Simulation-optimization framework to evaluate a sustainable first mile transit access program using shared mobility

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Research Question

➢ Background

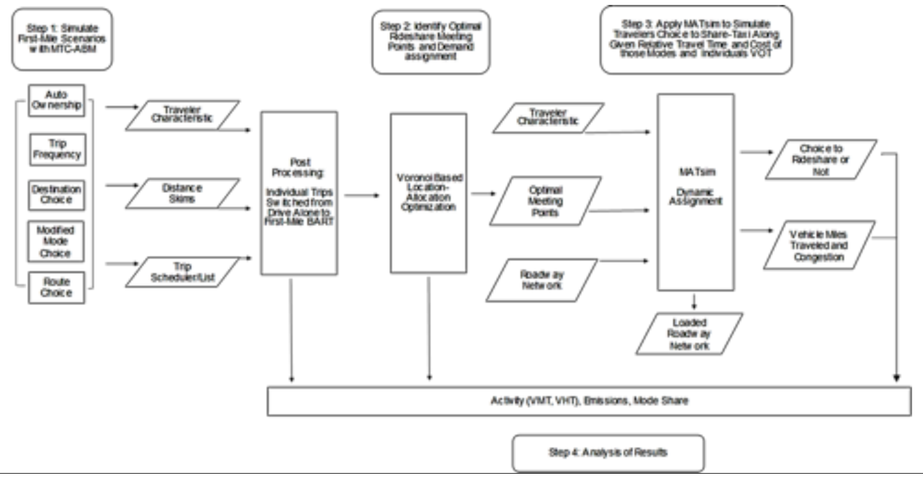
- Land use context and dominant culture in suburban areas contradict with the long-term cost-effective operation of public transit. Commuting by private cars also causes externalities such as traffic congestion and emission.
- Access to existing limited transit stations by walk/bike is difficult due to the distance from residential areas, exposure to weather and discomfort.
- Park-and-ride mode can be a temporary solution, however it is expensive and inefficient over time

➢ Research Questions

- What is the potential of ride sharing services to fill the first mile transit access gap for BART?
- How many trips might be shifted from SOVs and what are the possible impacts?

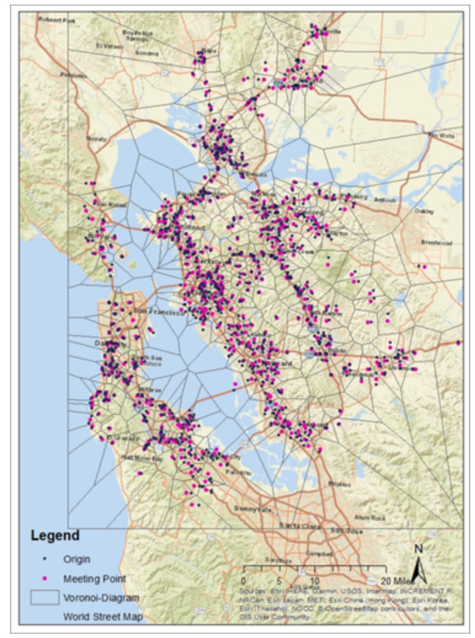
Methods and Data

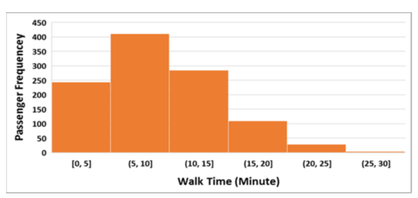
- Analyze the mode and destination choice models of the MTC-ABM to identify the important factors impacting mode choice decisions.
- Modify the BART's utility function based on research findings.
- Implement the model for best case scenario and identify the potential market for ridesharing first/last mile transit access.
- Develop continuous approximation models to explicitly solve facility location problem for pick-up decisions.
- Simulate the scenarios and evaluate the results using MATSIM

