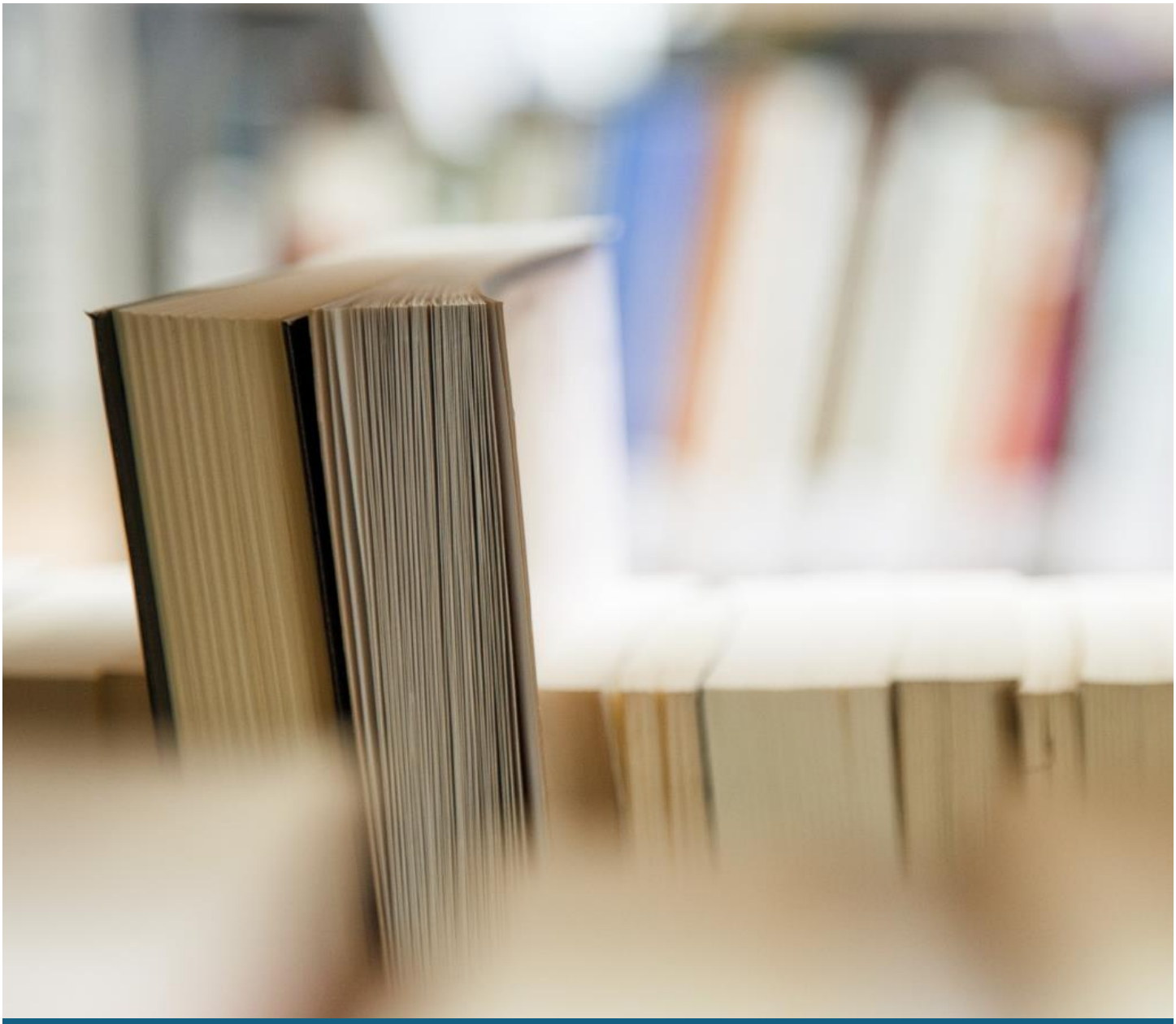


PBL portfolio

Program:

Group no.:

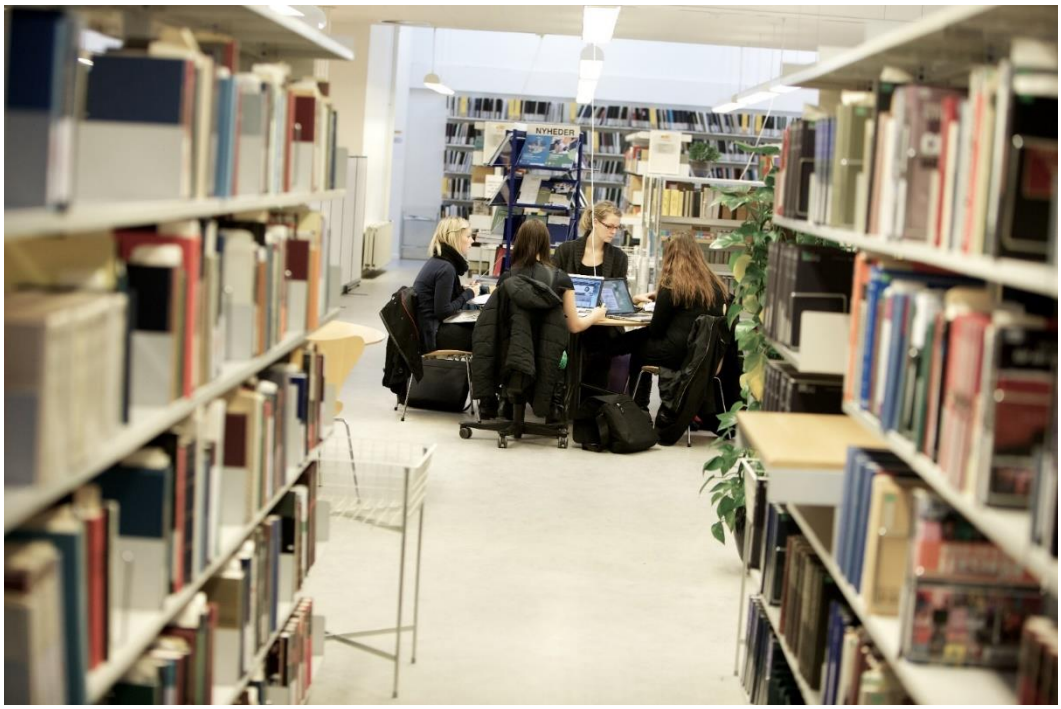
Members:

Contents

INTRODUCTION

The purpose of this document is for groups to document and reflect their learning and development of professional competences like collaboration, problem design, critical thinking and reflection, project management, and academic writing during the 1st semester B.Sc. at Aalborg University. This document is part of the 1st year course on Problem Based Learning (PBL). These competences are not only essential for your learning and growth throughout your education at Aalborg University (AAU) but also for your future professional life. The document comprises seven sections, which reflect the themes and work addressed in the PBL course. The PBL portfolio and learning documentation will take part in three sessions of the course: midterm evaluation 1 (end of September), midterm evaluation 2 (end of October) and final evaluation (middle of November). The PBL portfolio will also be used as point of departure for your assessment at end of the course, through an oral group examination.

[To complete by November 2024, with final evaluation workshop, with a PBL definition and synthesis of three most important lessons learned from this first semester and course]



1 COLLABORATION AND GROUP CONTRACT

*[Probing questions for the **mid-term evaluation 1**: i) What does the ideal and optimal student collaboration look like (make use of references and inputs from preparation material)? iii) What are the benefits of group work in a PBL environment; iii) What are the main challenges and benefits you expect to experience during your education at Aalborg University (AAU)? Etc.]*

Taking the literal definition of "collaboration" into a student environment, we know that student collaboration means that the different team members must share their findings, knowledge and information to accomplish a common goal. To achieve an optimal collaboration, then, it is necessary that each member in the team feels respected and important enough to contribute with their own research and previous knowledge on the topic discussed.

For the group, one of the main challenges through our entire education will probably be relying in other people/teammates. In an individualistic world where everyone seems to care for themselves and only themselves, the idea of letting others enter your "workflow" can be challenging at the beginning: specially, when it is the first time working in such a teamwork orientated program. However, the long-term benefits of this methodology will be reflected on our performance in the field, where different types of engineers (mechanical, electronics, chemical…) work together in the same project.

Overall, working in a PBL environment helps to personal development and improving our abilities while working together, which will be key in our later performance in the engineering field.

1.1 Purpose and development of the group contract

*[Probing questions for the **mid-term evaluation 1 deliverable**: How do the individual and group goals align? Which sections of the group contract do you consider the most important to agree upon and set up as rules when starting working in teams and why? How does the contract address disagreements?*

After having written down the individual goals of each group member (Appendix 1.1, point 2.1), we assessed them and extrapolated a few general points, which we applied as our group goals (Appendix 1.1, point 2.1). For instance, gaining expertise in the process of building an electronics prototype and documenting the process was one of our main common goals, as neither of us is too experienced in this field. Similarly, all of us are mostly strangers when it came to the concept of group work itself. This fact served as motivation for including the understanding of group mechanisms into the set of group goals as well. We believe that the fundamental agreement that allowed for our group to function in a healthy manner is the hierarchy, or lack thereof (Appendix 1.1, points 1.5 and 3.1). Additionally, agreeing on an agenda for each upcoming group meeting is imperative to the alignment of our goals, and the ability to work efficiently both individually and collectively. This flat hierarchy goes hand in hand with our approach to disagreements, or the resolution of conflicts. Since each opinion holds the same weight at the outset, choosing whichever we go forward with always comes down to a collective consensus (Appendix 1.1, points 2.4 and 2.5).

1.2 Implementation of the group contract

*[Probing questions for the **mid-term evaluation 1 deliverable:** Have you been using the group contract in the past month? If yes, what did you use and why? What did you not use, and why? Etc.]*

Since most of the guidelines in our group contract are based in “common sense”, we can affirm that most of the rules and agreements in it have been taken into consideration during our daily work, but without taking the content of it “literally”. For instance, communications (Appendix 1.1, point 2.1) between team members have been efficiently performed trough “WhatsApp” and “Teams”, respecting the function given to both these tools (daily communication and files storage/sharing point).

*[Probing questions for the **mid-term evaluation 2 deliverable:** Have you been using the group contract in the past month? If yes, what did you use and why? What did you not use, and why? Etc.]*

The use of the group contract has been the same as in the previous evaluation: it has been used in our daily work, since most of its content are common sense rules of behaviour shared by the team members, but without taking its content in a “strict” or “extremely literal” way. The different group members have respected the agreements stated in it and, as in the last review, the correct use of the communication methods has been one of the most important ones, leading to new strategies such as organizing the different tasks and documents on Teams in separated files for a better allocation of information.

*[Probing questions for the **final evaluation and to finalize PBL portfolio**: How have you been using the group contract until now? Etc.]*

The use of the group contract hasn’t changed much from the last revision: it has been a useful compass that points towards our group expectations and goals regarding the personal and professional dimensions of the project. It is not taken in a “strict” manner, but is serves as a good reminder of what we are striving for.

1.3 Evaluation and revision of the group contract

*[Probing questions for the **mid-term evaluation 1 deliverable**: How did the group contract help the group to collaborate until now? What did, and what did not, work with the group contract? Why? Which sections need to be revised, changed, or added, to the group contract and why? Have new collaboration challenges arisen in past month? If yes, which and why? Summarize the previous by making a matrix with stop, continue, and start. Add the revised to appendix 1.2]*

The group contract helped the group collaborate by defining roles and responsibilities, communication channels, and conflict resolution strategies. This allowed the group to stay on track and maintain a positive attitude toward each other. In Section 2 “Group Dynamics”, point 2.2 “motivation”, the group was having "a clear idea of our common goal" as at the beginning members of the group believed they figured out the common goal of the group, but later it was brought up at a meeting that the ideas of different group members varied believing that others in the group shared the same opinion. However, this miscommunication in the group was brought up and fixed at the following meeting, where group members were able to reevaluate the common goal that was set for the group project. The parts of the contract that has been working great for the group are Section 2 “Group Dynamics” point 2.1 “Communication” and Section 3 “Team Logistics” section 3.1 “Organization and Management of Day-to-day Work”. The group has kept a very good and open communication with each other, notifying their group members of any topics that must be addressed, change in scheduling and planning for future events. The group contract also works well with allocation of workload while keeping the group without a hierarchy. The allocation of group work based on expertise helps the group to work on the project more efficiently and helps stay on schedule. A section that needs to be added upon is Section 2 “Group Dynamics” point 2.1 “Communication” with the addition of an agenda of what has to be accomplished

by the group members previous to the group meeting, and then an agenda for what needs to be discussed and brought up at the group meeting, tutors meeting and at the supervisor meeting. (See appendix section 1.2)

Stop	Continue	Start
- Not asking others if there are doubts on the project's direction (or anything related to the project).	- Divide tasks between the members with more knowledge/interest on the topic. - Honest communication between teammates. - Keep a positive attitude towards the project.	- Before and after a meeting, establish an agenda for the topics to discuss on current and future meetings.

