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Team SDG Sky Snake UAV

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## 1. Statement of Work

The SDG Aerospace Division has accepted a contract from the Norfolk United States Coast Guard to design and build a new long range and lightweight unmanned aerial vehicle for search and rescue operations (SAR). The execution team will include Aerospace engineers and modeling and simulation experts from the firm. The team will demonstrate the feasibility of the approved design by implementing a working prototype of the aircraft. The team will also develop a virtual simulator for training new pilots to control and monitor the UAV during operation. This includes constructing the Airframe structure and propulsion system for the aircraft and installing the necessary electronic components such as the camera or on-board processor. It also includes material and performance testing to ensure long range endurance of the aircraft during missions. The proposed budget is approximately $850,000.00 which is comprised in large part by required materials and performance testing. Funding for this project is provided by the United States Federal Government through the Norfolk United States Coast Guard Acquisition Directorate (NUSCGAD). The project’s start date is August 17, 2017 and the expected end date is May 21, 2018 (approximately 9 months).

## 2. General Assumptions

All funding for the Sky-Snake UAV Project by the SDG Aerospace Division will be the provided by the USCG. These funds will be released in a timely manner, with no concerns of being in an at-risk funding status. The USCG assumes that a funding of $850,000.00 will cover all cost to construct, design, test, and simulate the UAV and an additional $450,000.00 will be set aside in a reserve that may be used as needed. USCG and SDG has also agreed on the assumption that a 9-month window will be sufficient to complete all work, considering no sporadic events, severe extrinsic seasonal weather considerations, etc. will interrupt the progress of the project. SDG assumes that USCG will readily provide all material, fuel, and electronic equipment and if unavailable will be purchased and delivered in a timely manner. USCG is also assumed to make timely design approval decisions. Skill in Aircraft Design and Simulation is also assumed to be sufficient to construct the UAV to standard.

## 3. Strategic Importance of the Project

The United States Coast Guard’s need to innovate their search and rescue capabilities by creating the Sky-Snake UAV is a project that enables SDG Aerospace Division to enhance their product design and construction capabilities and credibility. The Sky-Snake not only serves to improve the USCG’s search and rescue missions, but also will stand as a maker for the company’s UAV design and construction capabilities. With a highly competitive new market for UAVs, this partnership with the USCG servers to put SDG as a top competitor and represent that SDG is trustworthy company to produce innovation and quality products.

### Customer Value Proposition

Since August 4th,1790 the United States Coast Guard (USCG) has been assuring a high level of safety and security among sea traveler all around sea grounds around the United States. Of the many multi-mission services that are provided by the USCG, sea search and rescues has been a service that has been in need of reform. Due to vast areas of water around the Nation, rescue mission tend to be timely, cost effect, and in some cases unsuccessful. With the protection of the citizens of the Nation their first priority, the USCG has invest large amounts of time and money into research for ensuring that they are able to sustain a high success rate in their search and rescue missions and found that UAV technology will accomplish this goal, while reducing mission time and cost.

### Company Value Proposition

Derived from a solid foundation of hard work and putting high value in building a trustful relationship with their customers, SDG has been able to produce reliable and innovative products. SDG believes that the customer deserves large amounts of credit on all creations, because they have given the company the opportunity to push their limits and strive to achieve the next level in all products. In addition, SDG Aerospace Division has been entrusted to help serve our country by employing their knowledge and experience to designing and constructing a UAV, which will allow the USCG to improve their search and rescue missions. By working hand in hand with the USCG, can prove to take the capabilities of the company to the next level by motivating them to push their limits on the project and also establish greater credibility for future projects.

1. **Work Breakdown Structure**

Provided below in table 1 is a Work Breakdown Structure that provides the WBS # for major activities, a PERT ID, and their respective estimated completion time. The estimated completion time is provided in three forms, optimistic activity time (a), most likely activity time (m), pessimistic activity time (b), and weighted average activity time (te). These estimated completion time values contained in the WBS will allow for a reference to each activities time in the PERT chart as well as the Gantt chart.

