Lafayette College Project Management Plan

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Abstract

This document is the Project Management Plan for Lafayette College Motorsports. Overall this plan reflects the primary schedule goals and milestones for the various subsystems to ensure proper completion. Proper facilitation of the Project Management process creates discipline and motivation to complete nine subsystems, all of which have significant and specific deliverables. To ensure completion of the project this year, as project managers, we continue to guide the team to finish on time and facilitate the change process that affects all the subsystems. This execution is laid out in the document and corresponding appendix.

Scope

Our goal, as the Lafayette Formula Electric Vehicle Project Management team, is to help deliver a fully functional and rules compliant electric car in Spring 2020. The Lafayette Motorsports team is composed of thirteen Electrical and Computer Engineers and twelve Mechanical Engineers. One Project Manager was assigned to oversee the electrical subsystems and one for the mechanical subsystems. We intend on individually ensuring progress for each, using schedules created by each group and ourselves, that displays the progress of each subsystem's dependencies. The management team assists using printed schedules and informing each team how their progress or lack of continuously affects the project as a whole.

The Project Managers have structured a master schedule that is dictated by the Electrical Completion Date, as well as leaving a month for dynamic testing before the competition. This deadline requires the completion of every subsystem, along with testing in the first week of February. The schedule leaves our team with little wiggle room, especially during the second-semester window.

The Team is continuously working to meet deadlines. Lafayette Motorsports has had a car that ran in the past, but this year the Team is respinning four different PCB's and running with a new chassis. The two new AMS boards are entirely the design of Lafayette Motorsports and need to be tested in December if we want to compete. The enclosure called CarMan, which includes the Car Management hardware, needs to be finished by the end of this semester to be tested with the rest of the electrical subsystems. At this point, we have two critical paths to completing this car, which are our Car Management System and our Accumulators. The three primary goals we intend on completing as quickly as possible are a prototype AMS that is ready to be tested, a completed and integrated CarMan enclosure that has been tested, and a rolling chassis.

Operations

The first month of the project involved much busywork; everyone needed to read all the rules to become familiar before a preliminary rules quiz. We also read the already created Lafayette Motorsports Statement of Work, which states the goals of the team and external class-based deliverables. During the first weeks, the Project Management team dedicated their time to creating an organizational structure.

The team ended up with two Project Managers and four system engineers — the latter function as electrical and mechanical team leaders. Other manager positions became necessary as time continued, and new managers were needed for different tasks, such as website managers and inventory managers. Website managers ensure all documentation is uploaded and posted to the website. Inventory managers take note of everything the team already has, as well as its location, ensuring that unnecessary purchases are not made. Finance managers were also assigned who is responsible for compiling purchase requests and updating weekly spending information.

Work Breakdown[1]

The work breakdown structure was crafted using our final goals and then were constrained. Early in the semester, we identified the portions of the project that would take the longest and dedicated more people and time to those. Once this overall schedule was created, each system went item by item, creating a WBS for themselves that had small goals building up to necessary bench testing and system testing goals. Some of these WBS's ended up being 6 layers deep, and each of those small work packages helps motivate the overall system goal. These WBS's were used to create an overall schedule and Gantt Chart. The Gantt chart defines a critical path for the car being finished, and it provides a guide for what systems are affected when others fall behind. It is a useful management and motivation tool.

Now that the team knew what they needed to have done and when each system created a general budget. This budget included an estimation of 15% that would go towards shipping, as well as registration and travel costs.

Using the WBS we created and the budget[2], the project managers can define a metric for our progress to the completion of a rules compliant electric vehicle. Systems have a portion of their estimated budget that they have used and a portion of their WBS' that they have completed. Using this during weekly meetings, we can quickly tell which subsystems are falling behind.

Risk Management

The team has identified 4 things that have a high risk of failure for the project. We determined what we could do to mitigate that risk.

Accumulator Management System: A battery/accumulator management system is essential to the accumulators as specified in the rules; our plan to create two new boards is going to be exceptionally difficult to complete. Although TSV is the largest team, it will still be a challenge to finish this in time for the competition. A mitigation plan for the AMS has already been set, and we have already selected a commercial BMS if our designed AMS is not complete

Accumulator Pack: The issue of the packs being extremely mechanical is a significant risk. Without a container, regardless of if the AMS is working and the cells provide voltage, we cannot go to the competition. There are many rules involving the manufacturing of the packs, so this is a significant task for only two mechanical engineers. A mitigation plan for this is to get on top of it as soon as possible. If the two people working on the mechanical portion of the packs are not making enough progress, management will need to move people from suspension and drivetrain to help design and manufacture these packs. This could be after the rolling chassis is completed, or even before if that is possible.

