# Project plan

TSRT10 project group 7

December 18, 2022

Version 1



Status

| Reviewed | Jan Åslund, Daniel Jung | 2022-09-22 |
| --- | --- | --- |
| Approved | Jan Åslund, Daniel Jung | 2022-09-22 |

# Project Identity

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**Participants of the group**

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|------|-------------|--------|
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CONTENTS

## DOCUMENT HISTORY

| Version | Date | Changes made | Made by | Reviewed |
|---------|------|--------------|---------|----------|
| 0.1 | 2022-09-20 | First Draft | AB PK TN FL ES SS | 2022-09-20 |
| 1 | 2022-09-22 | Final Version | AB PK TN FL ES SS | 2022-09-22 |

# 1 ORDERER

The purchaser of this project is Jan Åslund, Assistant Professor at Vehicular Systems (FS) at Linköpings University.
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## 2  OVERVIEW OF PROJECT

This chapter explains the aims and goals of the project, what the project will deliver as well as some limitations made to the project.

### 2.1  Aim and goal

The goal of the project is to study how a single household can reduce energy expenses by utilizing an electric car battery and an accumulator tank for energy storage. A residential area with several houses will be simulated to analyze the effects on the low voltage grid. The aim is to solve this by further developing a pre-existing simulation environment and implementing an algorithm for optimization of energy consumption.

This will be carried out by implementing various algorithms and strategies for optimal control, mainly for the houses in a suburban area in Linghem, Östergötland. Included components will be power transformers, grid cables, residential buildings, electric vehicles, accumulator tanks and photovoltaics.

The research questions are:

- How can the energy consumption be optimised in a low voltage distribution system in order to decrease peak loads?

- How can different electricity price tariffs contribute to voltage stability?

The long term goal is to implement smart control in every household, making them as self sufficient as possible regarding energy consumption. In the electricity grid of the future, charging of all electric components in the household and the time of use is optimized so that the impact on the power grid is minimal.

### 2.2  Deliverables

| Requirement | Version | Description | Priority |
|---|---|---|---|
| 1 | Original | BP2: Requirement specification, Project plan, Time plan and draft of design specification will be delivered latest 21/9 | Base |
| 2 | Original | BP3 will be delivered 2-3 weeks after BP 2 | Base |
| 3 | Original | BP5 will be delivered about half a week before delivery of project (12/12) | Base |
| | | *cont. on next page* | |

| | | *cont. from previous page* | |
|---|---|---|---|
| Requirement | Version | Description | Priority |
| 4 | Original | delivery of project about 2 weeks before project conference (latest 12/12) | Base |
| 5 | Original | after study about a week before project conference (latest 12/12 kl 13.15) | Base |
| 6 | Original | Ready to print poster to the deliverer about a week before project conference (latest 13/12 kl 12.00) | Base |
| 7 | Original | BP6 and belonging deliverables latest by project conference 19/12 kl 13.15 | Base |

## 2.3 Limitations

The complexity of the models will be restricted with the intent of avoiding unreasonable calculations and simulation times.

The allocated time for the project is limited wherefore the various stages of work needs to be planned carefully. In addition, meetings with the supervisor, costumer and purchaser may only occur a limited amount of occasions.

# 3 PHASE PLAN

The following section briefly describes the activities for each stage of the project.

## 3.1 Before project start

The project starts with a thorough investigation of previous works on the subject. By reviewing scientific reports related to grid optimization and MPC algorithms, the group obtains knowledge about what already has been subjected to research and where new knowledge can be added. After consulting the supervisor and the client a requirement specification is designed. The requirement specification consists of detailed explanations of the different systems and sub-systems including their interdependencies. This is followed by a concise descriptions on what the sub-systems are expected to fulfill from a functional and performance point of view.

## 3.2 During the project

The aim of the project is to work agile and autonomous from idea to execution. An intention is solve a small scale problem at an early stage and thus lay a foundation for further development. In that way new features can constantly be added to meet the previously stated requirements. This working method ensures that the group has concrete evidence that suggests that work has been done at every meeting with the supervisor.

   The group will adopt a digital website where all project related information is provided. Every achieved milestone will be clearly indicated for the purchaser and client to view.

## 3.3 After project

The final solution will be presented to the purchaser. Subsequently a meeting will be arranged to assess whether the product fulfills the requirements that were agreed upon. After this the project group will compile a technical document, user manual and follow-up study. To finally conclude the project a short visual recording and a poster will be created for advertisement purposes.

