Bulldogs Racing Project Plan 2016 Competition Cycle
Revisions in italics

1. Introduction

The Project Plan outlines Bulldogs Racing's goals for the 2016 competition cycle and lists strategies that Bulldogs Racing will employ to ensure that the stated goals are met. This information is presented in four sections titled Background, Scope, Structure, and Schedule.

2. Background

2.1 Bulldogs Racing

Bulldogs Racing (BR) is a small engineering team that designs, fabricates, and tests Formula SAE style vehicles. In previous years, the team has competed with hybrid vehicles in Formula SAE Hybrid. This year, BR will break from the past and design and race an electric vehicle. This choice was made out of a desire to understand and implement the new EV technologies emerging in the automotive market and to race at more competitions. The car built for 2016 will be taken to Formula SAE Hybrid, Formula North, and Formula SAE Electric. This document will focus on the relation between BR and Formula Hybrid.

2.2 Problem Statement - Formula SAE Hybrid

Formula SAE Hybrid is an engineering competition that requires students to design, fabricate, and tune Formula SAE vehicles. At the competition, teams compete in events that test the vehicle's dynamic and static capabilities and that evaluate the management and design of the vehicle.

3. Scope

3.1 Goal

Members of BR will design, build, and tune an electric Formula SAE vehicle that will compete and win Formula SAE Hybrid, Formula North, and Formula SAE Electric. The vehicle will be durable, able to compete in three competitions without major repair, and powerful, competitive at all three competitions. The vehicle will be ready for dynamic testing by February 14th. By April 25thm it will be tuned and ready to race.

3.2 Objectives

BR has two objectives, listed below in order of importance, that direct the team's actions.

3.2.1 Realizable

Designers will create realizable designs that strive for simplicity, durability, and serviceability over lavishness. Fabricators will receive these designs and construct to the tolerance specified to ensure that parts are produced on time with the acceptable level of precision. The success of the vehicle will be evaluated by its completion on time and by its ability to complete three competitions without requiring major repair.

3.2.2 Competitive

BR will purchase and design around two Emrax 207 Medium Voltage electric motors and 86 A123 Lithium Iron pouch cells, creating the most competitive battery-motor combination available. The battery will provide a voltage of 284V and a peak current of 600A. This output will provide a max torque of 140 Nm and a max rotational speed of 6000 rpm. When coupled with a 4:1 planetary gearbox, these figures translate into a max top speed of 150 kph and an acceleration over 1g.

3.3 Deliverables

A tuned FSAE vehicle with supporting design and project management documentation will be completed by April 25th, 2016.

3.4 Milestones

Milestones are shown in the Gantt chart (figure 2). A full list can be found in appendix 1.

3.5 Expected Results and Measures of Success

An FSAE vehicle built in accordance to the objectives will be completed on time vis-à-vis the Project Plan. Accordingly, t*he vehicle will have a 0-100 kph time of 2.6 seconds, a 75-meter time of 3.2 seconds*, an efficiency of 80%, and the ability to finish a 44 km endurance course at an average speed of 48 kph. The vehicle and project will be deemed successful if they first meet the project deadline with the desired quality and second, achieve the stated expected results.

4. Structure

4.1 Work Breakdown Structure

From an examination of the problem statement and goals, it is possible to segment the project into a work breakdown structure (WBS). This structure is illustrated below.