Any TSV and GLV non-complete isolation: As of now, the team intends on creating one enclosure for TSI and GLV, and because there is GLV present inside the accumulator containers as well, there could be a lack of complete isolation in either of these systems. If it is not entirely isolated, the team will not be allowed on the track. To fix this during design, isolation on GLV and TSV subsystems should always be a consideration. Every stage of the design process should include a test for isolation. If there exists a place of non-isolation early in the design process, it can be resolved, but later we will need to remanufacture.

Cabling and Strain Relief: In years prior, we were informed that significant issues the team faces are creating and purchasing all the cable needed and providing the proper strain relief for all those cables. A significant concern is that we will not have enough time to get all the cables we need and if cables malfunction at the competition, we will not have the means of fixing them, especially if we do not strain

[1] **Detailed version of the Team Schedule** is found in **Appendix A.**
Full Project Timeline is found in **Appendix B**, this includes a list of Major goals for each subsystem

[2] Project Budget can be found in Appendix D

relief properly. To avoid this issue, the team designated a cabling group that is responsible for the inventory as well as purchasing and creating the cables in the car. We will need to have a list of every cable, how long it is, and how it is labeled to make the overall system easier to integrate.
The rest of the portions of the project are lower risk tasks that either exist already or are being redone, so completing the previous tasks will be essential in completing the car.

Expected Results

The following is a list of measurable goals that our team set out in the beginning of the semester. These goals were important because they provided a baseline for what we want to achieve this semester. If we fail any of these goals we will consider the year a failure.

1. Create a test plan based on a solid understanding of measurement and quality assurance methodology:
    - A testing plan will be created to ensure the system as a whole operates most effectively and in compliance with the rules. This is possibly the most important as any test (if failed) could result in the car being not allowed at competition. Things need to be tested early and frequently in order to control any errata as soon as possible.
2. EV accelerates from 0-60 mph in less than 3 seconds.
    - We know we have a heavy car and heavy packs but we think we can push it to go this fast and if it cannot accelerate this quickly it will not be very exciting to drive
3. EV passes Tech Inspection and completes endurance test.
    - This is the main goal for the Electrical Engineers this semester as everything they have worked on is part of the Tech Inspection and if we cannot complete endurance we will not only lose points, but also will be very disappointed.
4. EV passes rain test
    - If we pass the rain test that means we can drive in wet conditions, that we provided proper voltage isolation, and all our enclosures are properly resistant. This will be a success for the whole team, encompassing electrical and mechanical design and something we have wanted to achieve since the first day working on the project.
5. Earning extra points wherever possible
    - We already submitted the first ESF, but our initial goal is to do everything we can early in order to get extra points so that we can make up for any design flaws or point losses.

