

Final Process Report

By Team Solar International (PM8)

Overall our EE4 project was a success. Although there was significant deviation from our initial project planning, we had few problems actually completing the tasks of the project. In any large engineering project, some deviation from the plan is to be expected. Additionally, our team functioned well together and we had no significant intra-team conflict.

Planning

We had substantial deviations from our initial planning at the beginning of the semester. These deviations occurred in both the order of events and the length of time required for us to complete the various events. Additionally, unexpected and unplanned problems arose which were not included within the initial planning process.

The most significant deviations revolved around the construction of the solar car. Originally, we anticipated completing part acquisition and building an initial version of our solar car before we turned in Case SSV Part One. While completing our planning, we woefully underestimated the amount of time required to procure the various parts (plastic, bearings, fasteners) needed to construct the solar car we wanted to build. This significantly pushed back our original build schedule.

We also underestimated the amount of time required to build the SSV. We budgeted plenty of time to build parts in the FabLab. However, we still needed to make a number of modifications to the materials while building the solar car. Everything didn't fit together as planned as errors were found and we discovered flaws in our original design. This resulted in our SSV construction time ballooning over many weeks and lasting longer than desired. However, we still had enough time planned to successfully complete the solar vehicle before race day.

Other problems also occurred with the procurement of parts. We planned time for people to look up and find parts but did not adequately plan time for shipping. This resulted in further delays in our process.

Outside of these scheduling issues, most of our other planning was fairly effective. We encountered no significant team issues and most tasks generally were completed on time.

Cooperation

Although we planned tasks using the Work-Breakdown Structure and Gantt Chart developed at the beginning of the project, we remained much more flexible in distributing the work. This was very advantageous for the team as it gave each individual the flexibility necessary to cope with a fluctuating workload in other classes. This flexibility helped all members of the team maintain a good work ethic and helped prevent any members from "burning-out" during the project. The only disadvantage to this flexibility is that it is more difficult to determine how much work each individual actually contributed throughout the project. We estimated the proportion of time spent throughout this project on various tasks and documented this in Figure 1. We broke the tasks into five categories:

- Documenting – writing and preparing deliverables for the project
- Building – the actual construction of the SSV
- Procurement – finding and obtaining materials for the SSV
- Design – engineering work completed to create and develop the idea of the SSV for manufacturing
- Analysis – engineering work completed to optimize the SSV and ensure that it would properly work

There are some interesting facts we can extract from this data. First, documentation took a very large proportion of time. Meanwhile, the task of procurement, which should be normally simple, was also a large part of time. This aligns well with our selection of unusual components for manufacturing and our desire to scavenge as much as possible. Our SSV contained parts taken from cars, toys, and items that members found at home. This took much more time than simply buying all the components.

Skills

At the beginning of the project, all team members had the basic knowledge required to begin the project. Everyone understood the necessary math and science that provided the baseline for everyone to learn more about solar power and small toy manufacturing. Some team members were already familiar with various tools and techniques used during the project. For example, one team member had already taken a class in the modeling of physical systems and was already experienced with Simulink. Most significant was the disparity of manufacturing aptitude amongst team members. Some members were familiar with basic manufacturing techniques (e.g. how to use a drill press to cut parts), whereas others were less familiar.

Throughout the EE4 process, all team members learned how to conduct the various forms of analysis needed to make a small solar car. Nevertheless, there are certainly some discrepancies in the aptitude each member has for the various skills. In general, the individuals whom conducted a particular task now has the best understanding of the skills needed for that task. Given that some tasks only required one or two people to complete, this discrepancy is unavoidable.

In general, we found that no particular lack of skills caused problems. However, the lack of readily available manufacturing facilities was a significant impediment to our project development. The final manufacturing and assembly work for our SSV had to be conducted at a team member's home because the necessary tools to implement our design were not available to us at the FabLab or at Group T.

Conclusion

In general, we feel that the team worked well enough to complete the task at hand. However, our team still had a number of inefficiencies which could be improved upon. These inefficiencies resulted in us rushing in the end project. We are all very satisfied that the car worked and successfully traversed the ramp. Given another week or two of time, we feel we could have definitely polished the car more and performed better.

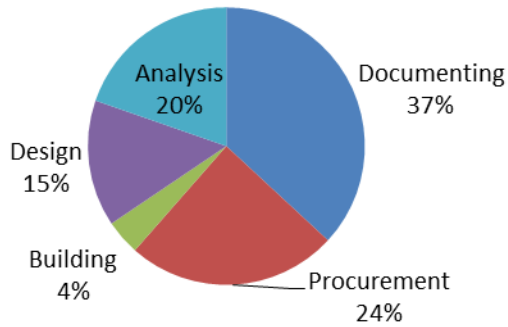
If we attempted a project of this nature again, there are certainly a couple changes we would make. First, we would order our parts earlier such that there was sufficient time for them to arrive. Second,

we would better account for vacation time. Our team completed very little during Spring Break. This was a tremendous disadvantage as it caused a great deal of rushing upon our return after break. Nevertheless, numerous team members were traveling, so we likely still would have been unable to complete much work anyways.

