## I. Executive Summary

[THIS WILL DEPEND ON THE SPECIFIC DETAILS FOR THIS YEAR'S COMPETITION.] Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetuer id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum.

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## II. Management Summary

### A. Team Organization

Figure 1 depicts the overall organization of our team structure. Each of the teams is lead by an individual who answers to the Engineering Lead and Project Manager. The skills required for each position/team are as follows.

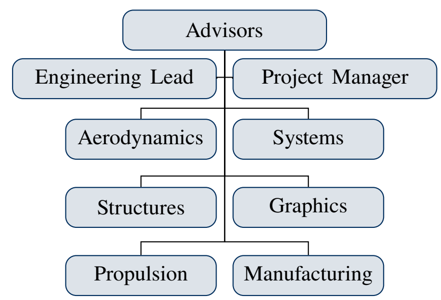



**Figure 1** Here we show the structure of, and assignment areas within, our team organization.

*Engineering Lead* As with the team leads, the Engineering Lead primarily requires good decision making and leadership skills, qualities the BYU Aero Club seeks to develop in all of its members. In addition the Engineering Lead has a well rounded understanding of the various systems and both design and testing expertise.

*Project Manager* The Project Manager has excellent organizational skills and oversees the logistical side of the project: heading up report writing, budgeting tasks, scheduling, etc.

*Aerodynamics* The Aerodyanmics team members have expertise in aerodynamic analysis and testing, including skills in hand calculations, computational analysis tools, wind tunnel and glide testing.

*Structures* The Structures team members focus on skills in structural analysis and testing, employing hand calculations, computational tools, and various structural testing methods.

*Propulsion* The Propulsion team focuses on analyzing and testing the propulsion system effectiveness and efficiency, but also has skills in electronics related to the propulsion system.

*Systems* The Systems team works very closely with the Engineering Lead, as they oversee all systems interfacing, avionics, etc. There is a sub-group of the Systems team that is assigned to work on the mission specific payload and related components, as well as related testing.

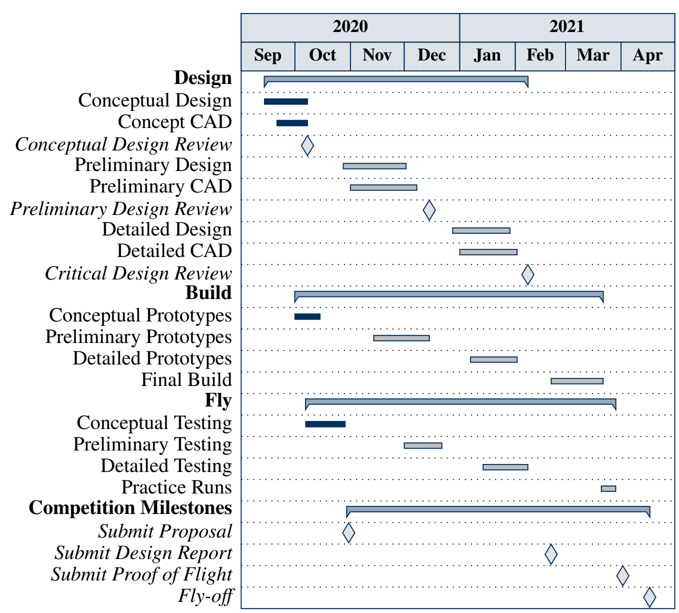



**Figure 2** This milestone chart shows our 3-phase plan for the major elements of our design, manufacturing, and testing processes.

*Manufacturing* The Manufacturing team oversees the manufacturing of all prototypes and testing apparatus.

*Graphics* The Graphics team has skills in CAD design as well as graphical marketing for the team.

### B. Schedule

Figure 2 depicts our planned timeline for the year. Sections IV and V describe the flow of our schedule in more detail. Note that at the time of submitting this proposal, we have completed the conceptual design presented herein and have moved on to our preliminary design phase. Also of note is that we began prototyping early in order to apply a "fail fast, fail often" methodology to quickly fill any gaps in understanding and allow our underclassmen to develop their aircraft design intuition faster than if we waited to prototype after completing all the design phases.

### C. Budget

Table 1 contains a breakdown of our budget estimates for the 2020-2021competition year. Note that we have not allocated any funds to aircraft shipping costs as it is more cost effective for us to drive rather than fly to the fly-off location; therefore, we can transport our aircraft ourselves at no additional cost.