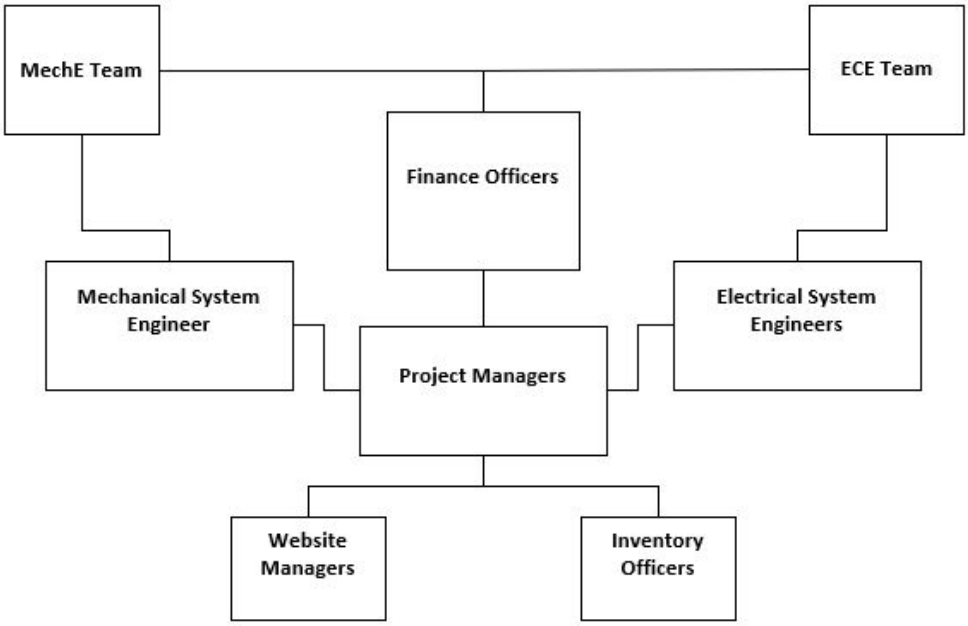
Change Management Process

Below is the process to change something about the project

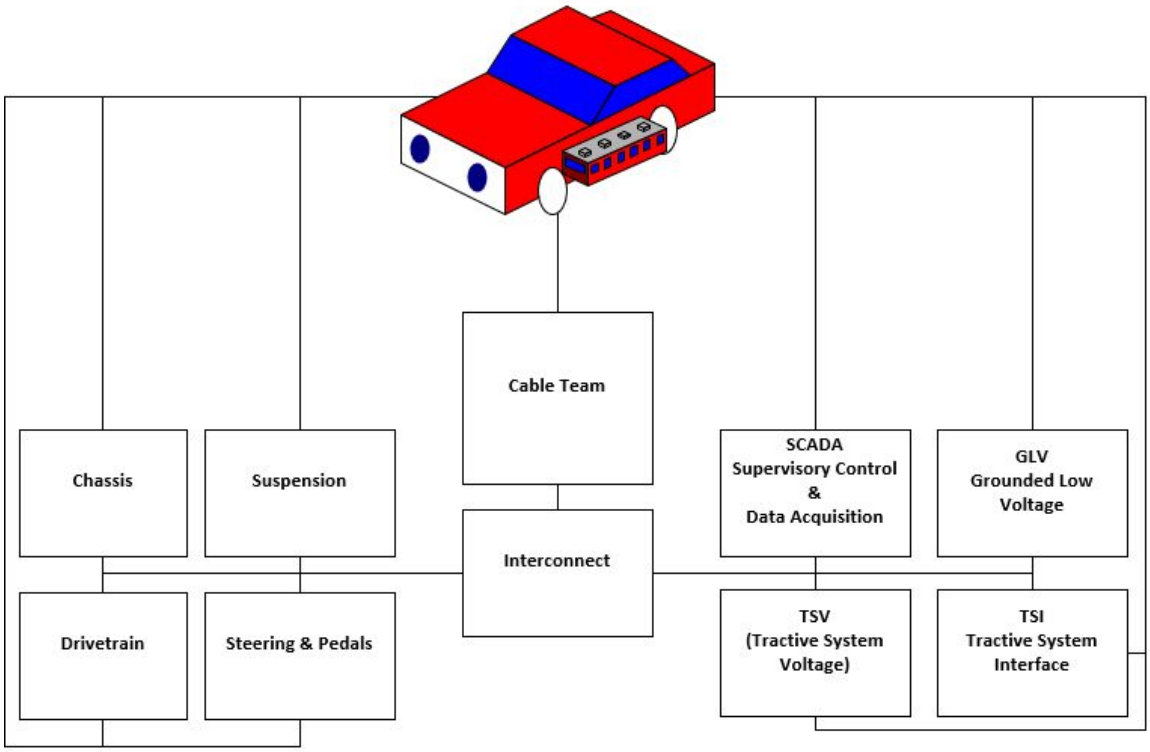
1. Submit the google form to the managers, for review to determine if this change is advisable or needed.
2. Add this requested change to your IPR so it can be documented in the Monday Meetings.
3. If the change is approved by Managers and Advisors in the Monday Meeting it will be told to all affected parties by spoken word and Email in order to record it officially and Slack (This team's Professional Messaging Software) in the case someone is unavailable.

