Complete the following SEMP sections for: **The DARPA Urban Challenge – See Canvas/Supplemental Files – Or other Project**

# Technical Management Processes

## Integration with Cost and Schedule Management

A&B will follow an Earned Value Management (EVM) program progress management system combined with Agile principles. EVM is needed to curtail schedule lags that may occur to address the proper integration between cost, schedule, and technical progress. To ensure technical progress matches schedule and cost updates, Program Managers below the Vice Presidents and Senior Managers on the Organization Chart will provide oversight. Each technical discipline will receive a PM. By doing so, the PM will have a deeper technical knowledge for schedule delays and will understand on a technical level why the delays are happening if they are technical. The Program Managers will be ranked equally and will require collaboration between each to prioritize differences that may occur. One Senior Program Manager will lead the Program Manager and will accept accountability, promote communication between the Program Managers, and will interact with customers and those higher on the Organization Chart for information relay on progress with cost, schedule, and technical details.

As mentioned, A&B will practice Agile for easier management tracking and progress increments. Program Managers will rely on Product Owners to engage the customer regularly with any questions they may have on the development of their technical product features they are responsible for. Scrum masters will lead teams under them and work on coordination with management, product owners, and engineers to guide the Agile process.

Different software programs will be needed for implementing EVM with Agile. VersionOne will be used for employees to track and manage their schedules with work needed to be done. Program Managers will use Microsoft’s project management software for key information relay. When applicable, data will be configured with Excel for easy, universal access and manipulation. Git will be used for version control on teams where it is relevant and applicable.

Program Managers will mostly ensure cost tracking is accurate. They will approve employees timekeeping bi-weekly to ensure they’ve charged their hours honestly and accurately. They will receive weekly reports detailing how cost is comparing with technical progress and schedule. They will consult with Scrum Masters and Product Owners on a daily basis to see if any roadblocks are impeding progress that they could help to remove and to find out how they could coordinate with other technical disciplines to accomplish tasks with upstream or downstream dependencies.

Variances in schedule with technical progress may require employees to work overtime. Although A&Bs only goal with the UAV program is to finish one design for the competition, with past and future production goals they have relationships to uphold. Although overtime may be a profits net loss, their relationship with those contributing to A&Bs success will contribute more to profits in the long-run to offset short profit detriments. A&B strives to retain past customers and build relationships with future customers, with customers knowing they can expect A&B to deliver what they have promised on-time and on-budget.

## Decision-Making

Trade studies will be performed for each major design decision and other decisions related to the implementation of A&Bs design.

High-priority trade studies will include: (1) vehicle frame; (2) application software; (3) system software; (4) communications; (5) navigation/guidance; (6) central computer; (7) fire control; (8) data display and controls; (9) survivability; (10) automatic handling control; (11) auxiliary equipment; (12) avionics; (13) test and engineering support; (14) testing verification; (15) testing facilities; and (16) all data functionality. The high-priority trade studies revolve around four WBS level 2 items: Vehicle Design, Testing, IT, and Data. The first 12 items listed flow from Vehicle Design will garner the most consideration and options presented but will be hampered by purchasing a pre-built, functional Tesla model.

Informal trades will be conducted before a PDR. Before PDR, most trade studies will be searching for practical solutions and innovative ideas alike where the potential for implementation is high and any ideas are worth considering.

Up to CDR, a solidified design will take shape and any new trade studies and ideas worth implementing must consider and weigh the benefits of integration with the rest of the system. Decision matrices will be made for each formal trade study performed up to CDR for traceability and understanding on why design decisions are made.

No more formal trade studies will be conducted up to DDR. At DDR the design is thorough and well-reasoned. Any changes up for consideration to the design are only under consideration due to current design flaws with the potential to fail or compromise the performance of the UAV.

For the trade study matrices, each design decision will be weighted. Most design decisions will be fuzzy criteria, allowing for subjectivity and interpretation. For any design decision matrix with options listed and undecided up until CDR, technical specifications may be associated with the fuzzy criteria. The technical performance with its integrated components already decided on will also be considered. By weighing on a percentage decimal scale and rating each fuzzy criteria on a 1-5 scale, one decision will be reached for each design decision. One, in this case, stands for doesn’t meet minimal performance. Two interprets as meets minimal performance in some respects. Three interprets as meets minimal performance. Four interprets as exceeds minimal performance. Five interprets as significantly exceed minimal performance.