*Probing questions for the **mid-term evaluation 2 deliverable**: How did the group contract help the group to collaborate until now? What did, and what did not, work with the group contract? Why? Which sections need to be revised, changed, or added, to the group contract and why? Have new collaboration challenges arisen in past month? If yes, which and why? Summarize the previous by making a matrix with stop, continue, and start. Add the revised to appendix 1.3]*

The group contract played a similar role to how it did before the mid-term evaluation 1. It was a reminder for the group members of the expectations placed on them for the work they do together or individually, as well as helped the group dynamics by keeping everyone responsible for their actions, whether it was with lack of communication, time management or personal behaviour. The revision made last time to Section 2 "Group Dynamics", point 2.1 "Communication" with the planning of an agenda for the meetings was something that worked extremely well and was a very beneficial revision. There were no parts of the group contract that did not seem to work as intended, with all team members working together to uphold it. There is no need for revisions of the contract as the last revision made in mid-term evaluation 1 seemed to be the only thing that was missing from it, at least at the time being. The group did face a challenge with a deadline for a status seminar, with not being able to agree on an earlier time because of other commitments, yet this challenge was resolved when the group was able to gather together and be able to complete all the preparation necessary for the status seminar.

Stop	Continue	Start
- Last minute meetings.	- Agenda before and after meetings. - Keep collaborating with each other.	- For the future project exam, plan 1 or 2 meetings before to blend the different parts and practice together. - Set a time limit to finish the presentation slides.

*[Probing questions for the **final evaluation and to finalize PBL portfolio**: How did the group contract help the group to collaborate until now? What did, and what did not, work with the group contract? Why?*

Which sections need to be revised, changed, or added, to the group contract and why? Have new collaboration challenges arisen in past month? If yes, which and why? Summarize the previous by making a matrix with stop, continue, and start. Add the final version of the group contract in appendix 1.4]

Overall, the group contract has been a useful tool in the sense of putting in clear the limits and boundaries of the team, as well as the common goals and objectives of the different members.

As in previous evaluations, 2.1 "Communication" has been the most important disclosure on the contract, where a small revision should be added: in 2.5 "Conflicts Management", the group has agreed on the need of an external figure for conflicts that cannot be solved by the members themselves. We have never reached that stage in our internal conflicts, but it should be considered before reaching extreme situations that can harm both the project result and our relationship as teammates.

Regarding the Section 3 on "Team Logistics", while there have been some minor issues regarding group and supervisor meetings, the division of workload has been done correctly and the general workflow of the team has been consistent during time. A small revision would correspond to 3.5 "File sharing and storage", where it would be necessary the introduction of Overleaf as our main writing software for the report, as recommended by the supervisor.

The different changes can be seen in the final group contract (Appendix 1.4).

Stop	Continue	Start
- Forget meetings or not expressing. disagreement if a date is not suitable for any member.	- Trustful communication between teammates. - Distribute workload between members based on strengths. - Set timelines and limits for tasks.	- Use of external agent for difficult situations (problem management).

1.4 Future perspectives

*[Probing questions for the **final evaluation and to finalize PBL portfolio**: In overall, in which ways did the group contract help you developing your collaboration skills? What would you do differently, and why? In which ways can the group contract template be improved for future use? Regarding group collaboration, which aspects of group social dynamics could be worked on further? Etc.]*

The group contract helped with developing the groups collaboration skills by setting clear expectations for the members of the group. It kept everyone accounted to their expectations in both behaviour and work, helping the group work together by means of mandatory meetings and work sessions, causing the group to come out and spent more time working together as a team and not as much individually. The creation of the group contract was a great collaborative experience as all members had to work with each other to put a contract together, making sure everyone has input into the contract that the whole group can agree upon.

Introducing more social nights for group building dynamics to improve more on collaborative skills is something that the group should have been different, as there was a lack of team social nights towards the end of the semester.

Some way in which the group contract can be improved in by adding a section similar to section 1.2 “Group Members”. The inclusion of a supervisor section with the names of the supervisors and their contact information would have been a great addition to the contract template as it would have made contacting supervisors more convenient.

2 PROBLEM DESIGN 1: PROBLEM IDENTIFICATION

*[Probing question for the **mid-term evaluation 1 deliverable**: What is the group understanding of what a problem is and the role it plays in your learning (individually and as a group)? What is the group perceived challenges and expectations to formulate and solve a problem as part of your project work? Etc.]*

The group identifies and understands that a problem is usually the discrepancy that exists between a current situation (e.g., there is people in the world that doesn’t have access to drinking water) and what it should be (everyone should have access to drinkable water). As engineers, our main goal is changing what seems “impossible” to achieve at a first glance, by utilizing different tools (math, physics, chemistry,...) to change a currently problematic reality. In a more personal way, these problems can take many shapes: from a lack of knowledge that must be acquired in order to accomplish our tasks, to personality traits that should be improved to make our lives better (e.g., enhance our communication skills through project-oriented work, which can result beneficial in our future projects).

There are plenty issues to overcome during our first semester project. For instance, robots are not charged efficiently, docking systems use plates that get degraded over time, robots use too many sensors to operate, etc. Therefore, our group is motivated to learn more about said problem and research in the field. Our view on solving the problems we listed above could be summarized in finding a way to charge robots in an efficient way by, for example, using induction to avoid the plates degrading and save time, in order to have more work done by them and reduce the overall costs of autonomous robots in industrial environments.

2.1 Group process to identify problems

*[Probing questions for the **mid-term evaluation 1 deliverable**: Describe the problem area (i.e., topics, themes and subjects that work as point of departure to identify problems) and who/when it was proposed to the group. Outline the tools you used to map the problem area, and how they help the group to create an overview of the potential problems and of what is unknown. Describe the challenges and benefits in using these tools to create an overview and understanding of the problem area. List at least three initial problems. Add the tools in the appendix 2. Etc.]*

At the beginning, our group was interested on the workflow of an autonomous warehouse, where a brainstorming process with general ideas of the subject (Appendix 2.1) lead to several questions, such as how can robots and human coexist in the industrial field? How efficient could be a 100% robot warehouse? Is this being accomplished anywhere? Among others.

However, as the group research started, our interest changed towards the autonomy of the robots, being the main concern the charging station recognition and how to reduce the number of sensors by relying solely in a camera. To delimitate this idea, we used a 5W1H map (Appendix 2.2), which resulted difficult to fill at the beginning, but helped us identify the main questions our report should answer.

2.2 Decision making processes and choice of initial problem for further analysis

*[Probing questions for the **mid-term evaluation 1 deliverable**: State the initiating problem the group choose. Describe the processes that lead to the group decision, and the challenges the members encountered. Etc.]*

The problem that the group chose was "Docking system for autonomous robots", which was selected after a lot of research, discussion, debating and selecting. The problem was selected after choosing the field of the project to focus on "robot routing" as it was the more intriguing and a good challenge as it requires a diverse set of skills. From robot routing different problem topics were brough up and compared with each other assessing the seriousness of the problems and the skills that are required to solve them. The problem that the group faced was to do with needing to change the problem the report focused on as the previous problem of "improving the efficiency of robots in a warehouse setting" was too broad and covered too much in itself. The problem also did not fit the project requirements so it was instead changed to something that would require a balance of mechanical, electrical and software engineering.

3 PROBLEM DESIGN 2: PROBLEM ANALYSIS AND FORMULATION

3.1 Methodology to analyse the problem

*[Probing questions for the **mid-term evaluation 1 deliverable**: Add the protocols to search bibliographic information and to collect information from stakeholders to answer the questions for problem analysis to appendix 5.1 and 5.2 respectively. Describe the challenges encountered in establishing such protocols, including their scientific quality and appropriateness given the initial problem (e.g. feasibility, validity and reliability). Describe in which ways these protocols provided the group a better understanding of the existing gaps, leading to a final problem formulation and potential solutions…etc.]*

Protocols to search bibliographic: Identify problem/topic -> make a list with keywords -> make search strings -> use reliable databases -> extract relevant information -> analyse information -> fill knowledge gaps -> put down citations.

Protocols to collect information from stakeholders: Establish a meeting with group -> research stakeholders and set a meeting with them -> set goals for our meeting with stakeholders -> meet with stakeholders and present our ideas -> collect evidence for our problem -> have a meeting with group in order to select relevant evidence and make a priority list -> to fill in gaps we set a meeting with stakeholders, during the meeting we also share feedback from the first one -> when we're done with gathering and sorting evidence we will write a report.

Our group didn't have problems in establishing these protocols since we believe they are essential steps in order to have great results. These protocols helped us identify the different gaps in our knowledge and how we can fill them instead of becoming overwhelmed by the lack of information.

3.2 Final problem formulation

*[Probing questions for the **mid-term evaluation 1 deliverable:** Evaluate the final problem statement using the criteria provided by the book in the mandatory material, p. 51-52. Describe to what extent the problem could be better formulated based on your evaluation. What would you do differently in the problem analysis phase and why? Etc.]*

If we blend our final problem statement with the theory, we get the following regarding the problem formulation:

Challenging? Yes, because most of the current solutions depend on the mix of different sensors (infrareds, ultrasonic, LIDAR...). By using only one sensor, the camera, the level of error must be minimum to achieve the different tasks our robot must accomplish autonomously (such as following a path on the floor to move around or detect the QR while docking into the charging station.

Documented? Camera recognition isn't something new in the robotics field: we can even find many current solutions that use this method to accomplish the docking to the charging station. However, this has always been with help of other sensors, where our main difference with the competence would be reducing the sensors to the minimum required.

Clear and unambiguous? Yes, since it is a basic system: a small robot will follow the paths drawn on the floor to move around. When the battery of the robot is running out, it will drive itself to the charging station designated, using a QR as a reference to successfully dock.

One question? We manage different questions, which can be explored further or less depending specially on the time to work on the project (for example, "can we make a safe charging in the dock by using electromagnets?"). However, the main concern in our project ends always in the same direction: the relation robot-station, with the camera functioning as a bridge between them.

A basis for action? Yes, since it covers the main topic of our investigation and project idea in general.

Researchable? Yes, there is plenty information to cover up for this project. From battery types to different docking techniques, our research has been fruitful with all the information available.

Feasible in the time available? Yes, since we are mainly focusing on the camera recognition for docking, we think there is enough time to deliver a proper project. We also count with the help of our tutors, who have some background on the topic and can help us save time with their advice.

Ethically sound? Yes, since it doesn't compromise other peoples, animal and environment well-being. We are only improving an already existing reality, and the biggest impacts expected are an increase in productivity and efficiency, along with a cost reduction with "simpler" robots.

Interesting? Yes. For most of the group, it seems like an exciting challenge to accomplish.

Relevant to your studies? Absolutely, with different skills to learn or polish. Energy, electronics, robotics, design, programming, economics, etc.

Therefore, our problem formulation can be summarized in the following question: ***"How can reliable and efficient alignment between a robot and a charging station using computer vision be achieved?"***

3.3 Future perspectives

*[Probing questions for **the final evaluation and to finalize the PBL portfolio:** For future semesters, make recommendations on what to stop doing, start doing and continue doing concerning the problem design (i.e., identification, analysis and formulation). Etc.]*

With all the stages of problem identification, analysis, formulation etc. concluded, the group agrees on a general lack of direction in the beginning. This caused some confusion and stalling of project work. More specifically, we had issues with determining all aspects that our problem encompassed. Some members of the group had ideas for the prototype that others assumed were redundant, or irrelevant to the problem at hand, while some members were going in a different direction with the project overall. We determined that in the future, it is necessary to continuously check up on our sense of direction in order to make sure that our expectations are aligned within all group members. This will allow us to distribute the workload more efficiently and avoid any drawbacks.

4 PROJECT PLANNING AND MANAGEMENT

[*Probing questions for the **mid-term evaluation 2 deliverable**: What is the group definition of a project, and which elements are essential to manage for it to be successful? What are your project goals? Etc]*

For our group, the idea of different tasks that blend in order to accomplish a certain goal or bigger purpose would define a project. In an environment where limited resources and time are the biggest constraints during the collaboration, the different members must share their knowledge and expertise with a common objective in mind, while strengthening themselves and their peers in the process.

