Evaluating the Speed Advantage of Urban Elevated Small Vehicle Arterials (SVAs): A Case Study of Chicago, New York City, and San Francisco

Daniel Price

Abstract

This study investigates the potential of urban elevated Small Vehicle Arterials (SVA(s)) to alleviate urban traffic congestion and reduce car dependency. Building upon previous research highlighting the need for further exploration of SVA routing and transit times, this paper presents a rudimentary analysis of three diverse US metropolitan areas: Chicago, New York City, and San Francisco. Using Google Maps data, travel times for automobiles, mass transit, and proposed SVA routes were compared during a Friday evening rush hour. Results indicate that while SVA travel speeds consistently exceed those of mass transit, automobile speeds show greater variability, sometimes exceeding and sometimes falling short of SVA speeds. The findings suggest that while SVA offer a potentially faster alternative in many urban contexts, further research with larger, more robust datasets is needed to fully understand the impact of factors such as city geography, cultural norms, and existing infrastructure on SVA effectiveness. This research highlights the need for future studies to quantify observed average modal speed nuances and identify optimal locations for SVA implementation worldwide.

Key Words: Urban, Highways, Bicycle, Elevated, Small, Vehicle, Arterial, Modal, Speed.

Introduction

Urban elevated Small Vehicle Arterials (SVA) are introduced by this author in a journal publication, “Urban Elevated Small Vehicle Arterials: A Critical Review”. [1] The article points out urban automobile arterials have a minimum of lanes miles in USA automobile transportation networks, however move a disproportionately large amount of traffic. The article also suggests any research area for automobile arterials is a potential topic area for SVA. This article demonstrates the potential of the SVA proposition by performing a rudimentary study of travel time comparisons between existing city transportation modes and transportation mode speed should novel SVA be installed.

Modal transit times are an important factor for passenger modal choice[2]. Therefore routes are proposed for three USA cities: San Francisco, Chicago and New York City. A route was chosen based on the 5 miles pitch spacing [1] and construct-ability considerations. Data was then gathered and analyzed for locations along this route.

Many studies of modal choice involve the choice between automobile centric trips and those using mass transit. The Small Vehicle Arterial (SVA) concept provides a third choice which will require newly organized econometric studies to quantify parameters and to discern places where elevated SVA may have the most economical application.

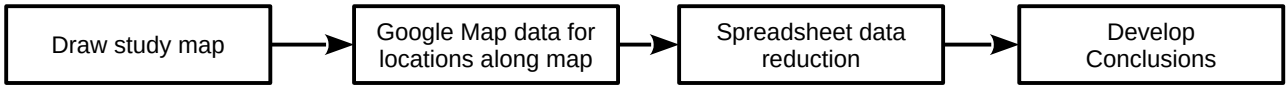
Ongoing studies have worked to understand causes of car dependency through study of correlations and causes [3]. However, no studies exist to understand how elevated SVA might overcome car dependency. This article is intended to show how relatively simple analysis of novel elevated SVA can unveil important dependencies suggesting a need for larger more robust studies.

Received date: Mar 12th 2025
Publication date: July 2nd 2025
https://doi.org/10.63211/j.p.25.145305

Study Methodology

Google Map tools were used to estimate a potential SVA route. In summary: Trips were selected along the SVA routes shown on this map. Google Maps data was collected for bus and automobile modes for these trips. Then the Google Maps data are compared with estimated time to travel the mapped SVA network. Figure 1 Logical Flow Diagram for map study pictorially describes this process.

Figure 1: Logical Flow Diagram for map study.



A rudimentary routing and time study for three metro areas was completed for Chicago, New York City and San Francisco. USA cities are chosen due to author familiarity with the transportation networks. Elevated SVA are located on a 5 mile grid or within 5 miles of the waters edge consistent with prior findings. [1] These locations are marked within My Maps [4], a mapping tool provided by Google. The results are then exported as images to this paper and are represented by Figures 2, 3, & 4.

Representative trips for the time study along this grid are chosen. Automobile and bus travel times is then collected for the three cities with data provided by Google Maps tool [5]. Travel time was recorded for a Friday rush hour, travel commencing at 5:00 pm. Google maps tool calculates the travel time along a route selected by Google for each mode of travel. Therefore each travel time is based on a unique route. To compare the results it is most useful to normalize the data to a common distance, the results were normalized to an average speed based on a common distance along the SVA network. The normalization formula is show by the equation below.

$$\frac{SVA\ Distance(miles)}{Travel\ Time(min)/60(min/mile)}$$

Resulting in:

$$\frac{(miles)}{(hour)}$$

This data normalization allows us to compare the speed of fastest route chosen by Google maps tools with a route along an elevated SVA route.