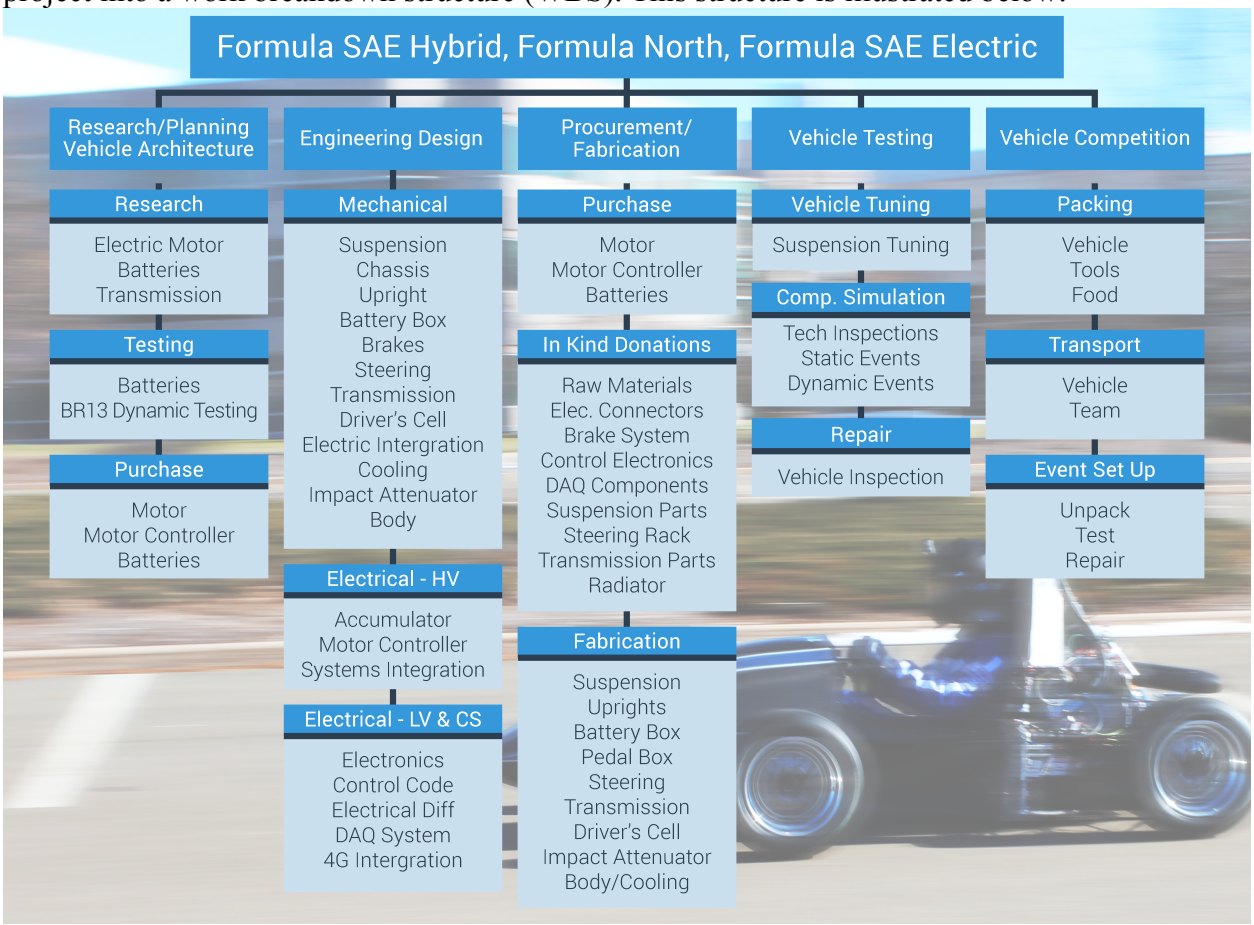

Figure 1: Work Breakdown Structure

4.2 Team structure

Using the WBS as a guide, BR is split into a series of divisions, each tasked with accomplishing one aspect of the project. The first division, Leadership, is responsible for describing the vision of the team and communication between the team and administration. The second division, Business, focuses on managing and securing funding and in kind donations. *This division is further broken into two sub-teams, Fincance and Media. The Finance team*

searches and secures funding and purchases material and components. The Media team manages the webpage and monthly newsletter and creates promotional media. The final division, Engineering, is tasked with designing and fabricating the vehicle. Since design and fabrication is the most time consuming portion of the project, the structure of the Engineering Division is further designed.

The Engineering Team is led by a Chief Engineer and supported by a Project Manager. Together, the two determine the subtasks and associated work packages (see appendix 2) that must be designed. These work packages are assigned to project teams. Once the package is completed, the members of the project team are reassigned to a new task.

4.3 Succession Plan

To promote team growth and continuity between years and build cycles, the Leadership Division has created a succession plan that focuses on retention of engineering and leadership institutional knowledge. Engineering knowledge will be stored using two main functions, a series of design revisions housed on an SVN repository available to all team members, and design reports (appendix 3) that describes the process to complete the work package. These design reports, along with similar leadership handbooks and engineering standards adopted by BR are stored on the SVN repository in a digital library. This system will create and store the collective knowledge of BR.

5. Schedule

5.1 Gantt Chart

A list of project activity parameters (appendix 4) was constructed from the WBS and work packages. These parameters were used to create a Gantt chart that includes project timeline and critical path. A shortened version of the chart is below (full chart appendix 5).