To achieve this, different elements challenges must be sorted: during the collaboration, for example, the lack of motivation in the group or the different conflicts that arise during the work can lead to complete failure. The project goals, a good planification and the recognition of the personal strengths and weaknesses of each member must be identified and shared to secure the project's success in time.

In our case, the academic goals for this project go from learning about microcontrollers and understand different electronic concepts, such as computer vision, to develop more technical abilities with electronic circuits and 3D printing. On the other hand, the members of this group look forward to learning from each other and develop a better understanding of teamwork-oriented work.

4.1 Project timeline and management

*[Probing questions for the **mid-term evaluation 2 deliverable**: Describe your project timeline (e.g., start, end, milestones and main deliverables) and the elements of SCRUM to manage the project. Add the project timeline and management tool (SCRUM) in the appendixes 4.1 and 4.2 respectively.]*

Our project, which consists of a robot able to recognise and align towards a docking station by using a camera, started on September 2nd and will consist of a report and a possible prototype to back our investigation. Being the end date for the report (December 20th) and an oral examination in the second half of January settled, it is important for the group to organise in the given period of time.

To accomplish that, the group liked the idea of the Excel template to delimitate the overall work in tasks, time to complete them, comments, responsible and status, because it's simple to follow and organizes the overall workload.

4.2 Implementation of the project timeline and management tools

*[Probing questions for the **mid-term evaluation 2 deliverable**: Explain how the project timeline and the SCRUM has been used by the group to monitor progress, and how frequently. Has the group been adjusting in the timeline and project SCRUM? If yes, why and how often? Etc.]*

In the group, we have taken each problem at a time: in other words, the organization has been more week-orientated, while keeping the important deadlines in mind to avoid last-minute work. Since there is also a minimum of one meeting per week and the communication uses to be continuous in the group, we keep track of the different aspects of the project and, therefore, manage to accomplish our weekly goals.

However, the use of an Excel template, such as the one submitted as deliverable (Appendix 4.1), would be helpful for the practical part of the project, the prototype, where it is important to have a good time organization and track of the advancements towards the project (each members contribution results fundamental for the others work). It could also result beneficial in December, when most team members won't be available at campus and communication can be more difficult.

In conclusion, even when the group hasn't relied much on said techniques, the use of an organization tool regarding the prototype planification and the rest of the report seems to be necessary to complete the work on time.

*[Probing questions for the **final evaluation and to finalize PBL portfolio**: revise the text from mid-term evaluation 2, namely, explain how the project timeline and the SCRUM have been used by the group to monitor progress, and how frequently. Has the group been adjusting in the timeline and project SCRUM? If yes, why and how often? Etc.]*

Our approach to time management and assignment of tasks has remained consistent since the mid-term evaluation 2. Considering the different skillsets of each group member, the workload is primarily distributed according to what task fits the abilities of each member. This allows us to be flexible, democratic, and to place the responsibility for each task into the hands of each respective group member.

Regarding the SCRUM framework, we mainly took advantage of the existing Excel file to refer to the tasks that had to be completed and the person in charge of completing it. As we found the existing method reliable, we didn't find ourselves having the need to transition to a different method. In the future however, we would like to implement this framework, as we will be able to create the time schedule from scratch.

4.3 Evaluation of the project timeline and management tools

*[Probing questions for the **mid-term evaluation 2 deliverable**: What worked well, and what did not work well with the timeline and SCRUM? Why did things work the way they did? What to change, adjust and why? Summarize proposing a matrix with items on the timeline and SCRUM to stop doing, continue doing and start doing. Revise the timeline and SCRUM based on the evaluation and add the revised version in appendix 4.3 and 4.4 respectively. Etc.]*

As mentioned before, the organization until know has been good despite the lack of a specific organization tool. The group considers that planning ahead is something beneficial in the long term but, since it is our first semester in the university and, particularly in AAU, the schedules are very flexible,

organizing in base of a future work that changes constantly in the present day can be troublesome and, even, stressful.

However, for the other half of semester and the rest of our studies, the use of organization tools like the Excel template can result beneficial to keep a good track of the project's tasks and their state. As support for a daily communication within the group members, planning tools can result beneficial to delimitate each member's work, have a better view of the different stages of the project and, in general, work in a more efficient and organised way.

A revised version of the Excel has also been provided with some updates related to the project's current stage (Appendix 4.1).

*[Probing questions for the **final evaluation** and to finalize PBL portfolio: Revise the above text from mid-term evaluation 2, namely, what worked well, and what did not work well with the timeline and SCRUM in the past month? Why did things work the way they did? What to change, adjust and why? Summarize proposing a matrix with items on the timeline and SCRUM to stop doing, continue doing and start doing. Revise the timeline and SCRUM based on the evaluation and add the revised versions in appendix 4.5. Etc.]*

After the second mid-term evaluation, the team considered a good idea to implement the Excel as a part of our work and organization. In general, the format stills the same, while changes have been made to adjust the old template with the latest updates in our project (Appendix 4.5).

In general, it has been beneficial by providing structure and order in the different tasks to accomplish. However, it would have been better to apply this method in an earlier stage of the project: something to keep in mind for future projects. The possible benefits of introducing some of the other SCRUM methods during the project planification has also been discussed.

Stop	Continue	Start
- Not using a SCRUM tool during the project planification.	- Using Excel to make lists with the different tasks, members responsible of each task and deadlines to keep in mind. - Use similar format in other contexts (e.g., budget list with components, price, retailer, comments,...)	- Investigate the other possible SCRUM alternatives provided in the workshop. - Add the latest changes in the project (new exam dates, changes in the project,...).

4.4 Future perspectives

*[Probing questions for **the final evaluation and to finalize PBL portfolio:** For future semesters, make recommendations on what to stop doing, start doing and continue doing concerning the project timeline and management].*

Stop	Continue	Start

- Managing tasks solely on a weekly basis without a more structured, long-term timeline.	- Using the Excel template for task tracking, as it has proven useful for monitoring individual responsibilities and overall project progress.	- Incorporating additional SCRUM principles, such as regular sprint planning and review meetings. - Creating a shared digital calendar for deadlines, meetings and to express unavailability of group members.

5 STRENGTHENING TEAMWORK: CONFLICT MANAGEMENT AND WORK ENVIRONMENT

[*Probing questions for the **mid-term evaluation 2 deliverable**: What is the group definition of conflicts? What are the typical disagreements in the group? How frequent it is and how do they impact on group working environment?*]

The definition that the group agreed on for conflicts is any challenge, disagreement or difference of interest/perspective within the group regarding any education or personal matters. Conflicts lead to tension between the group members interfering with the work of the group and usually leading into new conflicts arising.

The typical disagreements between the group are very minor and usually based around time management, with group not always being able to agree upon a time for meetings and deadlines, yet these problems are always able to be resolved without causing major disturbances within the group. These disagreements are not too common within the group, usually arising once every two weeks, but once again they have a quick resolution and the impact on the group is that there is a time waste in taking time to decide the schedule for the meeting.

5.1 Tools to manage conflicts and improve group work environment

[*Probing questions for the **mid-term evaluation 2 deliverable**: Describe the strategies, or tools the group devise to manage conflicts and improve its work environment. Add the tools in appendix 5.1 and 5. 2. Etc.]*

There were no great conflicts within the group that required major strategies or tools for the resolution of problems, with continues good communication within the group being more than sufficient for problems. Any problems that were not able to be settled over communication using electronic devices, with most of communication happening over WhatsApp, were turned into in person group meetings with all members as face-to-face discussion promoted more openness and encouraged all members to speak more leading to faster resolutions. Tools that were used to improve group environment were things such as setting up social nights where the team would gather and play games and socialize to promote team building.

5.2 Implementation of conflict management tools

*[Probing questions for the **mid-term evaluation 2 deliverable**: Explain how the tool(s) has been used by the group to manage conflicts, and how frequently. Has the group been adjusting in the tool (s)? If yes, why and how often? Etc.]*

Good communication between the group was always the first tool used to manage any conflicts that have arisen. This tool was always used for conflict management whether it was through text or call through WhatsApp or by talking in person. There were no other tools which required to be used to resolve group conflicts as the group was more than capable of solving their issues without any external help or without setting for more unconventional methods as the communication method worked perfectly, so if it is not broken, better to don't fix it.

*[Probing questions for the **final evaluation and to finalize PBL portfolio**: Revise the text from the mid-term evaluation 2, namely, explain how the tool(s) have been used by the group to manage conflicts, and how frequently. Has the group been adjusting in the tool (s)? If yes, why and how often? Etc.]*

The group's primary tool for managing conflicts has been consistent communication, both through WhatsApp for quick resolutions and in-person meetings when needed for more thorough discussions. Conflicts have generally been minor, often related to scheduling, and have been quickly addressed through open and respectful dialogue. This approach has effectively minimized disruptions.

Given that these methods have worked well, the group has not needed to adjust or add new tools. Instead, we rely on the already existing communication practices, which have proven sufficient for maintaining productivity within the team.

5.3 Implementation of tools to improve group work environment

*[Probing questions for the **mid-term evaluation 2 deliverable**: Explain how the tool(s) have been used by the group to manage conflicts, and how frequently. Has the group been adjusting in the tool (s)? If yes, why and how often? Etc.]*

Setting up group social nights to improve group environment was a good idea for team building as it helped the group understand each other characters. The social night was currently a one-time thing due to time constrains, so it is not frequent occurrence, yet there are plans to do these nights again as all members really enjoyed the gathering and built a better group environment with each other.

*[Probing questions for the **final evaluation and to finalize PBL portfolio**: Revise the text from the mid-term evaluation 2, namely, explain how the tool(s) have been used by the group to manage conflicts, and how frequently. Has the group been adjusting in the tool(s)? If yes, why and how often? Etc.]*

Adjustments to the conflict management tools have been minimal. We have found that the existing methods meet our needs effectively, so no additional tools or major changes have been necessary. Unfortunately, no further social nights have been organized due to time constrains and the focus of each group member on their own social circles. However, we have been dedicating portions of our group meetings to discuss informal matters.

5.4 Evaluation of tools to manage conflicts and improve group work environment

*[Probing questions for the **mid-term evaluation 2 deliverable**: What worked well, and what did not work well when using the tools? Why things worked the way they did? What is needed to change, adjust and why? Summarize proposing a matrix with items of the tools and correspond "stop doing, continue doing and start doing". Revise, if needed, the strategy to manage conflicts and add the revised version in appendix 5.3 and 5.4. Etc.]3*

The communication both in person and over social media between the group when managing conflicts worked well for the group that in fact no other tools had to be used to deal with conflicts. With tools that were used to improve group work environment which includes setting up social nights, there has been great success in team building and improvement of environment. It has worked so well in fact that the group has been discussing of setting up another group night to improve the attitude of the team. The only change that the group could come up with is once again more implementation of group social nights.

*[Probing questions for **the final evaluation and to finalize PBL portfolio:** revise the text from the mid-term evaluation 2, namely, what worked well, and what did not work well when using the tools? Why things worked the way they did? What is needed to change, adjust and why? Summarize proposing a matrix with items of the tools and correspond "stop doing, continue doing and start doing". Revise the strategy to manage conflicts and add the revised version in appendix 5.5. Etc.]*

In the mid-term evaluation, we found the Excel template effective for tracking tasks and distributing accountability, as it allowed us to clearly monitor each other's contributions. Our weekly meetings and open communication further helped keep everyone aligned. However, relying primarily on week-to-week planning created challenges, especially near deadlines, as tasks occasionally became rushed without a structured long-term timeline. The simplicity of the Excel tool made it easy for us to use, but the absence of clear milestones limited our overall project visibility. To improve, we are considering implementing a comprehensive project timeline with key milestones and incorporating SCRUM-style sprints to create more regular checkpoints, allowing for better scheduling and reduced last-minute pressures (matrix summarizing this reflection on the next point, 5.5).

5.5 Future perspectives

*[Probing questions for **the final evaluation and to finalize PBL portfolio:** For future semesters, make recommendations on what to stop doing, start doing and continue doing concerning conflict management and improvement of group environment.]*

Stop	Continue	Start
- Relying on last-minute scheduling. This can lead to last-minute changes that interfere with individual plans. This is important as there are several courses alongside the project that all students must invest time in.	- Communicating openly, with honesty, and respect.	- Implementing a structured agenda for all group meetings. - Considering a periodical check-in to address any potential emerging conflicts before they boil over.