# 4 ORGANIZATION PLAN FOR THE PROJECT

In this section, the organization plan for the project is presented.
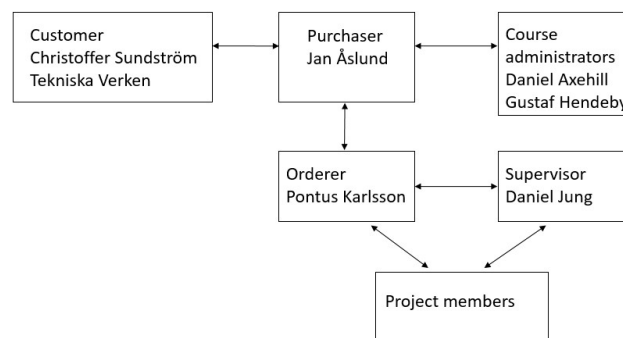
## 4.1 Organization plan per phase



**Figure 1:** Project organization

## 4.2 Organization plan at the Orderer

Christoffer Sundström.

## 4.3 Terms for group work

Group contract attached.

## 4.4 Definitions of work topics and responsibility

The responsibility of the different project roles are described below.

**Project leader**:
Leader of the project and responsible for the delivery of the final product. The responsibility of the project leader is to make sure that the group is on the right track to reach the project goals and encourage the mem-

bers to work efficiently together.

**Head of documentation:**
Responsible for ensuring that the different documents are available and ready in time. Also responsible of ensuring that document templates are followed and version management is correctly performed.

**Head of simulation:**
Responsible for ensuring that the simulations are made according to the requirement specification. This also includes planning and comparing the different simulation scenarios.

**Head of testing:**
Responsible for testing and ensuring that all coding files are included and work together.

**Head of design:**
Responsible for setting up guidelines for how the design is to be carried out, including coordination and planning. Responsible for the website and overall graphic design.

**Head of software:**
Responsible for ensuring that the code follows a certain standard, is version managed, well structured, well documented and commented.

## 5 DOCUMENT PLAN

In this section, the plan of deliverables will be presented with their respective deadlines.

| Document | Graded by | Aim | Delivered to | Deadline |
|---|---|---|---|---|
| Requirement specification | | Defines all requirements | Jung,Sundström | 2022-09-20 |
| Time plan | | Describes who will do what and for how long | Jung,Sundström | 2022-09-20 |
| Project plan | | Defines solutions and approaches to solve the requirement specification | Jung,Sundström | 2022-09-20 |
| Design specification (first draft) | | Describes how the product will work and be implemented | Jung,Sundström | 2022-09-20 |
| Design specification (final draft) | | Describes how the product will work and be implemented | Jung,Sundström | 2022-10-12 |
| Test plan | | Describes how tests will be carried out | | 2022-10-12 |
| Test protocol (BP5) | | Protocol for test results | | 2022-12-07 |
| User manual (BP5) | | Explains how the final product is used | | 2022-12-07 |
| A short lecture (BP5) | | A short lecture demonstrating the important parts of the requirement specification is achieved. | | 2022-12-07 |
| Oral Presentation w. Powerpoint | | Oral presentation at the delivery | | 2022-12-07 |
| After study | | Evaluation of the project with follow-up of results and used time for project. | | 2022-12-12 |
| Poster | | Poster summarizing the project | | 2022-12-13 12:00 |
| Website (BP6) | | Presenting the results and documentation from the project | | 2022-12-15 |
| Technical report (BP6) | | Detailed description of the product and the system | | 2022-12-18 |

| Project movie | | Presenting the project in an interesting way | | 2022-12-19 |
|---|---|---|---|---|

# 6  DEVELOPMENT METHODOLOGY

This project utilizes an agile management methodology to promote adaptability and flexibility. With this, the group has the opportunity to work with iterative models by going back an revising the project as needed during the process. In short, the group aspires to work with frequent testing, reassessment and adaptation.

As software is developed the code is stored in GitLab under an appropriate sub-project repository. Regarding the version control, accurate and relevant descriptions are appended to the different versions for a third party to understand. Similarly, the functions constituting the code have comments that clarifies the structure and any local variables.

# 7  EDUCATIONAL PLAN

During the working process the members of the project group will have to acquire additional knowledge and education within some areas.

It is conceivable that the project purchaser will need information about the functionality of the final product. This information might regard weight variables in the optimization algorithm which depend on the preferences of the user.

# 8  REPORTING PLAN

To verify that the project proceeds according to plan, reports are to be filed every week. Two reports should be written, status, and time report. The project leader is responsible for making sure that the reports are handed in prior to deadline every week.

| Requirement | Version | Description | Priority |
|:---:|:---|:---|:---:|
| 8 | Original | The status report must be filed every week from each team member | Base |
| 9 | Original | The time report must be filed every week from each team member | Base |

## 8.1  Time Report

The time report must be filed no later than 10:00 PM every Sunday and can be found in the Teams-channel. The members have individual sheets where one fills in the time spent on pre-decided activities. In addition, there is a summary sheet with the aggregated amount of hours spent on every activity.

## 8.2  Status Report

The status report must be filed no later than 10:00 PM every Sunday and can be found in the Teams-channel. Each member has their own sheet where one...