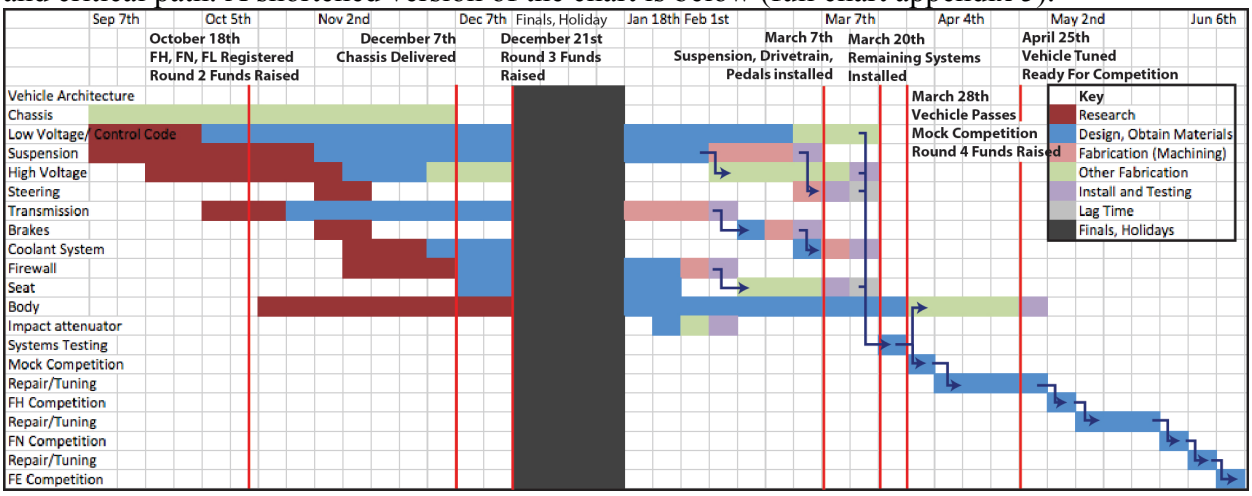

Figure 2: Gantt Chart

5.2 Change Management Process

When a project team assigned a work package realizes that they will overrun their current schedule, they submit a change request form (appendix 6) that states the cause of the delay, any potential fix that might right the delay, and a request for an extension if one is needed. The project manager reviews this document and, if a change to the project schedule is required, meets with the affected parties with the aim to find a solution that satisfies everyone. After this meeting, the project manager issues an updated project schedule *and requests new drawings with revision date. These revisions and updates are held in a repository available to all.*

6. Appendix

6.1 List of Milestones

Vehicle architecture defined	6/1
Chassis design finished	7/1
Chassis Work Order finalized	8/3
Round 1 Fundraising Goals met	8/3
Register for Formula Hybrid	10/18
Round 2 fundraising Goals met	10/18
Project Plan Finalized	11/4
Chassis delivered	*12/7*
Round 3 fundraising goals met	12/21
Suspension, Drivetrain, Pedal Systems installed	*3/7*
Remaining systems installed	*3/14*
Vehicle moves under own power	*3/20*
Vehicle completes mock competition	*3/30*
Round 4 fundraising goals met	3/28
Vehicle is tuned and ready to race	4/25

6.2 Example of Work Package

Work Package: Transmission – Design and Fabrication
Principle Designer: Dante Archangeli
October 8th, 2014
Version 1

Task Description
Design and fabricate the structures that couple the electric motors to the rear wheels. Must design for peak torque of 160nm per motor. Design should not deform plastically at 40g collision. Torsional flex of axle at peak torque no more than .7 degrees. Compatible with purchased planetary gearboxes. Max weight per axle (not including electric motor or planetary) 5 kg.

Responsible Parties
Dante Archangeli and Patrick Lawe will co-design the structure. Patrick supplies the physics knowledge while Dante supplies the material strength knowledge and design skills.

Dante will lead fabrication.

Deliverables
Structure to hold electric motor, planetary, and half shaft. Selection of half shaft, joints, and hub. Design documentation.

Budget

1	Aluminum Sheet	$145	$145
1	Steel Cylinder	$100	$100
2	Half Shaft	$120	$240
4	Joints	(included)	0
2	Hubs	$200	$400
4	Bearings	$25	$100
	Fasteners	(included)	0
			$985

Resources (human and machine)
Discussion with Joe belter (.3 Hours)
New car time to weld tabs (2 hours)
Machining and fabrication (10+ hours) (Dave Johnson and Nick Bernadino)

Time to complete
Estimate 60 hours of 2 peoples work. 3 weeks of design followed by 3 weeks of fabrication.

Measures of Success
Completion of the design within the time frame with high level of quality. Design should meet the characteristics described in the description. Additionally, the design should distribute loads to chassis nodes and should be have a working life beyond this racing season.

Required Inputs
Finalized rear axle location.

