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Plan of approach

EE4 – Building a SSV – Team PM9

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[In the making]

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Introduction

This document contains the plan of approach(POA) of the team Sol Invictus. With this file an agreement is created between the students and the client (our personal coach). This POA will be turned in during the first week of the second semester and the client will give its approval during the second week. They decide if they want to continue with us with this plan or not. If not, corrections will be made in agreement with the customer and the plan will be turned in once more to get the coach's approval. Changes in the POA during the semester are possible if deemed necessary by the team and will only be made after discussion with the whole team. The POA was written on the occasion of the EE4-project of the second bachelor electro mechanics at GroupT.
The project itself concludes the designing of a Small Solar Vehicle (SSV).
Further this POA contains a project description, objectives and the expected result.

Project description

Client

The clients of this EE4-project is the Umicore Solar Team.

Contactor

The executive team consists of six members, all student industrial engineering electro mechanics at GroupT Leuven:

Name	Function	Contact
Adriaan Buntinx	Teamleader	Adriaan.buntinx@student.groept.be
Wannes De Bruyn	Mechanics	Wannes.de.bruyn@student.groept.be
Charles Colin	Programming	charles.colin@student.groept.be
Stijn Lenaerts	Material responsible	stijn.lenaerts@student.groept.be
Loic Massart	Programming	loic.massart@student.groept.be
Wouter Meyers	Technical drawing	wouter.meyers@student.groept.be

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Context

The central theme of the Engineering Experience 4 - project is “Make stuff work”. Different teams of students design and build a ‘Small Solar Vehicle’ (SSV). Each team receives a solar panel and a DC-motor at their disposal. The Vehicle is also subjected to a number of tests and its behavior is predicted, at first using manual calculations; later using simulation software. In the end, every SSV will take part in a “solar-race”. Moreover, additional grades can be gained in following categories: - most innovative vehicle, - most beautiful vehicle. Next, the team performs a critical analysis on the SSV. The analysis is carried out in the following fields: aerodynamics, dynamics, strength of materials, material science, mathematics and energy.

The whole idea behind this project is that the team works as an engineering office in service of the solar vehicle team and have to design a miniature of their solar car to bring on the market. This to gain some additional budget.

Objectives

The project aims to develop a miniature solar that is totally powered by solar energy and operates without a battery package.
The objective is to fully optimize and to energetically study the car, after which it will participate in the race. This race will take place in week 10 if the weather conditions allow. To participate at the race, the car has to meet the competition rules (see Annex 1).
The route of the race consists of a flat surface of 10m. At the end of the road there is a shelf of 6 cm height hanging, against which the vehicle comes to halt. Behind that plank is an upward ramp on which a petanquebal can roll up. The aim is to get the ball as high as possible. There are always three teams racing against each other because the solar energy is not always the same.
Furthermore, the cars are also classified for most innovative and beautiful design.

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Problems

During the execution of the project, a number of problems can arise. This can be both technical and personal problems.

Technical problems: engine, solar panels, programming, connections, building materials, ...
Solution: We look at at alternatives. If the team sees no solution they step towards the supervisor or external contact points.

The schedule is compromised.
Solution: It will be discussed with the client which parts should be treated as a priority. The schedule is arranged so that there are some recovery days available.
Lack of time should therefore be noticed, scheduled and be reduced.

One of the staff is chronically ill or can no longer cooperate for other reasons.
Solution: A new task division is made and the associated timetable is drawn.

One of the staff does not cooperate.
Solution: The team comes together and brings the person(s) in question aware of the situation and tries to motivate him/them. If this is insufficient, sanctions will be made or the team leader will step towards the supervisor.

Expected results

Engineering

Part 1: Design and building of the SSV. This includes the various design choices such as frame, wheels, drive, navigation system, solar panel, total weight and combine the to get an optimal result. The following shall be determined and calculated:

1. Determine the characteristics of the solar panel in a UI and UP diagram. In analytical calculations we use the error theory.
2. Calculating the optimum gear ratio between the DC motor and the wheel, and the optimum mass of the SSV, taking into account of the route, the solar panel of the engine and the assumed characteristics of the trolley. Also a prediction of the maximum height of the ball will be made.
3. Simulating the behavior of at least 10 different gear ratios and masses using Matlab.
4. Performing a detailed sensitivity analysis on one uncertain initial value.
5. Calculating the optimum gear ratio with the bisection method. With this relationship we can numerically determine the displacement and the acceleration characteristics in several cases.
6. Simulation of the behavior of the solar panel coupled to a resistance between 10 ohms and 100 ohms with meaningful milestones in Matlab-Simulink.
7. Simulating the behavior of the car with DC motor and without solar panel in Matlab-Simulink.
8. Simulating the race in Matlab-Simulink in which the solar panel is attached to the solar car.

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Part 2:

1. Testing the impact between ball and cart, determining losses and analyzing the power flow through the SSV using a Sankey diagram.
2. Strength calculations to analyze whether the SSV can survive the impact.
3. Creating 2D technical drawings with dimensions of the frame of the car.
4. Comprehensive analysis of the collision process.

Enterprising

Designing a webpage on Wikiversity to get promotion of the product and engraving the team logo on the SSV.

Educating

The essence of this case is to collect and digest information. Drafting a technical report with the calculations en the solutions of the engineering and enterprising parts are also part of this case. Along with a technical report, there will be set up a final process report on our wikipage.

Preconditions

We are responsible for the development of the SSV en this between the agreed deadlines. Marked research, marketing… don't belong in the contract by Umicore Solarteam.
We are therefore not responsible for this part.
Preconditions (mass, height, width, … of the car) on the subject of the race can be found in the competition rules.

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Management aspects

Time management

The deadlines in the imposed Gantt Chart should be strictly followed up. If these deadlines threaten to compromise, the necessary sanctions will be taken. Each week there will be a meeting to follow up the project. If necessary there will be extra meetings.

Quality management

The SSV gets 20 seconds for a 10 m run, after which it collides with a petanqueball of (710 ± 10)g. This ball is on a ramp and the aim is to get the ball as high as possible. Furthermore, the SSV should survive the collide minimum 3 times.
Therefore the vehicle should have a minimum mass, be fast and strong. By tests, simulations and calculations, it is possible to develop the most optimal parts and to define the best materials for its objective.

The created Gantt Chart is a control in order to verify of each part is completed on time. In this way, unfinished parts could be detect and finished.

Information management

The whole progress of this project shall be written in detail on our wikipage. On this way the team members and other interested people can follow us closely. The wikipage can be opened by this link: http://en.wikiversity.org/w/index.php?title=Engineering_Experience_4:_Design_a_Small_Solar_Vehicle/Nl/2014:_Team_PM9

Each week there will be held a meeting where all of the team members can be informed of all the details. During this meeting, the work should be criticized and eventual problems should be solved. Also from these meetings, a detailed report is made.
Further, a log will be updated with information about the work done.

Organisation management

Meetings (presents an absents, participation, preparations, …), sanctions, deadlines, agreements, … are all listed up in the cooperation contract, which you can find on the wikipage.

Money

By brainstorming about the construction of the SSV, the material prices and other costs will be collected. When the total price fits within the budget of the team, the materials are purchased and the price will be divided between the team members.