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Private SUV or Carpooling? – investigating impact of choices on Indian roads.

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Outline

- Introduction
- Data
- Methodology
- Results
- Conclusion

Increasing trend of buying SUVs

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May sees SUVs, commercial auto sales soar, while car sales lag

Vehicle sales are hitting a new high, leaving the pandemic era lows a distant memory



By K. Sunil Thomas | Updated: June 13, 2023 14:14 IST



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SUVs boost India's passenger vehicle sales to record high in FY23

By Aditi Shah and Yagnoseni Das

April 13, 2023 3:55 PM GMT+5:30 · Updated 6 months ago



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Published on June 2, 2023 In Endless Origins

Stuck in Traffic? Don't Blame BMTC

In Bangalore, there are currently more than one crore private vehicles, compared to 6800 buses.



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New study suggests today's SUVs are more lethal to pedestrians than cars

June 16, 2020



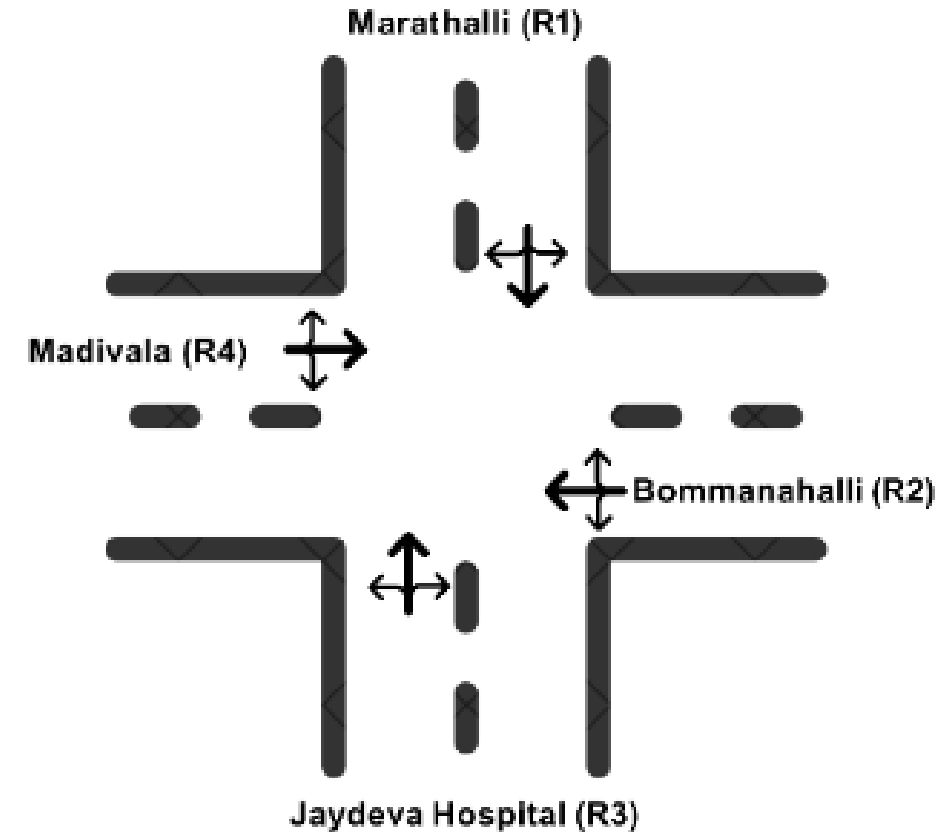
Study Area - data

- Traffic Survey and Analysis - Central Silk Board Junction¹ published by BMRCL
 - Location - Silk board Junction
 - road geometry
 - traffic volume
 - turning movement counts
 - traffic composition
- Signal Phase design
 - Webster method
- VISSIM
 - Calibrated based on Indian conditions

Vehicle Composition

Two-Wheeler	Auto Rikshaw	Bus	Car	LCV/HGV	Scenario Total
43.1	4.7	7.3	41.9	2+1	100

Central Silk Board Junction



¹“Traffic Survey and Analysis - Central Silk Board Junction,” Bangalore, Aug. 2017.