6 STRENGTHENING TEAMWORK: SHARING AND DOCUMENTING KNOWLEDGE

[*Probing questions for the **mid-term evaluation 2 deliverable**: How has the group sharing knowledge been so far (e.g., co-writing, sharing the collected information, etc.)? What has been working so far? What could be improved? How does the group use AI in the project work? Did the group discuss and agree on how to use it and when and why to use it? If yes, what are the agreements made? If not, why not and could it be relevant?*]

Our group has decided on a variety of ways to share knowledge. We co-write our Report and assignments. We have a group chat on WhatsApp where we share links of information we have obtained on our own time, as well as a Microsoft Teams group for the same purpose. Of course, knowledge is also shared verbally at our group meetings. These methods seem to be working quite well for us, so as of now we will stick to our current methods of sharing knowledge amongst the group. Overleaf is our program of choice for cowriting. As a group, we have decided to not allow AI to do all our work for us, rather to use it as in instrument to support our knowledge. After much deliberation, as we all had various opinions on the use of AI, we landed on the idea that AI is a tool for guidance, but certainly not a source to just trust blindly for all our writing.

6.1 Academic (co)writing and peer-review

[*Probing questions for the **mid-term evaluation 2 deliverable**: (academic writing and peer review) Describe the strategies, or tools the group devise to manage conflicts and improve its work environment. Add the tools in appendix 6.1. Etc.]*

Our strategies, and entire group, are all built on respect. We operate with the mutual trust that we are all in this together, and that we all wish for success for the group. When it comes to co-writing and peer-review, we follow this same guidance. A similar strategy to our conflict resolution, we decided it would be best that any issues with a member's writing or ideas would be discussed amongst the team, with a conclusion of what the majority believes is best for the overall project. If we have any issues with a part of the report, we can bring it up at a group meeting, so we can discuss it. Peer review is not meant to be malicious, so we work with the understanding that it is okay to provide constructive feedback. We have not come across any major issues regarding peer reviewing each other.

6.2 Implementation of tools for (co)academic writing and peer-review

*[Probing questions for the **mid-term evaluation 2 deliverable**: Explain how the tool(s) have been used by the group. Has the group been adjusting the tool. If yes, why and how often? Etc.]*

Our tools for successful co-writing are used all the time. Any time we work on the report together in a group meeting, we address any issues we have with any of the sections. We peer review each other, because we all want to have the best report we possibly can. The tool has not been adjusted much at all because we have not faced any major disagreements while writing. We all continue to operate based on respect.

*[Probing questions for the **final evaluation and to finalize PBL portfolio**: Revise the text from the mid-term evaluation 2, namely, explain how the tool(s) have been used by the group. Has the group been adjusting the tool. If yes, why and how often? Etc.]*

Until now, the group has kept using the same tools towards (co)-academic writing and peer-review. Namely, Overleaf to write the report of the project, and the different tools from Office360 (Word, PowerPoint, Excel, Teams, ...) for other purposes, such as using a Word document to gather different research links and summarize their content and relevance for the other members or using Teams to set meetings, agenda and goals for the week, etc. Even though Overleaf was relatively new for most of us, we quickly got into the dynamics of the software and, with tons of trial and error, tutorials research and tips exchange between the members, the learning curve has improved exponentially. For example, after one of the members discovered a sequence to add comments, other members have made use of said command to leave their thoughts and suggestions through the different chapters of the report. As in the previous evaluation, respect is held in all interactions, something that facilitates the improvement of the different chapters and general workflow of the team.

6.3 Evaluation of tools for (co)academic writing and peer-review

*[Probing questions for the **mid-term evaluation 2 deliverable**: What worked well, and what did not work well when using the tools? Why things worked the way they did? What is needed to change, adjust and why? Summarize proposing a matrix with items of the tools and correspondent "stop doing, continue doing and start doing". Revise the tools to adjust to group needs and add the revised version in appendix 6.4 Etc.]*

So far throughout writing together, whether it be our project report or PBL assignments, our tool of respect has worked quite well. We continue to respectfully discuss any disagreements we may have regarding the direction of our writing, and we provide constructive feedback for each other. This is the only tool we use, so we can surely say that we will continue to use it. If we come across a situation where the disagreement is too big to just vote on, then that will require adjustment to our techniques, but that is a case-by-case issue.

Stop	Continue	Start
- Relying solely on informal votes for major disagreements.	- Respectful discussions and constructive feedback.	- Using structured conflict resolution techniques when needed.

*[Probing questions for the **final evaluation and to finalize PBL portfolio**: Revise the text from the mid-term evaluation 2, namely, what worked well, and what did not work well when using the tools? Why things worked the way they did? What is needed to change, adjust and why? Summarize proposing a matrix with items of the tools and correspondent "stop doing, continue doing and start doing". Revise the tools to adjust to group needs and add the revised version in appendix 6.4 Etc.]*

As with other chapters of this portfolio, we evaluated that not enough time has passed, and not enough work has been done on the project to significantly affect our opinion on this matter. In any case, in our co-writing and peer-review process, respect and open communication have worked well as our primary tools. Respectful discussions have allowed us to navigate disagreements productively, and constructive feedback has been effective for refining our writing. This approach has ensured that we

maintain a good team dynamic and produce high-quality work. Moving forward however, we recognize the need to establish a clearer process for handling any significant disagreements which may come up.

6.4 Code of conduct to use AI in project work

*[Probing questions for the **mid-term evaluation 2 deliverable**: Describe the process to develop a code of conduct for the use of AI in the project work (incl. agreements/disagreements, quality control, etc. Add the code of conduct in appendix 6.3.]*

In general, there were no major disagreements while creating a code of conduct for the application of AI. All group members agreed that the body of our work, including the structure and content of our report, and the rest of our course work such as PBL deliverables, should be written by us. This is advisable for both ethical and practical reasons. As the final project exam is structured to motivate all group members to be part of a creative discussion about the report and prototype, all group members should have a good grasp of all the concepts utilized in the project. It is therefore undesirable to let AI do the work for us.

On the other hand, as stated in the code of conduct, we acknowledge the potential of AI tools as proofreading tools or instruments for explaining concepts and topics that can be difficult to comprehend to some. This is possible because of the flexibility of chatbots and their ability to be moulded according to one's preference. For example, most professors or experts have a specific, personal way of describing concepts. In contrast, chatbots can be asked to explain topics in a myriad of ways, using different metaphors, and analogies, all while delving as deep or surface-level into the subject as the "prompter" finds useful.

6.5 Future perspectives

*[Probing questions for **the final evaluation and to finalize PBL portfolio**: For future semesters, make recommendations on what to stop doing, start doing and continue doing concerning academic (co)writing and peer-review, and the use of generative AI in project work]*

The use of AI in generation of ideas and templates is something that should be continued to be used as it provides a good starting point when starting a new task or project. The AI should however be used only for idea generation and not for completion of the needed work. The use of proper peer reviewed sources is something that must be continued to be done as it provided more honest sources for the projects and the group work being completed. Something that should be started doing is cross checking the peer reviewed sources to see if there is any bias in the report or to see other perspectives on the same question.

Stop	Continue	Start
- Relying solely on informal votes for major disagreements.	- Maintain respectful and constructive criticism. - Use AI in a responsible way.	- Cross checking peer reviewed sources.

7 ENGINEERING IN BROADER CONTEXT

*[Probing questions for **the final evaluation and to finalize PBL portfolio:** What are the group perspectives the group has about the societal role of engineers? What are the group thoughts about what the professional engineer ethical norms should look like? What are the group perspectives on engineering contributions in solving sustainable development problems?]*

In this group, we perceive engineers as important agents for human progress, being the ones responsible to solve (almost) all the issues that trouble the different angles and shapes of human society. From solving biological and chemical issues to building efficient robots and machines or strong bridges and skyscrapers, engineering is a broad discipline that affects notoriously our daily life. Therefore, engineers have a big power in their hands, which should be used for a better purpose and never for unethical practices against human rights.

Being a broad discipline, each engineering field should have their own ethical rules and codes to follow. However, common rules or principles we highlight from an engineer are creativity yet critical thinking to solve problems from different perspectives while pursuing the most efficient ones, cooperation and respect towards coworkers, superiors and employees, honesty and transparency in their projects and intentions with them and awareness of social problematics, looking forward to addressing them and, overall, improve our lives.

As said before, engineers must be ready to solve the different problematics surrounding us: from social inequalities to environmental issues, engineers have the tools in their hands to create and develop possible solutions for these. However, engineers must also find the most efficient and cost/time effective ways to address problems, a trait that makes them perfect for solving sustainable development problems.

7.1 The engineering student (professional) code of ethics

*[Probing questions for **the final evaluation and to finalize PBL portfolio**: Summarize the main points of your "the engineering student (professional) code of ethics." Discuss how these points can be transferred to and practiced in your project work at AAU. Add the full code of ethics in appendix 7.1]*

The content of the first chapter, regarding the ethical code for electronics engineers, is divided in several responsibilities and guidelines all electronic engineers should follow: the relations with the state, cooperating with it and providing their services to the best causes; with the public, aiming for using their abilities to ensure the security and wealth of the people around them; their behaviour in the workplace, with clients and as employees or employers; their behaviour towards other engineers, striving for collaboration to build a better place; and, finally, their responsibilities with the profession, keeping their knowledge updated and ensuring an efficient and cooperative ambience.

"Honesty, justice and courtesy" are some characteristics highlighted at the top of the document which, in our point of view, are fundamental for an electronics engineer: aiming for equality and better conditions for everyone with hard, honest and respectful work towards society and nature. The lack of a moral code in relation to generative Artificial Intelligence should also be mentioned. However, it could be complemented with our code of conduct from Workshop 6, where an engineer should use this tool in a thoughtful way, without compromising their own originality in the work.

In general, we find that this code of ethics coincides with our project. At the end of the day, autonomous robotics are trying to rid us of the burden of repetitive manual labour, which generally contributes

towards the mental and physical well-being of those affected in a negative way. During our 5W1H analysis, we gathered information on stakeholders affected by our project. All in all, we concluded that the entities affected by the problem we're trying to solve would benefit greatly from our solution, which again corresponds to a positive effect on society.

7.2 Contributions to sustainable development goals

*[Probing questions for **the final evaluation and to finalize PBL portfolio**: Summarize in which ways your project addresses the SDGs, and how it could contribute even more. Add your project impact assessment in appendix 7.2]*

Out of the 17 SDG's (*Sustainable Development Goals)*, our project would be able to contribute to the following 5 goals:

3 – Good Health and Well-being: from hospitals to nursing homes, the use of completely automated, non-stop working robots would be beneficial for the different healthcare services. Doctors and nurses would be focused on the most focus demanding tasks, while the robots would be doing the most time consuming yet repetitive tasks (e.g., deliver the different meals for the patients), making hospital environments a bit less stressful. Focusing on a warehouse-like environment, these robots could also be used in pharmacies to allocate the different medicines and distribute them in a 24h service.

5 – Gender equality: in a general perspective of the project, we are a mixed group of man and woman who treat each other with respect and work alongside with the purpose of accomplishing a common goal. No matter the gender, each opinion is taken into consideration, and everyone has the chance to contribute in their own way. Now, regarding the prototype, robots would treat everyone as they are: humans who deserve respect, no matter their gender, race, religion, sexuality, ethnicity, etc.

8 – Decent work and economic growth: as every industrial invention, robots will have their pros and cons: some repetitive jobs will disappear, while other more demanding jobs will be created. Overall, the increase in efficiency and productivity by implementing robots in industries would lead to higher benefits and profits for industries, that will result beneficial for the global economy. At the end of the day, robots would be designed to rid humans from tedious and/or dangerous tasks that could compromise their integrity.

9 – Industry, innovation and infrastructure: the main target of this project are industrial environments where the implementation of robots would contribute to better results in terms of efficiency and productivity: with non-stop workers, higher results would be achieved. This could lead to new industrial environments and infrastructures, designed specifically for robots' operations, and mixed robot-human workplaces.

12 – Responsible consumption and production: obviously, robots would be designed to reduce errors and energy consumption to the bare minimum. With constant autonomous robots and the proper systems and mechanisms, it would result easier to simulate and plan the production of different products with a more exact approximation of products produced per day, leaving space to improve the consumption and use of resources.

CONCLUSION

[*Probing questions to **finalize the PBL portfolio***: Define problem-based learning. Describe the most important lesson you got from course and explain why. How do you describe your learning progress/ curve throughout this semester in this course?

Which recommendations can you make to colleagues who might come to study at AAU? What aspects of studying at AAU will you pay special attention to in the coming semester and why? What advice can you give the course lecturers to improve the course? Etc.]

Problem Based Learning (or PBL) is a methodology which involves the collaboration of different individuals to solve a discrepancy between a real-world situation and how it should be in order to move forward. Through this journey that will represent the project, different conflicts and uncertainty may arise but, with proper planification, communication and, in general, collaboration, the different members of a team are able to identify and understand the different angles of a problem and organize themselves to study and research possible approaches, while learning and improving the different abilities required to solve said problematic.