6.3 Outline of Design Report

Bulldogs Racing Design Report - Outline

Title

1. Abstract
Brief description to the project, goals, findings, and successes.

2. Introduction
Outline of the goals of this document and the order in which information will be presented.

3. Summary of Project and Aims
An indepth description of the project and goals including a project statement and potential solutions.

4. Description of Work Performed
Description of the phases of the design cycle performed. This section might include a sumamry of the research, thought, design, and fabrication process.

5. Main Resuslts Achieved
A description of the achievements of the team. A time to boast about what you did. A comparison of what you created and the measures of success outlined in the work package.

6. Challenges of the Current Solution
Improvements that could be made on the current system.

7. Further Investigation
Other directions or ideas that could be implemented into a future design.

8. Resources
A list of resources either found or created that assisted in the completition of the work package or major design.

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6.4 Project Activity Parameters

Project Activity Parameters - Based on Work Packages

Sub-Task Category	Activity	Predecessor Activity*	Duration	Responsible Party**	Resources	Cost
Planning	Vehicle architecture conceptual design		4 weeks	Executive Board		
Chassis	Design	P. Completion	8 weeks	Phil Piper, Dante Archangeli		$4,500.00
	Fabrication	Design	12 weeks		Chassis Materials, A Fabricator, Money	
Suspension	Tire selection	P. Completion	2 weeks	Phil Piper	Access to TT(	$500.00
	Research and development	P. Completion	10 weeks		Tire Selection	
	Obtain Components	R and D	2 weeks		Money	$4,000.00
	Fabrication	R and D	2 weeks		Machine Shop Acces, Welding Team	
	Install	Fabrication	1 week		Car Time	
Low Voltage	Circuit diagram	P. Completion	3 weeks	Phil Piper		
	Wiring diagram	Circuit Diagram	2 weeks			
	Obtain Components	Wiring Diagram	2 weeks		Money	$1,000.00
	Wiring Harness fabrication	Obtain Components	4 weeks		LV Components	
	Harness Test	Fabrication	2 weeks			
	Install	Fabrication	1 week		Car Time	
High Voltage	Wiring Diagram	P. Completion	5 weeks	Phil Piper		
	Obtain Components	Wiring Diagram	1 week		Money	$15,000.00
	Test batteries	Obtain Componenets	2 weeks		Batteries	
	First Battery Stack fabrication	Battery Test	2 weeks		Batteries, Machine Shop Access	
	All Stacks fabrication	First Stack Fabrication	2 weeks		Batteries, Machine Shop Access	
	Accumulator Box fabrication	Accumulator Design	3 weeks		Machine Shop Access, Protocase Sponsorship	
	Accumulator Test	Accumulator Box Design	2 weels			
	Install	Fabrication	1 week		Car Time	
Impact Attenuator	Design	P. Completion	2 weeks	Claire Mallon		
	Obtain Components	Design	1 week		Money	$100.00
	Fabrication	Design	1 week		Extra material from chassis, Machine shop access, Welding Team	
	Test	Fabrication	1 week		Extra IA device	
	Install	Fabrication	1 week		Car Time	
Firewall	Design	P. Completion	2 weeks	Jordan Gardner		
	Obtain Components	Design	1 week		Money	$300.00
	Fabrication	S. Design, Design	2 weeks		Machine shop access	
	Install	Fabrication	1 week		Car Time	
Seat	Design	P. Completion	3 weeks	Jordan Gardner		
	Obtain Components	Design	1 week		Money	$300.00
	Fabrication	F. Design, Design	7 weeks		Composites Team, Extra people, Wood shop access	
	Install	Fabrication	1 week		Car Time	
Body	Concept Creation	P. Completion	4 weeks	Sida Tang	Graphic Designer	
	Design	F. and Se. Completition, (	4 weeks	Jordan Gardner		
	Obtain Components	Design	1 week		Money	$1,000.00
	Fabrication	Obtain Components	6 weeks		Composites Team, Extra people, Wood shop access	
	Install	Fabrication	1 week		Car Time	
Steering	Design	S. Design, P. Completion	4 weeks	Yossi Kohrman-Glaser		
	Obtain Components	Design	1 week		Money	$750.00
	Fabrication	Obtain Componenets	4 weeks		Machine shop access, Welding Team	
	Install	Fabrication	1 week		Car Time	
Transmission	Design	P. Completion	4 weeks	Dante Archangeli		
	Obtain Components	Design	1 week		Money	$1,000.00
	Fabrication	Obtain Components	3 weeks		Machine shop access, Welding Team	
	Install	Fabrication	1 week		Car Time	
Brakes	Brake selection	P. Completion	1 week	Holden Lessie-Bole		
	Design	Brake Slelection	3 weeks			
	Obtain Components	Design	1 week		Money	$500.00
	Fabrication	Obtain Components	2 weeks		Machine shop access, Welding Team	
Coolant System	Design	B. Completion, P. Comple	4 weeks	Craig Wojtala	Fluids/Heat transder Lab Access	
	Obtain Components	Design	1 week		Money	$300.00
	Testing	Obtain Components	2 weeks		Fluids/Heat transder Lab Access	
	Fabrication	Obtain Componenets	2 weeks		Composites Team, Wood shop access	
	Install	Fabrication	1 week		Car Time	
Total Cost						$29,250.00