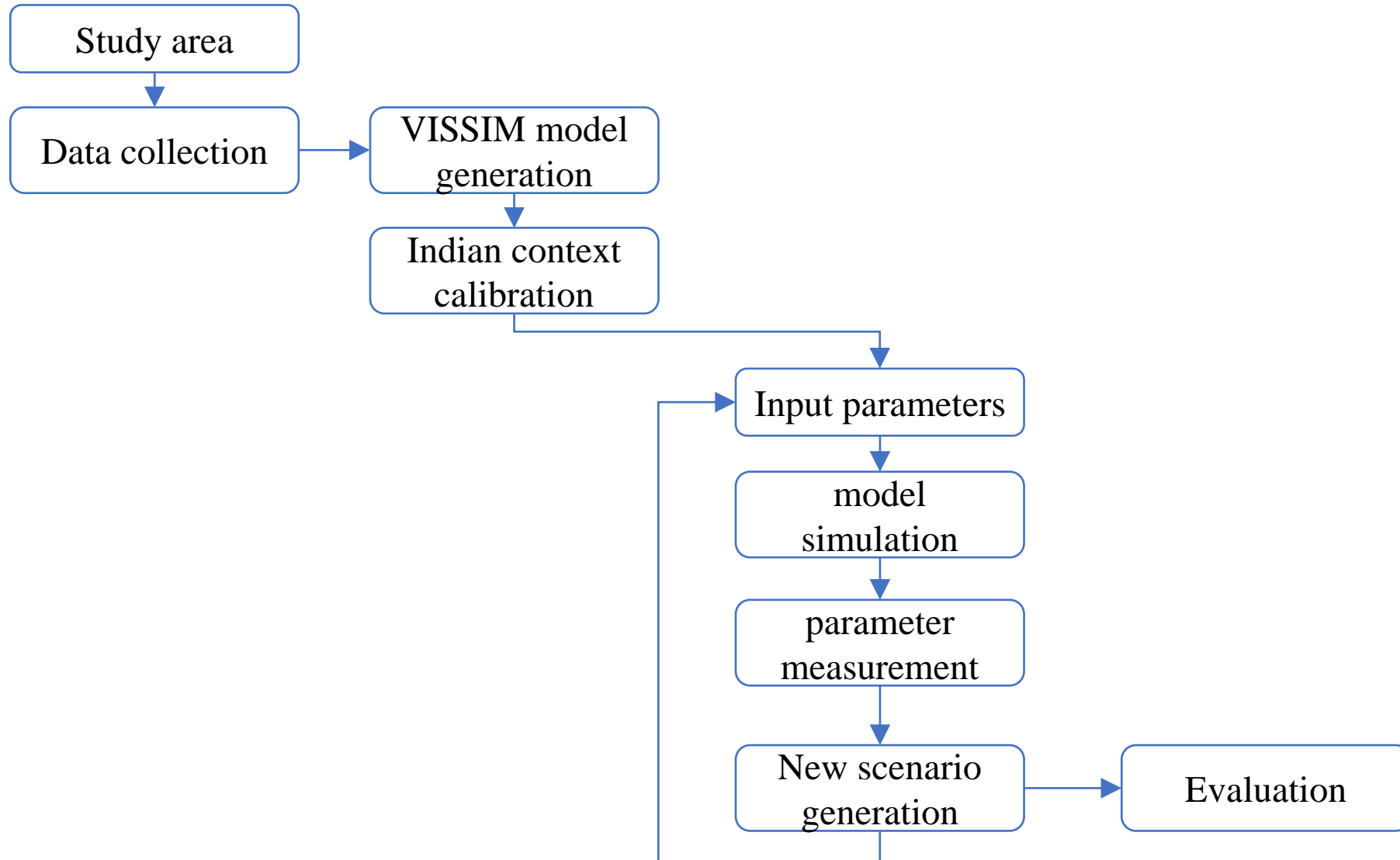
Scenarios

- SUV penetration level – 0%, 10% 20% is considered in all scenarios
- **Base Scenario (BS)** - All cars are considered to have a single occupancy.
- **Vehicle pooling scenario (VPS)** - cars and SUVs are assumed to have double occupancy.
- **SUV pooling scenario (SPS)** - cars have single occupancy while SUVs will have triple occupancy

