

GroupT International Engineering College feb-jun 2012 BAC 2
Engineering Experience 4: "Make things work" Small Solar Vehicle
Group 17A/B

Super Solar Speed Entertainment Articles

Engineering Office



Small Solar Vehicle

Plan of Approach

Version 1

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In their search for additional budget, the Umicore Solar Team found out there was a great demand on the toy market for a scale model of their solar car. As being a respected engineering department of *Super Solar Speed*, a solar powered entertainment article manufacturer, we were asked by the team to develop a fully functional scale model prototype of the Umicar. Therefore, the seven members of our engineering team will commence collaboration on the prototype development of a Small Solar Vehicle (SSV) within the specified limitations. In order to obtain a satisfactory prototype, the SSV should be purely solar propelled, should have a mass of at least 750g and the cost price should not exceed €200. The energy used for propulsion must be directly delivered by the solar panel, without the use of batteries to accumulate energy. The energy input into the scale model must be limited to the sunlight conversion of sun rays that fall directly into the solar panel provided. In June the Umicore Solar Team will organize a contest where the different engineering offices will race against each other. The office with the fastest, most beautiful and most innovative model will get the contract. Therefore our main focus will be on the speed of the model and secondary attention will be paid to the beauty and innovative solutions and features. In order to develop the ultimate, energy-efficient, fast and profitable solar car prototype within our capabilities and provided materials that is also stunning to watch, we will need a thoroughgoing understanding in technologies like solar panels, electric motor efficiency under variable speeds and loads and gear ratios. The client not solely expect a prototype but also count on a business plan, product identity and communication plan, promotional material and in-depth market research that reveal some details on the main competitors of solar powered toys. On top of that the Umicore Solar Team will hire our engineering office also to produce a technical report on the SSV, that will dig deeper into the fields of aerodynamics, dynamics, strength of materials, material knowledge, maths and energy. The cooperation is limited by the mentioned engineering and marketing tasks and does not cover the actual production of the toys.

This temporary POA will be presented to the Umicore Solar Team by the end of the first collaboration week in order to give them enough time to audit it on time. The coach will give the green light once the POA is considered to be satisfactory. If not, we will keep revising it until the coach is completely contented.

Close succession of the project will be covered by the team members during a weekly meeting where we will share ideas, correct strategy and approach, divide the work and where deadlines will be nailed. During the project, a person-centered planning approach will be followed that will improve the quality of the delivered work through efficient communication, decision making, stimulating new ideas and interpersonal respect. The objective of that dialogue would be an agreement that would enjoy the loyalty of all sections of the people. Team members will keep a logbook that will be used to update the Gantt-Chart time by time.

In the next paragraphs, we assume some potential restrictions that may be cause delays or a restriction of the project in the future. We also manage to formulate solutions for problems.

Enterprising aspect:

One of the potential problems is caused by the limitation of the budget. There is a risk that we will come across an accident that we need some other materials to redo the components of our SSV.

Solution: Firstly, we make a list of the materials we need for the project, then we seek for some useful substitutes as possible as we can to reduce our expenses. And we will set up a reserved fund to deal with emergency.

Another problem is that team members maybe have divergences when we build our SSV.

Solution: when this happens, the team leader should judge different proposes and get a unified conclusion.

Engineering aspect:

When we assemble the car model, there is a possibility that some components do not match the model, resulting in we cannot complete the tasks in time.

Solution: Before we start the assembling of the car model, we try to find a various sizes of the same components, to ensure we can use the most appropriate one in our car model.

Some parts of the car do not work for unknown reasons. This maybe occurs in the race and we do not have enough time to figure out why it does not work or try to fix it.

Solution: For those components that easily break down, we will make spares of them. When there are accidents, we will replace these parts as fast as possible.

Central Research Question: How can we develop a fast, innovative and beautiful SSV using the provided solar panel and DC motor, within the fixed €200 budget?

Sub-question

Sub-sub-question

Physical design?

Motor? Frame? Wheel, shaft and their fixation system (e.g. bearings)? Drive structure? Gear ratio? Guiding system? Fixation system and orientation for the solar panel? Total weight?

Testing?

Computer simulations

Gear ratio simulations in Matlab?

