MTFC Scenario Quest Response 2025–26

Team Name: **Error 404: Human Not Found**

Team ID: **23915**

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Part: Project Proposal Prompts

PROMPT #1: IDENTIFY THE TOPIC

Prompt. In 3–5 sentences, summarize what is the topic your team is proposing to investigate and why it is important. Provide a statement on what the topic is and why it is important. Has it seen a sudden or recent change that brings it to the forefront? Who does it affect, where is it prevalent, is it tied to any other areas of impact?

Response. We are exploring the impact of autonomous vehicles (AVs) on local carbon emissions and traffic patterns. Over the past few years, the field of computer vision and autonomous systems has been gaining prevalence, making larger scale AV systems possible. Based on their current development and environmentally sustainable nature, it is projected that by the year 2040, AVs will make up around 75% of all vehicles on the road. This will mostly affect people living in urban areas who experience a large amount of traffic congestion. Moreover, this adjustment will decrease the dependency on unreliable human drivers and limit the necessity for third-party roadside services.

PROMPT #2: IDENTIFY POTENTIAL RISKS

Prompt. In 3–5 sentences: Identify and describe 2–3 areas of risk for an individual, society, or organizations/industry/governmental groups related to your topic. Hypothetically, what could be a "best case scenario" outcome for the risks identified? What could be a "worst case scenario" outcome for the risks identified?

Response. On the individual level, pollution poses serious health risks leading to headaches and coughing, as well as respiratory illnesses and neurological impediments. Certain industries, especially in the healthcare sector, face significant risk due to pollution as it leads to higher expenditure on procedures that are becoming increasingly necessary. The government also suffers from pollution as they have to spend more money on maintaining crucial resources, such as water and clean air. The best possible scenario is the natural reduction of pollution and a cleaner world without significant expenses. The worst case scenario is world-wide pollution which leads to natural resources and current architecture becoming unusable.

PROMPT #3: IDENTIFY A BEHAVIOR CHANGE RISK MITIGATION STRATEGY

Prompt. In 1–2 sentences describe: a specific behavior change risk mitigation strategy relevant to your topic that could mitigate (lessen the severity of) risks you identified associated with the topic. Identify who (individual, society, organization/government, etc.) would be impacted by its implementation?

Response. One strategy that could be used to reduce risk is to increase the sale of autonomous vehicles in urban areas, leading to a higher average fuel efficiency, consequentially decreasing the amount of pollution. The government would provide an initial investment for new vehicles, but the reduction in infrastructure damage and decrease in pollution related illnesses would offset the costs.

PROMPT #4: IDENTIFY A MODIFYING OUTCOMES RISK MITIGATION STRATEGY

Prompt. In 1–2 sentences describe: a specific modifying the outcomes risk mitigation strategy relevant to your topic that could mitigate (lessen the severity of) risks you identified associated with the topic. Identify who (individual, society, organization/government, etc.) would be impacted by its implementation?

Response. Autonomous vehicles can directly decrease the total amount of carbon emissions in the atmosphere by being more fuel efficient. Their ability to reduce the amount of fuel expended would minimise the effects of pollution in a given area, impacting the local community and landscape on a societal level.

PROMPT #5: IDENTIFY AN INSURANCE RISK MITIGATION STRATEGY

Prompt. In 1–2 sentences describe: a specific way that insurance as a risk mitigation strategy (relevant to your topic) that could mitigate (lessen the severity of) risks you identified associated with the topic. Identify who (individual, society, organization/government, etc.) would be impacted by its implementation?

Response. Insurance companies could offer specialized AV insurance policies to cover autonomous system failures, and human and AV accident responsibility. This protects individuals from financial losses whilst also providing data on AV related claims to governments, distributing the risk equally between individuals and government.

PROMPT #6: IDENTIFY DRIVING RESEARCH QUESTIONS FOR YOUR TOPIC

Prompt. Driving research questions should each be 1–2 sentences long, and should be probing deeper research and aligned with the goals of addressing the issue of the risk. Thinking about these questions will help you frame your project. List 2–3 driving research questions whose answers would be needed in order to mitigate the risk of your project topic.

Response.

- What are the long term projections for changes in air, water, and soil quality in cities around the US, and how would these projections change different percentages of AV density within cities and roads?
- What is the percentage of people who experience severe respiratory and neurological conditions that live in high pollution risk areas?
- How effective are the use of autonomous vehicles in reducing pollution in urban areas?

PROMPT #7: IDENTIFY THE TYPE OF DATA YOU HOPE TO FIND

Prompt. As you begin to look for data related to your project, some teams experience a dissonance between what data they hope to find and what data is actually available. It can be easy to lose sight of what data would actually enable your team to explore the project, so articulating the data that you hope to find is valuable. Describe in 2–3 sentences what the "perfect" or "ideal" data/dataset(s) would be that would enable you to answer and explore the questions you posed. Think about what the data would include – frequency of past events? geographic locations? dates? charts? costs of repairs? financial claims values?