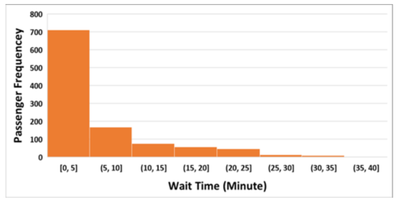


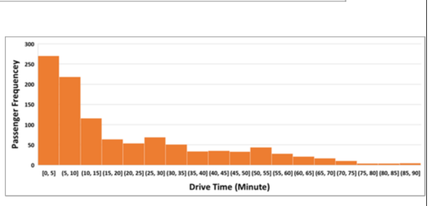
Results

Scenario	Drive alone	Shared ride	Walk transit	Drive transit	Drive BART	Total
Base	1,081,554	222,579	140,871	30,203	65,013	1,540,220
R+T_AAO	1,081,429	222,729	140,851	30,151	64,945	1,540,105
Diff	(125)	150	(20)	(52)	(68)	(115)
% Diff	**-0.01**	**0.07**	**-0.01**	**-0.17**	**-0.10**	**-0.01**
Base	1,078,735	222,306	142,024	31,055	66,660	1,540,780
R+T_10AT	1,069,351	218,916	139,075	26,423	89,528	1,543,293
Diff	(9,384)	(3,390)	(2,949)	(4,632)	22,868	2,513
% Diff	**-0.87**	**-1.52**	**-2.08**	**-14.92**	**34.31**	**0.16**
Base	1,081,586	222,557	140,850	30,224	65,014	1,540,231
R+T_50AT	1,077,611	221,023	139,183	27,957	76,056	1,541,830
Diff	(3,975)	(1,534)	(1,667)	(2,267)	11,042	1,599
% Diff	**-0.37**	**-0.69**	**-1.18**	**-7.50**	**16.98**	**0.10**
Base	1,078,536	222,118	142,128	31,131	66,612	1,540,525
R+T_75AT	1,074,737	221,231	141,359	30,228	72,404	1,539,959
Diff	(3,799)	(887)	(769)	(903)	5,792	(566)
% Diff	**-0.35**	**-0.40**	**-0.54**	**-2.90**	**8.70**	**-0.04**
Base	1,078,575	222,114	141,857	31,035	66,621	1,540,202
R+T_50CPM	1,075,731	221,401	141,343	29,683	72,230	1,540,388
Diff	(2,844)	(713)	(514)	(1,352)	5,609	186
% Diff	**-0.26**	**-0.32**	**-0.36**	**-4.36**	**8.42**	**0.01**
Base	1,078,036	222,208	142,215	31,227	65,906	1,539,592
R+T_150CPM	1,078,603	223,310	143,049	32,160	61,918	1,539,040
Diff	567	1,102	834	933	(3,988)	(552)
% Diff	**0.05**	**0.50**	**0.59**	**2.99**	**-6.05**	**-0.04**
Base	1,077,636	222,316	142,127	31,351	66,812	1,540,242
R+T_200CPM	1,078,565	223,970	143,887	33,391	58,122	1,537,935
Diff	929	1,654	1,760	2,040	(8,690)	(2,307)
% Diff	**0.09**	**0.74**	**1.24**	**6.51**	**-13.01**	**-0.15**









Pool case	Time: Change from Base Case	Cost: Change from Base Case	Generalized Cost: Change from Base Case
Trips Gain%	1%	68%	26%
Average	4 (min)	$7	$5
Total	8 (min)	$4,943	$1,426

Conclusion

- BART AM work trips increases by 8% (a total of 72,404 trips)
- From the 5,792 new BART trips, 1,077 switched from drive-alone mode
- Increases in travel delay by almost all the trips is a serious operational issue
- About 74% of trips exhibit an increase in the generalized cost (considering the value of time of different income group levels)
- Increases in travel delay by almost all the trips seems to be a serious operational issue for encouraging demand to this mode

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