Behavior simulations in Matlab-Simulink?

Diagrams?

Sankey diagrams?

Calculations

Forces on the solar panel?

Technical drawings?

Frame of the SSV (in 2D)?

Enterprising part?

Analysis of main players in this market category?

Marketing?

Business plan?

Analyze company name and logo?

Promotional website/wiki?

Budget control?

What milestone products have to be delivered? 17/2: Make cooperation contract, plan of approach, work breakdown structure, Gantt Chart

24/2: assignment about solar panel and DC-motor

23/3 Case SSV part 1 and Simulink, Process Report and PA1

17/4 Case SSV part 2 and test about SSV part 1 + Simulink,

24/4 SSV test

11/5 – 29/5 SSV race

22/5 Test

jobs	tasks	subtasks	subsubtasks			
1. Engineering	1.1. Design	1.1.1. Parts	1.1.1.1. Motor			
			1.1.1.2. Frame			
			1.1.1.3. Wheel			
			1.1.1.4. Solar Panel			
			1.1.1.5. Evaluation			
			1.1.1.6. Team Discussion			
			1.1.2. Control	1.1.2.1. Drive Structure		
				1.1.2.2. Guiding System		
	1.2 Simulating	1.2.1. Gear Optimisation		1.2.1.1. Matlab Calculation		
				1.2.1.2. Sankey Diagram		
				1.2.2. Simulink	1.2.2.1 . Solar Panel Simulation	
					1.2.2.2. System Modelling	
				1.2.3. Solar Panel		1.2.3.1. 2D-sketch
						1.2.3.2. Moment Diagram
		1.2.3.3. Shear Force Diagram				
					1.2.3.4. Stress and Strain Calculation	
				1.2.4. Umicar Exercise	1.2.4.1. Max Speed Sankey Diagram	
					1.2.4.2. Half Speed Sankey Diagram	

		1.2.5. Technical Drawing	1.2.5.1. 2D Technical Car Drawing
	1.3. Testing	1.3.1. Body Testing	1.3.1.1. Rolling Test
			1.3.1.2. Sankey Diagram
		1.3.2. Solar Panel Testing	1.3.2.1. Weight
			1.3.2.2. Acceleration
			1.3.2.3. Air Resistance
			1.3.2.4. Evaluation
	1.4. Planning	1.4.1. Project Planning	1.4.1.1. WBS
			1.4.1.2. Plan of Approach
			1.4.1.3. Cooperation Contract
			1.4.1.4. Gantt Chart
	1.5. Building	1.5.1. Assembly	1.5.1.1. Assembly
2. Enterprising	2.1. Economical Analysis	2.1.1. Cost Analysis	2.1.1.1. Product Description
			2.1.1.2. Price + VAT
			2.1.1.3. Transportation Cost
			2.1.1.4. Bills + Buyers
		2.1.2. Company and Product	2.1.2.1. Market Research
			2.1.2.2. Business Plan
			2.1.2.3. Company Name and Logo
			2.1.2.4. Webpage
			2.1.2.5. Blog
			2.1.2.5. Engraving
	2.2. Price Limit	2.2.1. Map of Proofs	2.2.1.1. Tickets + Invoices
3. Educating	3.1. Independent Info Gathering	3.1.1. Solar Panel	3.1.1.1. Seminar
			3.1.1.2. Self-Study
		3.1.2. Learning MatLab	3.1.2.1. Self-Study
			3.1.2.2. Seminar
		3.1.3. Learning Technical Drawing	3.1.3.1. Seminar
			3.1.3.2. Self-Study
	3.2. Final Report	3.3.1. Writing	3.3.1.1. Process
			3.3.1.2. Results
			3.3.1.3. Calculations

			3.3.1.4. Diagrams, Flow Charts, Figures
			3.3.1.5. Intro
			3.3.1.6. Conclusion
		3.3.2. Evaluation	3.3.2.1. Evaluation
	3.4 Contest	3.4.1. Contest	3.4.1.1. Contest

Sources:

http://www.mim.saxion.nl/documenten/p_en_a/Instructions%20Plan%20of%20Approach%20%5Bversie%2025%20augustus%202011%5D.pdf

Willemaerts C., Project organization and project management, GroepT, September 2007