**Table 1: Work Breakdown Structure**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | | | **Description** | **Estimated Completion Time** | | | | |
| **PERT ID** | **a** | **m** | **b** | **tavg** |
| 1.0 |  |  |  | **Sky Snake UAV** |  |  |  |  |  |
|  | 1.1 |  |  | Structural Design and Build |  |  |  |  |  |
|  |  | 1.1.1 |  | Airframe |  |  |  |  |  |
|  |  |  | 1.1.1.1. | Develop Structural Design | A | 25 | 43 | 70 | 45 |
|  |  |  | 1.1.1.2. | Layout Mechanical Systems | B | 13 | 14 | 15 | 14 |
|  |  |  | 1.1.1.3. | Obtain Required Structural Materials | C | 2 | 3 | 3 | 3 |
|  |  |  | 1.1.1.4. | Construct Airframe | D | 25 | 28 | 42 | 30 |
|  |  | 1.1.2 |  | Landing Gear |  |  |  |  |  |
|  |  |  | 1.1.2.1. | Design Landing Gear | E | 11 | 12 | 13 | 12 |
|  |  |  | 1.1.2.2. | Obtain Bearings, Wheels, and Retractors | F | 2 | 3 | 7 | 3 |
|  |  | 1.1.3 |  | Structural Tests |  |  |  |  |  |
|  |  |  | 1.1.3.1. | Test Aerodynamics | G | 3 | 6 | 7 | 6 |
|  |  |  | 1.1.3.2. | Test Landing Gear Retraction | H | 1 | 3 | 7 | 3 |
|  |  |  | 1.1.3.3. | Test Structural Durability | I | 5 | 10 | 15 | 10 |
|  |  |  | 1.1.3.4. | Test Material in All Weather Conditions | J | 3 | 6 | 15 | 7 |
|  | 1.2 |  |  | Propulsion System Design and Build |  |  |  |  |  |
|  |  | 1.2.1 |  | Fuel System |  |  |  |  |  |
|  |  |  | 1.2.1.1. | Create Fuel System Design | K | 7 | 12 | 14 | 12 |
|  |  |  | 1.2.1.2. | Install Propellers | L | 1 | 1 | 1 | 1 |
|  |  |  | 1.2.1.3. | Install Fuel tanks | M | 3 | 7 | 14 | 8 |
|  |  |  | 1.2.1.4. | Install Air Intake and Exhaust Manifolds | N | 3 | 6 | 12 | 7 |
|  |  | 1.2.2 |  | Engine |  |  |  |  |  |
|  |  |  | 1.2.2.1. | Create Engine Design | O | 11 | 12 | 13 | 12 |
|  |  |  | 1.2.2.2. | Construct Engine | P | 6 | 7 | 14 | 8 |
|  |  |  | 1.2.2.3. | Connect Engine to Fuel Tanks and Air Intake | Q | 1 | 2 | 5 | 2 |
|  |  | 1.2.3 |  | Propulsion Tests |  |  |  |  |  |
|  |  |  | 1.2.3.1. | Test Ignition | R | 1 | 2 | 5 | 2 |
|  |  |  | 1.2.3.2. | Test Fuel Injection and Flow Rate | S | 1 | 2 | 7 | 3 |
|  |  |  | 1.2.3.3. | Test Air Intake | T | 1 | 3 | 5 | 3 |
|  |  |  | 1.2.3.4. | Test Emergency Fuel | U | 2 | 3 | 6 | 3 |
|  | 1.3 |  |  | Electrical System Design and Build |  |  |  |  |  |
|  |  | 1.3.1. |  | Electrical Components |  |  |  |  |  |
|  |  |  | 1.3.1.1. | Create Electrical Diagram for All On-Board Systems | V | 21 | 28 | 45 | 30 |
|  |  |  | 1.3.1.2. | Install On-Board Generator | W | 2 | 5 | 7 | 5 |
|  |  | 1.3.2. |  | On-Board Electronics |  |  |  |  |  |
|  |  |  | 1.3.2.1. | Install Computer Processing Components | X | 4 | 10 | 14 | 10 |
|  |  |  | 1.3.2.2. | Install Video Cameras and Infrared Sensors | Y | 5 | 6 | 8 | 6 |
|  |  |  | 1.3.2.3. | Install Transceivers for Data Uplink and Downlink | Z | 3 | 5 | 10 | 5 |
|  |  | 1.3.3. |  | Auxiliary Systems |  |  |  |  |  |
|  |  |  | 1.3.3.1. | Program Controller for Propulsion and Mechanical Systems | AA | 3 | 6 | 14 | 7 |
|  |  |  | 1.3.3.2. | Integrate Autopilot Software for Control | BB | 21 | 30 | 37 | 30 |
|  |  |  | 1.3.3.3. | Integrate Automatic Stability Enhancement | CC | 7 | 14 | 20 | 14 |
|  |  | 1.3.4. |  | Electrical Systems Tests |  |  |  |  |  |
|  |  |  | 1.3.4.1. | Test Electrical Wiring for Shorts | DD | 1 | 1 | 1 | 1 |
|  |  |  | 1.3.4.2. | Test On-Board Generator | EE | 2 | 3 | 7 | 3 |
|  |  |  | 1.3.4.3. | Test Microprocessor Communication with UAV Systems | FF | 5 | 10 | 14 | 10 |
|  |  |  | 1.3.4.4. | Test UAV Data Uplink and Downlink with Remote Pilot | GG | 2 | 7 | 14 | 7 |
|  | 1.4. |  |  | Sky-Snake Simulator |  |  |  |  |  |
|  |  | 1.4.1. |  | Controller and User Interface |  |  |  |  |  |
|  |  |  | 1.4.1.1. | Develop user interface that is intuitive to USCG pilots | HH | 20 | 28 | 45 | 30 |
|  |  |  | 1.4.1.2. | Develop control scheme for required aircraft maneuvers | II | 4 | 7 | 12 | 7 |
|  |  | 1.4.2. |  | Visualization |  |  |  |  |  |
|  |  |  | 1.4.2.1. | Build realistic virtual environment for the simulator | JJ | 27 | 65 | 70 | 60 |
|  |  |  | 1.4.2.2. | Implement either virtual or live user interface | KK | 12 | 32 | 37 | 30 |
|  |  | 1.4.3. |  | Simulator Tests |  |  |  |  |  |
|  |  |  | 1.4.3.1. | Test effectiveness of user interface and control scheme | LL | 3 | 6 | 14 | 7 |
|  |  |  | 1.4.3.2. | Implement several scenarios to test boundary conditions for the UAV | MM | 2 | 5 | 6 | 4 |
|  |  |  | 1.4.3.3. | Validate UAV simulator with real-life flight tests | NN | 2 | 3 | 5 | 3 |
|  | 1.5. |  |  | Test Plan and Flight |  |  |  |  |  |
|  |  | 1.5.1. |  | Flight Tests |  |  |  |  |  |
|  |  |  | 1.5.1.1. | Create mock scenarios to test Search and Rescue capabilities | OO | 7 | 13 | 15 | 12 |
|  |  |  | 1.5.1.2. | Choose appropriate locations to test | PP | 3 | 5 | 14 | 6 |
|  |  | 1.5.2. |  | Results Review |  |  |  |  |  |
|  |  |  | 1.5.2.1. | Determine scoring of various systems based on USCG requirements | QQ | 3 | 4 | 5 | 4 |
|  |  |  | 1.5.2.2. | Obtain testing tools for each deliverable | RR | 2 | 3 | 4 | 3 |