The most important lesson taught while participating in a PBL programme is to rely on others, which can be difficult sometimes. Each of the group members have different personalities, work approaches, strengths and weaknesses, but it's precisely that what makes things more interesting: you can develop abilities with help of your teammates, learn how to do things in a different way that you would usually do and develop interpersonal skills which, in the real world, are as important as the grades and academic knowledge received from university.

The learning of the group grew exponentially with each new workshop: from understanding the terminology to explore the more practical parts of PBL approach, there was time enough to learn and reflect around the different elements to, then, apply them in our specific cases which, from our perspective, results much better than study the theory without having the possibility to see its correlation with our project.

Some great advice to a person interested in studying in an AAU programme, would be to not be afraid of interacting with other people, since they will be your partners throughout the education process and can understand you better than anyone else, as they are also sharing the unique AAU experience with you. This social aspect will also be translated into the courses, where it is important to be open for other opinions, ideas and suggestions.

In relation with this, tell them that everything can feel a “little strange” at the beginning, but that is completely normal as everyone needs time to adjust to a new atmosphere. With time and dedication, things will start matching with each other and make sense in the end. Coming with good disposition and interest to learn and become better in company of others should be enough to fuel this whole journey!

Next semester, most of us will try to improve our teamwork approach based on what we have learnt through this first semester and in the PBL lessons: from adding other SCRUM techniques in the workflow to improve our peer-review, there are still plenty of elements to master if we want to be effective engineers. Working on our writing and referencing skills should also be considered to make better reports, while the development of a good and functioning prototype will also gain more importance than in the first semester.

Lastly, regarding the course, the idea of having practical activities and online material to prepare beforehand for them has been very good, as it lets students come into a lecture with already some knowledge on what will be discussed. There was time enough to prepare and to do the tasks assigned, which is highly appreciated. An exception being the stakeholder's lesson, which was a strange and confusing for our group and the groups around us. The introduction of the research techniques also felt like it was discussed in a relatively “late” stage of the course. With the rest of the classes felt appropriated and useful for our studies. From the lecturers, we wanted to highlight their disposition to help and guide us during the whole course: something more than appreciated from the members of this team!

REFERENCES

- Holgaard, J.E., Ryberg, T., Stegeager, N., Stentoft, D. and Thomassen, A.O. (). ”An Introduction to Problem-Based Learning in Higher Education” (1. edition 2021), Samfundsliterattur.

APPENDIX 1. GROUP CONTRACT

Appendix 1.1. Group contract from workshop 1

Group Contract

This Group Contract consists of three sections:

1. *The group – Information on each member, incl. perceived strengths, weaknesses and ambitions.*
2. *Group dynamics – Roles in the group and how they will function. (incl. communication, motivation and group cohesion, management of conflicts, etc.).*
3. *Team logistics – Organization and management of day-to-day work, such as schedule meetings, contact with supervisor and others, file storage, etc.).*

Section 1. The Group

1.1. GROUP INFORMATION

Group no.:	2
Group email:	dpilec24@student.aau.dk

1.2. GROUP MEMBERS

(probing question: List the members of the group and emails)

Name	Student email
Casiana Alexia Stanciu	cstanc24@student.aau.dk
Daniel Ignacio Osorio	dosori24@student.aau.dk
Emma Kaitlin Wulff Harcrow	eharcr24@student.aau.dk
Arseny Shiman	ashima24@student.aau.dk
David Pilecek	dpilec24@student.aau.dk

1.2. INDIVIDUAL AND GROUP GOALS

(probing questions: What individual and group goals does the group want to achieve (e.g., grades, skill development, personal goals etc.). What are your individual learning goals for teamwork?)

Individual goals: D.O.: Achieve a better understanding of electronics D.P.: Readjust to a higher group work oriented workload C.S.: Become a better writer E.H.: Learn and develop skills and knowledge A.S.: Get a feel for engineering
Group goals: Master the report. Get a basic understanding of the prototype building process. Understand the basic mechanisms of group work. Get along with each other, become a better team.

1.3. STRENGTHS AND WEAKNESSES

(Probing questions: What are the individual strengths and weaknesses of each member? For example, one team member may have excellent drawing or drafting skills while another team member may have excellent writing skills. What could you do to overcome team member weaknesses? What can you do to enhance the skills of each team member? Etc.).

Strengths: Honesty, respect, willingness to compromise, time management, organization, willingness to contribute
Weaknesses: Lack of communication and teamwork experience, not a ton of progress

1.4. QUALITY AND SUCCESS STANDARDS

(Probing questions: what does success and quality look like for the group? How is success and quality measured and verified by the group? Etc.)

Consistency, communication and compromise. Measured by continuous group evaluation and comparison of set goals with achieved results.

1.5. ROLES

(Probing question: what roles do you anticipate the group to need to function? What is expected from the roles (e.g., tasks, or outcomes)? What are all the members responsibilities in contributing for the successful implementation the roles? Etc.)

Everyone does their fair share of work. Contribution of each member has the same weight. There is no hierarchy of ideas. Each member is responsible for the final result, for their actions and punctuality.

Section 2. Group Dynamics

2.1. COMMUNICATION

(Probing questions: How will your team stay in touch outside of meetings? How will you keep track of the work being done? How will you share knowledge you acquire individually? How will you compromise of different learning and communication styles? Etc.)

WhatsApp for urgent info and scheduling, MS Teams for file sharing

2.2. MOTIVATION

(Probing questions: The motivation is not going to be a straight line during the length of project. And members can experience lack of motivation and frustration in the different moments of the project. How can the group have identified when the levels of motivation and commitment are decreasing? What strategies could be used to help the group to boost its members motivation? Etc.)

Pushing each other to do better and stay consistent regardless of motivation. Having a clear idea of our common goal. Dedication above motivation.

2.3. GROUP COHESION AND TRUST

(Probing questions: There will be moments when one, or more members will feel vulnerable, will doubt him/ herself, or be stressed. This will affect not the specific members for also the cohesion and performance of the team. Outline some ideas on who and how members can approach to address such situations (i.e., calling in student advisor).

Respecting everyone's human needs and their feelings. Talking through problems and not bottling up our worries.

2.4. DECISION MAKING, CONSENSUS AND RISKS

(Probing questions: How will your team make key decisions? How will you manage so every member is included in process? Will you have a formal procedure? What are the risks of poor decision processes and long discussions to reach consensus? How will the group monitor and minimize such risks? Etc.)

We make all important decisions with all members present. In case a member is not present, we ask for their opinion and consent before going forward with the decision.

2.5. MANAGEMENT OF CONFLICTS

(Probing questions: How will you reduce conflict in your team? How will you resolve any conflicts that arise? To what will you agree so the conflicts can be avoided?)

Survival of the fittest. The better idea perseveres.

Section 3. Team Logistics

3.1. ORGANIZATION AND MANAGEMENT OF DAY-TO-DAY WORK

(Probing questions: Will the group assign a group 'leader', or organizer? Will the role rotate? What is expected from this role? How will the group members duties towards the organizer, and the fulfillment of the rules established? What would be the consequences of not complying with rules and expectations? Etc.)

There is no hierarchy when it comes to making decisions. We all try to contribute equally. We discuss tasks together and allocate them to the person with the most expertise/enthusiasm in the field.

3.2. MEETINGS (TIME, LOCATION, AND LENGTH)

(Probing questions: Who will chair team meetings and what is expected from it? Will the role rotate? How will you organize the meetings daily (e.g., agenda, scheduling, summarizes and minutes, etc.)? How will you organize the meetings with the supervisors, or other staff members (e.g., agenda, scheduling, summarizes and minutes, etc.)? How will you keep track of the outcomes of the meetings? Etc.).

Always to be determined by group members beforehand, usually at the end of a group meeting. If running late, inform other members.

3.3. SUPERVISOR MEETING TIME AND LOCATION

(Probing questions: Who will chair team meetings and what is expected from it? Will the role rotate? How will you organize the meetings with the supervisors, or other staff members (e.g., agenda, scheduling, summarizes and minutes, etc.)? How will you keep track of the outcomes of the meetings? Etc.).

We all meet with the supervisor once we feel we are prepared to share the results he expects from us.

3.4. SUPERVISOR EXPECTATIONS

(Probing questions: What are the mutual expectations between your team and your supervisor?)

We will have questions and issues prepared before meeting with supervisor. We expect advice on basic issues related to report or direction of out project. Supervisor expects responsibility, diligence and respect of his time schedule.

3.5. FILE SHARING AND STORAGE

(Probing questions: How will the group record project drafts, facts, conclusions, data, etc. as they occur along the project work? What platforms and formats will the group use to keep a record? Who and how will manage it? Will you have a template for various documents and who will create this? How will you name files to ensure versions, numbers and team members inputs are recorded? Etc.)

All members may upload files and contribute to them on MS Teams.

Date and Signatures

10. 9. 2024

Casiana Alexia Stanciu

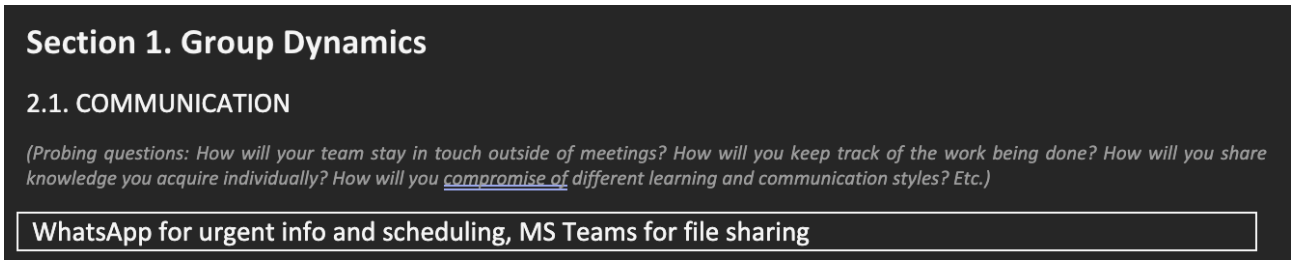
Daniel Ignacio Osorio

Emma Kaitlin Wulff Harcrow

Arseny Shiman

David Pilecek

Appendix 1.2. Revised group contract (mid-term evaluation 1)



+ An agenda will be made before each meeting with tasks that are to be completed by the group and its members before the next meeting.

+An agenda will be made before each group, tutors and supervisor meeting with what needs to be addressed and brought up during the meeting (questions, comments, concerns).

Appendix 1.3 Revised group contract (mid-term evaluation 2)

(No major changes to be mentioned)

Appendix 1.4 Final group contract

Group Contract

This Group Contract consists of three sections:

1. *The group – Information on each member, incl. perceived strengths, weaknesses and ambitions.*
2. *Group dynamics – Roles in the group and how they will function. (incl. communication, motivation and group cohesion, management of conflicts, etc.).*
3. *Team logistics – Organization and management of day-to-day work, such as schedule meetings, contact with supervisor and others, file storage, etc.).*

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(probing question: List the members of the group and emails)

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Emma Kaitlin Wulff Harcrow	eharcr24@student.aau.dk
Arseny Shiman	ashima24@student.aau.dk
David Pilecek	dpilec24@student.aau.dk

1.2. INDIVIDUAL AND GROUP GOALS

(probing questions: What individual and group goals does the group want to achieve (e.g., grades, skill development, personal goals etc.). What are your individual learning goals for teamwork?)

Individual goals:

D.O.: Achieve a better understanding of electronics

D.P.: Readjust to a higher group work oriented workload

C.S.: Become a better writer

E.H.: Learn and develop skills and knowledge

A.S.: Get a feel for engineering

Group goals:

Master the report. Get a basic understanding of the prototype building process. Understand the basic mechanisms of group work. Get along with each other, become a better team.

1.3. STRENGTHS AND WEAKNESSES

(Probing questions: What are the individual strengths and weaknesses of each member? For example, one team member may have excellent drawing or drafting skills while another team member may have excellent writing skills. What could you do to overcome team member weaknesses? What can you do to enhance the skills of each team member? Etc.).

Strengths: Honesty, respect, willingness to compromise, time management, organization, willingness to contribute

Weaknesses: Lack of communication and teamwork experience, not a ton of progress

1.4. QUALITY AND SUCCESS STANDARDS

(Probing questions: what does success and quality look like for the group? How is success and quality measured and verified by the group? Etc.)

Consistency, communication and compromise. Measured by continuous group evaluation and comparison of set goals with achieved results.

1.5. ROLES

(Probing question: what roles do you anticipate the group to need to function? What is expected from the roles (e.g., tasks, or outcomes)? What are all the members responsibilities in contributing for the successful implementation the roles? Etc.)