Response. An ideal dataset would include data about the amount of greenhouse gas emissions and resource efficiency of autonomous vehicles compared to electric and gas-powered vehicles. Additionally, a dataset including how many crashes occur over a certain period of time, the type of services needed to address the issue, and their greenhouse gas emissions would help us estimate a crash rate and their effects. Lastly, data about the costs of owning an AV and costs of government programs to mitigate the impact of greenhouse gasses would be essential to calculate the return on investment when purchasing an AV.

PROMPT #8: IDENTIFY POTENTIAL DATA SOURCES FOR YOUR TOPIC

Prompt. Since you won't use most of these for the data analysis until the Project Phase, it's important to create thorough notes for yourself and your mentor on each source to reference later. Find 2–3 data sources related to the project topic (include links to the sources). For each data source: Provide a 1–2 sentence description of the credibility and scope of the data sources and identify which one (or more than one) of the three categories of data from the Actuarial Process Guide (see section 2.1) for more details does the data source fall into. In 1–2 sentences, describe what data summaries or visualizations your team would be able to do with this dataset in Phase 2: Projects. Examples could include charts, tables, or descriptive statistics (mean/standard deviation/frequency/range, etc).

Response.

Source 1: `https://www.nhtsa.gov/nhtsa-datasets-and-apis`

These datasets are produced by the US National Highway Traffic Safety Administration, a federal agency under the US Department of Transportation, making it a highly credible external publicly available dataset. This dataset covers both categorized risks and potential outcomes, as it discusses the types and categories of data that define historical frequency, as it provides numbers for annual crashes, fatalities, and injuries. Using the data, we could create crash frequency tables, severity distributions, urban vs. rural crash comparisons, and time series plots of AV related accidents. These tables would allow us to focus on the impact of AVs on accident rates.

Source 2: `https://catalog.data.gov/dataset/energy-and-emissions-implications-of-automated-vehicles-in-the-u-s-energy-system`

This dataset was produced by the U.S. Environmental Protection Agency, a federal agency concerned with how external factors, such as AVs, affect the environment. This dataset helps categorize risks and potential outcomes, since it talks about how simulations were used to find changes in environmental factors and

risks/outcomes for this project. Using this data, we could compare emissions, fuel use by simulation types alongside energy production mixes and efficiency improvements. This would allow us to create bar graphs (emissions by scenario) and line charts (emissions over time) to help illustrate our central point.

Source 3: `https://waymo.com/open/download`

Waymo, a leading AV manufacturing company, has provided several datasets which include multimodal and synchronised sensor data from cameras, LiDAR, maps, and trajectory data. This data has been collected across many cities and weather conditions with carefully annotated 2D and 3D labels.

Because of their size, we can use these datasets to create traffic-scene heatmaps, distribution charts of obstacle occurrences to see how often potential crashes occur, and analyses of certain interactions, such as stopping at pedestrian crossings or lane changes. The frequency at which frames are captured in the Waymo datasets is very high, so this data will allow us to come to strong conclusions after analysis.

PROMPT #9: MODELING RESEARCH ON YOUR TOPIC

Prompt. Conduct some online searches with your topic + "math models", "math modeling" or "modeling." In 3–5 sentences, summarize and describe the results of your online searches by answering the following questions: What kind of results, published papers, and credible literature does this yield? Include links from your findings in your response so you can reference them later. What is helpful in what you found? What was unfamiliar or beyond the math you are familiar with?

Response. Search results yielded several academic peer-reviewed papers and modeling frameworks. For example, one model explored traffic flow simulation with energy/emission prediction models to analyse how varying levels of AV adoption affect congestion, fuel consumption, crash rates, and environmental impact. These papers were helpful as they showed us how simulation models such as system dynamics, Monte Carlo crash modeling, and agent based traffic models are able to estimate AV impacts on both safety and emissions. Certain techniques like differential equation traffic models and multivariate risk optimization were more advanced examples of strong models that could be used as inspiration for our own model.

PROMPT #10: GOALS OF A MATHEMATICAL MODEL IN THE PROJECT PHASE

Prompt. Note: You won't actually create a mathematical model until Phase 2: Project Phase. For now, you need to identify what you hope that your mathematical model will be able to accomplish. Your mentor in the Project Phase will work with you to actually create a mathematical model. In 3–5 sentences: Describe what – ideally – you hope that a mathematical model would be able to do for you? How could it help you identify the likelihood & severity of risk and the changes over time or other elements that will help you characterize risk? What kind of mathematical analysis seems to be fruitful to pursue in the Project Phase for your proposed topic?

Response. A mathematical model should be able to calculate the impact on the environment through the costs of mitigating the impact. This means that the model should be able to compare the costs of only using autonomous vehicles, only using gas powered vehicles, only using electric vehicles, and using a combination of both gas and electric vehicles on the road. To identify the risk over time, we can use the

model to see the environmental impact due to the greenhouse gas emissions and compare that with the costs of reversing the impact. We hope to use a comparative scenario analysis to analyze the different emissions of vehicles and identify the return on investment for each type of vehicle. Additionally, we will analyze the effects of crash rates on emissions, by comparing probability and severity change under different vehicle mixes.

