

SAE Mini Baja West

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Team 11

Problem Statement and Project Planning Document

*Submitted towards partial fulfillment of the requirements for
Mechanical Engineering Design I – Fall 2014*



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Introduction

Society of Automotive Engineers (SAE) is a world known association for setting standards in the automotive industry around the world. SAE is also interested in collegiate opportunities and participation to help educate and stimulate future engineers. For many years SAE has helped students of all ages to develop their skills and knowledge of mechanical operations and properties. For NAU, the senior capstone mechanical engineering students are participating in competitions held by SAE in the fields of the regular class aero, the micro aero, the moon buggy and the mini Baja.

The mini Baja project is a compilation of design, from the ground up, of suspension, steering, drivetrain, frame, wheels, and overall presentation with respect to cost. The vehicle needs to be built to handle off road conditions and be competitive in different dynamic events against other schools teams. The events at the competition that the Baja vehicle will have to go through are acceleration, hill climb/traction event, maneuverability, endurance, and the sales presentation event. Each event is worth a certain amount of points, adding up to a total of 750 allowable points. Based on how the vehicle does in each event, the team will be ranked accordingly out of 100 positions. The closer you are to being rank 1, the better your vehicle overall is. This 2014-2015 competitions rules and locations have been released by SAE, as every year there are changes made to requirements and locations.

Problem Statement

Here at Northern Arizona University (NAU), Dr. John Tester has assigned the senior design project of the SAE Mini Baja to a set of senior mechanical engineering students. The task is to design and build the SAE mini Baja for the 2015 SAE competitions that will outperform Dr. John Tester's SAE mini Baja of 2014.

For the capstone project of the mini Baja, the frame team is focusing on the design and building of a single seat mini Baja frame that a fictitious firm would want to manufacture. The frame will be put through a series of dynamic events that will test the structural integrity.

Customer Needs

Dr. Tester's highest concern with the previous Baja vehicle was the weight. Last year's mini Baja vehicle weighed about 650 lbs. in total [1]. This caused them to have an acceleration

struggle while competing with the other mini Baja vehicles that had better power to weight ratios. Dr. Tester also needs the front of the frame to have a better angle for clearing obstacles and climbing hills [2].

Goals

As being the frame team of the mini Baja vehicle, our goals are many. One is to design and build a light weight frame that will meet strength, safety, and dimension requirements for SAE Baja competition(s) and our customer needs. Another goal is to integrate all additional equipment into the frame with mounting tab. Last year's mini Baja team did not design the frame with the thought or consideration of how the suspension and other components of the vehicle were going to be installed, and thus had to increase the number of structural members along with the weight of the vehicle. This year, the frame team is going to make sure to consider all other components of the vehicle when designing the frame. A third goal for us is to try and incorporate packaged extras that the vehicle can have installed while not being used in the competitions such as a glove box in the front of the vehicle, a speaker system, a winch, and additional body paneling for cosmetics. These extra will attract a buyer's eye, while not affecting the ability of the Baja while it is being used for competitions. The driver ergonomic designs is another goal for the frame team because comfortability is important, but not too important. The driver should not get fatigued or cramped while driving the vehicle in competition while being able to drive with ease. While keeping all of these goals in mind, we realize that the frame needs to be as inexpensive as possible to manufacture, but good enough to outperform previous NAU Mini Baja teams in the competitions with our current constraints.

Constraint

Most of the constraints that we must adhere to are within the SAE Mini Baja rules which can be found on their web page. A few extra constraints that we are being given is that the total width of the vehicle must not be wider than 59 inches and that the total weight must not be exceed 450 lbs.

Objectives

The objectives for the frame team are to:

- Design and build a light weight frame of maximum 150 pounds
- Design a frame that can be built within a short amount of time
- High enough strength to withstand a roll over and/or a collision
- Build the frame with considerations to all other components of the vehicle with respect to the overall dimensions so that it may be transported to and from competitions with ease

QFD

The following is the QFD with our engineering requirements and customer needs along with the House of Quality that shows the positive or negative correlations. This chart also shows the NAU's and ASU's previous mini Baja strengths in correlation with Dr. Tester's