Everyone does their fair share of work. Contribution of each member has the same weight. There is no hierarchy of ideas. Each member is responsible for the final result, for their actions and punctuality.

Section 2. Group Dynamics

2.1. COMMUNICATION

(Probing questions: How will your team stay in touch outside of meetings? How will you keep track of the work being done? How will you share knowledge you acquire individually? How will you compromise of different learning and communication styles? Etc.)

WhatsApp for urgent info and scheduling, MS Teams for file sharing.

2.2. MOTIVATION

(Probing questions: The motivation is not going to be a straight line during the length of project. And members can experience lack of motivation and frustration in the different moments of the project. How can the group have identified when the levels of motivation and commitment are decreasing? What strategies could be used to help the group to boost its members motivation? Etc.)

Pushing each other to do better and stay consistent regardless of motivation. Having a clear idea of our common goal. Dedication above motivation.

2.3. GROUP COHESION AND TRUST

(Probing questions: There will be moments when one, or more members will feel vulnerable, will doubt him/ herself, or be stressed. This will affect not the specific members for also the cohesion and performance of the team. Outline some ideas on who and how members can approach to address such situations (i.e., calling in student advisor).

Respecting everyone's human needs and their feelings. Talking through problems and not bottling up our worries.

2.4. DECISION MAKING, CONSENSUS AND RISKS

(Probing questions: How will your team make key decisions? How will you manage so every member is included in process? Will you have a formal procedure? What are the risks of poor decision processes and long discussions to reach consensus? How will the group monitor and minimize such risks? Etc.)

We make all important decisions with all members present. In case a member is not present, we ask for their opinion and consent before going forward with the decision.

2.5. MANAGEMENT OF CONFLICTS

(Probing questions: How will you reduce conflict in your team? How will you resolve any conflicts that arise? To what will you agree so the conflicts can be avoided?)

Survival of the fittest. The better idea perseveres. In complicated circumstances, the group will ask for the advice of an external agent (student counsellor, teacher, impartial classmate,...) to solve the conflict.

Section 3. Team Logistics

3.1. ORGANIZATION AND MANAGEMENT OF DAY-TO-DAY WORK

(Probing questions: Will the group assign a group 'leader', or organizer? Will the role rotate? What is expected from this role? How will the group members duties towards the organizer, and the fulfillment of the rules established? What would be the consequences of not complying with rules and expectations? Etc.)

There is no hierarchy when it comes to making decisions. We all try to contribute equally. We discuss tasks together and allocate them to the person with most expertise/enthusiasm in the field.

3.2. MEETINGS (TIME, LOCATION, AND LENGTH)

(Probing questions: Who will chair team meetings and what is expected from it? Will the role rotate? How will you organize the meetings daily (e.g., agenda, scheduling, summarizes and minutes, etc.)? How will you organize the meetings with the supervisors, or other staff members (e.g., agenda, scheduling, summarizes and minutes, etc.)? How will you keep track of the outcomes of the meetings? Etc.).

Always to be determined by group members beforehand, usually at the end of a group meeting. If running late, inform other members. To avoid misunderstanding, two agendas are held: one is an agenda with tasks to be accomplished before a meeting, and the other one is an agenda made afterwards summarizing the different topics and conclusions of the meeting.

3.3. SUPERVISOR MEETING TIME AND LOCATION

(Probing questions: Who will chair team meetings and what is expected from it? Will the role rotate? How will you organize the meetings with the supervisors, or other staff members (e.g., agenda, scheduling, summarizes and minutes, etc.)? How will you keep track of the outcomes of the meetings? Etc.).

We all meet with the supervisor once we feel we are prepared to share the results he expects from us. To set up a meeting, we send an invitation to the supervisor through Outlook Calendar after checking his agenda for the week. The meetings are held in the group room (A217).

3.4. SUPERVISOR EXPECTATIONS

(Probing questions: What are the mutual expectations between your team and your supervisor?)

We will have questions and issues prepared before meeting with supervisor. We expect advice on basic issues related to report or direction of out project. Supervisor expects responsibility, diligence and respect of his time schedule.

3.5. FILE SHARING AND STORAGE

(Probing questions: How will the group record project drafts, facts, conclusions, data, etc. as they occur along the project work? What platforms and formats will the group use to keep a record? Who and how will manage it? Will you have a template for various documents and who will create this? How will you name files to ensure versions, numbers and team members inputs are recorded? Etc.)

All members may upload files and contribute to them on MS Teams. To write the report, the team compromises to use Overleaf (LaTeX).

Date and Signatures

10. 9. 2024

Casiana Alexia Stanciu

Daniel Ignacio Osorio

Emma Kaitlin Wulff Harcrow

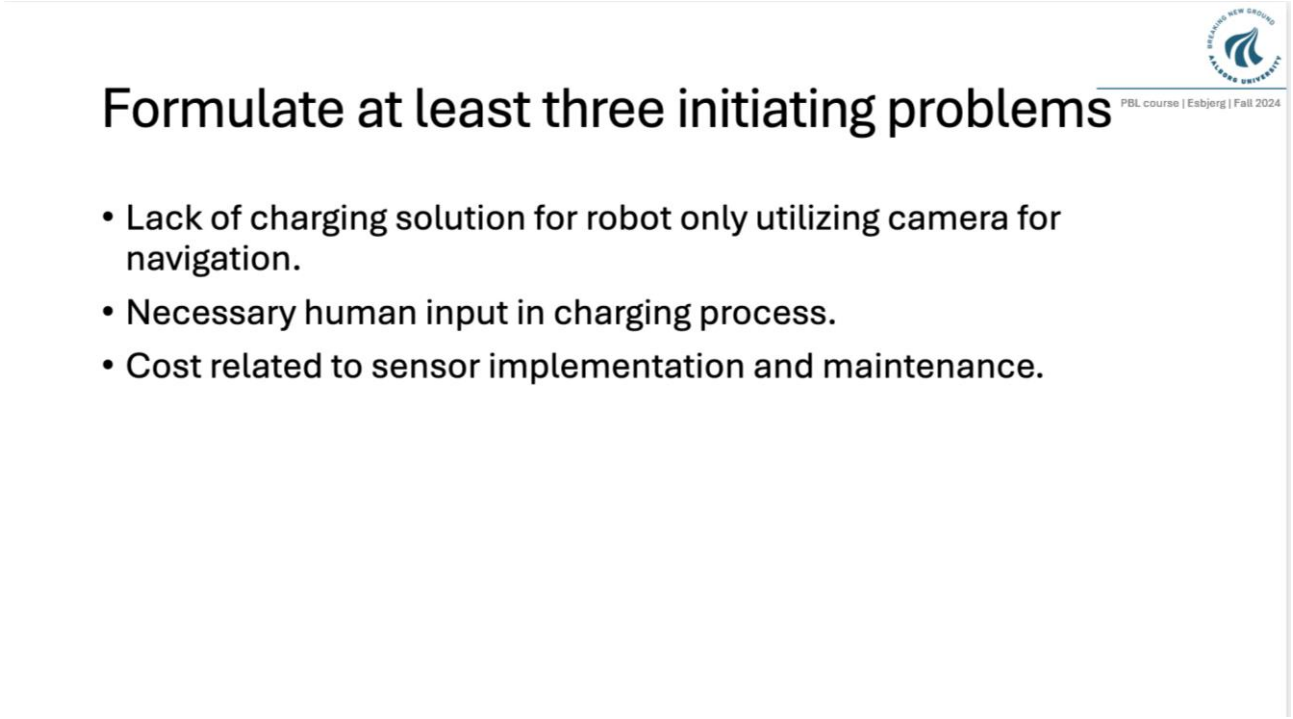
Arseny Shiman

David Pilecek

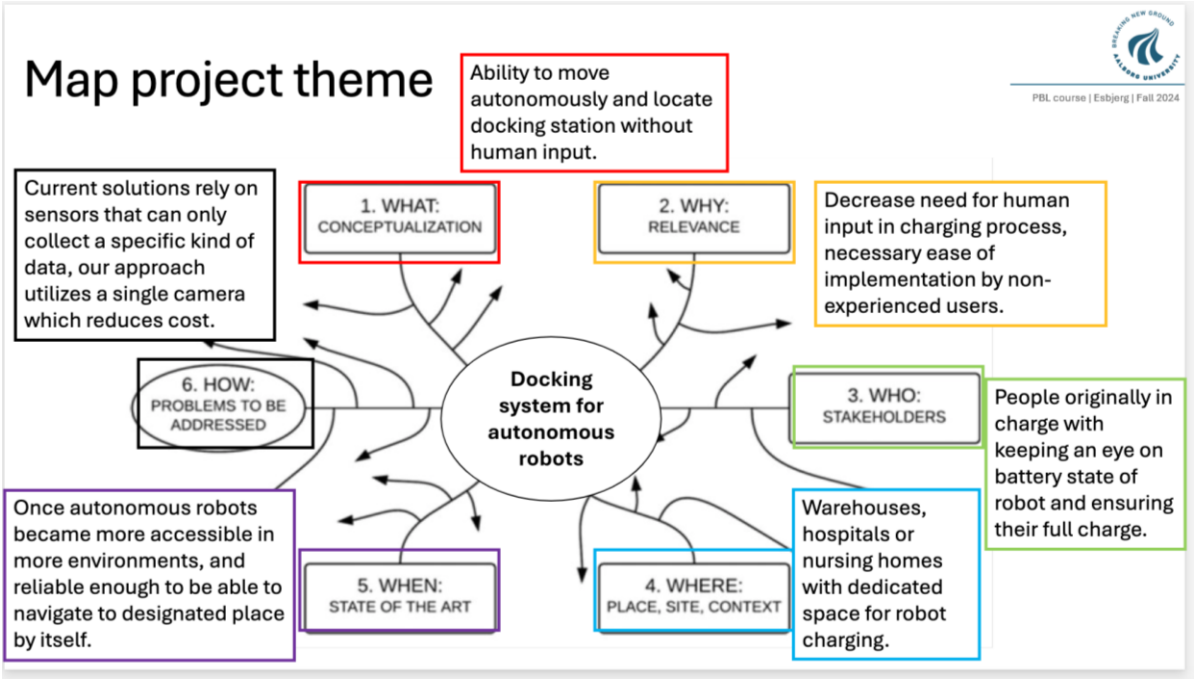
APPENDIX 2: PROBLEM DESIGN AND PROBLEM IDENTIFICATION

Appendix 2.1 First meeting brainstorming

Appendix 2.2 Initiating problems



Appendix 2.3 Map of problem areas (5W1H, and 5Whys)



Initial Problem Formulation:			
Precise questions	**Assumptions, hypothesis, etc.**	**Sources of information**	**Information gathered/ collected and sources**
(Who) will the cost reduction impact?	Mostly manufacturers that use robots in need of charging.	Manufacturing.net Quicktron	Cost reductions in robotics influences a variety of groups, with small and medium-sized manufacturers being one of the most impacted. These companies benefit significantly from automation as it reduces operational costs, increases productivity, and improves product quality. Cost savings in robotics, such as reduced maintenance, shorter time-to-market, and streamlined production, help manufacturers, especially small-scale operations, to stay competitive. Robotics can cut production costs by reducing labor dependency, enhancing precision, and minimizing human error. By increasing productivity and reducing labor costs (robots are not getting paid), overall benefits are reflected in the industries around the world. For example, in Mondelēz: *"Snacks giant triples its warehouse productivity with robotics automation, resulting in $ 844K savings per year, 70% error reductions, and a 133% efficiency boost."*
(What) makes the robot more effective than humans?	Robots are naturally more effective than humans since they're coded to focus on a specific task.	Digital Teammates: *"Why are robots not equal to humans?"* Cobalt AI: *"5 things that robots do better than humans"*	Among other advantages, in an industrial environment, robots show to be more effective and precise than humans. As an example, a robot doesn't need to sleep or "recover" from a high-demanding task.
(Where) is our solution viable to implement?	Warehouses, nursing homes, hospitals. Ideally, open spaces that have room for docking stations.	MDPI PDF on Transportation Science	During the last decade, warehouse automation has developed rapidly. A big boost to this development has been given by autonomous vehicle–based storage and retrieval. Robotic handling systems are increasingly applied in distribution centers. They require little space, provide flexibility in managing varying demand requirements, and are able to work 24/7. This makes them particularly fit for e-commerce operations. Mobile robots are used across various fields, including surveillance, planetary exploration, dangerous environments, factory automation, search and rescue operations, and indoor manufacturing environments.
(When) did our solution become more feasible than sensor-based approaches?	Once camera technology reached a point of high resolution at low costs.	https://recognitionrobotics.com/vision-sensors-vs-vision-systems-in-industrial-robotics/CNN	One robot equipped with a robotic vision system can do the tasks of multiple robots fitted with simple sensors, which reduces significantly the overall cost of the robot (one component with many functions, instead of multiple components for one function). 2012-2015: Convolutional Neural Networks (CNNs) gained popularity, revolutionizing how cameras could interpret visual data for navigation. CNNs enabled robots to better understand complex environments, identifying objects and terrain more precisely than basic distance sensors.
(Why) is it beneficial to use our approach, compared to the industry status quo?	Cost and size reduction, flexibility thanks to amount of data cameras are able to collect.	https://www.inovec.tech/en/what-is-virtual-sensor	For specialized HW sensor for the given task: High level of customization and necessity of engineering knowledge - 99.9% of costs are people. HW costs initially very low, but electronics are hard to replace. Collection of only specific information. On the other hand, a universal computer camera is easily replaceable and quickly scalable.
(How) is the robot able to dock precisely and reliably?	By using a camera that recognizes the docking system.	This Report	The active perceptual method for robot docking emphasizes real-time feedback from visual sensors rather than relying on pre-defined coordinates or maps. This approach, the robot adjusts its motion by continuously analyzing the visual data it captures, such as the object's position or orientation.

