**DATA-DRIVEN**

**DECISIONS AID TOOL**

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# Introduction

*(To Be Completed By Fairfield U Team)*

# Executive Summary

*Note: Needs to be reviewed prior to final submission*

This tool will use event data in a given area to find an optimal route between two points. Of primary interest are the algorithms used to define these routes.

For example, troops in Iraq have identified a need for a tool that would be able to provide them with the safest route of travel from one location to another. This request stems from incidents of IEDs, hostility, etc. and the danger that they impose on our troops. This application would enable the troops to travel a safer route based on avoiding areas that have been statistically dangerous in past events.

**Key features:**

* Ability to operate in three dimensional space
* Ability to choose parameter(s) by which to rank routes (safety, speed, directness)
* Displays top three ranked routes for specified parameter(s)
* Able to apply to air, land, or water travel

**Key risks:**

* Shortfalls in externally furnished components: The event data used to determine routes contains recorded events that have happened in the past. It is possible at the time of or just after the route request that an event could occur causing a safest route in actuality to be dangerous.

# Application Context

*(To Be Completed By Fairfield U Team)*

# Functional Requirements

* 1. **Input Module:** 
     + **User Input:**
       - **Coordinates:** 
         * start (latitude, longitude)
         * end (latitude, longitude)
       - **Parameters:** Used to rank routes. Must choose at least one.
         * **Safest:** Based on event severities, routes will be ranked from the least severe (safest) to the most severe.
         * **Fastest:** Using the road speed, rank from the shortest length of time to the longest length of time to travel from point A to B.
         * **Most Direct:** Using the distance to travel from point A to point B, routes will be ranked from the shortest to the longest.
         * **Combinations:** Routes will be able to be ranked according to multiple parameters.
       - **Event Data:**
         * **Date:** String representing yyyy/mm/dd event occurred
         * **Time:** String representing 24-hour or military time, the time the event started and when it ended.
         * **Severity:** Numerical ranking of the severity of the event from 0 (less severe) to 10 (most severe).
         * **Impact:** Numerical ranking of the impact the event had on the affected area from 0 (less impact) to 1 (most impact)
         * **Shape:**

**Origin Point:** Location

**Type:** String

**Criminal Events:** (not limited to)

Murder

Robbery

Assault

Arson

**Military Events:** (not limited to)

IEDs

Hostility

Seizure

Raid

**Natural Disasters:** (not limited to)

Hurricane

Earthquake

Tornado

Wild fire

**Motor Vehicle Accidents:** (not limited to)

Head-on collision

Rear-end collision

Side-impact collision

Multi-car collision

Single-Auto Accident

Auto-Pedestrian Accident

**Traffic Patterns:**  (not limited to)

Construction

Heavy traffic

Road work

Signal controlled

**Points:** Collection of Locations

**Dimensions:** Collection of Dimensions

**Name:** (not limited to)

**Polygon**

**Circle**

**Square**

**Value**

**Radius**

**Area**

* + - * + **Location:**

Latitude

Longitude

* + - * **Vehicle object**
        + Maximum vehicle speed
        + Width of vehicle
        + Turning radius
  1. **Path Module**
     + **Path Finding Module:** Calculates possible routes from point A to B based on parameters.
       - **Road Data:**
         * Intersections (latitude, longitude) comprising road
         * Speed of Road
         * Width
       - **Route:** 
         * **Collection of Intersections** from point A to B.
     + **Path Ranking Module:** Based on selected parameters rank routes from the path finding module.
       - **Transit Information:**
         * **Route safeness**
         * **Route directness**
         * **Route speed**
  2. **Output Module:** Display routes on a map.
     + Top ranked route displayed green.
     + Second ranked route displayed yellow
     + Third ranked route displayed