## 5. Technical Specifications

Provided below in table x is the technical specifications. The technical specifications are defined by the contract as well as any laws/regulations that must be upheld by the final product. Each specification below is mandatory for the final project and failing to complete any part will possibly lead to the early termination of the contract

**Table 2: Technical Specifications**

|  |  |  |
| --- | --- | --- |
| Camera:   * Infrared Capability * 25 MegaPixel   Propulsion:   * Gasoline Based * 100 hp * Single Propellor   + 4 Blades * Range 300 Nm * 90 mph - Cruise * 150 mph - Max | Structure:   * Aluminum Alloy * Retractable Wings * Weather Sealed * Landing Gear   + Retractable   + Land and Water   Dimensions:   * 1,250 lbs * 24’ x 14’ | Communications:   * Radio Controlled * Telemetry * Live Video Feed * Still Images   On Board Systems:   * Autopilot * Processor   + Multi-Core |

## 6. Stakeholder Analysis

Table x and y list the major stakeholders for the project. Table x describes how the stakeholder is linked to the project and the organization. Table y describes the approach to deal with the stakeholder and measure satisfaction. Of particular note is the inclusion of the Airframe and Electronic Manufactures and the Federal Aviation Administration (FAA). The manufactures may be third party or part of the SDG Division, but they will likely have other work besides this project. The FAA is also an important stakeholder as the UAV must hold up to regulations in order to fly.

**Table 3: List of Major Stakeholders**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Alignment of interests w/ project | How linked to the project | What power stakeholder has over project | How past performance is important |
| Customer | Obtain a product that can perform in the field while preventing injury to pilot. | Purchases final product and is a source of funding and design requirements. | Defines the contract details and approves project funding. | Shows willingness to cooperate with contractors and overall commitment to the project. |
| Engineering Team | Increase credibility and point of contacts | Designs the product | Final say over the final design | Gives members the chance to develop hands on knowledge of what is needed for success and how handle conflict/risks/planning/scheduling/etc. |
| Manufacturers | Contract renewal | Uses design to create physical product | Product assembly  Insight into the practicality of design | Dictates the reliability of production standards and rate.  Recurring work with manufactures can also enable cost breaks. |
| Upper Management | Maintains relationship with customer under contract  Possibility of promotion or bonus | Manages the development and creation of the product | Directs engineering team and manufactures. | Good management is able to learn from success and failure which all can impact performance, decision making, problem solving, and various other areas and skills when working on a project |
| FAA | Promotes and enforces safety, standards, and research in multiple areas of aeronautics. | Acts as a ruling authority on aeronautical design. | Certifies aircraft and enforces regulations on product design. | Experience with UAV design may lead to aircraft disapproval.  Previous incidents with FAA may also hinder aircraft design approval. |

**Table 4: Alignment Approach with Stakeholders**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Approach to deal with alignment or misalignment | How the approach will be implemented | How the satisfaction will be measured | How the performance of the stakeholder will be measured |
| Customer | Review time, scope, and cost of project and sustain frequent communicate with customer | Schedule weekly meetings with project manager and review all design decisions | Overall positive feedback on receiving finished product and design requirements met on time with minimal delays and minimal budget adjustments. | Ability to maintain a regular meeting schedule, communicate effectively, and the customer’s overall satisfaction with project. |
| Engineering Team | Reviews components that have passed or failed tests. | Weekly or Bi-weekly meetings held to review progress. | Good customer satisfaction  Stuck to budget Milestones on time | Ability to meet technical specifications in a timely manner |
| Manufacturers | Be transparent with current status of product | Maintain open communication with engineering team and customer | Product is completed to the fullest with few issues and a promise of future collaboration. | Ability to fill work order within tolerances in the agreed amount of time |
| Upper Management | Frequent communication with project manager and customer representative | Weekly meetings with project manager, customer representative, manufacturers, and engineering team | All meeting attendees provide positive feedback | Customer feedback of management’s conduct, involvement, and communication and the finished product |
| FAA | Abide by all FAA standards and regulations | Project manager will keep up-to-date with all FAA regulations and requirements | Ability to abide by all FAA regulations and requirements | Ability to provide information on a complete and thorough UAV survey with a signature of approval |

