Role Play Scenario:
A City Decides on Self-Driving Buses

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I. THE SCENARIO

Your city has been selected to participate as a testbed during a one-year period for a fleet of self-driving public buses by a company looking to expand its market presence in the autonomous vehicle space. The buses would travel on standard roads, often using a designated bus lane, within the city's downtown area. The company indicates that the self-driving bus fleet will be able to interact with regular traffic and would operate within SAE International's levels 4-5 of driving automation.[1] What follows from this is that a human operator (in other words, a bus driver) would not be necessary in the vehicle. The company indicates that the capital and operating expenses associated with a self-driving bus is 1-1.5 million dollars per year--a figure that is based on estimates from published reports (e.g., Chamblee 2018).[2] However, the company claims that a self-driving bus fleet will prove financially advantageous over a short period of time (e.g., it will eliminate the cost of employing human drivers). Moreover, the city may be eligible for a federal transportation grant to help subsidize the initial purchase of the vehicles.

City officials are interested in incorporating self-driving buses into their public transportation system. They have been pushing for the use of autonomous vehicles as part of their approach to mass transit in order to discourage reliance on the individual passenger car and (hopefully) increase safety. The average number of fatalities due to car accidents in the US hovers between 30,000-40,000.[3] The "critical reason" for approximately 94% of these car accidents is connected to the driver, according to the US Department of Transportation.[4] Thus, city officials aim to reduce the number of individual passenger cars on the road and have received assurances from the company that using self-driving buses would lower the number of traffic accidents. Furthermore, projections from city planners indicate that the use of self-driving buses may lower traffic density, which could draw more businesses, tourists, and others into the downtown area and thus generate economic growth.

Before proceeding with the test period for the self-driving bus fleet and in order to be considered eligible for the federal transportation grant, a formal community engagement process between city officials and various stakeholders must occur. City officials must convene a diverse collection of stakeholders to receive public comment and community input, and ultimately build a fuller understanding of how this emerging technology might impact the city. Although city officials are intrigued by the economic aspects of this initiative, their primary responsibility during the stakeholder committee process is to protect the public's interest and well-being. The stakeholder committee, which will include representatives of the company with computer science expertise, must decide whether to recommend that the city participate as a testbed for the self-driving bus fleet.

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II. STAKEHOLDERS

Role 1. City Planner

City planners, according to the American Planning Association, are supposed to "maximize the health, safety, and economic well-being of all people" in a community.[1] The role of city planners can include being part of the decision-making process that determines the locations of parks, streets, and residential and commercial areas. They develop these plans based on a variety of factors that include looking at demographics, considering economic and environmental impacts, and incorporating community input.

Many reports indicate that autonomous vehicles will be a vital cog in the design of the future city (e.g., World Economic Forum 2018).[2] As a planner working for the city planning department, you must assess what the deployment of self-driving buses would entail for your city, including its downtown area. Your role is to facilitate a group discussion about how self-driving buses might shape the city's infrastructure and in the end, to deliver a set of recommendations that will aid city officials in deciding whether or not to participate as a testbed for the self-driving bus fleet.

As a city planner, your main points of prioritization include:

- Maximizing the safety of the public
- Creating a livable built environment
- Describing the impact of self-driving buses on transit-dependent populations
- Encouraging the design of "complete streets" that allow for all types of users, including pedestrians, bikers, and transit riders
- Upholding the tenets of green design and sustainability, which could include encouraging shared rides
- Prompting a resilient economy by improving transportation access to employment centers, particularly for populations that may not have personal vehicles
- Upholding equity principles by expanding access and mobility for all ages, abilities, and incomes
- Addressing concerns related to street congestion

In addition, during the stakeholder committee phase, you are responsible for ensuring that all of the stakeholders in your group have a meaningful opportunity to voice their point of view. This could involve having each stakeholder provide a brief opening statement. You could also brainstorm a set of potential recommendations as a group, and then allow each stakeholder to weigh in on a proposed recommendation.