It is recognized that 28 mph for Class 3 vehicles is close to most local road speeds limits in the USA at 30 mph [1], therefore no adjustment was made for local road travel. The average modal travel speeds, for bus and automobile modes, are then compared to estimated data for the non-stop Class 3 SVA transit mode at 28 mph. See Table 1 below.

Results

Received date: Mar 12th 2025
Publication date: July 2nd 2025
https://doi.org/10.63211/j.p.25.145305

Chicago terrain is non-mountainous with a large lake to the east. The terrain has been created by a combination of glacial and coastal processes. [6]

The city's automobile street network is laid out mostly on a grid. Therefore Figure 2 routing example resembles a grid with a 5 mile pitch spacing. The grid was laid out to cover Chicago and the sprawling suburbs. Routes were chosen based on 5 mile pitch spacing over signalized arterials.

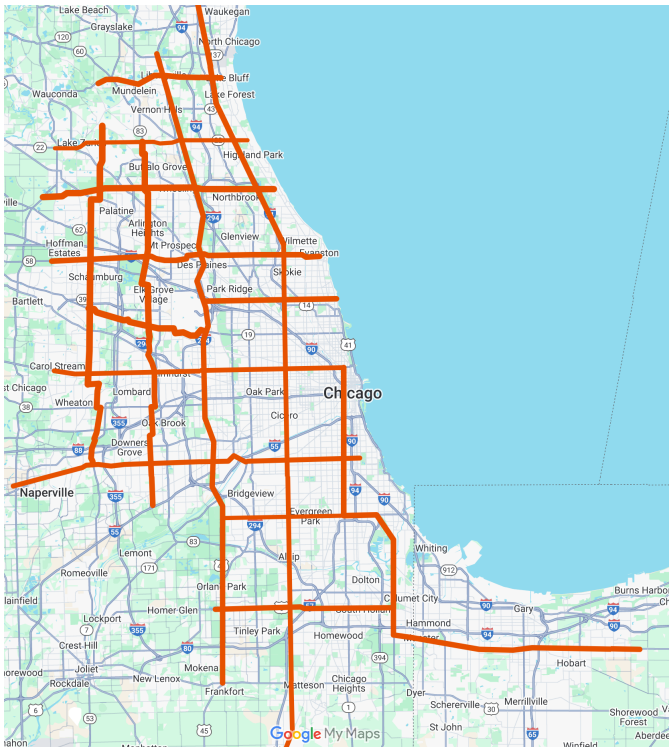


Figure 2: Example Chicago elevated SVA network for study [4].

New York City metro area terrain is glacially formed [7] with the Hudson, a large river, bisecting the New York state and New Jersey state sides of the metro area. Various tributaries of the Hudson further divide the city with Manhattan Island being the functional core of the metro area.

New York City's transportation network has evolved from the British Colonial past to the modern day. The network of streets is grid shaped on Manhattan Island and partly grid shaped on the New Jersey side of the Hudson River. Figure 3 shows a routing example for the New York metro area. The routes were chosen in step wise: first a route down the middle of Manhattan Island was chosen with alignments along Park and Broadway. Then an alignment was chosen within 5 miles of the Jersey Shore mostly paralleling the Hudson River running near to Newark Airport. These areas where then connected by way of new or existing bridges. The routes were extended both to the east into Long Island and north into Harlem. These extensions were generally spaced 5 miles from the water and 5 mile grid spacing between each other. Generally these routes are over existing signalized arterials.

Received date: Mar 12th 2025
Publication date: July 2nd 2025
https://doi.org/10.63211/j.p.25.145305

