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

# Technical Processes

## Business/Mission Analysis

By participating in the DARPA Urban Challenge, A&B strives to contribute innovative complete ideas to the field of UAVs. The DARPA Urban Challenge gathers willing companies to participate in the competition for a monetary prize. Although the prize offers substantial money to the winner, DARPA gains significant advancements for a relatively small monetary amount in Darwinian fashion. By setting the bar high and requiring the winner to complete an obstacle course in an urban environment, A&B as well as all the other competitors must construct unique approaches to problems still causing trouble with autonomous driving, such as a passenger darting out into the road without a crosswalk.

Past DARPA challenges will be analyzed to determine the systematic approach bringing past successes and to utilize beneficial technologies into A&Bs own UAV. Consultation of past groups and organizations participating will provide useful insight about how A&B can learn from past mistakes.

## Stakeholder Needs and Requirements Definition

Considering A&B will be funding the entire operation for its own entry, A&B is the sole stakeholder and may set its evolving requirements as the entity sees fit. A&B will come up with all relevant requirements pertaining to schedule, budget, Measures of Effectiveness (MOEs), Measures of Performance (MOPs), and Technical Performance Measures (TPMs). Requirements may need modifications to fit within the guidelines set by DARPA but all other requirements are solely for A&Bs gain in keeping with a systems engineering approach and reducing costs short-term and long-term.

Trade studies will determine requirements’ definitions. Past case studies related to DARPA challenges and commercial autonomous vehicles will give relative measurements for defining the system.

Modeling and simulations will be conducted to ensure competitive progress. Mock demos will be run in-house treating the situation as though key stakeholders need progress updates. Progress will be broken down from the requirements into key features and objectives for each requirement.

## Requirements Definition, Validation, and Traceability

Requirements will be translated and stored in a running Microsoft Word document and Microsoft Excel document. Requirements will be grouped by function. Systems engineers will consult various other engineers on the progression towards validation of each requirement. Systems engineers will also compare in-house design progress to the challenges’ guidelines to make sure the design stays within tolerance on the challenges’ requiremetns. Design and analysis engineers will work towards actively modeling and simulating all the key aspects of the UAVs design. Since the amount of simulating and modeling is limitless, design and analysis will systematically prioritize the different aspects of the UAV deemed critical to success based on the priorities.

## Architecture Definition and Traceability

The system’s architecture will be broken down 3 levels by systems engineers to visualize all of the relationships between functions and operands. The relationships established in the architecture will tie back to various requirements needing sorting. During the sorting process, the architecture’s functions and operands will tie back into how each requirement is allocated between personnel and system components.

## Design Definition and Traceability

The system’s architecture will guide the system’s design. Communication needs establishment between the interface and remote computers capable of handling and controlling the vehicle. The system needs to be studied before any modifications take place from the purchased Tesla.

## System Analysis

To ensure the UAVs success, analysis will prove the systems capabilities before mock test runs. Simulations will give key indicators about what points of failure to look out for, what the system’s limitations will be, and what minimal performance thresholds to expect. Thermal simulations will point to the temperatures the vehicle and more importantly, the electronic components, can expect to endure. Structural testing will provide baselines for what crash ratings to expect and general endurance measures of the materials used.

## Implementation

Implementation of A&Bs UAV will include procurement, prototype fabrication, software, and low-rate initial production.

A&B will compile a list of established vendors from which they will purchase their aftermarket parts. A&B will analyze alternatives for each part, comparing both quality and cost, to make informed decisions. A&B will actively work to negotiate bulk order purchases and will include room in the budget for replacement parts. Tooling or other equipment may be ordered on an as-needed basis if the cost-benefit of repairing a part vs. ordering another part proves worthwhile. A log will be kept tracking the progress of each part and an active procurement area will be designated for handling product defects. Storage areas in the garage for ordered parts will be designated with neon tape and will receive their own warehouse room to move parts around. Parts may be moved around by hand when no safety risk is posed or by forklifts as needed, following strict safety and licensing rules for operation. Weekly inventory checks will help keep track of all parts to keep the vehicle free of debris (FOD). The actual vehicle will be transported on a company semi-truck, not driven, for warranty purposes and to minimize potential damage.

Machining of any metals and circuitry will be conducted on-site in the garage as needed. After carefully studying the purchased Tesla, modifications may be made for better performance, such as added dash cameras, added rollbar protection, etc… Designated zones will be partitioned where each modification will take place in the garage.

After studying the software built into Tesla’s vehicle, software engineers will work to improve upon the built-in functions. The second floor of the garage will consist of an office environment where software engineers will be allotted two 32” Dell monitors, a docking station, a company laptop with Dell i7 processor, computer mouse, office chair, and necessary cables for configuration. The software engineers will analyze what improvements need to be made, make suggested improvements, and demo their progress every two weeks. Software engineers will work closely with integration engineers during their demos to make sure the hardware poses no issues for configuration.

Given A&B will be purchasing a Tesla vehicle and will not be building one from scratch, the system needs to pay special attention to how each modification to the vehicle affects the whole system. A rotating schedule of integration will better track how each addition/modification affects the system so if a demo event goes wrong, the problem source can be isolated quickly and fixed.

Each day after attaining the Tesla, A&B will work towards meeting program deadlines and working overtime as needed. Before attaining the Tesla, some production will take place preparing modifications based on best guesses on what will work.

## Integration

A&Bs facilities will consist of a garage and 100-acre test racing track. Other racing tracks may be utilized owned by third parties. The garage will host a warehouse area, circuitry assembly area, retrofit area, modifications/additions zoning areas, software and miscellaneous engineering office environment on the second floor, procurement storage area, classified room if needed, conference room, and executive suite.