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Role 2. Chief Innovation Officer for the City

As the city's chief innovation officer, you want to make sure the city is seen as a hub of innovation and are concerned primarily with generating economic growth and expanding the knowledge-based economy, which includes data-based technologies and services. For example, you are expected to identify new job opportunities and losses for those impacted by self-driving buses. Likewise, you are aware that the city's leadership thinks introducing self-driving buses into the downtown area is valuable for the city for a variety of reasons. The leadership suggests it will (1) strengthen the city's identity as a future-looking hub of innovation, thus attracting additional economic investment from entrepreneurs, (2) support the city's comprehensive plan to develop and maintain strong multi-modal connections, which may help reduce parking challenges and enable residents to choose the mode of transportation most appropriate for each specific trip (drive to work, walk to the grocery store, bus to the city park, etc.), and (3) achieve regional transportation related greenhouse gas reduction targets and improve air quality if the city chooses an electric vehicle fleet.

As the city's chief innovation officer, your main points of prioritization include:

- Encouraging the development and use of new technology in the city
- Emphasizing the importance of increasing the availability of knowledge-based jobs
- Explaining the importance of incorporating state-of-the-art technology into the city's infrastructure and thus planning for the future
- Demonstrating the link between incorporating new transportation technology and future investment in the city (e.g., companies will be more likely to build headquarters in cities with robust and modern public transit systems)

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Role 3. Bus Driver Union Representative

Your role during the stakeholder process is to represent the city's bus driver union, which has serious concerns about the elimination of jobs if the self-driving bus fleet is introduced. Significant job losses are expected with the advent of autonomous vehicles, including in the taxi industry,[1] and the trucking industry.[2] It may be no different for the city's bus drivers, especially if the company moves forward with its plan to remove human operators from the vehicles. In your city, there are over a thousand individuals employed as bus drivers.

You must advocate for the interests of bus drivers and identify any relevant concerns surrounding the self-driving bus fleet. You are also very aware of the fact that the transportation sector offers relatively well paying jobs, often for individuals who do not have a college degree.[3] If bus drivers lose their jobs on account of the self-driving bus fleet, the labor opportunities for a sector of the population with limited formal education beyond high school would be significantly impacted. The local chapter of your workers union has learned from other chapters that city council can potentially mandate that drivers be present on autonomous shuttles. The Columbus, Ohio bus driver union, for example, launched a public campaign to advocate for bus drivers.[4] Among other efforts, the campaign members spread awareness about the types of assistance that only human bus drivers can provide (e.g., spotting a lost child, being a first responder in an emergency, giving directions, and helping passengers get aboard).

As the representative for the bus driver union, your main points of prioritization include:

- Representing the interests of bus drivers in their attempt to retain employment opportunities
- Describing the virtues of keeping a licensed driver in the loop of a transit vehicle's operation
- Articulating the risks of removing a licensed driver from a transit vehicle's operation
- Advocating the need for the city to prioritize economic opportunities and jobs for the city's citizens

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Role 4. Disability Group Advocate

Your role during the stakeholder process is to represent the interests of those with disabilities who are currently unable to operate a standard car and/or may not have meaningful access to transportation options. Approximately 25% of American adults have some form of disability, and having a significant disability can severely restrict one's transportation options.[1] For example, an individual who is legally blind cannot drive a car and would currently need assistance to travel by vehicle. Individuals with lower body impairments can operate a car if the car is modified from a standard design, yet those with paralysis in both upper limbs may not be able to do so.

Advocates of autonomous vehicles indicate that the technology may appreciably enhance the mobility of those with disabilities. For example, blind individuals would not need to rely on another person to operate a car on their behalf if fully autonomous cars are available to them. In this context, however, the focus is on self-driving buses and whether they would similarly benefit people with disabilities. It is difficult to give a precise estimate of how many people with disabilities would benefit from the self-driving bus fleet in your city, but the self-driving bus company has cited increased access to downtown regions as a notable one benefit. The company also suggests that embracing the fleet could lead to a variety of infrastructure changes in the downtown area that would be beneficial to those with disabilities, including ramps at bus stops for those in wheelchairs. You must help evaluate the likelihood that a self-driving bus fleet would meet the transportation needs of people with disabilities, and more generally speaking, improve their lives.