Appendix A Overall Team Structure

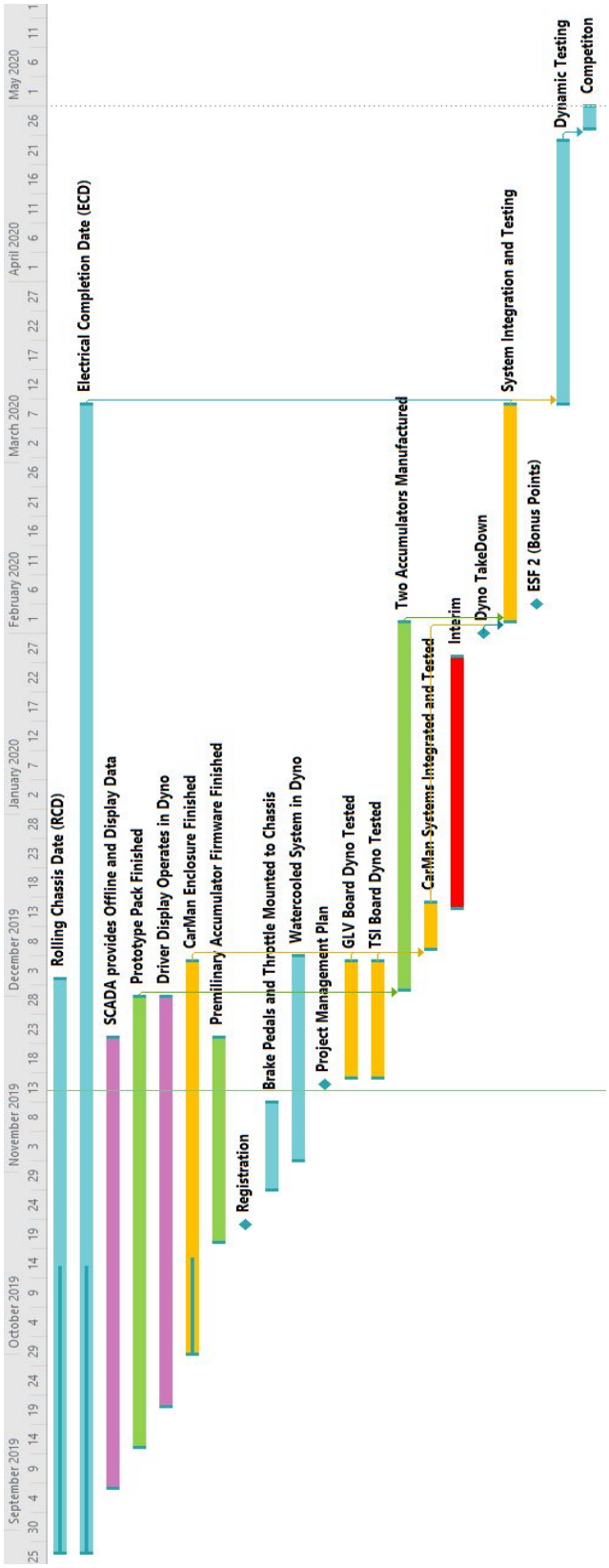
Organizational Structure



Team System Structure



Overall Gantt Chart



Appendix B Important Dates

System	Date	Goal
Management	PM plan finished	November 16th, 2019
GLV (Grounded Low Voltage)	Amend the current break out board for GLV and have it operating in the Dyno room.	December 1st, 2019
Chassis	Delivering a rules compliant chassis, with appropriate firewalling and enclosure mounts placed on frame.	December 10th, 2019
Drivetrain	System designated to mounting the motor to the chassis as well as providing appropriate torque to the wheels to actually move the car. Also responsible for handling the watercooled system and having a radiator connected to motor and controller.	December 15th, 2019
TSI (Tractive System Interface)	Amend the current TSI board and to have it soldered and testing in the Dyno room.	November 30th, 2019
TSV (Tractive System Voltage)	Produce an operational AMS (Accumulator Management System).	December 15th, 2019
TSV (Tractive System Voltage)	Produce a finished prototype pack.	December 1st, 2019
Drivetrain	Spin wheels via motor	February 14th, 2020
Interconnect	Final high level diagram completely correct.	December 15th, 2019
Suspension	System designed to be able to hold chassis off the ground under full load. Have a rolling chassis completed.	December 15th, 2019