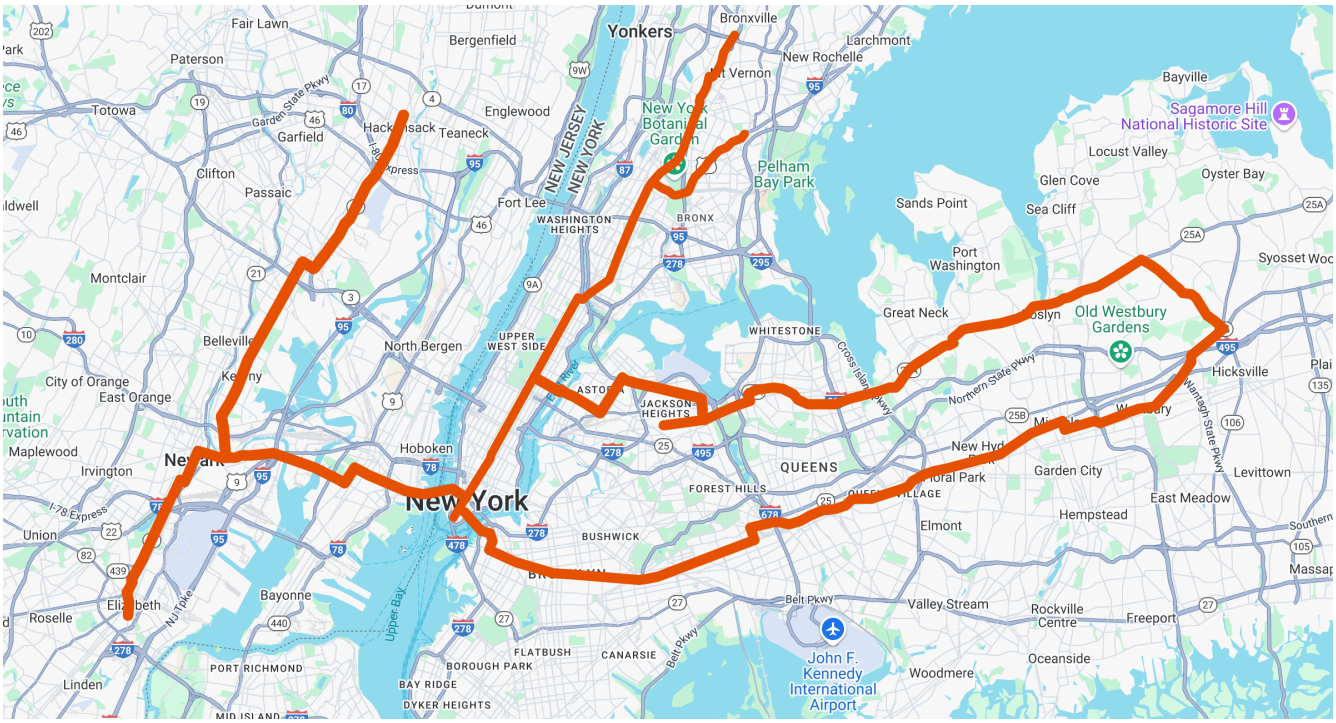


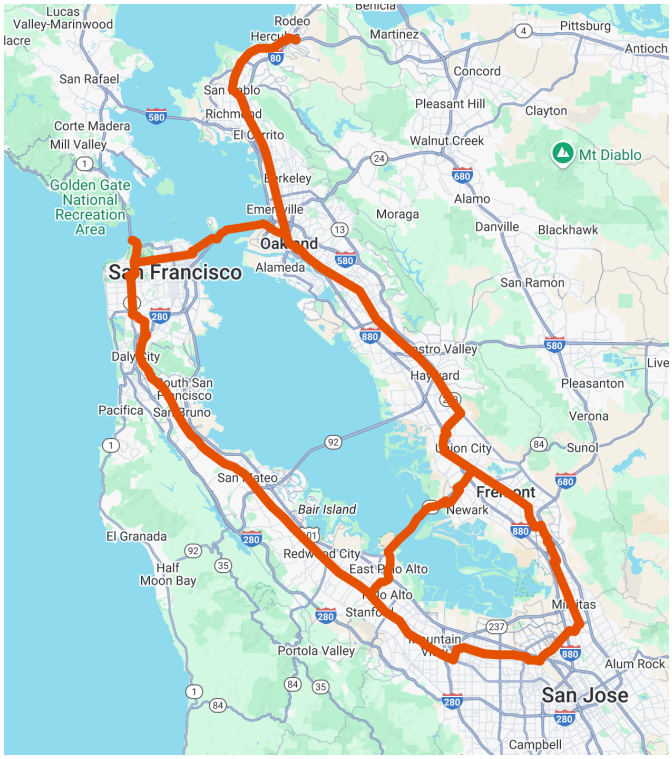
Figure 3: New York City example elevated SVA network for study [4].

San Francisco has a complex geological history which shaped the terrain. [8] These processes produced mountains and a large bay with a narrow inlet to the Pacific Ocean.

Figure 4 shows an example routing for Elevated SVA through the San Francisco Bay area. The intention of the route is to propose a bay area circumnavigation which maximizes utility of the perceived 5 mile SVA coverage limit. The chosen routes are mostly over signalized arterials. The routes are chosen to be not more than 5 miles to the water. Bicycle routes are used where available to cross the bay. A new bridge from San Francisco east to Yerba Buena Island is shown.