PROMPT #11: ASSUMPTION DEVELOPMENT

Prompt. In this stage of the proposal process, you are still operating at a very "high level" of project overview and you will tackle your project at a deeper level in the Project Phase. Even at this stage, however, you have conducted enough initial background research to be able to begin formulating assumptions that will allow you to formulate recommendations you have suggested in your problem statement. In 1–2 sentences each, address some initial assumptions that you anticipate that need to be made in order to provide a framework for your model.

Question 1. What is the appropriate future time period for your analysis? That is, how far out into the future do you anticipate needing to consider for the risk and the mitigation strategy to take effect? What leads you to consider this a rational and logical assumption?

Response. The appropriate time period is from now to 2050, which is when autonomous vehicles are predicted to be a majority of the vehicles on the road. This means that we can measure the impact of the current vehicles and model the transition to measure the environmental and financial impact. `https://www.weforum.org/stories/2025/05/autonomous-vehicles-technology-future/`

Question 2. How do you expect your data to change over that time period? Will the rate of change be the same or different from the historical rate of change or trend? What leads you to consider this a rational and logical assumption?

Response. We expect the number of autonomous vehicles to increase and hence, the environmental impacts to potentially decrease. With the mitigation actions provided, the rate of change for the greenhouse gas emissions will decrease from the historical trend, as a critical factor resulting in climate change will decrease.

PROMPT #12: GOALS FOR MITIGATION STRATEGY

Prompt. In 2–3 sentences, consider potential outcome scenarios for the risk(s) you identified in Step 1: Project Definition. Based on your background research, what does the current trajectory and forecast of the risks for your topic lead to if no interventions are made? What would be the goal and hope for the impact that the risk mitigation strategy would have?

Response. Because of rising greenhouse gas levels in the atmosphere, the current trajectory of climate change will lead to environmental destruction and increase many risks to safety, such as an increase in the amount of cardiovascular and neurological diseases. It would also mean that car crashes continue to claim many lives each year, with human error still affecting driving conditions. With the risk mitigation strategy, the goal would be for more individuals to purchase autonomous vehicles due to the advantages they are receiving.

PROMPT #13: RECOMMENDATION DIFFERENCES BETWEEN MITIGATION STRATEGIES

Prompt. In the Project Phase, you will ultimately select one risk mitigation strategy to characterize and recommend. The strategy you choose will depend on a variety of factors (and you'll need to justify why you pursue one risk mitigation strategy over another). For now, revisit the risk mitigation strategies identified for your topic in #3–5 from Step 1: Project Definition responses of this Project Proposal. In 2–3 sentences, what metrics do you anticipate being helpful to prioritize which one of the three risk mitigation strategies to pursue when you fully model your project in the Project Phase of the MTFC (e.g., cost, effectiveness, ethics, complexity, timeframe, etc.)? What rationale leads you to your response?

Response. To measure health risk, we can look at the city's hospitalization rate as an increase in pollution would result in more sick people. For crashes (cost), we can just look at the annual crash rate. The strategy we will use in our project will be modifying outcomes, as providing AVs is predicted to lower risk.

PROMPT #14: AUDIENCE FOR RECOMMENDATIONS

Prompt. There may be two different groups to consider when formulating a recommendation for action: those who actually are facing the risks and those who are in a position to do something about mitigating those risks. It's possible that those at risk are the same who may be in a position to enact change, but it is possible that they will not be. In 1–2 sentences, identify one potential target audience for your recommendations who may be in a position to make decisions based on your recommendations (e.g., based on financial investment or authority to enact change). What rationale leads you to identify this audience? Explain.

Response. A possible target audience are vehicle owners with gas vehicles who have to switch electric vehicles due to gas car bans. These customers will be inclined to buy autonomous, electric vehicles when provided with reasonable prices or other benefits compared to normal electric vehicles.

PROMPT #15: GOALS FOR SITUATION IMPROVEMENT

Prompt. Ultimately, the goal of your MTFC project is to model the future and recommend a strategy to improve the outlook for the future for your project topic. In 3–5 sentences, summarize what improvements would you hope your recommendations would lead to for your project topic (i.e., what is your best case scenario outcome)? Explain.

Response. We hope the recommendations decrease the carbon emissions produced by the automobile industry as buyers will obtain electric, autonomous vehicles instead of inefficient gas powered vehicles. The addition of autonomous vehicles will also decrease the amount of crashes on the road, which will subsequently decrease the carbon emission on the road. Construction companies, towing businesses, and other groups will have to arrive at the scene and use resources to mend the situation, leading to more carbon emissions. With more autonomous vehicles on the road, the time for travel will decrease as well, leading to less emission by all vehicles. Overall, carbon emissions by automobiles will decrease to prevent further climate change, natural disasters, and harmful fumes for individuals.