APPENDIX 3. PROBLEM ANALYSES AND FORMULATION

Appendix 3.1. Literature search protocols for background understanding

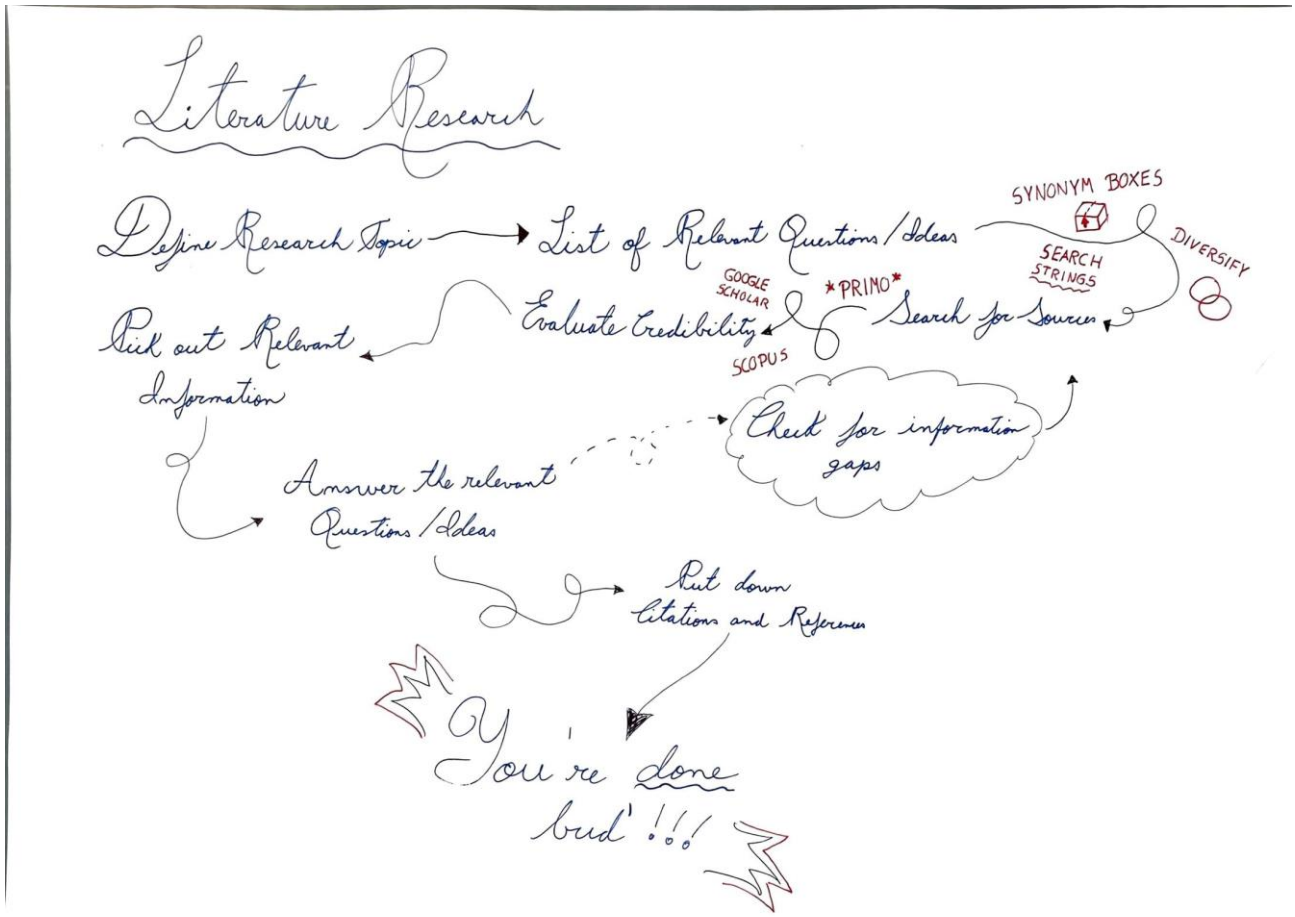
David Pilecek, Casiana Stanciu, Emma Harcrow, Daniel Osorio, Arseny Shiman.

Group 2: Search Protocol

1) **Identify our problem and/or topic.**
2) **Make a list with keywords, to facilitate the creation of search blocks.**
3) **Make search strings based on our previous search blocks. For example, in our project's case: robot* dock* or camera* dock*.**
4) **Use reliable databases, such as "Primo" or "Scopus".**
5) **Extract the relevant information.**
6) **Analyse the information and fill the knowledge gaps shown after the research, if necessary.**
7) **Put down citations.**

For us, a problem formulation should delimitate the range of the project by addressing specific and concrete questions that will define the following work and experiments/prototypes.

Therefore, our propose for problem formulation would be: ***"how effective are computer vision and camera guidance to give a robot the sufficient autonomy to self-dock in a charging station?"***


Literature Research
Define Research Topic
List of Relevant Questions / Ideas
SYNONYM BOXES
SEARCH STRINGS
DIVERSIFY
Search for Sources
PRIMO
GOOGLE SCHOLAR
SCOPUS
Evaluate Credibility
Pick out Relevant Information
Check for information gaps
Answer the relevant Questions / Ideas
Put down Citations and References
You're done bud!!!

Appendix 3.2. Stakeholder involvement and additional research methods for additional information

GROUP **MEMBERS:**
Stanciu Casiana Alexia, Daniel Ignacio Osorio, Emma Kaitlin Wulff Harcrow, Arseny Shiman, David Pilecek
PROJECT IDEA
Camera based autonomous docking system
COLLABORATION WITH STAKEHOLDERS AND OTHER EXTERNAL PARTNERS
1. WHO ARE THE STAKEHOLDERS:
Factory owners
2. OVERALL GOAL TO COLLABORATE WITH STAKEHOLDERS
Establish a contact with stakeholders in order to understand and be able to solve immediate and future problems using their requirements. With a first contact we can also gather information of what works and what doesn't work with the previous system. Have a survey for the current charging situation and how much space is available for charging stations.
3. MECHANISMS FOR COLLABORATION

IDENTIFICATION	Establish a meeting in order to brainstorm ways we can find factories that meet the criteria meaning they use robots for labour work and they charge ineffectively. And factories that don't meet our criteria meaning they use very effective charging in order for us to understand how we can outstand them.
COORDINATION	Research specific factories that use robots for work and reach out to them via email or company phone in order to establish a meeting in person since we can present a PowerPoint with our ideas and also harvest their feedback on old charging methods. We will have a primary person that takes notes.
TRANSFORMATION	After collecting all the evidence we will have another meeting that helps us select relevant points and also make a priority list with all the problems that need addressing. For missing information we can set up a meeting with the stakeholders to fill in the gaps and also share our results.
REFLECTION	After gathering, sorting and getting feedback from stakeholders, we will write a report that contains all of the information including problem analysis and solution, improvements and plan of action.

APPENDIX 4. PROJECT PLANNING AND MANAGEMENT

Appendix 4.1. Project timeline (WS 4)

MAIN OBJECTIVE: Develop a robot that's able to dock precisely to it's charging station using computer vision

DATE	TASK	RESPONSIBLE	STATUS	NOTES
Sep. 21 - Oct. 20	Research			
Sep. 25	Look at current problems based around "robot routing"	Emma, David	DONE	Problem at hand "Alignment using camera sensor"
Oct. 1	Research the setting where the problem selected in the report will be relevant, and the different challenges that come with it	Arseny	DONE	Prioratize settings based around Denmark
Oct. 5	FIgure out how the concept of the problem soluction opperates (mechanical, electrical, software)	Daniel	DONE	Create a spreadsheet on "Teams", add a link to all relevant resources
Oct. 20	Research a list of components that will be required for the problem and create a budget	Casiana	In-Progress	Only EU retailers, keep total budget under 1000dkk
Oct. 21 - Oct. 31	Summary of existing solutions and their shortcomings			
Oct. 25	Research open-source products or available papers	David	DONE	primo, etc. to investigate the industry approach to our problem
Oct. 31	Study "tear-downs" of commercial products	Arseny	DONE	reports about how they work, both hardware and software
Nov. 4	Summarize existing methods	Casiana, Emma	DONE	as sensor, battery, etc. and decide for the best option for each
Nov. 6	Reason about what the best solution for our problem is and pick one	All members	DONE	method we want to use to solve the problem at hand
Nov. 1 - Nov. 21	Development of prototype			
Nov. 15	Gather all components and confirm their function	DAVID	DONE	
Nov. 7	Configuration of the camera and RPi	CASIANA	DONE	ask Jeppe to order and add it to the budget.
Nov. 14	Design the robot chasis and 3D printing.	ARSENY, DANIEL	In-Progress	talk with the tutors regarding the big 3D printer.
Nov. 19	Integrate the technological into the mechanical parts of the prototype	EMMA	In-Progress	
Nov 22 - Nov. 28	Testing of prototype and investigating the impact			
Nov. 22	Test docking mechanism	All members	In-Progress	
Nov. 23	Test camera for correct path following	All members	In-progress	
Nov. 29 - Dec. 19	Write and review a report			

Appendix 4.2. Project management (SCRUM)(WS 4)

(Same shown before)

Appendix 4.3. Revised project timeline (Mid-term evaluation 2)

DATE	TASK	RESPONSIBLE	STATUS	NOTES
Sep. 21 - Oct. 20	Research			
Sep. 25	Look at current problems based around "robot routing"	Emma, David	DONE	Problem at hand "Alignment using camera sensor"
Oct. 1	Research the setting where the problem selected in the report will be relevant, and the different challenges that come with it	Arseny	DONE	Prioratize settings based around Denmark
Oct. 5	FIgure out how the concept of the problem soluction opperates (mechanical, electrical, software)	Daniel	DONE	Create a spreadsheet on "Teams", add a link to all relevant resources
Oct. 20	Research a list of components that will be required for the problem and create a budget	Casiana	DONE	Only EU retailers, keep total budget under 1000dkk
Oct. 16	Hand-in current report (Status Seminar)	All members	DONE	Remeber to add supervisor feeback from last meeting
Oct. 20	Finish presentation (Status Seminar)	All members	DONE	
Oct. 21 - Oct. 31	Summary of existing solutions and their shortcomings			
Oct. 21	Status Seminar at 9:30 - 10:30	All members	DONE	Gather at 8:30 to discuss before presentation
Oct. 25	Research open-source products or available papers	David	DONE	Use platforms like github or find individual available products, such as ArduMower; for engineering papers, use google scholar, AAU primo, etc. to investigate the industry approach to our problem
Oct. 31	Study "tear-downs" of commercial products	Arseny	DONE	Watch yt videos/find articles on medium, github etc. of tech nerds tearing down and reverse engineering commercial products and creating reports about how they work, both hardware and software
Nov. 4	Summarize existing methods	Casiana, Emma	DONE	Separate our prototype into different parts, such as sensor, battery, etc. and decide for the best option for each
Nov. 6	Reason about what the best solution for our problem is and pick one	All members	DONE	We know that for our project, using a single camera and the OpenCV framework is the method we want to use to solve the problem at hand
Nov. 1 - Nov. 21	Development of prototype			
Nov. 15	Gather all components and confirm their function	David	DONE	
Nov. 7	Configuration of the camera and RPi	Casiana	DONE	Ask Jeppe to order and add it to the budget.
Nov. 14	Design the robot chasis and 3D printing.	Arseny, Daniel	In-Progress	Talk with the tutors regarding the big 3D printer.
Nov. 19	Integrate the technological into the mechanical parts of the prototype	Emma	In-Progress	
Nov 22 - Nov. 28	Testing of prototype and investigating the impact			
Nov. 22	Test docking mechanism	All members	In-Progress	
Nov. 23	Test camera for correct path following	All members	In-Progress	
Nov. 29 - Dec. 19	Write and review a report			
Dec. 19	Final review of report	All members	In-Progress	

