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Evaluation of Post-Incident Traffic Management Measures for Emergency Response: A Case Study of Kolkata City

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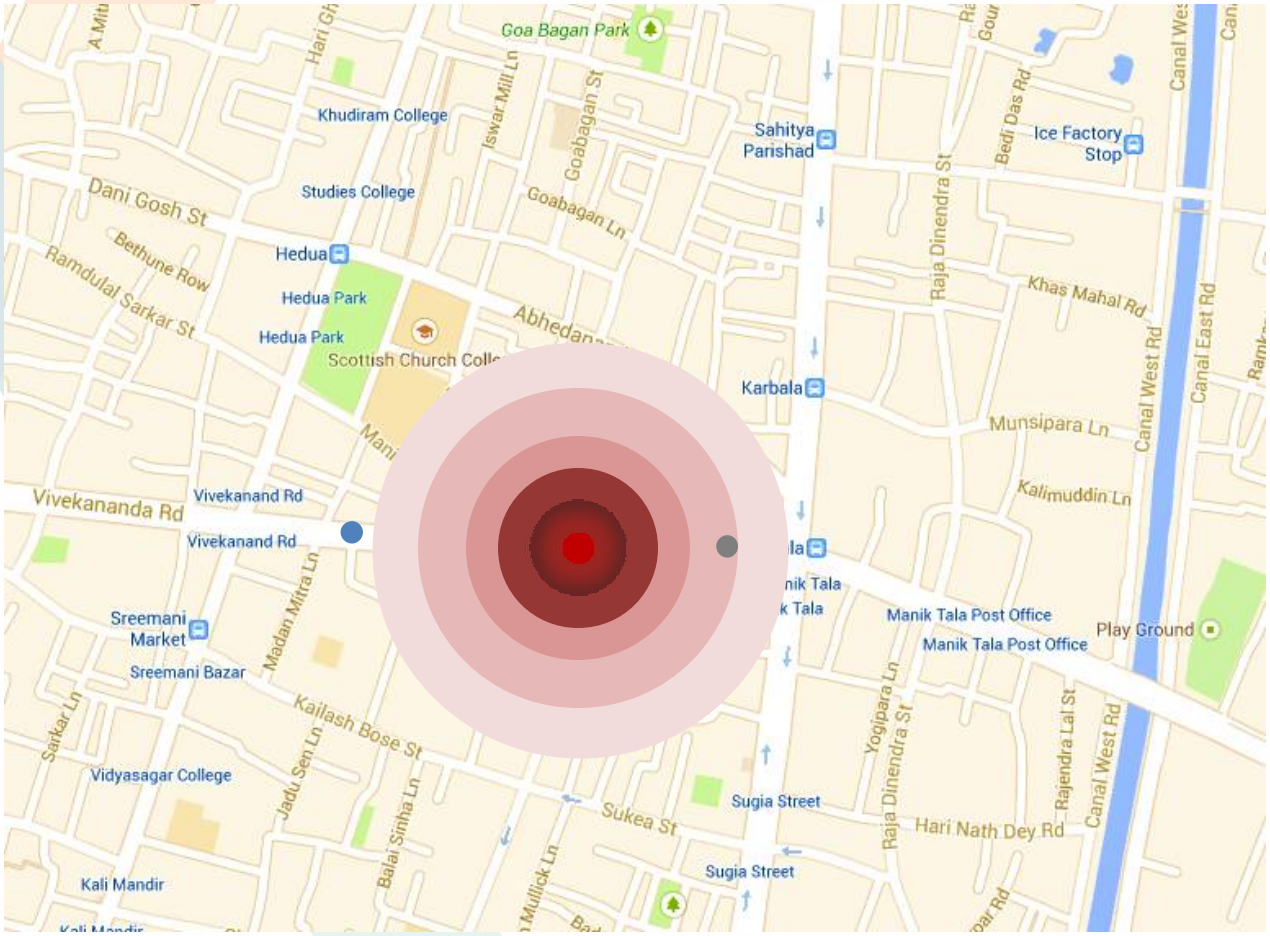
Overview of the presentation

- Motivation
- Methodology
- Study Area
- Creation of Incident Scenarios
- Analysis and Results
- Conclusion

Motivation

- Rapid urbanization and growth of private vehicles
- Demand-supply imbalance resulting in increasing traffic congestion
- Major traffic incidents - Situation becomes worse
- Effective coordination among different response agencies like police, fire, medical etc. is needed
- Current Practice in India is based on experience and judgment of key personnel


