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AutoMerge

A Transportation Alternative for NYC

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Problem

Overview

- NYC plans 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

Description

Alternative 1 Do Not Implement AM.
This are the costs that would be incurred if the status quo continues so there is little uncertainty for this alternative.

Alternative 2 Implement AM.
Implementing AM comes with uncertainty with respect to AM performance.

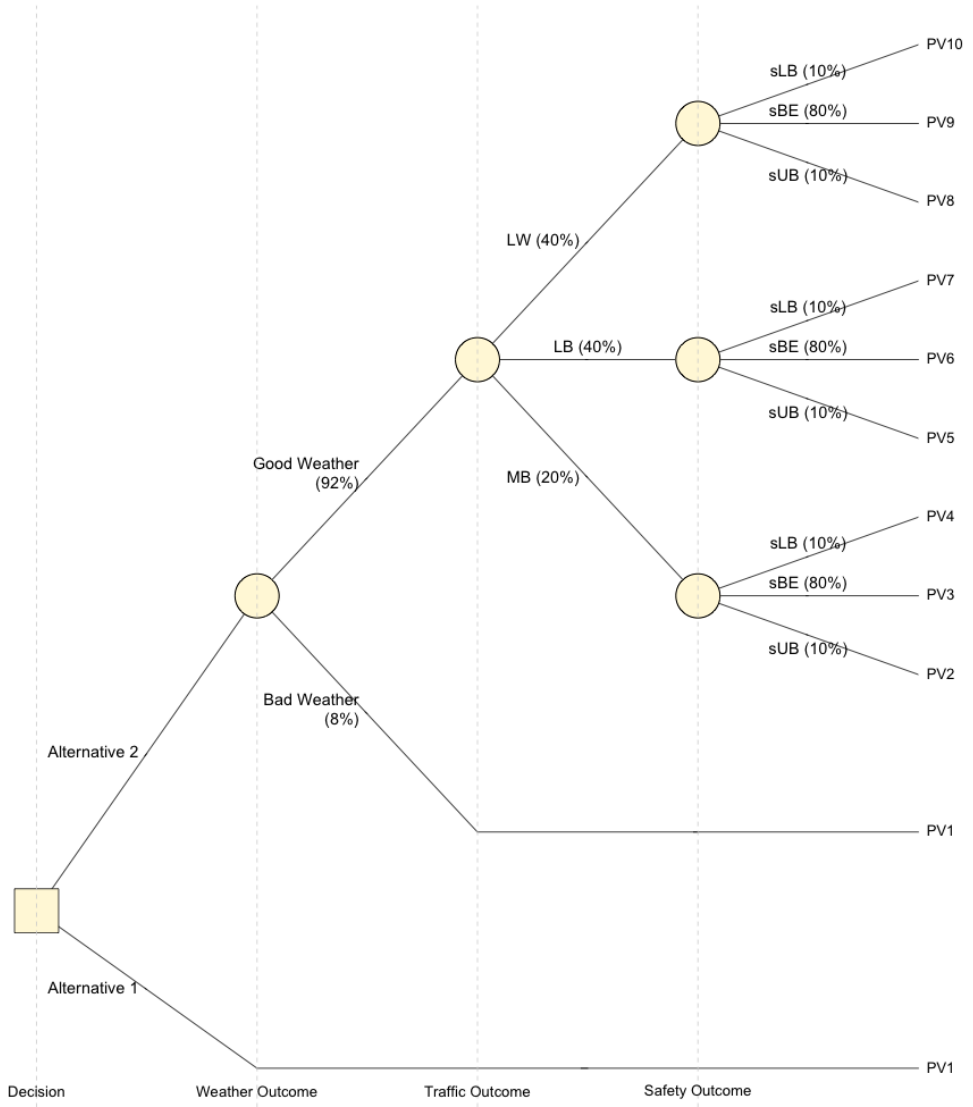
Alternative 3 Perform a pilot study.
We decide size of pilot study. A larger the study reduces more uncertainty than a smaller one but costs more.