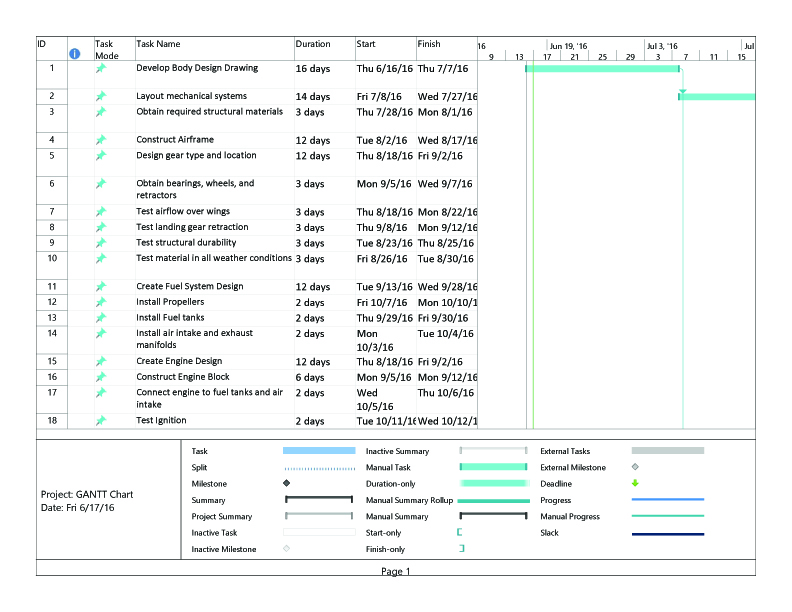
## 7. Analysis of Schedule

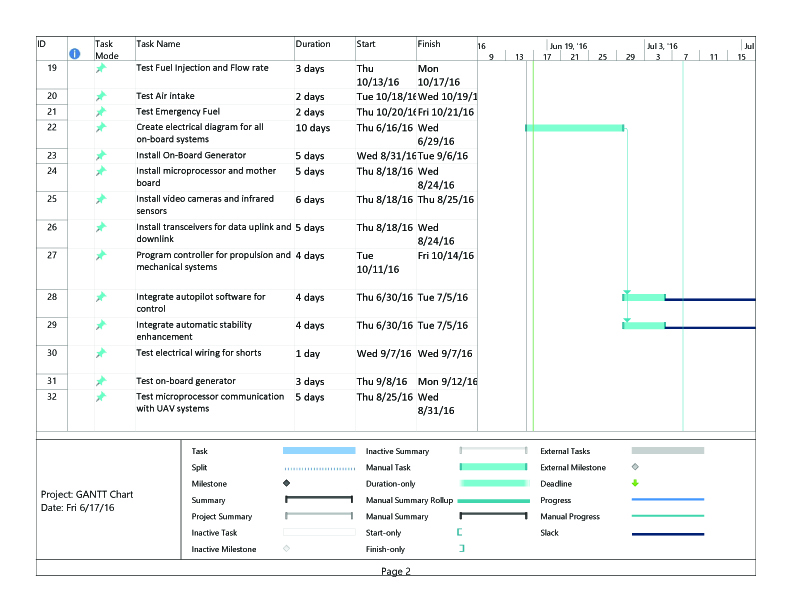
### PERT Chart

A PERT Chart is a tool that graphically represents a timeline of the project, depicting activities that must be completed throughout to life of the project in a successive order. By creating a PERT Chart, a schedule of the activities and their relationships amongst each other could be determined and a visual representation of the minimum time needed for the project completion can be shown (critical path: highlighted in red).

### GANTT Chart

By creating a Gantt Chart project coordinators can more effectively plan, coordinate, and track specific tasks in the project. Figure X, provides a Gantt Chart of all the activities required to complete Project Sky Snake. This Gantt Chart includes activity duration, start and end date, as well as indications of each task's successors and predecessors. The tavg from table X WBS were used for all activity durations.





## 8. Resource Allocation

The Resource Allocation Chart, Table/Figure X, shows the assignment of project employees/resources over duration of each activity for the life of the project. As shown resources may be exchanged amongst activities in the case of one finishing prior to another or an activity is struggling to stay on track with the schedule, in order for facilitate activity completion in a timely fashion.

Table X Resource Allocation Chart

## 9. Responsibility Matrix

Provided in table X is a responsibility matrix defining who in the organization is responsible for various work elements and deliverables. In order to ensure that SDG provides top level design of efficiency a management, assembly, testing, and various specialized engineering teams are used (i.e. aerospace, electrical, computer, and simulation engineering) will have various responsibilities distributed amongst them, based on expertise. Various responsibilities indicted in the table are as follows: R- Responsible, M - Must be consulted, S - May be consulted, I - May be notified, N - Does not play a role.

Figure X Responsibility Matrix

## 10. Risk Management

Risk management involve identification of events or conditions that may have a positive or negative impact on project objectives or project progress. Table x illustrates the four major areas of the project that risks may impact. Funding refers to the availability of current and future investment from the customer and also involves company credibility. Cost refers to any change in project budget brought on by a risky event. Technical refers directly to project goals and meeting the requirements of the customer. Scheduling refers to changes in the timeline of activities brought on by the risky event.

**Table 5: Risk Impact**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Severity of Risk and Impact | | | | |
|  | Negligible  1 | Low  2 | Moderate  3 | Significant  4 | Catastrophic  5 |
| Funding | No impact on obtaining funding or availability | May slightly impact funding amount and availability | May reduce funding amount and availability | Will limit funding and availability | Will cease higher funding and availability |
| Cost | < 2% cost overrun | 2%-5% cost overrun | 5%-10% cost overrun | 10%-50% overrun | >50% overrun |
| Technical | Almost no deviation from specifications | May deviate slightly from specifications | Will have an deviation from specifications | May have deviations that cannot be recovered | Will have deviations that cannot be recovered |
| Schedule | < 1 week delay | 1-2 week delay | 2-4 week delay | 1-2 month delay | > 2 month delay |

A score is then given for each of the areas in question. The average of this score represents the severity of the risk to the project overall. To assess the risk factor of each identified risk, both the severity of the risk and the likelihood of it occurring must be weighed together as a product. Table x illustrates both axes and a scale for how critical a risk may be to the project.

### Risk 1

Risk Title: Testing Location Unavailability

Description: Bad weather or other problems outside the project team’s control can cause testing to temporarily stop, slow down, or cause re-location of testing.

Area(s) of Impact (table X): Technical \_2\_ Cost \_4\_ Funding\_3\_ Schedule \_4\_

Severity of Impact: 3 x Likelihood: 3 = Risk Factor: 9

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Severity | Catastrophic | 5 | 5 | 10 | 15 | 20 | 25 |
| Significant | 4 | 4 | 8 | 12 | 16 | 20 |
| Moderate | 3 | 3 | 6 | **9** | 12 | 15 |
| Low | 2 | 2 | 4 | 6 | 8 | 10 |
| Negligible | 1 | 1 | 2 | 3 | 4 | 5 |
| Key:  Catastrophic ⬛ Stop  Unacceptable ⬛ Urgent Action  Undesirable ⬛ Action  Acceptable ⬛ Monitor  Desirable ⬛ No Action | | | 1 | 2 | 3 | 4 | 5 |
| Improbable | Remote | Occasional | Probable | Frequent |
| Likelihood | | | | |

Strategy to Deal with Risk: This risk will be retained and a contingency plan will be developed

Risk Indicator: Obtain daily and weekly weather reports as well as ensure management is monitoring the status of the location

Action to Tackle Risk: The project manager as well as all location site project supervisors will frequently monitor weather reports and status of the location. A contingency plan will be developed that will provide an alternative plan based on the weather severity or loss of availability. For a severe weather forecast prediction lasting longer than a week will require the PM to relocate to an alternatively planned location, rather than reschedule to keep on time. If for any reason the location becomes unavailable, then the alternative location in the contingency plan will be utilized. If unable to relocate due to conflict or unpredictable weather conditions, then additional resources will be moved to aid in gaining back lost time after the weather or condition subsides.