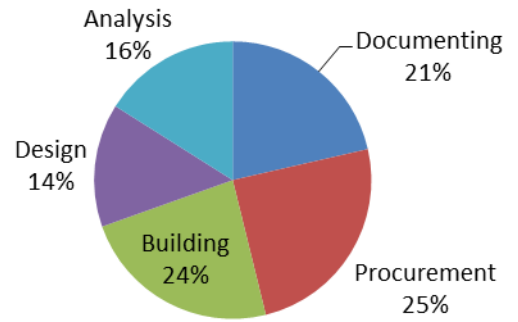
Literature

Excluding the project manual and other guiding documents provided as part of the course, no single resource was used throughout the process. When we used outside resources, we cite those sources in each separate report and/or deliverable.

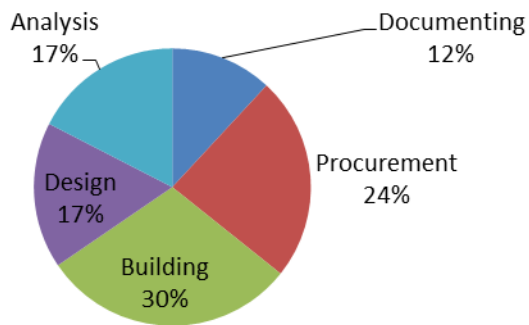
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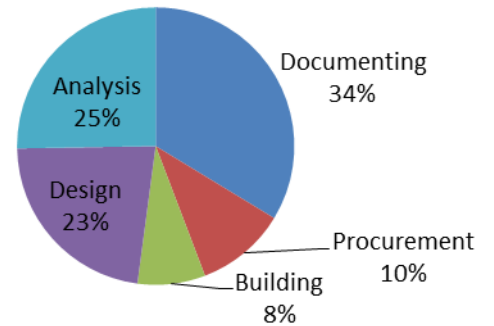
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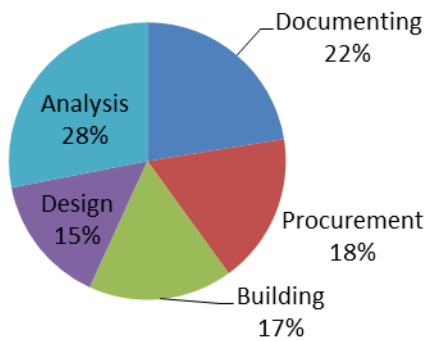
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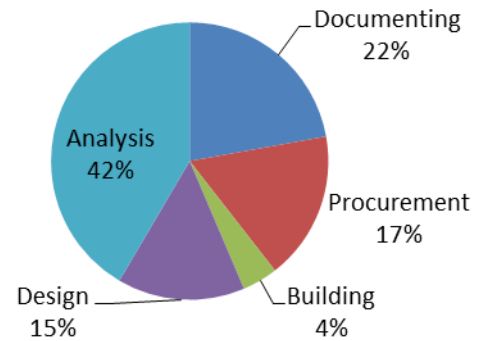
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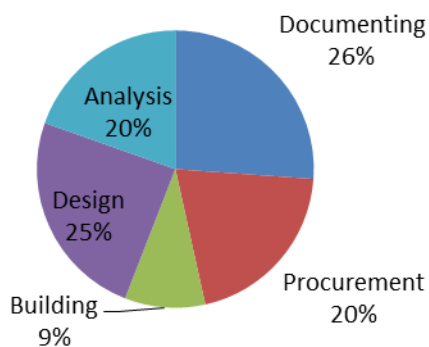
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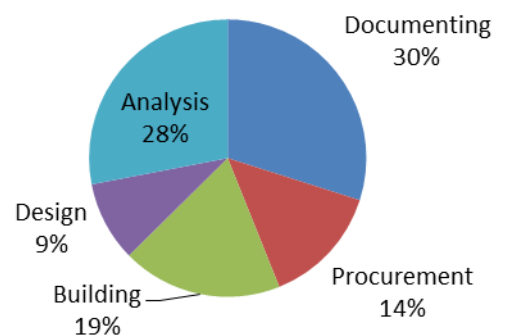


Figure 1 – Estimated breakdown of five major task groups per team member