# EE4: Building a small solar vehicle

Process report

**TEAM AM3**


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# Introduction

This report is written commissioned by Group T, for an EE4-project. Specifically, this report will deal with the implementation of the project within the electro-mechanics.

Within the report we will cite several aspects of our self-built SSV. The first aspect is the energy, where comes it from and where does it goes to? The car will also be analyzed critical to predict the behavior of the SSV when it's riding on the flat part of the track and on the slope.

For the realization of this report, some aspects were decisive. So we had to immerse ourselves in the fields of aerodynamics, dynamics, technology and strength of materials, mathematics, energy, ... But the work in team, consisting of different personalities and still remain motivated despite the setbacks, it was a must for achieving a good result.

This report is created by combining all the calculations, results, solutions and answers of all the team members. Towards the end, all of us did an effort to bring it to a successful conclusion. There are consulted several sources for answering the questions, especially courses, the internet and good advice of our coach Tan Ye.

# Description of the SSV

The SSV has three wheels, two in the front and one at the back. The electromotor will power the two wheels in the front which means that the car will drive with front wheel traction. The materials used for the wheels are a cd for the wheel at rear end of the car and Perspex for the other 2 wheels. We chose those materials because they are light and have a lot of grip on the rubber of which the track consists.

For the frame we mainly used mdf, this is easy to work with and to cut in Fablab. It is also pretty firm and not too heavy. It was the perfect material that we could use to attach our bearings and our axes on.

For the transmission we used three spur gears in addition to the one attached on the motor. We had to use three to get the 1:12 gear ratio. The material of which the spur gears exist is POM, this is a very firm and light material with only few energy losses.

At last the solar panel comes on top of the SSV in an angle of 30 degrees to have the perfect incidence of the sun. if necessary it is possible adjust the angle for a higher efficiency of the panel.

## Planning

When we look at the Gantt chart again, we see that the planning was good in the sense that the order of the different tasks is followed. But some parts have taken more time so at the end there was more work to do than we hoped at the beginning of the project. Especially the building of the SSV has many times seized. For example we started with a frame of Styrofoam and the building of the car was still good advanced but then we decided to throw it away because it wasn't that solid. And we built a new car with the other parts that we still had. This also makes that the mass of our car is very high.

Other problems we'd to solve were the cases, especially the case of Simulink wasn't easy but with good team work and the different insights, we have reached a solution.

## Cooperation

The Gantt chart of February is updated and shown below. The persons that are responsible for a task are not the only persons who did that task. Everybody had his share in the result of the project.

It was very easy for case I and the case of Simulink to divide the tasks because there was enough to do. But for the building of the car, sometimes it was difficult to decide who's going to do what because you can't build a small car with five people at the same time. But then again or common sense decided who was the best to do what. We've never had big problems about unmotivated team members.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Gantt chart** | | | | | | | |

| Project EE4 | | | | | timeline | work load | responsible |
|---|---|---|---|---|---|---|---|
| jobs | tasks | subtasks | subsubtasks | … | weeks | hours | |
| 1. Orientation phase | 1.1 Cooperation contract | | | | 1 | 2 | Thibauld |
| 2. Analyse phase | 2.1 Plan of approach | | | | 1 | 3 | Thomas |
| | 2.2 WBS | | | | 1 | 2 | Maarten |
| | 2.3 Gantt chart | | | | 1 | 3 | Maarten |
| 3. Execution phase | 3.1 Engineering | 3.1.1 Case SVV, part 1 | 3.1.1.1 Characteristic of the solar panel | | 1 | 10 | Tom |
| | | | 3.1.1.2 Optimal ratio | | 1 à 2 | 12 | Kristof |
| | | | 3.1.1.3 Bisectionmethode | | 1 à 3 | 6 | Thibauld |
| | | | 3.1.1.4 Sankey diagrams | | 1 à 3 | 12 | Filip |
| | | 3.1.2 Case simulink | 3.1.2.1 Simulation behavior SSV | | 2 à 3 | 40 | Thomas |
| | | 3.1.3 Case SVV, part 2 | 3.1.3.1 Test predictions | | 2 | 12 | Kristof |
| | | | 3.1.3.2 Study Shaft | | 2 à 3 | 18 | Thibauld |
| | | | 3.1.3.3 2D Technical drawing | | 2 à 3 | 24 | Thomas |
| | | | 3.1.3.4 Collides equation | | 2 | 16 | Filip |
| | | | 3.1.3.5 Bicycle equation | | 2 | 16 | Kristof |
| | | 3.1.4 Building SVV | 3.1.4.1 Brainstorming | | 1 | 15 | Thomas |
| | | | 3.1.4.2 Research | | 2 | 25 | Tom |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | 3.1.4.3 Comparing materials and methodes | | 1 à 2 | 12 | Kristof |
| | | | 3.1.4.4 Buidling SSV | | 4 à 6 | 52 | Thibauld |
| | | | 3.1.4.5 Test SSV | | 3 à 4 | 42 | Filip |
| | 3.2 Enterprising | 3.2.1 Promotion on webpage | | | 1 à 4 | 6 | Tom |
| | | 3.2.1 Engrave logo on SVV | | | 1 | 4 | Thomas |
| | 3.3 Education | 3.3.1 Technical report | | | 5 à 6 | 14 | Thibauld |
| | | 3.3.2 Process report | 3.3.2.1 Documents from orientation and analyse phase | | 1 | 4 | Tom |
| | | | 3.3.2.2 Blog on wiki | | 12 | 15 | Kristof, Filip |
| | | | 3.3.2.3 Intermediate description from SSV | | 2 à 3 | 12 | Tom |
| | | | 3.3.2.4 Final description from SSV | | 3 à 4 | 24 | Thomas |
| | | | 3.3.2.5 Final process report | | 3 à 4 | 20 | Tom |
| 4. Contact hours | 4.1 Seminars | | | | 5 | 50 | Everybody |
| | 4.2 Meetings | | | | 13 | 65 | Kristof |
| | 4.3 Race | | | | 1 | 20 | Thibauld |

# Skills

## Present

At the beginning of the project everyone started with the same skills. Everyone had enough theoretical knowledge and building qualities to start this project successful.

## Developed

As the project progressed we attended classes witch we could use in the project. With the new knowledge we gathered we could end our project successful.

For example; we learned more about strength of materials, motors, mechanics and signals and systems.

During the project every person in the team worked on a specific instruction. As we are a team; we explained to the rest of the team how the instruction is solved.

### Missed skills

When there were problems with a certain instruction because of missing knowledge, we discussed in a team to find the answer or asked other people. When solving difficult or large instructions we made sub teams containing several people. As a team we didn't had big problems with missed skills. When having a problem, we always came to a solution.

## Conclusion

### Final evaluation of the process

Generally speaking, the team is pleased with the progress of this project. We made good decisions as a team, respected the deadlines and made a revolutionary SSV.

Beside this we had fun as a team building our SSV.

### Final judgment of the product

We founded a new design with our SSV instead of using the traditional SSV with everything build on a base. As a team we are very satisfied with the final product.

With more time we are convinced that we could make the SSV more efficient and quicker.

Furthermore, we have thought the car would be quicker and not that heavy. This was certainly a disappointment. These problems we could optimize by using other materials.

As a team we look back on a successful SSV!

### What could be better?

As a team we are happy to end this project successful. We respected deadlines because every assignment was announced on time. But it would be a good idea to handle in the paper after the race so we could mention the results of the race. We also suggest an extra advice session about the paper. Thereby we could do some adjustments before handling in the final version of our paper.