# Environmental Requirements

*(To Be Completed By Fairfield U Team)*

# Software Qualities

1. **Correctness:** Based on supplied data, the algorithms will return the top three ranked routes according to selected parameters.
2. **Verifiability:** The user will be able to tell if the route which was returned is the best based on selected parameters.
3. **Robustness:** The program will check to make sure that correct data was entered and will alert the user if not.
4. **Reliability:** The algorithm will return the best path to take in relation to provided data and selected parameters.
5. **Safety:** The data-driven decision aid tool will supply routes to users that they will be depending upon to get them to their destination. These routes must be correct to aid in the safe arrival of the user.
6. **User Friendliness:** The user should be able to be trained to use the program within no more than 2 hours. From this training, the user will be able to understand the output and any possible errors.
7. **Evolvability:** In the future, we plan to add elements to the software which can gauge how resistant a vehicle or platoon set up may be to an impending threat. As well as other GUI functionalities that will further aid the user detailed in the future changes section.
8. **Maintainability:** Each module of the data-driven decision aid tool will be encapsulated from other modules to ensure ease of maintainability. Functionality within the modules will be able to be altered with minimal changes.
9. **Understandability:** All documentation and deliverables will be written with appropriate grammar and punctuation. The language used will be clear and unambiguous to ensure those utilizing the software will have a clear understanding of the system and its functionality.
10. **Portability:** The main focus of this project is to develop a working algorithm that suits the needed functionality of the decision-aid. Re-working the algorithm to fit different languages or platforms will not be a difficult process.
11. **Timeliness:** All deliverables will be completed in their entirety and delivered on or before established deadlines.
12. **Repair-ability:** If the data-driven decision aid tool does not work properly, problems that arise in one module will not have a large impact on other modules in the system. The amount of work required to correct errors in the software will be minimal.
13. **Size:** The final product will occupy as little space as possible.
14. **Productivity:** Those working on this software will abide by a particular software cycle in order to maintain organization and develop fully functional software in an efficient manner.
15. **Visibility:** All phases of the software development will be properly documented. All documentation will be understandable by the user or any other person.
16. **Reusability:** The algorithm that will be developed for this decision-aid will not incorporate any existing systems. It will be re-used by MSE as well as expanded upon to fit all types of needs, including military, business, and personal.
17. **Interoperability:** This particular software will not need to interact with any other system, at least not yet. In the future however it would most likely need to draw the data from some database populated with known threats and their details.
18. **Performance:** The algorithm will take as much time as needed to produce the various routes ranked according to selected parameters. In the future the algorithm will be tweaked to improve time.
19. **Security:** This decision aid need not be a security critical system as all security concerns are assumed to be already addressed and handled by governing systems.

# Other Requirements

*(To Be Completed By Fairfield U Team)*

# Time Schedule

*(To Be Completed By Fairfield U Team)*

# Potential Risks

*(To Be Completed By Fairfield U Team)*

# 10. Future Changes

**Change in** Algorithm – The algorithm determining routes may be rewritten and replaced with an algorithm that is more efficient.

**Expansion of Algorithm** – The algorithm will be able to be expanded to solve other path generating problems.

**Modes of Transportation** – Take into account different types of vehicles (tanks, cars, walking by foot) when determining appropriately ranked routes.   
  
 **Terrain** – Extended to use terrain outside of roads (like an open field or hills).

**Ease of Movement** – Predicting the ease of movement of different types of vehicles through different types of terrain may be added as a parameter.

**Safety Alert** – Alert when a route's safety is changed en route and then provide the next best route (depending on the input parameters).

**Real World Data –** Use real world data in place of the grid data we are now using.

**External Systems –**Draw from a database or other structure that holds data about events and road data (street intersections, speed, and road width).

# 11. Acceptance Test Plan

*(To Be Completed By Fairfield U Team)*

# 12. Training

*(To Be Completed By Fairfield U Team)*

# 13. Glossary

*(To Be Completed By Fairfield U Team)*

# 14. Reference Documents

*(To Be Completed By Fairfield U Team)*

# 15. Prototype