Appendix 4.4. Revised project management (SCRUM) (Mid-term evaluation 2)

(Same shown before)

Appendix 4.5. Final version of project timeline and project management tool (SCRUM) (final evaluation)

DATE	TASK	RESPONSIBLE	STATUS	NOTES
Sep. 21 - Oct. 20	Research			
Sep. 25	Look at current problems based around "robot routing"	Emma, David	DONE	Problem at hand "Alignment using camera sensor"
Oct. 1	Research the setting where the problem selected in the report will be relevant, and the different challenges that come with it	Arseny	DONE	Prioratize settings based around Denmark
Oct. 5	FIgure out how the concept of the problem soluction opperates (mechanical, electrical, software)	Daniel	DONE	Create a spreadsheet on "Teams", add a link to all relevant resources
Oct. 20	Research a list of components that will be required for the problem and create a budget	Casiana	DONE	Only EU retailers, keep total budget under 1000dkk
Oct. 16	Hand-in current report (Status Seminar)	All members	DONE	Remeber to add supervisor feeback from last meeting
Oct. 20	Finish presentation (Status Seminar)	All members	DONE	
Oct. 23 - Oct. 31	Summary of existing solutions and their shortcomings			
Oct. 23	Status Seminar at 9:30 - 10:30	All members	DONE	Gather at 8:30 to discuss before presentation
Oct. 24	Status Seminar reflection	All members	DONEA	Hold a group meeting to discuss shortcomings of status seminar, reflect on feedback given by opposing group and supervisor. Schedule meeting with supervisor to talk about report.
Oct. 25	Research open-source products or available papers	David	DONE	Use platforms like github or find individual available products, such as ArduMower; for engineering papers, use google scholar, AAU primo, etc. to investigate the industry approach to our problem
Oct. 31	Study "tear-downs" of commercial products	Arseny	DONE	Watch yt videos/find articles on medium, github etc. of tech nerds tearing down and reverse engineering commercial products and creating reports about how they work, both hardware and software
Nov. 4	Summarize existing methods	Casiana, Emma	DONE	Separate our prototype into different parts, such as sensor, battery, etc. and decide for the best option for each
Nov. 6	Reason about what the best solution for our problem is and pick one	All members	DONE	We know that for our project, using a single camera and the OpenCV framework is the method we want to use to solve the problem at hand
Nov. 1 - Nov. 21	Development of prototype			
Nov. 15	Gather all components and confirm their function	David	DONE	
Nov. 7	Configuration of the camera and RPi	Casiana	DONE	Ask Jeppe to order and add it to the budget.
Nov. 14	Design the robot chasis and 3D printing.	Arseny, Daniel	In-Progress	Talk with the tutors regarding the big 3D printer.
Nov. 19	Integrate the technological into the mechanical parts of the prototype	Emma	In-Progress	
Nov 22 - Nov. 28	Testing of prototype and investigating the impact			
Nov. 22	Test docking mechanism	All members	In-Progress	Document success rate of robot docking
Nov. 23	Test camera for correct path following	All members	In-Progress	Document reliability of path following
Nov. 29 - Dec. 19	Write and review a report			
Dec. 19	Final review of report	All members	In-Progress	Proof-reading of report
Dec. 20	Report submission	All members	In-Progress	Submit report into digital exam page
Dec. 20 - Jan. 22	Preparation of presentation, final adjustments of prototype			
Dec. 21	Creation of joint Powerpoint file	All members	In-Progress	Create an online Powerpoint file where everyone can collaborate
Jan. 12	Last testing of prototype, video-documentation for presentation	All members	In-Progress	Film video of prototype to use during group exam
Jan. 17	Finalization of presentation	All members	In-Progress	Finish slides, start practicing your part of the exam
Jan. 22	Final exam	All members	In-Progress	8:15-12:00

APPENDIX 5. CONFLICT MANAGEMENT AND WORK ENVIRONMENT

Appendix 5.1. Tool to manage conflicts (WS 5)

- ***In person communication***
- ***Online communication texting/voice calls (WhatsApp)***
- ***Group social nights***

Appendix 5.2. Tool to improve work environment (WS 5)

- ***Group social nights***

Appendix 5.3. Revised strategy to manage conflicts (if applicable) (mid-term evaluation 2)

Appendix 5.4. Revised tool to improve work environment (if applicable) (mid-term evaluation 2)

Appendix 5.5. Final versions of strategy to manage conflicts and list of activities to improve work environment (final evaluation)

Tools and strategies to solve conflicts:

- In-person communication over everything: in case it is not possible, use Online communication, such as texting, voice calls or video calls (WhatsApp).
- In case of an argument, try to solve it between the group members by respectful exchange of perspectives and facts.
- For internal conflicts that can't be solved, ask for advice from an external agent (e.g., student counsellor) as soon as possible.

Activities to improve work environment:

- Group social nights.
- Small chats before/after meetings.

APPENDIX 6. SHARING AND DOCUMENTING KNOWLEDGE

Appendix 6.1. Plan and actions to improve knowledge share and co-writing (WS 6)

1) The group will utilize two main software tools to work on the project:

- **Overleaf** will be the main tool for writing the report, by recommendation of our tutors and supervisor. There is a common Overleaf file which uses the AAU template for reports. Each member will be responsible of writing their own part on the report, while also providing advice and help to those members who require it (e.g., not understanding how to use the different commands of the program).

- **Office360** (Microsoft) will be used for other documents (Word), presentation slides (PowerPoint), organization and planning (Excel) and, overall, gather all the information acquired in the same place, as well as organize meetings (Teams). At the moment, there are several files on Teams with the different documents and their purpose (PBL tasks, Research, Lab Access paperwork, etc).

2) Important findings must be discussed during meetings, as well as important changes on the general direction of the project must be notified to other members.

3) All teammates must be aware of the different parts of the project. It is important to ask other members if anything is not clear, so the most suitable member can solve the question/doubt.

4) All citations must be put on the Report and on the Research documents, allowing the different members to track the information and revise it on their own (if necessary).

5) Comments/suggestions might be added on Overleaf by adding % and the comment after a paragraph. Nothing should be changed without the permission of the person, or without major inconvenience from the other members perspective.

Appendix 6.2. Revised plan for academic (co)writing and peer-review (mid-term evaluation 2)

(No major changes to mention)

Appendix 6.3. Code of Conduct to use AI in project work and reporting (WS 6)

An idea that used to be seen as "science fiction" is now a reality: artificial intelligences (AIs) have undoubtedly been the biggest revolution of this century, bringing new possibilities and AI-supported workflows to the table. Even when it would result absurd not to make use of this invention, whose overall intention is to facilitate or lives by improving excessively time-consuming processes, our group is firmly against the lack of originality behind an excessive or "lazy" use of AI.

Therefore:

- DEFINITION: Group 2 recognises AI as an INSTRUMENT, capable of supporting OUR work and previous knowledge.
- AI CAN be used to ask for guidance: for example, to get a better understanding of a complicated topic or to check for possible grammatical errors in a text.
- AI CAN'T do our work: it is unacceptable to present AI work without proper credit or to entirely rely on its help in any stage of the project. In case of using AI provided material, it is imperative to STATE IT clearly.
- Even when AI tools generally provide trustful information, gathered from different sources, it is important to VERIFY the validity of said information.

Appendix 6.4. Final versions of plan and actions to improve knowledge sharing and co-writing and code of conduct to use AI (final evaluation)

Regarding Knowledge sharing and co-writing:

1) The group will utilize two main software tools to work on the project:

- **Overleaf** will be the main tool for writing the report, by recommendation of our tutors and supervisor. There is a common Overleaf file which uses the AAU template for reports. Each member will be responsible of writing their own part on the report, while also providing advice and help to those members who require it (e.g., not understanding how to use the different commands of the program).

- **Office360** (Microsoft) will be used for other documents (Word), presentation slides (PowerPoint), organization and planning (Excel) and, overall, gather all the information acquired in the same place, as well as organize meetings (Teams). At the moment, there are several files on Teams with the different documents and their purpose (PBL tasks, Research, Lab Access paperwork, etc).

2) Important findings must be discussed during meetings, as well as important changes on the general direction of the project must be notified to other members.

3) All teammates must be aware of the different parts of the project. It is important to ask other members if anything is not clear, so the most suitable member can solve the question/doubt.

4) All citations must be put on the Report and on the Research documents, allowing the different members to track the information and revise it on their own (if necessary).

5) Comments/suggestions might be added on Overleaf by adding % and the comment after a paragraph. Nothing should be changed without the permission of the person, or without major inconvenience from the other members perspective.

Regarding AI code of conduct:

- **DEFINITION**: Group 2 recognises AI as an **INSTRUMENT**, capable of supporting **OUR** work and previous knowledge.
- AI **CAN** be used to ask for guidance: for example, to get a better understanding of a complicated topic or to check for possible grammatical errors in a text.
- AI **CAN'T** do our work: it is unacceptable to present AI work without proper credit or to entirely rely on its help in any stage of the project. In case of using AI provided material, it is imperative to **STATE IT** clearly.
- Even when AI tools generally provide trustful information, gathered from different sources, it is important to **VERIFY** the validity of said information.

APPENDIX 7. ENGINEERING IN BROADER CONTEXT

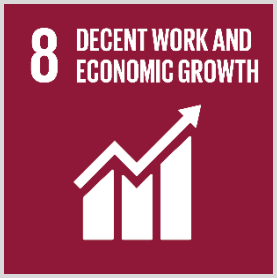
Appendix 7.1. The professional engineer student code of ethics and standards (WS7)

"Manual of professional practice for electronics engineers", pages 2-5:

https://jrcanedo2.wordpress.com/wp-content/uploads/2007/11/manual-of-professional-practice-for-electronics-engineers.pdf

Appendix 7.2. Impact assessment of project (WS7)

Sustainable Development Goals (SDG's)	*Short description*	*SDG in relation to your project*
	*Economic growth must be inclusive to provide sustainable jobs and promote equality.*	
	*The food and agriculture sector offers key solutions for development, and is central for hunger and poverty education.*	
	*Ensuring healthy lives and promoting the well-being for all at all ages is essential to sustainable development.*	With the implication of robots in the workspace, robots can focus on heavy lifting and long hours of work, while humans can focus on safer tasks, reducing then the chance of strain, injury and fatigue.
	*Obtaining a quality education is the foundation to improving people's lives and sustainable development.*	
	*Gender equality is not only a fundamental human right, but also a necessary foundation for a peaceful, prosperous and sustainable world.*	The field of STEM, unfortunately, remains to be highly unequal in the distribution of gender. In the context of our project work though, we are contributing to an equal workspace by treating all ideas with the same respect and openness, regardless of gender.

		Regarding the prototype, our robot is designed to not discriminate and treat all humans equally.
	*Clean, accessible water for all is an essential part of the world we want to live in.*	
	*Energy is central to nearly every major challenge and opportunity.*	
	*Sustainable economic growth will require societies to create the conditions that allow people to have quality jobs.*	We believe that, by implementing robots in workplaces among humans, we can give them the opportunity to focus on higher paying jobs and make room for economic growth and space expansion, creating more jobs.
	*Investments in infrastructure are crucial to achieving sustainable development.*	By investigating the alignment of robots to a charging station, we can provide an innovative way of effective charging in workspaces that require automated solutions.
	Reducing inequalities and ensuring no one is left behind are integral to achieving the	

	*Sustainable Development Goals.*	
	*There needs to be a future in which cities provide opportunities for all, with access to basic services, energy, housing transportation and more.*	
	*Securing a responsible production and consumption*	We try to focus on creating a workspace with no errors by implementing robots with specific tasks that are autonomous, so there would be a reduced or no failure in mass production.
	*Climate change is a global challenge that effects everyone, everywhere.*	
	*Careful management of this essential global resource is a key feature of a sustainable future*	

	*Sustainably manage forests, combat desertification, halt and reverse land degradation, halt biodiversity loss.*	
	*Access to justice for all and building effective, accountable institutions at all levels.*	
	*Revitalize the global partnership for sustainable development.*	

NB: Add other appendixes if they are relevant