Along the testing track, every 20 miles, will be monitoring towers equipped with video surveillance, road maintenance tools, and first aid kits. These towers will provide check points during testing.

Each different area of production will be zoned off with safety tape. Daily toolbox checks will take place to keep the production floor FOD-free. Rearrangement of the production floor may take place depending on integration needs.

## Verification and Traceability

The main verification event for A&Bs UAV will be DARPAs National Qualifier Event (NQE). The NQE will show if the technologies developed by A&B are good enough to qualify for the national event. Up until the NQE, all verification will come from subcomponent demos and test track runs. The test track runs should show improving times and obstacles avoided with each new piece of technology added. With the goal of winning the grand prize, A&B strives to field a UAV with test track run times besting past winners and will include more difficult obstacles than to be expected in the challenge.

## Transition

The company will secure the modified tesla onto a company semi-truck one week before the DARPA Urban Challenge. Upon arriving at the challenge’s destination, A&B will have rented a private storage garage for inspection and tests.

Leading up to the event, A&B will conduct daily stationary tests to determine functionality and any possible points of failure. By the time the vehicle arrives at its storage garage, no further software modifications will be made for improvement but software changes may be needed if they prove to be a possible point of failure.

A&B employees needed at the challenge will be transported by company buses or will set up flight travel arrangements on a company card.

Basic repair tooling, test laptops, data recording devices, and other pieces of technology used for monitoring A&Bs UAV will be brought aboard the buses as well.

## Validation

A&Bs final evaluation event will be how it fares at DARPAs Final Event. With the end goal of ultimately winning the competition, A&B will set reasonable but competitive requirements for winning the Final Event. The designed UAV will be considered exceptional if it wins the Final Event. If the designed UAV fulfills ninety percent or more of its requirements but does not win the Final Event the program will be satisfactory. Incompletion of the course will be considered unsatisfactory.

## Operations

Operations will include the Final Event described previously as well as future testing events with the prototype. In preparation for driving the UAV, many engineers of various disciplines will be capable of fully operating the UAV to not only make future training easier but also to enhance their understanding and role within the context of the program. Official training documents, videos, and exercises will be captured and stored for future knowledge transfer. Step-by-step operation procedures will explicitly state all of the different functions the interface can do with the modified Tesla.

A checklist will be started and revised bi-weekly to determine all of the relevant tests to test the system’s capabilities and the user-system interactional capabilities.

During operational tests, sensors will be attached to monitor aspects of the Tesla’s performance. From the data collection, corrections may be made incrementally. Each testing event will be video-recorded and monitored the entire time. The improvements stemming from test runs will not only come from statistical-proof but video-reference too.

A&B reserves the right to enter the UAV in future events. While A&B aims to use the UAV in the DARPA Urban Challenge as a stepping-stone to full-scale production on a global scale, the initial UAV used in the challenge will continue to test out new features within the R&D department of A&B.

## Maintenance

Once A&Bs UAV completes the DARPA Urban Challenge, the product effectively moves into the maintenance phase of its lifecycle. A&B retains full discretion to enter into other autonomous competitions or use its proprietary technologies as part of other competitions or products. The UAV used for the challenge may also be retrofitted if it is to participate in future challenges or to test out future developing technologies.

After the competition, the UAV will be driven back to A&B facilities on the back of a company-owned semi-truck with coverings over it to not only protect it but also to avoid unveiling technologies A&B wants kept private. Upon returning to a storage garage owned by A&B, the vehicle will be parked and immediately inspected for any damage occurring during the competition or on the return trip. Reserve money will fund any further damage repair to the UAV.

A checklist will provide all of the weekly test procedures the UAV will undergo on a weekly basis to ensure it is still performing as it was originally intended. The UAVs weekly check-up drive will be no longer than 8 hours long on one day and will take place during normal weather conditions conducive to effective driving. A&B will purchase 100-acres of land to construct a test track leading directly from the storage garage. Funds will be allocated for video monitoring the track both during performance and during down-time to keep the track secure and untampered.

A&B reserves the right to rent or lend out the UAV for an agreed upon amount. Further negotiations may be decided by a contract-to-contract basis.

All employees previously falling under A&Bs UAV program will be trained on proper maintenance of the UAV. Separate personnel will be hired specifically for maintenance while previous employees under the program will be absorbed under other departments and programs within A&B.

## Disposal

A&Bs UAV is a prototype for future production on a global scale. The UAV driven for the challenge will not be sold. The prototype will be utilized for future testing and studies.

The life cycle of the UAV is approximately 25 years before disposal. While the prototype will be periodically tested for its controls, fixed for bugs, and retrofitted as necessary, the material structure and outdated technologies of the UAV will make it obsolete by year 2050 at the latest. Since the prototype will be used for other vehicular ventures, the UAV will be test wherever relevant. The prototype will provide useful insight on whether to pursue a particular type of vehicle suited for A&Bs choosing but once a decision is made, prototypes for the specific model going into production will drive further testing and evaluation.

Further studies will be conducted before disposal. A&B will gain knowledge on how the structural components fared over time and where points of failure would most likely be located on A&Bs other models going into production.

By taking apart the UAV component by component to the subcomponent it was inventoried as, each part can be individually analyzed outside of how it once operated in the system. Components needing anti-rust treatment will receive such before their storage. Electronic components will be stored in climate-adjusted, anti-flammable conditions. Each component will be logged in a computer database, taking note of inventory, condition of the part, and any other relevant metrics. All components will be stored in the garage used during maintenance.