### Risk 2

Risk Title: Part Backorder

Description: A required part’s availability may be delayed, causing the the assembly of the UAV to deviate from the schedule.

Area(s) of Impact (table X): Technical \_3\_ Cost \_2\_ Funding \_1\_ Schedule \_4\_

Severity of Impact: 3 x Likelihood: 3 = Risk Factor: 9

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Severity | Catastrophic | 5 | 5 | 10 | 15 | 20 | 25 |
| Significant | 4 | 4 | 8 | 12 | 16 | 20 |
| Moderate | 3 | 3 | 6 | **9** | 12 | 15 |
| Low | 2 | 2 | 4 | 6 | 8 | 10 |
| Negligible | 1 | 1 | 2 | 3 | 4 | 5 |
| Key:  Catastrophic ⬛ Stop  Unacceptable ⬛ Urgent Action  Undesirable ⬛ Action  Acceptable ⬛ Monitor  Desirable ⬛ No Action | | | 1 | 2 | 3 | 4 | 5 |
| Improbable | Remote | Occasional | Probable | Frequent |
| Likelihood | | | | |

Strategy to Deal with Risk: Reduce likelihood through mitigating risk

Risk Indicator: Research information on parts from manufacturers

Action to Tackle Risk: Be aware of the availability of certain materials as well as the reliability of the part manufacturers. To reduce this risk the project manager will conduct thorough research on materials and review with designers for alternative that are not only cost effective, but also not difficult to obtain. A trusting relationship between the manufacturers and the project manager can also assist in obtaining the parts on a timely basis. In the event a part cannot be obtained without compromising project schedule, a review will be held with the designers to discuss alternatives.

### Risk 3

Risk Title: Technical Requirement Failed/Unrequired

Description: Requirement may not be able to be met or the design and construction of the UAV may surpass the established requirements resulting in a reassessment of the technical requirements and determine adjustments in the cost and schedule.

Area(s) of Impact (table X): Technical \_4\_ Cost \_3\_ Funding \_4\_ Schedule \_3\_

Severity of Impact: 4 x Likelihood: 2 = Risk Factor: 8

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Severity | Catastrophic | 5 | 5 | 10 | 15 | 20 | 25 |
| Significant | 4 | 4 | **8** | 12 | 16 | 20 |
| Moderate | 3 | 3 | 6 | 9 | 12 | 15 |
| Low | 2 | 2 | 4 | 6 | 8 | 10 |
| Negligible | 1 | 1 | 2 | 3 | 4 | 5 |
| Key:  Catastrophic ⬛ Stop  Unacceptable ⬛ Urgent Action  Undesirable ⬛ Action  Acceptable ⬛ Monitor  Desirable ⬛ No Action | | | 1 | 2 | 3 | 4 | 5 |
| Improbable | Remote | Occasional | Probable | Frequent |
| Likelihood | | | | |

Strategy to Deal with Risk: Eliminating this risk will be accomplished through avoiding

Risk Indicator: Design reviews and test evaluations

Action to Tackle Risk: In order to assure that all requirements can be met a there will be thorough design reviews with the customer, who will approve all requirements are met. The construction of the UAV will also be followed by testing that will determine if reworking activities are needed. This will repeat until all requirements are fulfilled. The project manager will also clearly identify all roles and requirements that will be follow precisely.

### Risk 4

Risk Title: Assembly Time Overrun

Description: SDG assure quality products by collaborating with top of the line manufacturers. However, it is of important to recognize that some tasks may unexpectedly be delayed due to manufacturing problems or other contracts the manufacture may have at the time. This can cause an increase in assembly time and overall higher cost.

Area(s) of Impact (table X): Technical \_1\_ Cost \_3\_ Funding \_2\_ Schedule \_4\_

Severity of Impact: 3 x Likelihood: 2 = Risk Factor: 6

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Severity | Catastrophic | 5 | 5 | 10 | 15 | 20 | 25 |
| Significant | 4 | 4 | 8 | 12 | 16 | 20 |
| Moderate | 3 | 3 | **6** | 9 | 12 | 15 |
| Low | 2 | 2 | 4 | 6 | 8 | 10 |
| Negligible | 1 | 1 | 2 | 3 | 4 | 5 |
| Key:  Catastrophic ⬛ Stop  Unacceptable ⬛ Urgent Action  Undesirable ⬛ Action  Acceptable ⬛ Monitor  Desirable ⬛ No Action | | | 1 | 2 | 3 | 4 | 5 |
| Improbable | Remote | Occasional | Probable | Frequent |
| Likelihood | | | | |

Strategy to Deal with Risk: Reduce likelihood through mitigating risk

Risk Indicator: Weekly estimates

Action to Tackle Risk: Each activity will have a time buffer worked into its duration, which will allow for time on each activity to overrun past its allotted time frame if the risk were to occur. In addition, a report will be required from the manufacturer if assembly is overdue.

### Risk 5

Risk Title: Cost Overrun

Description: Various cases may cause the cost of the project to increase. This can be due to inaccurate cost estimates, inflation of labor and part cost, poor scheduling, etc. As a result the customer may have a lower amount of trust in the company and lower future funding opportunities.