As a disability group advocate, your main points of prioritization include:

- Ensuring that the design of the self-driving bus fleet is consistent with the needs of those with disabilities
- Comparing the benefits and drawbacks of a self-driving bus to a human operated bus for those with disabilities
- Evaluating the cost effectiveness of self-driving bus transportation for those with disabilities as compared to other transportation options
- Evaluating the likelihood that a self-driving bus will improve mobility for those with disabilities as compared to other potential transportation options

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Role 5. Computer Scientist who specializes in Computer Vision

You work for the self-driving bus company as an expert in the area of computer vision and machine learning. You have served as part of the technical team that designed and implemented the algorithms that detect objects in the environment, including other vehicles, pedestrians, bicyclists, and immovable items such as concrete barriers or curbs. The fleet has been designed in such a way that lane markings and traffic signal information necessary for the vehicle to "make decisions" does not require computer vision (sensors in the roads will communicate that information to the buses instead).

You have been asked by your company to join the stakeholder process, answer questions that arise about the technology, and "reassure people" (a phrase used in a note from your boss about the event) that the self-driving bus fleet is a safe and viable transportation option.

As the company's computer vision specialist, your main points of prioritization include:

- Describing the state of computer vision and its ability to detect other vehicles as well as pedestrians, bikers, and others not in vehicles
- Explaining the effect that different weather conditions can have on the reliability of computer vision
- Delineating other factors that can interfere with the reliability of computer vision (e.g., if people tamper with street signs)
- Describing strategies that can increase the reliability of computer vision

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Role 6. Cybersecurity Professional

Your role during the stakeholder process is to describe whether the self-driving bus fleet can be designed in such a way to guard against security vulnerabilities. You also must communicate the importance of cybersecurity to a diverse and broad audience. While many of the other stakeholders may advocate for the use of self-driving buses, you need to provide the committee with insight on critical security issues, including the possibility that the fleet might be vulnerable to hacking. Also, many privacy concerns are emerging related to the data collected and used by self-driving automobiles.[1] You are expected to describe and address cybersecurity problems related to the self-driving bus fleet.

As a cybersecurity professional, your main points of prioritization include:

- Identifying and communicating potential vulnerabilities, including the risk that the self-driving bus fleet's system may be hacked in ways that might compromise the functionality of the vehicles
- Identifying the risks associated with collecting data from bus riders
- Describing the types of harms that could result if the self-driving bus fleet system is hacked
- Describing specific strategies that could mitigate or prevent the security risks

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Role 7. Active Transportation Advocate

Your role during the stakeholder process is to represent the interests of pedestrians, bicyclists, and others who want meaningful access to active transportation options. Your primary concerns are related to safety and access for pedestrians and bicyclists if self-driving buses are integrated into the mass transit system. In recent years, the city has been increasing its investment in active transportation options, including a growing number of dedicated bike lanes and bicycle sharing programs. Many residents now walk and bicycle for commuting, health, and recreation purposes, and you are concerned that the city's pursuit of self-driving buses might prioritize vehicle access over these pursuits.

Moving around the city as a bicyclist or pedestrian usually involves interacting with motorized vehicles, which in some cases can result in injury or death. According to the National Highway Traffic Safety Administration, "a pedestrian was killed every 1.5 hours in traffic crashes" on average in 2016.[1] It is thus critical that any system of transportation prioritize the safety of people who walk and bicycle. You suspect that autonomous vehicles might improve safety by removing some of the individual passenger cars from the road. However, you are not fully sure how to evaluate the safety of self-driving buses if they are going to be in close proximity to pedestrians and bicyclists.

As the active transportation representative, your main points of prioritization include:

- Explaining the concern about whether autonomous vehicles can reliably detect and avoid pedestrians and bicyclists
- Encouraging the city to prioritize infrastructure updates for active transportation such as fixing potholes, creating walkable sidewalks, and maintaining bike lanes
- Describing how the use of the self-driving bus fleet might impact pedestrians and cyclists, including by potentially requiring them to purchase expensive equipment that improves the fleet's ability to detect them
- Explaining how the use of the self-driving bus fleet might discourage citizens from taking part in active transportation
- Describing how the presence of the self-driving buses might negatively affect low income and minority populations

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Role 8. Human-Computer Interaction expert from a local university

Your role during the stakeholder process is to represent the interests of individuals who may directly interact with the self-driving buses. Your expertise pertains to how people interact with computing technology, how to improve its usability, and how to convey risks emerging from human-computer interaction (HCI). Although you neither work for the company nor for the city, as an interested citizen and a local university professor, you want to ensure that a self-driving bus can safely and effectively interact with passengers and other people within its proximity. For example, easy and effective communication (both between the passengers and the bus as well as the bus and the outside world) is an important area to consider. Someone having an emergency must be able to signal their need for an unscheduled stop.