* Predecessor Activity is prefaced with sub-task acronym if activity falls within a different sub-task
** A Party is responsible for the activities listed at, and below, their name

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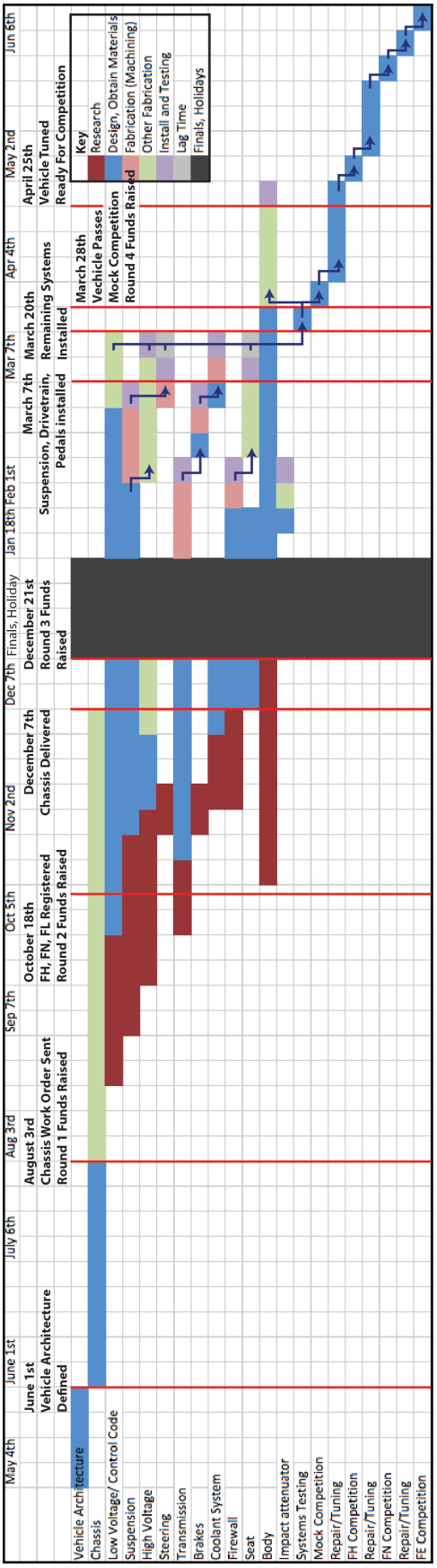
6.5 Full Gantt Chart



6.6 Change Request Form

Bulldogs Racing Change Request Form - Example

Work Package Title: Chassis Fabrication
Project Lead: Phil Piper, Dante Archangeli, Pete Sanca
Date: October 1st

Situation:
The chassis is behind schedule.

Problem:
The problem can be broken into two parts: (i) the chassis is not complete and (ii) chassis is being produced at a slow rate.

Pete Sanca, the fabricator and owner of Str8line Performance, is behind schedule for chassis delivery. The chassis was due 4-6 weeks after the material, work order, and $1000 advance were received. Pete had these items in his possession in mid August, yet the chassis is not complete. Furthermore, he has completed less than 25% of the work in the allotted time. He attributes delay to a busy racing season and many other higher priority projects.

Proposed Solution:
Currently, timely chassis completion is not a necessity. The chassis order was put in well ahead of time, thus there is a lot of lag time to account for hold ups. This solves problem one. Problem two proves trickier. If Pete continues at his current rate, he will be done in 12 to 18 weeks from today. That is far too long. Somehow we need to increase our priority. We will offer any assistance that he requires and will consider incentivizing completion before mid November (when we will begin installing some sub-systems).

Changes to Schedule:
6 weeks are added to chassis fabrication time.

Affected Parties:
No parties are currently affected. However, pedal box, suspension, and other systems are notified that their install dates may be shifted into early December or second semester.