to-day direction. Here, as well as in the unfreezing stage, all the stakeholders should be involved in the process.

Refreezing

Controls

Controls should be established to ensure that change is occurring. The leaders should monitor the progress to identify what supports and barriers the change. E.g. one should schedule random checks to see if the lecturers/TAs use the new system or if they just stick to the old way which they are used to.

Additional training

As mentioned in the last stage, training and support should be provided. Everyone should be informed and supported at any time. This can include having tutorials available, each suitable for the given stakeholder.

Transformation Force Analysis

As with any change, there is always some resistance, and the success depends on persuading many groups and individuals to change the way they work. This is a transformation people will only accept if they can be persuaded to think differently about their jobs. In effect, leaders must alter the mind-sets of their employees and other stakeholders, which is no easy task¹⁰. According to Lewin's Force Field Analysis, the transformation includes two forces:

Restraining Forces

Restraining forces are forces that make change more difficult. These forces counteract driving forces and lead to the avoidance or resistance of change. We see these forces as some of the restraining forces for our IS change:

- Requires training
- Uncomfortable with frameworking current processes
- Fear
- Capital investment
- Time investment
- Disruption

Driving Forces

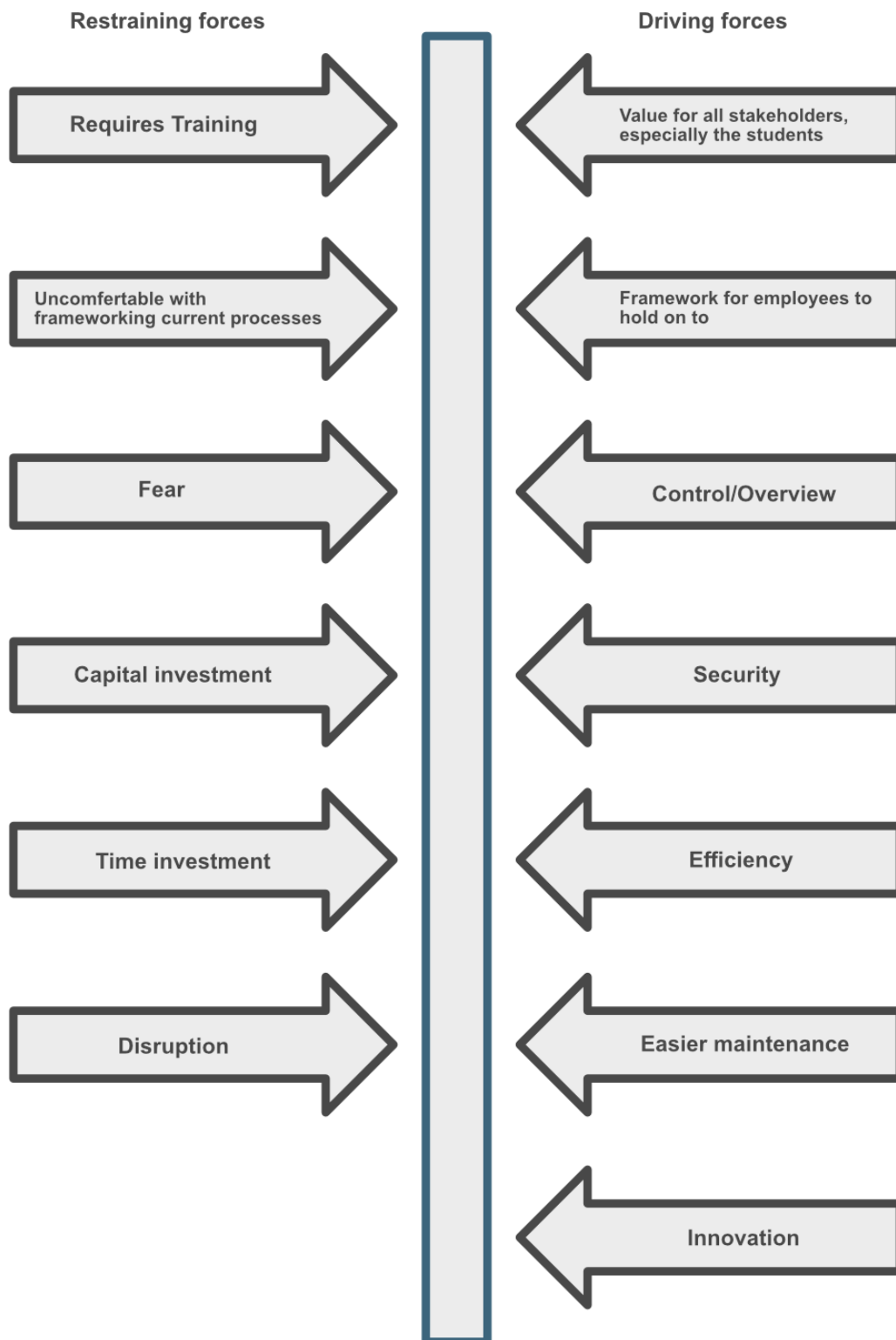
Driving forces are all forces that promote change. These change drivers promote and encourage the change process. We see these forces as some of the driving forces for our IS change:

- Value for all stakeholders, especially the students

¹⁰

<https://www.mckinsey.com/business-functions/organization/our-insights/the-psychology-of-change-management>

- Framework for employees to hold on to
- Control/Overview
- Security
- Efficiency
- Easier maintenance
- Innovation



Implementation risks

Additionally, to some of the risks pointed out in the Change Management Model and in the Transformation Force Analysis (restraining forces), there is also some implementation risks. The implementation risks are often caused by development and/or deployment failures.

For our change to the information system, there could med potential risks for:

- data inconsistencies that causes deployment to fail
- unstable code that causes the system to repeatedly crash
- information security vulnerabilities that lead to widespread security attacks.
- the change may be rolled back due to failing procedures to deploy the new system feature
- the system may seem to deploy successfully but will over time require troubleshooting to fix critical bugs