Area(s) of Impact (table X): Technical \_1\_ Cost \_5\_ Funding \_3\_ Schedule \_2\_

Severity of Impact: 3 x Likelihood: 4 = Risk Factor: 12

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Severity | Catastrophic | 5 | 5 | 10 | 15 | 20 | 25 |
| Significant | 4 | 4 | 8 | 12 | 16 | 20 |
| Moderate | 3 | 3 | 6 | 9 | **12** | 15 |
| Low | 2 | 2 | 4 | 6 | 8 | 10 |
| Negligible | 1 | 1 | 2 | 3 | 4 | 5 |
| Key:  Catastrophic ⬛ Stop  Unacceptable ⬛ Urgent Action  Undesirable ⬛ Action  Acceptable ⬛ Monitor  Desirable ⬛ No Action | | | 1 | 2 | 3 | 4 | 5 |
| Improbable | Remote | Occasional | Probable | Frequent |
| Likelihood | | | | |

Strategy to Deal with Risk: Reduce likelihood through mitigating risk

Risk Indicator: Weekly estimates

Action to Tackle Risk: Of the total about of money dedicated to the project, a portion will be set aside as into budget reserve, while the rest is distributed amongst the various activities. If there is a cost overrun, money can be extracted from the reserve to cover the cost.

### Risk 6

Risk Title: FAA Compliance

Description: It may be the case that the UAV Design or Construction does not meet FAA regulations, which can alter technical requirements, increase cost and completion time, as well as cause distrust that may cease funding and cause an out of pocket expense to fix the UAV.

Area(s) of Impact (table X): Technical \_5\_ Cost \_4\_ Funding \_5\_ Schedule \_4\_

Severity of Impact: 5 x Likelihood: 3 = Risk Factor: 15

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Severity | Catastrophic | 5 | 5 | 10 | **15** | 20 | 25 |
| Significant | 4 | 4 | 8 | 12 | 16 | 20 |
| Moderate | 3 | 3 | 6 | 9 | 12 | 15 |
| Low | 2 | 2 | 4 | 6 | 8 | 10 |
| Negligible | 1 | 1 | 2 | 3 | 4 | 5 |
| Key:  Catastrophic ⬛ Stop  Unacceptable ⬛ Urgent Action  Undesirable ⬛ Action  Acceptable ⬛ Monitor  Desirable ⬛ No Action | | | 1 | 2 | 3 | 4 | 5 |
| Improbable | Remote | Occasional | Probable | Frequent |
| Likelihood | | | | |

Strategy to Deal with Risk: Reduce likelihood through mitigating risk

Risk Indicator: Testing evaluations and FAA UAV rules, regulations, requirements, etc.

Action to Tackle Risk: The project manager will hold the responsibility of keeping up to date with all FAA UAV regulations. By keeping up with all FAA UAV information will allow the project manager to assure the UAV is up to FAA standard. When testing all results will be carefully reviewed and compared to FAA standards during the scoring phase. In the case that the UAV fails any requirements, it will be reworked until otherwise. There will be no release of the product until all tests are passed up to FAA standards.

## 11. Critical Knowledge

Critical knowledge is important for the project success as it enables SDG to gain a better understanding of the environment for which the product is entitled for with little or no outstanding issues, the various needs of customer, how to increase the likelihood that the product will be as efficient product for the task in which they are trying to accomplish, and how to maintain strong knowledge of a project that requires knowledge from multiple disciplines. By identifying these critical pieces of knowledge will enable a successful outcome in SDG’s Sky Snake UAV design and construction, allowing the team to strive for prosperous strategic goals, values, and incorporate skills present in the highly collaborative environment for which this project will take place. Provided below in table x are 4 areas of critical knowledge that SDG believes will elevate the overall understanding of the project and enable high efficiency throughout the project life cycle.

**Table 6: Critical Knowledge Analysis**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **USCG Expectations and Requirements** | **FAA Regulations** | **Cross-Discipline Knowledge and Communication** | **Design for Efficiency** |
| **Why the knowledge Is critical** | +Final Product is based on customer expectations and requirements | +Failure to follow regulation will likely result in penalties or termination | +UAV utilizes concepts across several disciplines | +Facilitates final product’s ability to meet and exceed expected specifications |
| **Source(s) of the critical knowledge** | +Customer | +FAA Engineering Codes | +Engineers’ own experience  +Common communication method | Trying to say something like communicating with expert engineers from other fields |
| **Method of knowledge Transfer** | +Meetings with customer | +Reading Document  +Inspections | +First meeting  +Team leaders | Weekly meetings, thorough documentation, team leaders |
| **Method of knowledge creation** | Customer requirements, concept of design | Environmental laws and safety standards | +Set Up new communication routes  +Assign authority | Senior level engineers and research |

## 12. Communication Management

Maintaining prompt communication throughout the progression of the project is a main objective of SDG. By ensuring that all those involved are up to date with the most current information, changes, and results is believed to allow for a much smoother overall progression of the project. Below in table X are 4 key communication activities that hold a critical purpose in allowing that proper succession of the project is maintained. Identified are each communication activity’s source, recipient, purpose, information and data needed frequency, channel, noise source, noise elimination, feedback, and ID/title.