Some Costs, Calculations, and Assumptions

Congestions, Capital, and Human costs

	Variable	Value	Notes
(a)	# buses with age $<$ 5 years	2313	Source: [3]
(b)	# buses with age 5-9 years	1296	Source: [3]
(c)	# buses with age 10-20 years	1437	Source: [3]
(d)	Capital Cost per bus age $<$ 5 years	$ 5000	Source: [3]
(e)	Capital Cost per bus age 5-9 years	$ 6500	Source: [3]
(f)	Capital Cost per bus age 10-20 years	$ 8500	Source: [3]
(g)	**Total Capital Cost**(*)	**$ 45.7 Million**	**=(a)*(d)+(b)*(e)+(c)*(f)**
(h)	Annual O&M Cost per Bus	$ 1500	Source: [3]
(i)	**Total Annual O&M Cost** (**)	**$ 7.6 Million**	**=[(a)+(b)+(c)]*(h)**
(j)	Annual Cost per Commuter	$ 1739	Source: [5]
(k)	Annual hours in congestion per commuter	74 hours	Source: [5]
(l)	Cost per minute	$ 0.39	$(h)/[(i) * 60]$
(m)	Total person trip per day	1.52 million	Source: [4]
(n)	Average time in daily person trip	49 minutes	Source: [4]
(o)	**Total annual congestion cost**	**$ 10.5 Billion**	**=360*l*(k)*(j)**
(p)	VSL (2015 $)	$ 8.7 Million	Source: [1]
(q)	Number of fatalities per year	16	Source: [4]
(r)	**Total annual mortality cost**	**$ 150 Million**	**=(p)*(q)**
(s)	Average Cost of Injury	$ 179,000	Source: [2]
(t)	Number of injuries per year	1740	Source: [4]
(u)	**Total annual injury cost**	**$ 311 Million**	**=(s)*(t)**

Uncertainty



- We account for uncertainty using decision trees.
- Source of uncertainty: Performance, Safety, and Weather
- We calculated Expected NPV for each outcome to evaluate.

Results

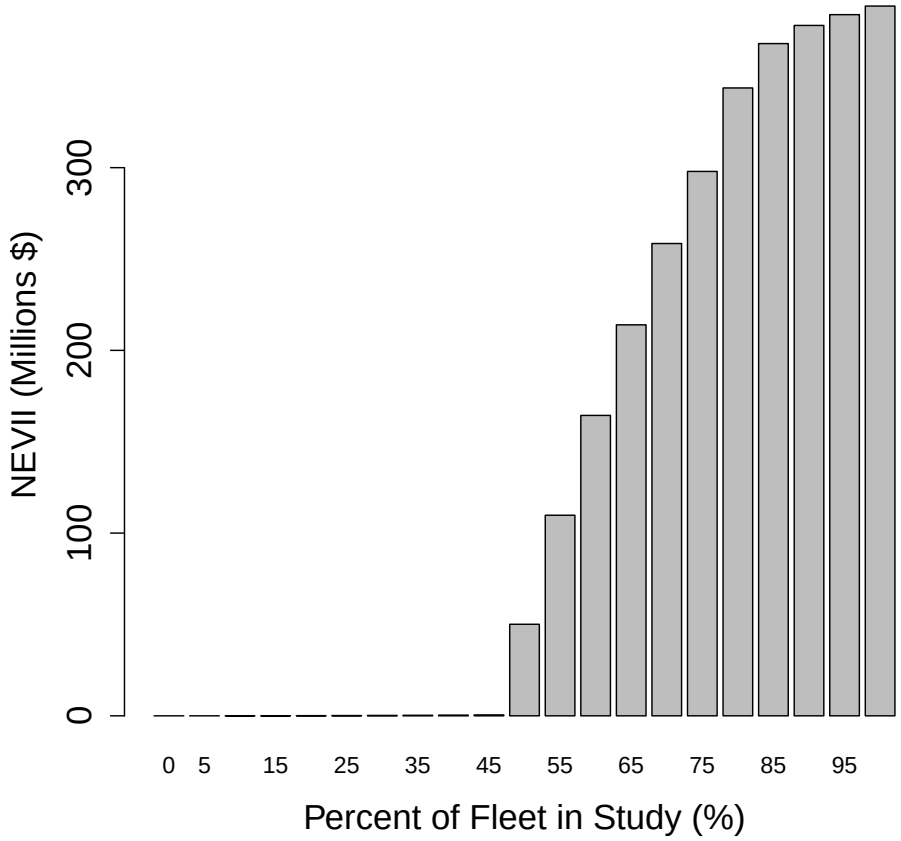
- Alternative 2 outperforms 1 in total cost.
- Congestion costs are based on total travel time.