	Peak Hour Traffic Flow				Non-peak Hour Traffic Flow			
	EB	WB	NB	SB	EB	WB	NB	SB
BS	3618	6339	5570	4683	2906	4205	3231	3055
VPS	2860	5011	4403	3702	2297	3324	2554	2415
SPS	3618	6339	5570	4683	2906	4205	3231	3055

EB – East Bound, WB – West Bound, NB – North Bound, SB – South Bound

Methodology



Simulation

The screenshot displays a traffic simulation software interface. The main window shows a 3D perspective view of a four-lane junction with various vehicles including cars, buses, and trucks. The interface includes a menu bar at the top with options like File, Edit, View, Lists, Base Data, Traffic, Signal Control, Simulation, Evaluation, Presentation, Scripts, and Help. Below the menu bar is a toolbar with icons for simulation control. On the left side, there is a Project Explorer pane showing a tree view of the simulation setup, including a 'Four Lane Junction' and several 'Scenarios' and 'Modifications'. The 'Simulation Runs' pane at the bottom right contains a table with the following data:

Count	No	Timestamp	RandSeed	StartTm	SimEnd	DynAssignConv
1	1	2023-04-13	52	00:00:00	2374.3	<input type="checkbox"/>

At the bottom of the interface, there is a status bar with the text: **** 2374.60 74.6 3095 + 1.2 (3850). The bottom of the interface also features a series of tabs for different simulation results: Simulation Runs, Delay Results, Data Collection Results, Queue Results, Vehicle Travel Time Results, Vehicle Network Performance Evaluation Results, and Node Results.

Results

Average queue (in km) with different % of SUVs on each leg of junction

Scenarios	SUV% (EB)			SUV% (WB)			SUV% (NB)			SUV% (SB)		
	0%	10%	20%	0%	10%	20%	0%	10%	20%	0%	10%	20%
<i>Peak hour</i>												
BS	1.64	1.67	1.65	1.67	1.67	1.68	1.66	1.68	1.66	1.68	1.69	1.69
VPS	1.49	1.44	1.49	1.68	1.68	1.68	1.64	1.63	1.66	1.62	1.63	1.64
SPS	1.64	1.62	1.55	1.67	1.69	1.67	1.66	1.67	1.65	1.68	1.68	1.64
<i>Non-peak hour</i>												
BS	1.55	1.56	1.54	1.64	1.65	1.64	1.53	1.55	1.55	1.58	1.56	1.57
VPS	1.20	1.26	1.26	1.55	1.55	1.55	1.28	1.29	1.27	1.29	1.29	1.32
SPS	1.55	1.46	1.27	1.64	1.60	1.58	1.53	1.47	1.40	1.58	1.46	1.40

Results

Average delay (in minutes) with different % of SUVs on each leg of junction

Scenarios	SUV% (EB)			SUV% (WB)			SUV% (NB)			SUV% (SB)		
	0%	10%	20%	0%	10%	20%	0%	10%	20%	0%	10%	20%
<i>Peak hour</i>												
BS	18.4	18.5	18.3	19.0	18.9	19.6	18.4	18.6	18.6	20.3	20.6	20.6
VPS	15.7	15.0	15.2	19.0	18.7	19.2	17.9	18.1	18.6	18.6	18.9	19.4
SPS	18.4	17.5	16.6	19.0	19.3	18.1	18.4	19.1	18.1	20.3	20.2	18.3
<i>Non-peak hour</i>												
BS	16.3	16.8	15.6	18.6	18.7	18.7	16.4	16.8	16.3	18.4	18.6	18.3
VPS	11.5	12.7	13.1	16.5	16.5	16.8	13.2	13.3	12.7	14.0	14.2	15.1
SPS	16.3	15.0	11.9	18.6	17.9	17.3	16.4	15.1	14.2	18.4	16.1	15.9