**Table 7: Critical Communication**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Critical Communication Activities** | | | |
| **Progress Reports** | **Contract Modifications** | **Test Results** | **Milestone Reviews** |
| **Sources** | Engineering Team or Project Manager | USCG or FAA | Engineering Team | Project Manager |
| **Recipient** | USCG and Upper Management | Project Manager | Upper Management | USCG and Upper Management |
| **Purpose** | Keep relevant stakeholders up-to-date | Add or remove requirements to the project in progress | Re-evaluate progress  Reassign activities | Determine if the project is on budget and deadline |
| **Information and Data Needed** | Activity Progress | Changes in Time, Scope, and Funding | Component pass or fail test | Current status of the project |
| **Frequency** | Weekly at end of workweek | At Discretion of USCG or FAA | After test batch has been completed or after a critical failure | After milestone is reached |
| **Channel** | By emailed document sent over secure connection | Can be by email but usually in person. | Presentation | Presentation |
| **Noise Reduction/Elimination** | Showcase only minimal information necessary to estimate progress | Must go through management first | Always submitted in specific format | Should incorporate all those involved in achieving milestone |
| **Feedback Timing** | Expect at the beginning of workweek | After modifications have been approved or denied | Initial results expected no later than a week after received | Feedback is usually given during the review |
| **ID/Title** | **WP** | **CM** | **TR** | **MR** |

## 13. Project Budget

Depicted in table X is the project budget for Sky-Snake UAV. The total budget for this project is $850,000.00, excluding a $450,000.00 budget reserve that may be provided to help accomplish an activity if needed. All project funding is time-phased based on the work breakdown structure. This table provides estimated costs for each activity along with totals for their respective workplaces as well as the total costs for each task. Each activity contains a date in which funds will be allocated in order to support it. In blue is the total project cost, shown in gray are totals for each tasks that summate to the project cost, in orange are work-packages that each subtotals to their respective tasks, and in yellow is the cost of each activity to their respective work-package.

**Table 8: Project Budget**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  | **Description** | **Budgeted Cost** | **Date of Allocation** |
| 1.0 |  |  |  | **Sky Snake UAV** | $850,000.00 | 8/1/2016 |
|  | 1.1 |  |  | Structural Design and Build | $192,000.00 | 8/1/2016 |
|  |  | 1.1.1 |  | Airframe | $94,000.00 | 8/1/2016 |
|  |  |  | 1.1.1.1. | Develop Body Design Drawing | $21,500.00 | 8/1/2016 |
|  |  |  | 1.1.1.2. | Layout Mechanical Systems | $13,500.00 | 10/3/2016 |
|  |  |  | 1.1.1.3. | Obtain Required Structural Materials | $48,000.00 | 11/21/2016 |
|  |  |  | 1.1.1.4. | Construct Airframe | $11,000.00 | 12/9/2016 |
|  |  | 1.1.2 |  | Landing Gear | $34,000.00 | 1/20/2017 |
|  |  |  | 1.1.2.1. | Design Landing Gear | $22,750.00 | 1/20/2017 |
|  |  |  | 1.1.2.2. | Obtain Bearings, Wheels, and Retractors | $11,250.00 | 2/7/2017 |
|  |  | 1.1.3 |  | Structural Tests | $64,000.00 | 1/20/2017 |
|  |  |  | 1.1.3.1. | Test Aerodynamics | $14,500.00 | 1/20/2017 |
|  |  |  | 1.1.3.2. | Test Landing Gear Retraction | $13,750.00 | 2/10/2017 |
|  |  |  | 1.1.3.3. | Test Structural Durability | $17,500.00 | 1/30/2017 |
|  |  |  | 1.1.3.4. | Test Material In All Weather Conditions | $18,250.00 | 2/13/2017 |
|  | 1.2 |  |  | Propulsion System Design and Build | $173,500.00 | 1/20/2017 |
|  |  | 1.2.1 |  | Fuel System | $55,800.00 | 2/15/2017 |
|  |  |  | 1.2.1.1. | Create Fuel System Design | $21,600.00 | 2/15/2017 |
|  |  |  | 1.2.1.2. | Install Propellers | $12,160.00 | 3/16/2017 |
|  |  |  | 1.2.1.3. | Install Fuel tanks | $11,340.00 | 3/3/2017 |
|  |  |  | 1.2.1.4. | Install Air Intake and Exhaust Manifolds | $10,700.00 | 3/3/2017 |
|  |  | 1.2.2 |  | Engine | $73,500.00 | 1/20/2017 |
|  |  |  | 1.2.2.1. | Create Engine Design | $48,510.00 | 1/20/2017 |
|  |  |  | 1.2.2.2. | Construct Engine | $22,900.00 | 2/3/2017 |
|  |  |  | 1.2.2.3. | Connect Engine To Fuel Tanks and Air Intake | $2,090.00 | 3/14/2017 |
|  |  | 1.2.3 |  | Propulsion Tests | $44,200.00 | 3/17/2017 |
|  |  |  | 1.2.3.1. | Test Ignition | $11,500.00 | 3/17/2017 |
|  |  |  | 1.2.3.2. | Test Fuel Injection and Flow Rate | $10,360.00 | 3/21/2017 |
|  |  |  | 1.2.3.3. | Test Air Intake | $9,500.00 | 3/24/2017 |
|  |  |  | 1.2.3.4. | Test Emergency Fuel | $12,840.00 | 3/29/2017 |
|  | 1 |  |  | Electrical System Design and Build | $187,500.00 | 8/1/2016 |
|  |  | 1.3.1. |  | Electrical Components | $36,875.00 | 8/1/2016 |
|  |  |  | 1.3.1.1. | Create Electrical Diagram For All On-Board Systems | $28,875.00 | 8/1/2016 |
|  |  |  | 1.3.1.2. | Install On-Board Generator | $8,000.00 | 3/2/2017 |
|  |  | 1.3.2. |  | On-Board Electronics | $66,625.00 |  |
|  |  |  | 1.3.2.1. | Install Computer Processing Components | $18,750.00 | 1/20/2017 |
|  |  |  | 1.3.2.2. | Install Video Cameras and Infrared Sensors | $29,500.00 | 1/20/2017 |
|  |  |  | 1.3.2.3. | Install Transceivers for Data Uplink and Downlink | $18,375.00 | 1/20/2017 |
|  |  | 1.3.3. |  | Auxiliary Systems | $56,000.00 | 9/12/2016 |
|  |  |  | 1.3.3.1. | Program Controller for Propulsion and Mechanical Systems | $18,500.00 | 3/17/2017 |
|  |  |  | 1.3.3.2. | Integrate Autopilot Software for Control | $18,000.00 | 9/12/2016 |
|  |  |  | 1.3.3.3. | Integrate Automatic Stability Enhancement | $19,500.00 | 9/12/2016 |
|  |  | 1.3.4. |  | Electrical Systems Tests | $28,000.00 | 1/16/2017 |
|  |  |  | 1.3.4.1. | Test Electrical Wiring For Shorts | $2,500.00 | 3/1/2017 |
|  |  |  | 1.3.4.2. | Test On-Board Generator | $4,200.00 | 3/2/2017 |
|  |  |  | 1.3.4.3. | Test Microprocessor Communication with UAV Systems | $8,800.00 | 1/25/2017 |
|  |  |  | 1.3.4.4. | Test UAV Data Uplink and Downlink with Remote Pilot | $12,500.00 | 1/16/2017 |
|  | 1.4. |  |  | Sky-Snake Simulator | $168,000.00 | 8/1/2016 |
|  |  | 1.4.1. |  | Controller and User Interface | $66,100.00 | 10/3/2016 |
|  |  |  | 1.4.1.1. | Develop user interface that is intuitive to USCG pilots | $34,050.00 | 10/24/2016 |
|  |  |  | 1.4.1.2. | Develop control scheme for required aircraft maneuvers | $32,050.00 | 10/3/2016 |
|  |  | 1.4.2. |  | Visualization | $58,900.00 | 8/1/2016 |
|  |  |  | 1.4.2.1. | Build realistic virtual environment for the simulator | $38,600.00 | 8/1/2016 |
|  |  |  | 1.4.2.2. | Implement either virtual or live user interface | $20,300.00 | 12/5/2016 |
|  |  | 1.4.3. |  | Simulator Tests | $43,000.00 | 12/5/2016 |
|  |  |  | 1.4.3.1. | Test effectiveness of user interface and control scheme | $12,000.00 | 12/5/2016 |
|  |  |  | 1.4.3.2. | Implement several scenarios to test boundary conditions for the UAV | $11,000.00 | 1/30/2017 |
|  |  |  | 1.4.3.3. | Validate UAV simulator with real-life flight tests | $20,000.00 | 1/25/2017 |
|  | 1.5. |  |  | Test Plan and Flight | $129,000.00 | 8/1/2016 |
|  |  | 1.5.1. |  | Flight Tests | $100,000.00 | 8/10/2016 |
|  |  |  | 1.5.1.1. | Create mock scenarios to test Search and Rescue capabilities | $40,000.00 | 1/30/2017 |
|  |  |  | 1.5.1.2. | Choose appropriate locations to test | $60,000.00 | 8/10/2016 |
|  |  | 1.5.2. |  | Results Review | $29,000.00 | 8/1/2016 |
|  |  |  | 1.5.2.1. | Determine scoring of various systems based on USCG requirements | $15,000.00 | 8/1/2016 |
|  |  |  | 1.5.2.2. | Obtain testing tools for each deliverable | $14,000.00 | 8/5/2016 |