To obtain funding for our team this year, we will be [NEED TO TALK ABOUT HOW YOU'RE GETTING FUNDS: CLUB, PREVIOUS YEARS WINNINGS, WEIDMANN CENTER, ETC.] Nam dui ligula, fringilla a, euismod sodales, sollicitudin vel, wisi. Morbi auctor lorem non justo. Nam lacus libero, pretium at, lobortis vitae, ultricies et, tellus. Donec aliquet, tortor sed accumsan bibendum, erat ligula aliquet magna, vitae ornare odio metus a mi. Morbi ac orci et nisl hendrerit mollis. Suspendisse ut massa. Cras nec ante. Pellentesque a nulla. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Aliquam tincidunt urna. Nulla ullamcorper vestibulum turpis. Pellentesque cursus luctus mauris.

**Table 1** Our project budget is broken down into several categories as well as individual items as shown here.

| Category | Items | Cost ($) |
|---|---|---|
| Propulsion | Brushless Motors (Qty?) \| Propellers (Qty?) \| ESCs (Qty?) | |
| Power | (how many cells?) Lipo Batteries (Qty?) | |
| Structures | Balsa Wood (Qty?) \| Monokote (Qty?) \| ABS Filament (Qty?) \| Foam (Qty?) | |
| Composites | Carbon Fiber Spars (Qty?) \| Fiber Glass (Qty?) \| Epoxy (Qty?) | |
| Electronics | Servos (Qty?) \| Receiver (Qty?) | |
| Travel | Vehicle Rental \| Gas (Qty?) | |
| Food & Lodging | Airbnb (Qty?) \| Meals (Qty?) | |
| **Total Cost** | | |

## III. Conceptual Design Approach

### A. Mission Requirements Decomposition

We have organized our sub-system requirements into aerodynamics, structure, propulsion, and specialty requirements explained below.

*Aerodynamics Requirements* Some of the major requirements for the aerodynamics sub-system are: Maximize aerodynamic efficiency in order to use less energy to overcome drag. Design wing loading to be able to take off and fly with design payload weight. Keep the wingspan within the maximum of [max span constraint this year]. Choose airfoil(s) and configuration that will make take off feasible in the [THIS YEAR'S TAKE-OFF REQUIREMENT]

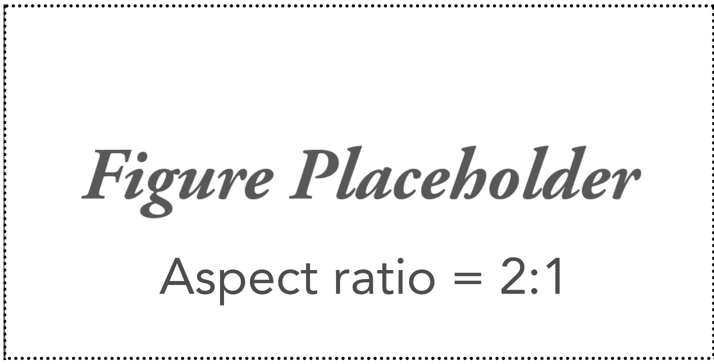
*Structural Requirements* The breakdown of mission requirements for the structures sub-system include: Minimize the structural weight while maintaining sufficient rigidity to keep the aerodynamics as designed, especially when full payload weight is in use. Make sure the structure is sufficiently rigid to avoid aerodynamic flutter within the flight envelope.

*Propulsion Requirements* The propulsion sub-system requirements are to: Have sufficient system efficiency and battery capacity to enable completion of the flight missions and maximizing endurance while also providing sufficient thrust for [THIS YEAR'S TAKE-OFF

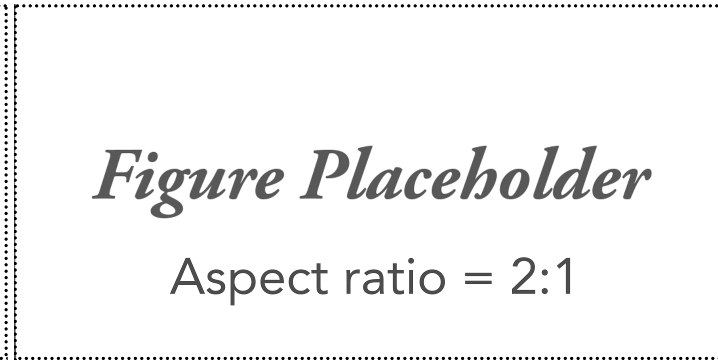
REQUIREMENT]

*Specialty Requirements* [REQUIREMENTS FOR THIS YEAR'S SPECIAL STUFF.]