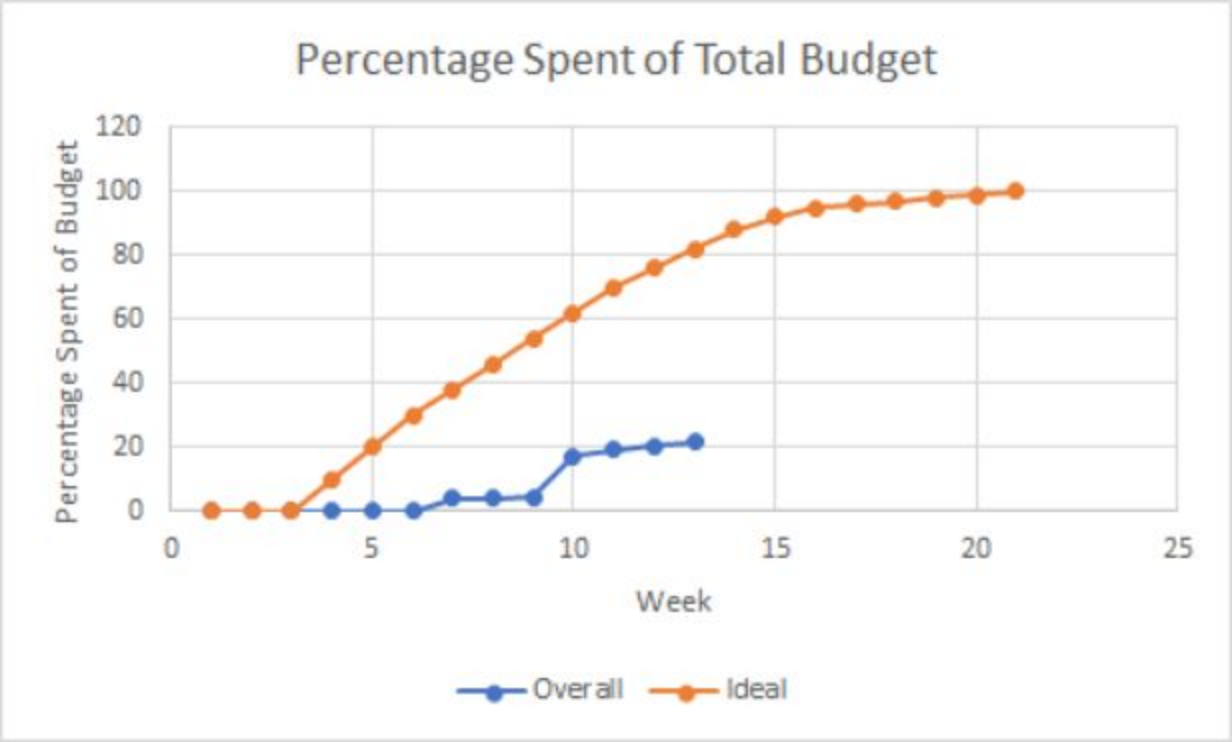
SCADA (Sensory Control and Data Acquisition	Refine current SCADA system in order to present more useful data, that can be viewed offline as well as remotely.	November 31st, 2019
TSV (Tractive System Voltage)	Produce two rules compliant packs.	February 28th, 2020
Interconnect	Enclosures mounted and wiring connected.	March 15th, 2020

Appendix C

Link to Lafayette College Motorsports Master Schedule

Appendix D Budget

Sub-System	Allocated Budget	Total Spent	Budget Remaining	Percentage Spent
Pedal/Controls	$200.00	$0.00	$200.00	0.00%
Cooling	$200.00	$170.90	$29.10	85.45%
Brakes	$400.00	$0.00	$400.00	0.00%
SCADA	$800.00	$218.87	$581.13	27.36%
Dyno	$100.00	$0.00	$100.00	0.00%
Suspension	$2,500.00	$1,309.84	$1,190.16	52.39%
Steering	$200.00	$0.00	$200.00	0.00%
CarMan (TSI/GLV)	$4,400.00	$1,109.82	$3,290.18	25.22%
Shipping/tax	$3,690.00	$206.83	$3,483.17	5.61%
Interconnect	$700.00	$371.52	$328.48	53.07%
Registration	$2,000.00	$2,000.00	$0.00	100.00%
Drive Train	$3,500.00	$69.00	$3,431.00	1.97%
TSV	$8,000.00	$574.67	$7,425.33	7.18%
Chassis/Body	$1,300.00	42.81	$1,257.19	3.29%
Overall	$27,990.00	$6,074.26	$21,915.74	21.70%


Percentage Spent of Total Budget
Percentage Spent of Budget
120
100
80
60
40
20
0
0
5
10
15
20
25
Week
Overall
Ideal