## 14. Project Journal

Table X. below contains information about all project meetings. Meetings are broken up into sessions based on deliverables (D1: project execution plan, D2: project report, D3: team presentation, no meetings for D4: peer evaluation; Ex: Deliverable 1, Session 1). Each meeting will contain the date, type, agenda, and actions items that may be assigned to an individual or group as a whole at the end of a meeting.

**Table 9: Project Journal**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Entry** | **Date** | **Event Type** | **Objective Focus** | **Action Items** |
| 1 | 5/24/16 | Deliverable 1 Session 1 | - Initiate project (assure members are aware of needed material, documentation, group folders, know roles and responsibilities, etc.)  - Gathered questions and concerns for a better understanding of project scope, deliverables, sections, etc.  - Begin deliverable 1 project execution plan and assign sections to each member | - Project Execution Plan |
| 2 | 5/25/16 | Deliverable 1  Session 2 | - Complete project execution plan  - Revise team member availability to make a solid meeting schedule | - None |
| 3 | 5/27/16 | Deliverable 2  Session 1 | - Identify stakeholder, risks, technical specifications, and assumptions  - Begin Statement of Work (SoW), General Assumptions (GA), and Strategic Importance (SI) | - List of stakeholders, risks, specifications, and assumptions  - Complete SoW, GA, SI |
| 4 | 6/1/16 | Deliverable 2  Session 2 | - Revise SoW, GA, and SI  - Begin Stakeholder's table and WBS | - WBS draft |
| 5 | 6/8/16 | Deliverable 2  Session 3 | - Revise WBS and send questions to professor  - Begin Critical Knowledge and Critical Communications, | - None |
| 6 | 6/9/16 | Deliverable 2  Session 4 | - Revise and organize completed project sections | - None |
| 7 | 6/13/16 | Deliverable 2  Session 5 | - Complete WBS and Responsibility Matrix  - Begin Budget, PERT Chart, and Gantt Chart | - PERT chart and Gantt Chart draft  - Budget Plan |
| 8 | 6/15/16 | Deliverable 2  Session 6 | - Begin Resource Loading Chart, Stakeholder Analysis, and Risk Management  - Revise and Organize sections | - None |
| 9 | 6/16/16 | Deliverable 2  Session 7 | - Revise, organize, and continue unfinished work  - Complete Risk Management | - None |
| 10 | 6/17/16 | Deliverable 2  Session 8 | - Complete Gantt Chart, project budget, Critical Knowledge, Critical Communication, Stakeholder Analysis  - Started presentation slides | - Resource loading chart  - Pert Chart  - Formatting (Using LaTeX if time allows) |
| 11 | 6/18/16 | Deliverable 2  Session 9 | - Revise and Organize  - Complete PERT Chart, Resource Loading Chart, Responsibility Matrix |  |