A rudimentary time study using Google Map tools was conducted recording travel time for automobiles and mass transit. The distance of the most direct route along the example routing above was used to compute the average travel speed.

Figure 4: San Francisco example elevated SVA network for study [4].



Received date: Mar 12th 2025
Publication date: July 2nd 2025
https://doi.org/10.63211/j.p.25.145305

Points along these routes, if uncongested, will be moving relative to the speed limit for the vehicle class. For Class 3 highways the speed is 28 mph. Therefore any trips within the city at 28 mph or less will be faster by Class 3 SVA.

Table 1 below presents the results for the three city examples. The results generally show the mass transit average travel speed is less than Class 3, 28 mph. The resultant average corridor speed for automobiles presents a more nuanced conclusion. In some areas and days the automobile is moving slower than an elevated SVA and at times faster than the elevated SVA.

Table 1: Average computed speed for select trips starting at 5:00 pm

Chicago		Distance [4]	Auto Min (mph) [5]	Auto Max (mph) [5]	Bus (mph) [5]
Waukegan, Illinois	Chicago Heights, Illinois	76.3	32.7	61.04	19.00
Chicago	Geneva Ill	46.5	18.6	37.2	28.18
Evanston Illinois	Hoffman Estates, Ill	24.2	16.13	36.30	
Orland Hills, Illinois	New Chicago, Indiana	35	24.71	46.67	
Buffalo Grove, Illinois	downers Grove, Illinois	32	25.6	54.86	9.95
Carol Stream, Illinois	Lincoln Park, Chicago, IL	33	13.2	28.29	12.61
New York					
Elizabeth NJ	La Guardia Airport	27	12.46	24.92	17.61
Newark NJ	Yonkers NY	29.6	22.20	27.32	16.60
Newark NJ	Brooklyn NY	16	11.29	24.00	8.97
Newark NJ	Harlem NY	26	14.18	39.00	20.53
Lower Manhattan NY	Harlem NY	8	6.86	16.00	14.55
San Francisco					
San Francisco	North San Jose	45	27.00	45.00	25.00
North San Jose	Oakland, CA	37	18.50	40.36	25.23
Palo Alto, CA	Freemont, CA	16	13.71	36.92	18.82
Sunnyvale, CA	Freemont, CA	20	15.00	42.86	21.43

Discussion and Recommendation

Since average modal speed is an important factor for mode selection [2], this study focuses on estimating average mode speed during an evening rush hour. To theoretically create the most compelling scenario, the elevated SVA should be faster than all other modes in the local area. New York City results indicate the elevated SVA option with Class 3, 28 mph speed may be highly competitive in most areas of New York City, especially on Manhattan Island. However in some areas, the SVA maximum speed may need to be greater than 28 mph to provide the most compelling service alternative.

If the modal speed for SVA is sufficiently fast to attract users the SVA system may become congested. This congestion will slow speed and create less competition for existing transportation modes. The local jurisdiction will then have the choice to expand capacity or to not expand capacity. The economic impacts of capacity expansion to relieve congestion is beyond the scope of this paper, therefore this SVA viability study is limited a comparison with Class 3, 28 mph non-congested SVA roadways.

The average mode speed study results allow interesting observations.

1. In most cases, Class 3 non-stop travel of 28 mph is faster than either the bus or the minimum automobile average speed.
2. It appears some areas of the cities are more congested than others such as the trip from Lower Manhattan, NY to Harlem, NY or west of downtown Chicago.

Received date: Mar 12th 2025
Publication date: July 2nd 2025
https://doi.org/10.63211/j.p.25.145305

3. New York City automobile average maximum speed is less than Class 3, 28 mph except for one case, Newark to Harlem.
4. San Francisco and Chicago in most cases have maximum average automobile speed greater than Class 3, 28 mph.
5. Areas nearest the urban core such as in New York City or Chicago show some of the lowest existing average speeds.

We can also see the possibility for new bridges in both San Francisco and New York City. Nearby bodies of water impose impediments for vehicles especially in those areas with limited or no bridge access.

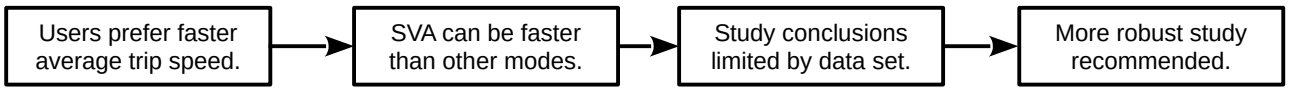
The study compares the existing congested net

The study performed is rudimentary with limited data sets that do not allow statistically determinate statements to be made. Therefore any observations are only indicative of underlying trends. The following indications are noted.