Results

Average speed (in kmph) with different % of SUVs on each leg of junction

Scenarios	SUV% (EB)			SUV% (WB)			SUV% (NB)			SUV% (SB)		
	0%	10%	20%	0%	10%	20%	0%	10%	20%	0%	10%	20%
<i>Peak hour</i>												
BS	10.2	10.2	10.3	10.0	10.0	9.7	10.2	10.2	10.1	9.48	9.35	9.37
VPS	11.4	11.9	11.7	9.9	10.0	9.8	10.4	10.3	10.1	10.1	9.94	9.75
SPS	10.2	10.6	10.9	10.0	9.8	10.2	10.2	9.9	10.3	9.48	9.50	10.2
<i>Non-peak hour</i>												
BS	11.2	10.9	11.6	10.1	10.1	10.1	11.2	11.0	11.2	10.3	10.2	10.3
VPS	14.3	13.4	13.1	11.1	11.0	10.9	13.0	13.0	13.4	12.5	12.4	11.8
SPS	11.2	11.9	14.0	10.1	10.4	10.7	11.2	11.9	12.4	10.3	11.3	11.4

Conclusion

- Compared to the base scenario, the vehicle pooling scenario saves up to 3-4 min for a 4 km ride, while SUV pooling scenario saves up to 2 - 5 min for the same length.
- Suggestions
 - Thus, vehicle pooling or adopting high occupancy vehicles needs to be incentivized.
 - Along with incentivizing pooling, buying private vehicles, especially SUVs as a personal mode of transport should be penalized.
 - Vehicle pooling should be strategy would give better results when combined with other strategies.
- Limitations
 - Incorporate willingness to share vehicle
 - Assumption that mode-shift would happen only between 4-wheelers
- Future Scope
 - Impact on emissions and willingness to share vehicle can be considered
 - Instead of junction, network level analysis can be done
 - Forecasting the impact for 2030 and Policy analysis

Thank you

Mindset



Source - https://www.youtube.com/shorts/bkm1K_WCuIM

Driver behaviour calibration

- **Indian traffic**

- high vehicular flow,
- lack of lane discipline,
- lane grading and separators;
- sense of driving behavior.

- Wiedermann-74 car-following model was used
 - safety distance during standstill
 - additive, and multiplicative parts of safety distance
 - number of interactive objects for each vehicle,
 - minimum look ahead and lookback distance,
 - minimum headway
 - acceleration of different modes at 0 km/h
 - Desired speed distribution curve
 - distribution between the minimum and maximum bounds of desired speed.

¹T. V. Mathew and P. Radhakrishnan, “Calibration of Microsimulation Models for Nonlane-Based Heterogeneous Traffic at Signalized Intersections,” *J Urban Plan Dev*, vol. 136, no. 1, pp. 59–66, Mar. 2010, doi: 10.1061/(ASCE)0733-9488(2010)136:1(59).

²S. M. P. Siddharth and G. Ramadurai, “Calibration of VISSIM for Indian Heterogeneous Traffic Conditions,” *Procedia Soc Behav Sci*, vol. 104, pp. 380–389, Dec. 2013, doi: 10.1016/j.sbspro.2013.11.131.

³R. Mohan, S. Eldhose, and G. Manoharan, “Network-Level Heterogeneous Traffic Flow Modelling in VISSIM,” *Transportation in Developing Economies*, vol. 7, no. 1, p. 8, Apr. 2021, doi: 10.1007/s40890-021-00117-4.