The design decision matrices will be produced in Microsoft Excel. The design decision matrices may be updated at any point to reflect the observance of more related fuzzy criteria or during information discovery, weight changes to reflect the desired system performance.

## Issue Identification and Resolution

A&B will conduct root cause analysis for all major defects. During the investigation process, three different types of causes will be thoroughly investigated: (1) physical causes where tangible, material items failed in some way; (2) human causes where people did something wrong or did not do something that was needed and may have lead to a physical cause; and (3) organizational causes where a system, process, or policy that people use to make decision or do their work is faulty. By investigating the patterns of negative effects, finding hidden flaws in the system, and discovering specific actions that contributed to the problem, root causes can be discovered to prevent their recurrence in the future.

Root Cause Analysis (RCA) begins with identification. The parties identifying a problem will flow them up to their production manager or directly to Quality Assurance. Quality Assurance will properly document the problem in accordance with DoD standards and store the data. Quality Assurance will then determine the level of impact the problem identification causes, whether the problem is frequently occurring or irregular to warrant a RCA, and the implications of the problem identification. If Quality Assurance weighs the problem objectively using scaled compliance and subjectively through meetings involving the necessary parties and determines a RCA is necessary, the process ensues.

The RCA process involves five major steps: defining the problem, collecting data, identifying possible causal factors, identifying the root causes, and recommending/implementing solutions. The first step, defining the problem, by looking at what the specific symptoms are and what is happening. The second step, collecting data, involves analyzing the situation fully before moving on to look at factors that contributed to the problem. Consulting experts is recommended and may include customers, responsible parties for implementing a solution, process owners, and people involved with environmental factors. The third step, identifying possible causal factors, aims to identify as many causal factors as possible to dig deeper and not just treat the most obvious causes. The fourth step, identifying the root causes, seeks to find why the causal factor exists and what the real reason is for the problem occurring. The roots of each factor are looked at to dig deeper at each level of cause and effect. The fifth step, recommending and implementing solutions, involves analyzing the cause-and-effect process, and identifying the changes needed for various systems while planning ahead to predict the effects of your solution.

When a RCA case study is complete and findings submitted to Quality Assurance, the Organization Chart head of QA, Program Managers involved, senior Program Manager, and other lower level organizational members involved with the RCA will need to sign off on the report to verify its accuracy.

Following a RCA, corrective measures will be put in place to mitigate the recurrence(s). Quality Assurance, safety, and Program Managers will implement corrective measures within 90 days of the incident to show A&Bs commitment to safety and customer satisfaction.

In addition to corrective actions, preventive actions may be necessary moving forward to mitigate recurrence(s). Following RCA(s), a bi-weekly meeting will be set up to implement preventive measures after surveying the involved parties. A minimum of 30 hours per RCA will be dedicated to preventive resolution(s) actions through meetings, surveys, etc. to figure out what could be improved to prevent the causes from occurring again.

## Risk and Opportunity Management

A risk assessment will be conducted and a risk matrix will be documented detailing the ranking or prioritizing of hazards. Factors deciding the hazard risk will be employee exposure and potential for incident, injury or risk.

The following Table 5-2 exemplifies a typical implemented Risk Matrix to be utilized by A&B once risks have been identified.

*Table 5-1. Risk Matrix*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Probability | High |  |  |  |
| Medium |  |  |  |
| Low |  |  |  |
|  | Low | Medium | High |
| Severity | | | | |

The x-axis Severity category will contain three severity levels:

1. High: major fracture, poisoning, significant loss of blood, serious head injury, fatal
2. Medium: sprain, strain, localized burn, dermatitis, asthma, injury requiring days off from work
3. Low: an injury requiring first aid only; short-term pain, irritation, or dizziness

The y-axis Probability category will contain three probability levels:

1. High: likely to be experienced once or twice a year by an individual
2. Medium: may be experienced once every five years by an individual
3. Low: may occur once during a working lifetime

The intersection of Probability and Severity will determine the risk level. Some risk measures require corrective actions, coded by color as follows in Table 5-2:

*Table 5-2. Risk Ratings*

|  |  |
| --- | --- |
| **Description** | **Color Code** |
| Immediately Dangerous |  |
| High Risk |  |
| Medium Risk |  |
| Low Risk |  |
| Very Low Risk |  |

The ratings resemble:

Immediately Dangerous: stop the process and implement controls

High Risk: investigate the process and implement controls immediately

Medium Risk: keep the process going; however, a control plan must be developed and should be implemented as soon as possible

Low Risk: keep the process going, but monitor regularly. A control plan should also be investigated

Very Low Risk: keep monitoring the process

Each risk will be analyzed separately, with members from safety and technical leads collaborating to confirm measures to mitigate each risk. Other systems will be studied to draw conclusions about what works for said related systems. The order of prioritization follows suit to the color coding received in the Risk Matrix, going from darker shades to lighter shades (Immediately Dangerous to Low Risk).