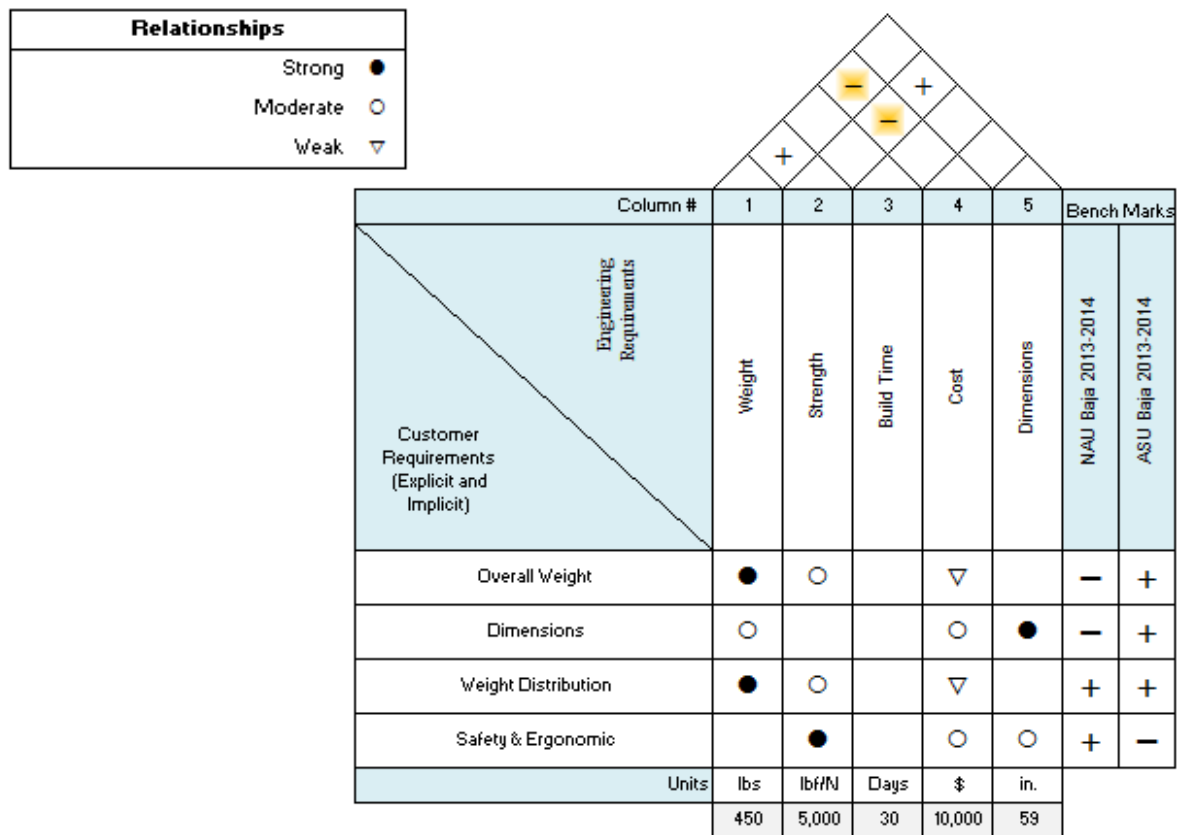


Figure 1 - QFD with HOQ: The above figure shows the relationships between customer requirements and the engineering requirements.

Project Planning

Gantt Project was used to develop a timeline for the next two semesters. Based off the Gantt chart below, the frame team's main goal is to have a frame design approved by Dr. Tester and build a prototype frame as quickly as possible for testing. Once the frame has started to be built, the team can then focus on other designs and builds for the overall vehicle.

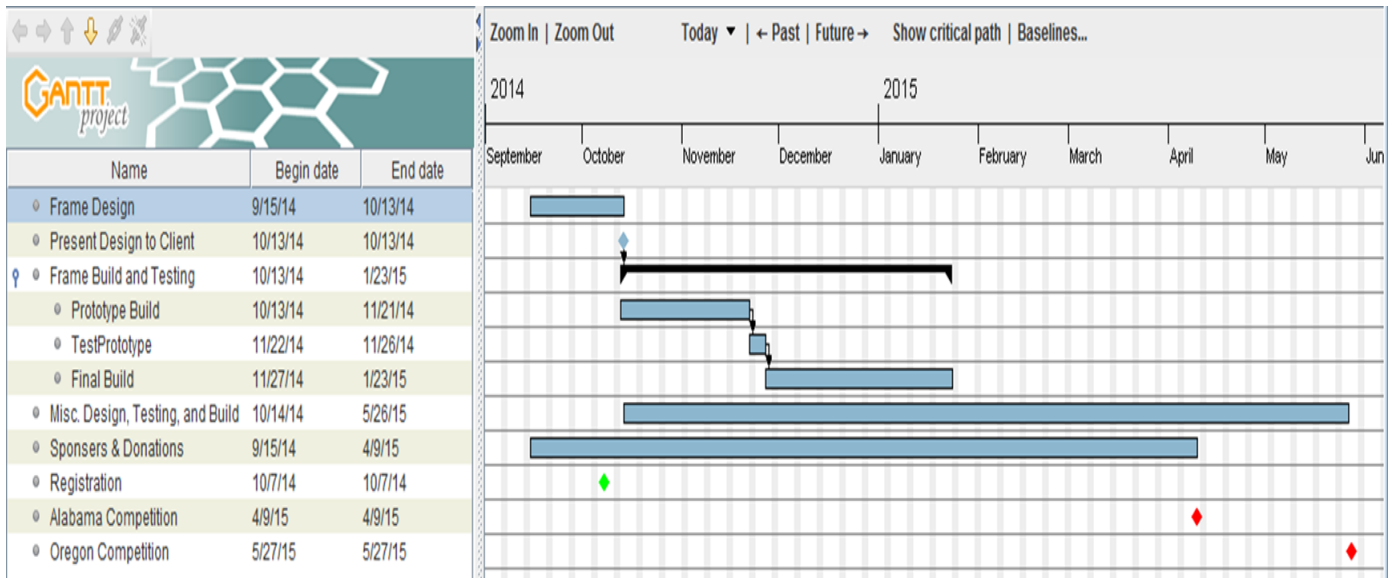


Figure 2 – Gantt chart: The following chart above shows a visual description what the frame team will be working on for the next two months.

Conclusion

Dr. Tester has asked our team to design and build a new mini Baja frame for the SAE Mini Baja 2015 Competition. He needs this new vehicle, as a whole, to weigh less than 450 lbs. The frame team has made this their main goal and objective when designing the frame with respect to the SAE Mini Baja Competition rules and constraints along with outperforming the previous NAU mini Baja team. The team would also like to design and build a prototype of the frame as quickly as possible, so they may test the structural integrity of the frame. The final product will be built no later than the Oregon Competition in May.

References

[1] Dr. John Tester

[2] K. Nam-Ho, "Introduction to Finite Element Analysis and Design" 2008, Wiley.

[3] SAE International, "2015 Collegiate Design Series Baja SAE Rules" 2014, 2014.

[4] A. T. Owens, "Structural considerations of a Baja SAE frame," 2006-12-05, 2006.

[5] NAU SAE Baja 2013-2014