# 9  MEETING SCHEDULE

Every Monday from 13:15 to 17:00 and every Tuesday from 15:15 to 17:00 the group has scheduled meeting times. Furthermore, every Friday sometime between 10:00 and 13:00 a meeting between the group, the purchaser and the client. Exactly when the meeting will take place will be depending on when all parties are available. All group members should be present at meetings, unless agreed beforehand. During the meetings the DOC will take notes.

## 10   RESOURCES PLAN

In this section the plan for resources of the project will be presented.

### 10.1   People

The project group consists of six engineering students pursuing M.Sc. degrees in various disciplines. As external resources are three advisors described above.

### 10.2   Material

The project group is equipped with academic reports and code files produced by students and professors at previous occasions. The code is mainly written in MatLab. Linköping University provides the necessary software packages such as MatLab and GitLab.

### 10.3   Facilities

Vehicle System's project room is the assembling point for the project members.

### 10.4   Economy

No financial compensation is paid.

## 11   MILESTONES AND DECISIONS

In this section, different milestones and decision point for the project will be presented.

### 11.1   Milestones

| Nr | Description | Date |
|----|-------------|------|
| 1. | Requirements specification | 2022-09-21 |

### 11.2   Decision Points

| Nr | Description | Date |
|----|-------------|------|
| 1. | Approval of requirements specification, decision to start the preparation phase | 2022-09-21 |
| 2. | Approval of project plan, decision to start the execution phase | 2022-09-21 |
| 3. | Approval of design specification, decision to continue the execution phase | 2022-10-12 |
| 4. | Not in use | |
| 5. | Approval of the functionality of the product, decision to deliver | 2022- |
| 6. | Approval of delivery, decision to dissband the group | 2022- |

# 12  ACTIVITIES

In this section, the different planned activities for the time plan can be seen.

**Table 4:** Overview of activities in project.

| **Main Activities** |
| --- |
| Lectures |
| Pre-study |
| Meetings |
| Requirement specification |
| Project Plan |
| Litterature study |
| Timeplan |
| Develop control algorithms |
| Modelling |
| Adjust assumptions |
| Collect data |
| Testing |
| Test plan |
| Test Protocol |
| Lecture: requirement spec OK |
| User manual |
| Result documentation |
| Technical Report |
| Poster |
| Homepage |
| Demo movie |
| Presentation |
| After study |

**Table 5:** The models.

| Models |
| --- |
| Thermodynamics of House |
| Heating of house |
| Electric charging of battery |
| Heat pump |
| Accumulator tank |
| Photovoltaics |
| Household activities (stochastic variables) |

## 13   TIMEPLAN

Time plan with estimated time spent on different tasks is attached.

# 14 PLAN OF CHANGES

If the project is delayed and fails to meet the target date the project leader will notify the supervisor and purchaser. At that point the group will have to assess the product and possibly renegotiate the requirement specification.

## 15 QUALITY PLAN

In this section, the different document that will be sent in for revision are presented together with a plan for testing.

### 15.1 Revision

Documents listed below are to be sent in for review by the project purchaser and the client.

$$lRequirement specification \tag{1}$$
$$Time plan \tag{2}$$
$$Project plan \tag{3}$$
$$Design specification \tag{4}$$
$$Test plan \tag{5}$$
$$Test protocol \tag{6}$$
$$User manual \tag{7}$$
$$Poster \tag{8}$$
$$Technical report \tag{9}$$
$$After study \tag{10}$$

### 15.2 Test plan

The code that is written will need to be tested to confirm that it functions according to the requirements. The tests will be performed regularly given that the project solely relies on software implementation.

The test will be carried out to evaluate how well the models work together, what their flaws might be and if there is something that needs to be improved before making further development.

## 16  RISK ANALYSIS

This project will only consist of software implementations with no intention of testing the product in actual existence. The project is thereby harmless for the participating students. Nonetheless, the final solution needs to follow the recommended settings of the components intended to be used.

There will however be some risks in this project, mainly the risk a deadline i not reached or the code does not work at all and the work has to be re done.

| Type of risk | Probability | Consequence | Score |
|---|---|---|---|
| Final Code does not work | 3 | 9 | 27 |
| A model does not work | 5 | 3 | 15 |
| Deadline is blown | 2 | 10 | 20 |

**Table 6:** Risk analysis

## 17  PRIORITIES

The project has a time budget of 240 hours per member which should not be exceeded. As stated in the requirement specification, the requirements are subdivided into base and optional. Base has the highest priority and must be completed on time while optional implies that the requirement will be met if permitted by the time frame. Ultimately, functionality within the constraints of time and resources is prioritized.

## 18 END OF PROJECT

The project is considered completed when at a minimum the base requirements are satisfied and the final product has been delivered to Tekniska verken. This also presupposes that all required documents are uploaded to the website and submitted to the person concerned.