Risk mitigation measures will be put in place for each risk identified. An active spreadsheet will flow from the Risk Matrix to connect a bulletpoint list of Risks to their respective Mitigation Strategies. In addition to Mitigation Strategies, another category on the list will be Closeout Criteria to show a definitive measure that Risks may be mitigated by following their Mitigation Strategies.

Twenty-One “Musts” identified below support DoD and civilian agency projects and programs. The list is not all-inclusive but represents A&B follows to meet minimum conditions needed to initiate and continuously execute risk management successfully [1].

1. Risk management must be a priority for leadership and throughout the program's management levels. Maintain leadership priority and open communication. Teams will not identify risks if they do not perceive an open environment to share risk information (messenger not shot) or management priority on wanting to know risk information (requested at program reviews and meetings), or if they do not feel the information will be used to support management decisions (lip service, information not informative, team members will not waste their time if the information is not used).
2. Risk management must never be delegated to staff that lack authority.
3. A formal and repeatable risk management process must be presentone that is balanced in complexity and data needs, such that meaningful and actionable insights are produced with minimum burden.
4. The management culture must encourage and reward identifying risk by staff at all levels of program contribution.
5. Program leadership must have the ability to regularly and quickly engage subject matter experts.
6. Risk management must be formally integrated into program management
7. Participants must be trained in the program's specific risk management practices and procedures.
8. A risk management plan must be written with its practices and procedures consistent with process training.
9. Risk management execution must be shared among all stakeholders.
10. Risks must be identified, assessed, and reviewed continuouslynot just prior to major reviews.
11. Risk considerations must be a central focus of program reviews.
12. Risk management working groups and review boards must be rescheduled when conflicts arise with other program needs.
13. Risk mitigation plans must be developed, success criteria defined, and their implementation monitored relative to achieving success criteria outcomes.
14. Risks must be assigned only to staff with authority to implement mitigation actions and obligate resources.
15. Risk management must never be outsourced.
16. Risks that extend beyond traditional impact dimensions of cost, schedule, and technical performance must be considered (e.g., programmatic, enterprise, cross-program/cross-portfolio, and social, political, economic impacts).
17. Technology maturity and its future readiness must be understood.
18. The adaptability of a program's technology to change in operational environments must be understood.
19. Risks must be written clearly using the Condition-If-Then protocol.
20. The nature and needs of the program must drive the design of the risk management process within which a risk management tool/database conforms.
21. Risk management tool/database must be maintained with current risk status information; preferably, employ a tool/database that rapidly produces "dashboard-like" status reports for management.

As always, the most effective way to mitigate risk is preventive safety measures. Documentation and training sessions will routinely be provided and reminded to members working in higher safety risk positions to make sure they know what applicable safety measures they can follow. Safety engineers will ensure compliance by members on-site. Safety personnel will keep in regular contact with Occupational Safety and Health Administration (OSHA). By doing so, A&B will proactively establish safety protocols and foster an open relationship with OSHA, showing A&Bs prioritization of safety.

Active documentation spreadsheets open to all employees showing active safety risks will establish an openness to preventing and staying safe. Posters/flyers/banners will be attached throughout A&B facilities to serve as safety reminders for application measures and for conscientious reminders for workers to focus on safety in their daily tasks. For consecutive periods with no accidents reported, A&B will host celebratory events or will distribute company apparel free of charge to all employees. The active spreadsheets detailing risks and accidents will retain anonymity to drive a cultural shift away from whistleblowers.

(2015) Risk Management Approach and Plan. In: The MITRE Corporation <https://www.mitre.org/publications/systems-engineering-guide/acquisition-systems-engineering/risk-management/risk-management-approach-and-plan>. Accessed 24 Feb 2020