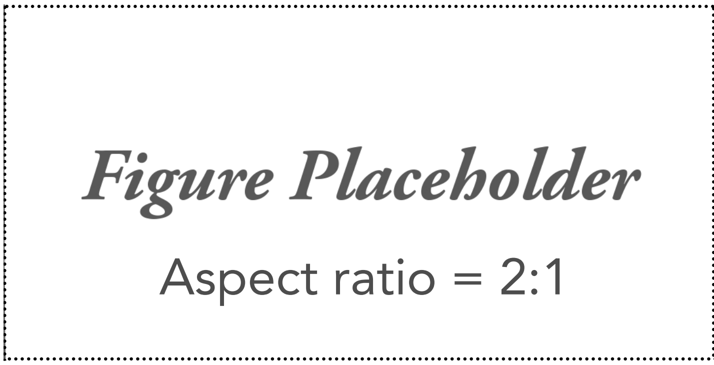
### B. Preliminary Design



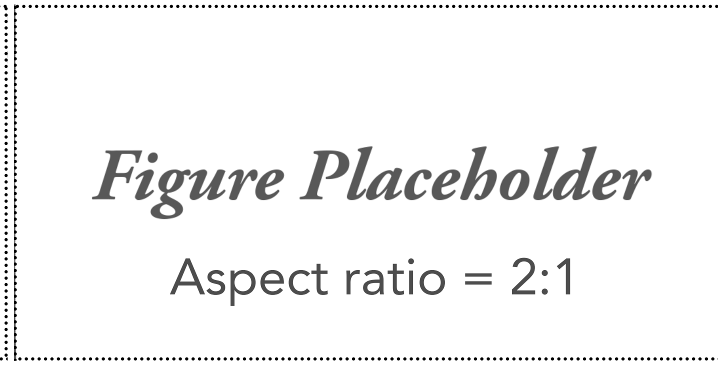

**a)** Top View




**b)** Side View




**c)** Front View




**d)** Rendered View

**Figure 3** Current drawings and rendering of our conceptual aircraft design.

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### C. Sensitivity Study

For our sensitivity study, we first differentiated between design variables that could increase/decrease our score and those that were only related to the minimum constraints. Based on the scoring metrics, we found the parameters that could affect the score to be: wing area, aircraft weight (including batteries), zero-lift parasitic drag coefficient, [WHICHEVER PAYLOAD ITEMS ARE IMPORTANT], and available power. To perform our study, we took our basic parameters and ran them through common hand calculations to find the mission objective scores. In order to normalize the scores as they are in the competition, we ran the analysis first without normalization, from which we saved the maximum scores like they are in competition. We then used those maxima as the normalization factors and re-ran the analysis, thus making sure all the sensitivities had the same order of magnitude. In our analysis, we found that the wing area and parasitic drag coefficient had the same sensitivities, thus we want to minimize drag and maximize wing loading (while still being able to take off). The available power was also important, and can be affected by increasing battery capacity, discharge rate, or voltage, or increasing system efficiency. [TAKE AWAYS FROM PAYLOAD STUFF]. We should also note that the aircraft weight had a negligible effect on the overall sensitivity, but is important to keep in mind when designing for a feasible aircraft.

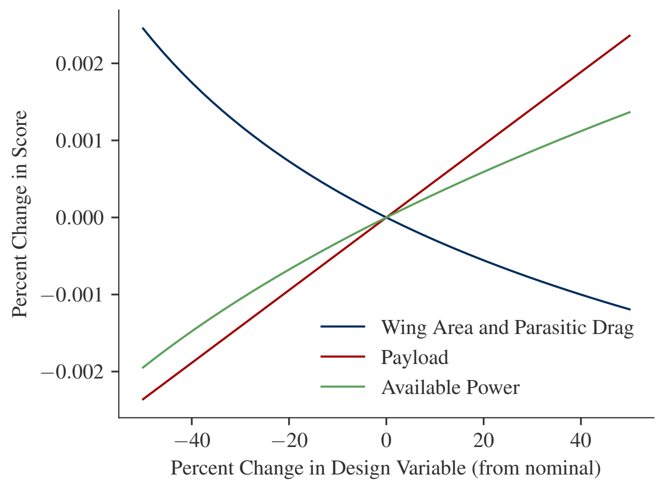


**Figure 4** This plot shows the effects of those design parameters that directly affect the increase/decrease in mission scoring beyond simple completion.

## IV. Manufacturing Plan

### A. Manufacturing Flow

Our manufacturing flow follows the outline found in figure 2 which includes three design-build-fly phases. Figure 5 shows this flow with more clarity. Note that for all phases, CAD will commence roughly a week after design starts, prototyping a week after that.

*Phase 1* We began with a conceptual design along with conceptual CAD, from which we have built concept prototypes to be used in testing as described below. [ADD A DETAIL ABOUT MATERIALS AND/OR PROCESSES.]