Similarly, if there is a dispute between passengers on board, communication and alert systems must be in place such that the bus can be made aware of the situation and potentially take action (e.g., facilitate the removal of involved passengers or notify the police). In addition to communication concerns, you know just how important it is for humans to trust the technology with which they interact. In order for a new technology to be effective, people must be able to trust the system they are using.[1] If, for instance, passengers on the self-driving buses feel they lack control and/or feel unsafe, they will be far less likely to use them. You are also an avid universal design advocate and you want to ensure that the self-driving buses are designed in a way that is inclusive and meets the needs of all passengers, regardless of ability, age, race, gender, nationality, literacy level, and so on.[2]

As an HCI expert, your main points of prioritization include:

- Determining whether effective mechanisms are in place to facilitate communication between the buses and passengers
- Determining whether the company would adhere to universal design principles that will accommodate a diverse range of users
- Identifying risks to passengers and others if the bus interfaces are not designed adequately
- Identifying ways to instill trust and confidence in passengers regarding the safety and performance of the self-driving bus

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Role 9. Computer scientist with expertise in networked technologies from within the company

Your role during the stakeholder process is to represent the company's team that is designing features which will enable a self-driving bus to communicate with other vehicles (vehicle-to-vehicle, or V2V, communication) and the world around it (vehicle-to-infrastructure, or V2I, communication). Two prominent justifications for a self-driving bus fleet is that V2V and V2I communication will (1) increase roadway efficiency by finding ideal routes and getting passengers from point A to point B faster, and (2) reduce the number of traffic accidents. Regarding the latter, misunderstandings and driver errors are the main cause of freeway traffic accidents, according to the National Highway Traffic Safety Administration.[1] In 2018, traffic accidents were the leading cause of death in the US among children and young adults aged 5-29.[2]

As a representative of the company and an expert in networked technology, you must describe the potential of V2V and V2I communication systems to improve roadway efficiency and, more importantly, traffic safety. You are confident that the company's self-driving bus fleet will save both time and lives. In order to realize the time-saving and life-saving potential of self-driving transportation, the reliability of communication between the buses themselves, other vehicles, networked infrastructure, and other networked technologies must be demonstrated. Thus, you must inform the stakeholder process by providing information about the current state of V2V and V2I communication and ensuring the committee of the benefits that will incur with the adoption of your company's self-driving bus fleet.

As the company's networked technologies representative, your main points of prioritization include:

- Emphasizing the time-saving and life-saving potential of self-driving technology
- Communicating up-to-date information to the other stakeholders on the reliability of V2V/V2I communication and the interoperability of current networking technology
- Addressing the concern about whether signals from different devices might interfere with each other
- Addressing data privacy, data security, and other related concerns about networked technologies

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III. ACTIVITY DESIGN

The role-playing scenario is designed to be used in a range of course types, including smaller courses (around 30-40 students) to larger courses (around 100 students). At least two hours of class time is recommended for the activity, but it can be compressed into one class period, especially if students are provided with the scenario and assigned roles prior to class time.

Phase One

Time estimate: 30-45 minutes

A. The scenario is introduced to the students; ideally before the students meet for class.

B. During Phase One, students are broken into groups based on stakeholder type (e.g., all city planners are together in one group); although randomly assigning students to most of the groups is likely fine, it is highly recommended to ask for volunteers who are willing to take on Role 1 (the city planner) because that role has more responsibility than the others.

C. There are nine stakeholder roles, listed in the order of their importance for the activity. Roles 1-5 must be included (i.e., groups must have at least five members). It is recommended to divide the class up as close to evenly as possible (e.g., if there are 35 students, then 5 groups of 7 stakeholders would be recommended).

D. Each student must prepare to represent their role during the stakeholder process when they will interact with the other roles (Phase Two); thus the purpose of Phase One is to have the students learn from each other about the nuances of their particular role.

