

# Carnegie Mellon University

## AutoMerge

Francisco Fonseca   Octavio Mesner

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# Problem

## Overview

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- ▶ NYC to become a leader in *smart city* infrastructure
- ▶ One piece: Evaluate autonomous vehicles
- ▶ By 2020, NYC expects its fleet to be autonomous.
- ▶ We will evaluate AutoMerge (AM) Inc as an alternative.

# Alternatives

1. Do not not implement AM.  
This are the costs that would be incurred if the status quo continues so there is little uncertainty for this alternative.
2. Implement AM.  
Implementing AM comes with uncertainty with respect to AM performance.
3. Perform a pilot study.  
We decide size of pilot study. A larger the study reduces more uncertainty than a smaller one but costs more.

# Costs and Calculations

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Variable	Value	Notes
(a) # buses with age < 5 years	2313	Source: [1]
(b) # buses with age 5-9 years	1296	Source: [1]
(c) # buses with age 10-20 years	1437	Source: [1]
(d) Capital Cost per bus age < 5 years	\$ 5000	Source: [1]
(e) Capital Cost per bus age 5-9 years	\$ 6500	Source: [1]
(f) Capital Cost per bus age 10-20 years	\$ 8500	Source: [1]
<b>(g) Total Capital Cost(*)</b>	<b>\$ 45.7 Million</b>	<b><math>=(a)*(d)+(b)*(e)+(c)*(f)</math></b>
(h) Annual O&M Cost per Bus	\$ 1500	Source: [1]
<b>(i) Total Annual O&amp;M Cost (**)</b>	<b>\$ 7.6 Million</b>	<b><math>=[(a)+(b)+(c)]*(h)</math></b>
(j) Annual Cost per Commuter	\$ 1739	Source: [3]
(k) Annual hours in congestion per commuter	74 hours	Source: [3]
(l) Cost per minute	\$ 0.39	$(h)/[(i) * 60]$
(m) Total person trip per day	1.52 million	Source: [2]
(n) Average time in daily person trip	49 minutes	Source: [2]
<b>(o) Total annual congestion cost</b>	<b>\$ 10.5 Billion</b>	<b><math>=360*(l)*(k)*(j)</math></b>

# Uncertainty

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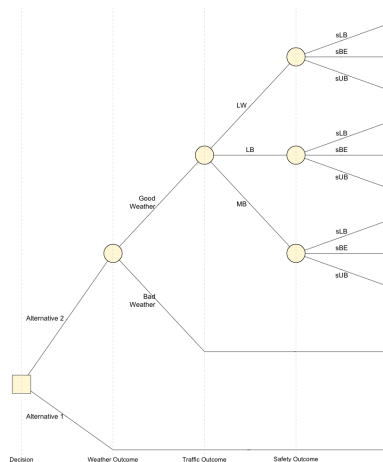
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We account for uncertainty using decision trees. Our sources of uncertainty are weather and performance of AM.



# Assumptions

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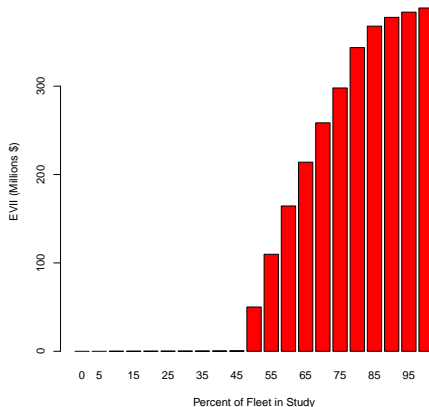
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- Uses EVII and Bayes Theorem to compute
- Figure shows value study after associated cost.
- Optimum value from 100% of fleet.



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# Sensitivity Analyses

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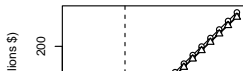
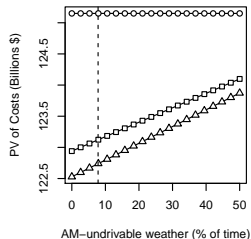
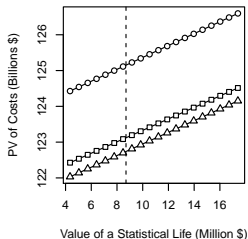
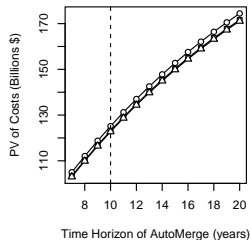
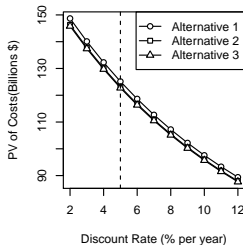
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- ▶ Input values varied between 50 and 200% or more.
- ▶ Dashed line indicates baseline assumption
- ▶ Discount rate, VSL, and per person cost of commute time all greatly affect net expected cost but similarly for all.
- ▶ Weather affects



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**AutoMerge Inc.**

Memorandum.

date of document: 22 December 2015.



**AutoMerge Inc.**

Summary of new york city transit data.



**Texas A&M Transportation Institute.**

Urban mobility information.