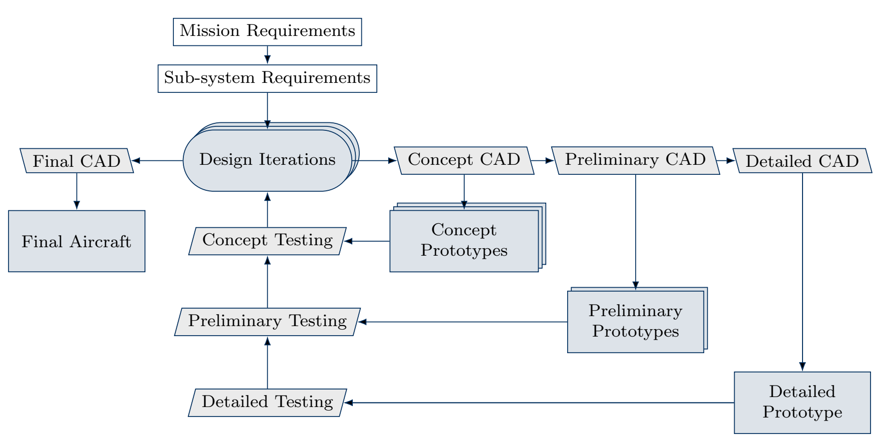


**Figure 5** Our 3-phase design, build, fly plan enables a more robust final aircraft.

*Phase* 2 We are currently beginning our preliminary design and CAD from which we will build preliminary prototypes for testing. [ADD A DETAIL ABOUT MATERIALS AND/OR PROCESSES.]

*Phase* 3 Around the new year, we will start on our detailed design and CAD, which will lead to our final testing prototypes. After polishing the design and CAD after final testing, we will manufacture our final competition aircraft. [ADD A DETAIL ABOUT MATERIALS AND/OR PROCESSES.]

### B. Critical Processes

[YOU NEED TO DISCUSS THE CRITICAL PROCESSES AND TECHNOLOGY BASED ON HOW YOU'VE DECIDED TO MANUFACTURE THINGS THIS YEAR. FOAM CUTTING? 3D PRINTING? LASER CUTTING? ETC.] Nulla malesuada porttitor diam. Donec felis erat, congue non, volutpat at, tincidunt tristique, libero. Vivamus viverra fermentum felis. Donec nonummy pellentesque ante. Phasellus adipiscing semper elit. Proin fermentum massa ac quam. Sed diam turpis, molestie vitae, placerat a, molestie nec, leo. Maecenas lacinia. Nam ipsum ligula, eleifend at, accumsan nec, suscipit a, ipsum. Morbi blandit ligula feugiat magna. Nunc eleifend consequat lorem. Sed lacinia nulla vitae enim. Pellentesque tincidunt purus vel magna. Integer non enim. Praesent euismod nunc eu purus. Donec bibendum quam in tellus. Nullam cursus pulvinar lectus. Donec et mi. Nam vulputate metus eu enim. Vestibulum pellentesque felis eu massa.

## V. Testing Plan

As mentioned in section IV.A and shown in figure 2, each of our design and build iterations culminate in testing. Testing is divided into two categories as follows: [NEED TO FLESH OUT DETAILS BELOW BASED ON THE SPECIFICS OF THE COMPETITION AND YOUR CONCEPTUAL DESIGN.]

### A. Component/Ground Test Plan

For all phases, ground testing will start roughly a week after prototyping has commenced.

*Phase* 1 We began by testing a quick series of concept prototypes for our [PAYLOAD, WING FOLDING MECHANISM, LAUNCH STATION, OR WHATEVER THEY ARE THIS YEAR] in order to quickly narrow down our brainstorming to the most viable solutions.

*Phase* 2 In our preliminary testing phase, we will be looking at functioning prototypes of [PAYLOAD, WING FOLDING MECHANISM, LAUNCH STATION, OR WHATEVER THEY ARE THIS YEAR] in order to nail down the major details of the design. This will prepare us for integration in the next phase. In this phase, we will also be begin performing preliminary wind tunnel testing to validate our propulsion system. In addition, we will perform preliminary structural testing of our anticipated wing and other critical structures.

*Phase* 3 Finally, we will integrate all the components and do dry runs of the ground mission, as well as final wind tunnel and structural testing to validate our detailed computational analyses.

### B. Flight Test Plan

In all phases, flight tests will typically take place at the end of the phase, in the week following the termination of the prototyping.

*Phase* 1 Flight testing began with our concept prototype: a hand-launched, unpowered, uncontrolled glider. Our primary goals for the concept test were to validate our static stability and general structural calculations, as well as illuminate any gotchas we may have missed in our initial design phase.

*Phase* 2 Our preliminary flight test prototype will be a powered, controlled aircraft, though without the full competition functionality. Our goal for the preliminary test is to validate our preliminary designs before moving on to detailed design aspects and full system integration, as well as note any unexpected behavior in the aircraft dynamic responses.

*Phase* 3 Our detailed design prototype will be complete enough that if desired, we could compete without building another iteration. Our goal for the final testing phase will be to fly the complete mission sequence, allowing for any final fine-tuning of the design before building our competition aircraft.