E. The goal of Phase One is not to resolve what the city should do; rather, the students should start to generate for and against arguments consistent with the role that they are representing.

Phase Two

Time estimate: 30-45 minutes

A. Students are broken into groups with one representative from each type of stakeholder; if there are not enough students per stakeholder type, there must at least be one city planner per group.

B. The goal of Phase Two is for the group to decide whether:
    - Yes, the city should proceed with the self-driving bus fleet testing and describe the circumstances under which that would be appropriate.
    - No, the city should not proceed with the self-driving bus fleet testing until the following conditions are met.

C. An important note: each stakeholder group does not necessarily have to arrive at a consensus; disagreement is okay but a majority opinion should emerge. If there is a minority view within a group, the reasons for the disagreement should be explained by the group.

Phase Three

A. Time permitting, each group can present its recommendation on whether to proceed with the self-driving bus fleet testing to the rest of the class.

B. In their presentations to the class during Phase Three, the groups may include answers to the following questions:
    - Which stakeholder considerations were the most significant factors in the group's decision?
    - What role did CS knowledge/expertise play in the group's decision?
    - Which ethical considerations did the group think were the most important to take into account?

IV. OTHER GUIDANCE FOR INSTRUCTORS

The students may need guidance when assigned a role with which they are unfamiliar. Assigning the scenario and role prior to class time would be helpful in this regard as well as the components of Phase One of the activity.

The students might request data on some of the issues that they confront. Some of the solutions for this issue include: (1) providing the students with time to perform research during or outside of class and/or (2) assigning additional readings that the instructor thinks are important (e.g., on the latest developments in computer vision).

During Phase Two, it is important to encourage the students in Role 1 (the city planner) to have each group member speak. One strategy for accomplishing this is that each student in a group has to have said something before allowing a group member to speak a second time.

V. OPTIONS FOR INCORPORATING ADDITIONAL ETHICS CONTENT

Ideally, ethical considerations should emerge organically from the student conversations, especially during Phase Two because of the presence of the different stakeholder views. However, the role-playing scenario can be supplemented with additional ethics content as an instructor prefers; for example:

Ethical Theory

If an instructor would prefers to add components of ethical theory to the role-playing activity, this could be done by assigning one or more readings on theory while distributing the scenario to students. Then, students could be asked to frame/structure at least some of their arguments using the assigned theory as a foundation (for example, from the perspective of this ethical theory, one would argue that the self-driving bus fleet is ethical/unethical based on the following reasons).

Many different types of ethical theories could be assigned including Kantian Ethics, Utilitarianism, and Ethics of Care.

If the ethical theory option is incorporated, it opens at least two grading possibilities:

A. Has the student accurately described what the assigned ethical theory entails?
B. How thoroughly has the student applied the ethical theory from the perspective of their assigned stakeholder role?

Societal Impact Statement

Somewhat akin to an environmental impact statement required by federal agencies for activities that "significantly affect the quality of the human environment", the instructor could consider a requirement that each student or group produce a “societal impact statement.” [1] In other words, the students would need to formally articulate how the self-driving bus fleet would impact the interests and well-being of the city’s citizens.

If this activity is done at the individual student level, then each student could describe, from the perspective of the assigned stakeholder role, the impact of self-driving bus fleet on the interests and well-being of the city’s citizens.

If this activity is done at the stakeholder group level, then the group could describe, from each of the assigned stakeholder perspectives, the impact of self-driving bus fleet on the interests and well-being of the city’s citizens.

VI. OTHER GRADING OPTIONS

There are several potential grading options related to the role-playing activity; for example:

A. After Phase One, each student could write up and submit the arguments for and against the self-driving bus fleet testing from the perspective of the assigned role.

B. After Phase Two, each student could write up and submit an argument on whether the city should allow the self-driving bus fleet testing and the reasons why or why not from the perspective of the assigned role.

C. Alternatively, instead of making it an individual assignment, item #2 could be submitted as a group assignment.

D. The “societal impact statement” (mentioned above) could be crafted into an assignment after Phase One and/or Phase Two; depending on when it is assigned during the activity, it could be an individual or group assignment.

References

1. National Environmental Policy Act Review Process. (2017, January 24). Retrieved from https://www.epa.gov/nepa/national-environmental-policy-act-review-process#EIS.

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