1. Study indicates SVA can be faster than some modes in all cities studied.
2. The study indicates wide variation in performance of competing modes.
3. Large data sets are required to definitively characterize phenomena.
4. Changes will occur especially as systems are built therefore continuous data collection into a repository may support study of before and after changes.
5. Behavioral changes may be induced if SVA systems are installed. Historical data can be valuable to assess behavioral changes that may occur.
6. The author suggests since this study can be conducted on a desktop with minimal resources, the results are suitable for inclusion into study proposals.

A more robust study can be conducted using big data resources. One study of personal transit times for mass transit used data from: HERE Traffic data , Twitter data, up-to-date GTFS (General Transit Feed Specification) transit data, and road networks from OpenStreetMap [9]. Many other data sources are possible. World wide studies could provide insight into what conditions will give the greatest quality of life improvements after SVA installation. Figure 5 depicts the logical development of this recommendation.

Figure 5 Study recommendation – Logical Flow Diagram.



Recommendation Statement: Design and perform world wide study of potential transit time improvements possible by installing elevated SVA over urban transit ways. The primary goal is to find conditions where the greatest service improvements are possible. Secondary goal is to establish a baseline monitoring program that will allow historic comparison studies to be performed. A tertiary goal is to reveal conditions where SVA accommodating vehicles traveling faster than Class 3, 28 mph may be economically justified.

Received date: Mar 12th 2025
Publication date: July 2nd 2025
https://doi.org/10.63211/j.p.25.145305

References

[1].D. Price, “Urban Elevated Small Vehicle Arterials: A Critical Review,” *Int. J. Inf. Sci. Discuss.*, vol. 1, no. 1, pp. 1–43, Feb. 2025, doi: 10.63211/j.p.25.124883.
[2].....Ch. R. Sekhar, “MODE CHOICE ANALYSIS: THE DATA, THE MODELS AND FUTURE AHEAD,” *Int. J. TRAFFIC Transp. Eng.*, vol. 4, no. 3, pp. 269–285, Sep. 2014, doi: 10.7708/ijtte.2014.4(3).03.
[3]. .P. Saeidizand, K. Fransen, and K. Boussauw, “Revisiting car dependency: A worldwide analysis of car travel in global metropolitan areas,” *Cities*, vol. 120, p. 103467, Jan. 2022, doi: 10.1016/j.cities.2021.103467.
[4]. .Google, “Maps of New York City, San Francisco, Chicago,” Google, n.d. Accessed: Apr. 08, 2025. [Online]. Available: www.google.com/
[5]..“Google Maps,” Google, n.d. Accessed: Apr. 08, 2025. [Online]. Available: maps.google.com/maps
[6].....Michael J. Chrzastowski, “The Chicago River—A Legacy of Glacial and Coastal Processes,” ILLINOIS STATE GEOLOGICAL SURVEY, Guidebook Guidebook 37, 2009. [Online]. Available: https://library.isgs.illinois.edu/Pubs/pdfs/guidebooks/guidebook-37.pdf
[7].....D. H. Cadwell and E. H. Muller, “New York glacial geology, U.S.A.,” in *Developments in Quaternary Sciences*, vol. 2, Elsevier, 2004, pp. 201–205. doi: 10.1016/S1571-0866(04)80197-0.
[8].….A. M. Sarna-Wojcicki, “Late Cenozoic paleogeographic reconstruction of the San Francisco Bay area from analysis of stratigraphy, tectonics, and tephrochronology,” in *Regional Geology of Mount Diablo, California: Its Tectonic Evolution on the North America Plate Boundary*, R. Sullivan, D. Sloan, J. R. Unruh, and D. P. Schwartz, Eds., Geological Society of America, 2021, pp. 443–472. doi: 10.1130/2021.1217(17).
[9].…Y. Liao, J. Gil, R. H. M. Pereira, S. Yeh, and V. Verendel, “Disparities in travel times between car and transit: Spatiotemporal patterns in cities,” *Sci. Rep.*, vol. 10, no. 1, p. 4056, Mar. 2020, doi: 10.1038/s41598-020-61077-0.

Received date: Mar 12th 2025
Publication date: July 2nd 2025
https://doi.org/10.63211/j.p.25.145305