Expected Cost in Billions ($)

	Alternative 1	Alternative 2
Capital Costs	0	0.05
O&M	0	0.06
Mortality	1.45	1.39
Injury	3.23	3.11
Congestion*	109.12	107.16
Air Pollution	10.55	10.55
GHG	0.8	0.8
Total	125.15	123.12

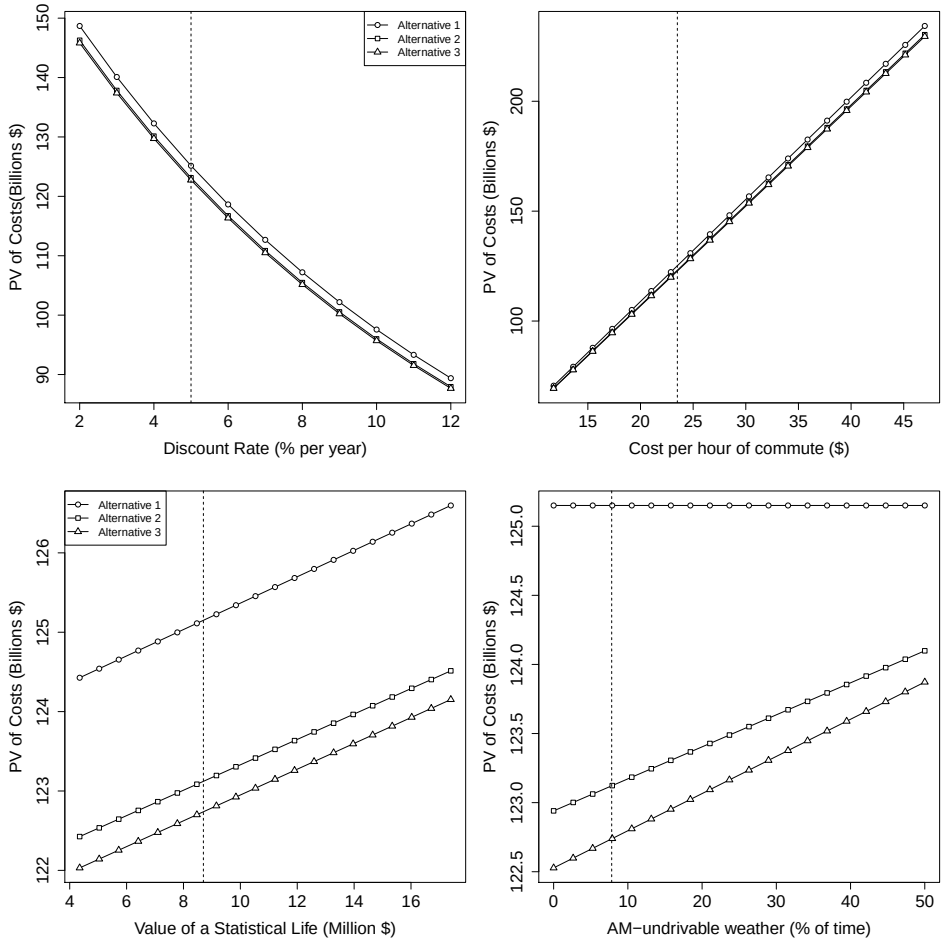
Pilot

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



Sensitivity Analyses

- Input values varied between 50 and 200% or more.
- Discount rate, VSL, and per person cost of commute time all greatly affect net expected cost but similarly for all.
- Weather affects alternatives 2 and 3 more then 1 but alternative 1 remained more expensive.



Conclusion

- Given uncertainty, investing in AM reduces cost over not investing.
- Using a risk-neutral metric, performing any pilot study with at least 50% of fleet adds value.
- Using 100% of fleet maximized value
- This recommendation is robust to necessary assumptions.

References

Questions?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