Goa Bagan Park
Khudiram College
Iswar Mitt Ln
Goabagan St
Sahitya Parishad
Bedi Das Rd
Ice Factory Stop
Canal West Rd
Dani Gosh St
Studies College
Goabagan Ln
Raja Dinendra St
Bethune Row
Ramdulal Sarkar St
Hedua
Hedua Park
Hedua Park
Khas Mahal Rd
Canal East Rd
Scottish Church Colle
Karbala
Munsipara Ln
Vivekananda Rd
Vivekanand Rd
Vivekanand Rd
Kalimuddin Ln
Madan Mitra Ln
Sreemani Market
Sreemani Bazar
Manik Tala Post Office
Manik Tala Post Office
Play Ground
Kailash Bose St
Sarkar Ln
Jadu Sen Ln
Vidyasagar College
Balai Sinha Ln
Sukea St
Sugia Street
Yogipara Ln
Raja Dinendra St
Rajendra Lal St
Hari Nath Dey Rd
Canal West Rd
Sugia Street
Kali Mandir

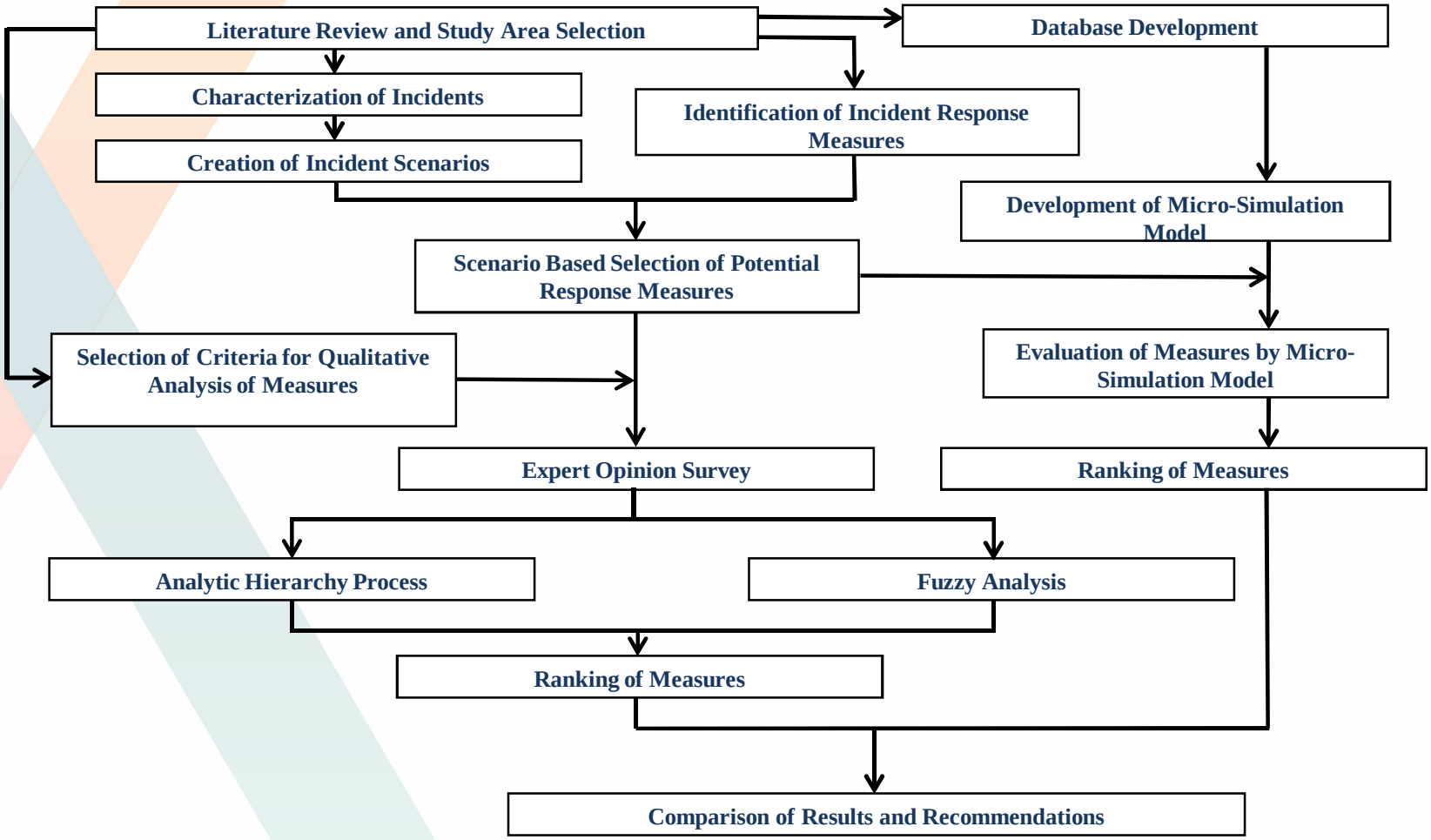

Emergency
Rescue


POLICE

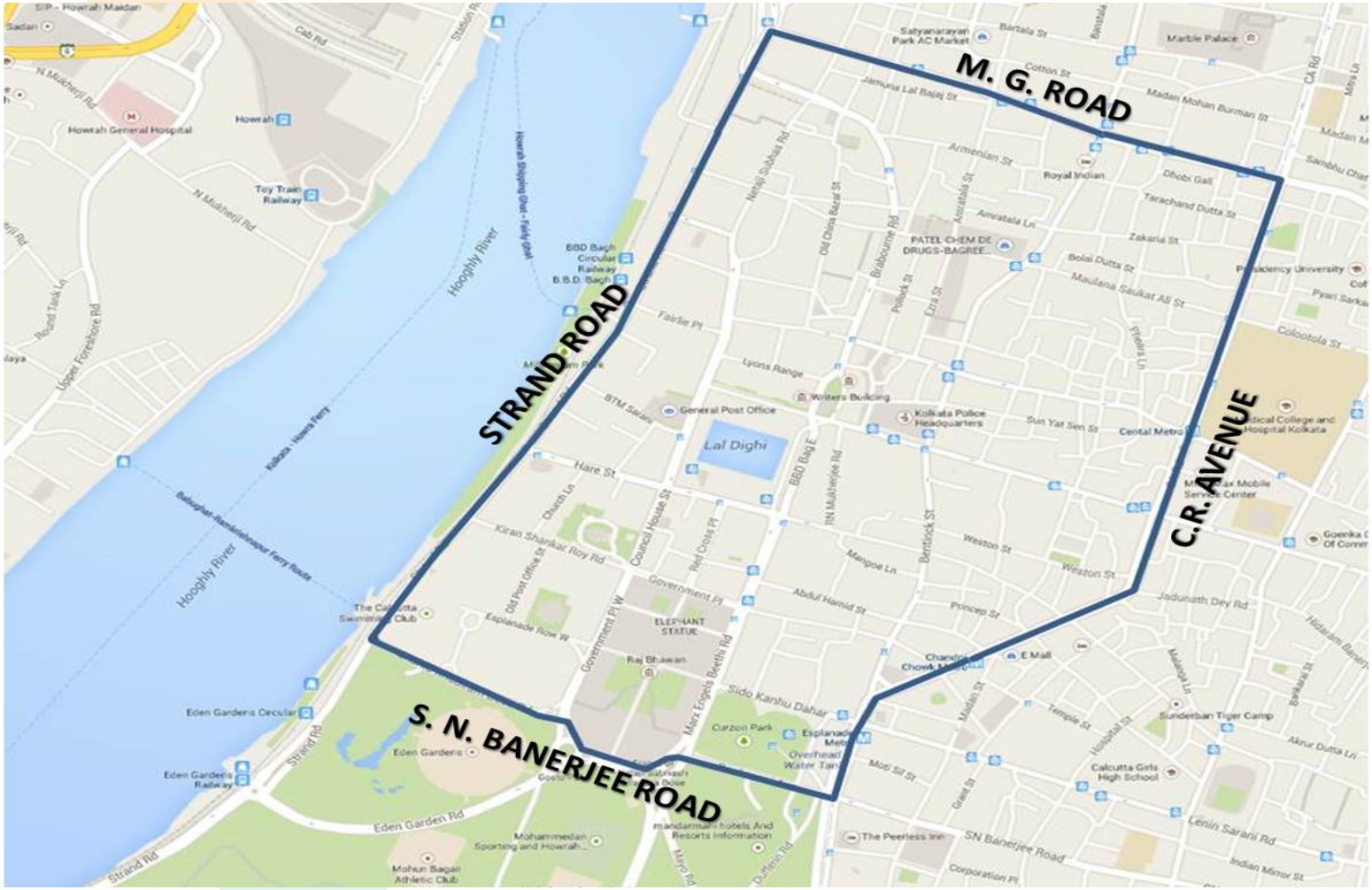
Objective of Study

To identify and analyze different dynamic measures for traffic management for different incident scenarios to ensure early arrival of emergency response units for relief and evacuation and to minimize the impact of such incidents on the traffic situation

Methodology



Study Area



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Categorization of Incident

- Incident Classification
- Level of Closure
- Time of Occurrence

Classification of Incidents

Attributes	Level 1	Level 2	Level 3	Level 4
Requirement	Wrecker (1-2) and/or Ambulance (1-2)	More than 2 Ambulances or Wreckers. If fire is involved < 2 Fire Brigade (FB) from single source.	Multiple ambulances, wreckers are required. If fire is involved multiple FB (from multiple sources)	Involvement of multiple rescue units, big cranes, special agencies like bomb squad, army, etc.
Duration	< 1 hr	< 2 hr	>2 hr	> 2 hr
Route Intervention	Limited	Limited	Multiple	Multiple
Organization Involvement	Limited	Limited	High	High

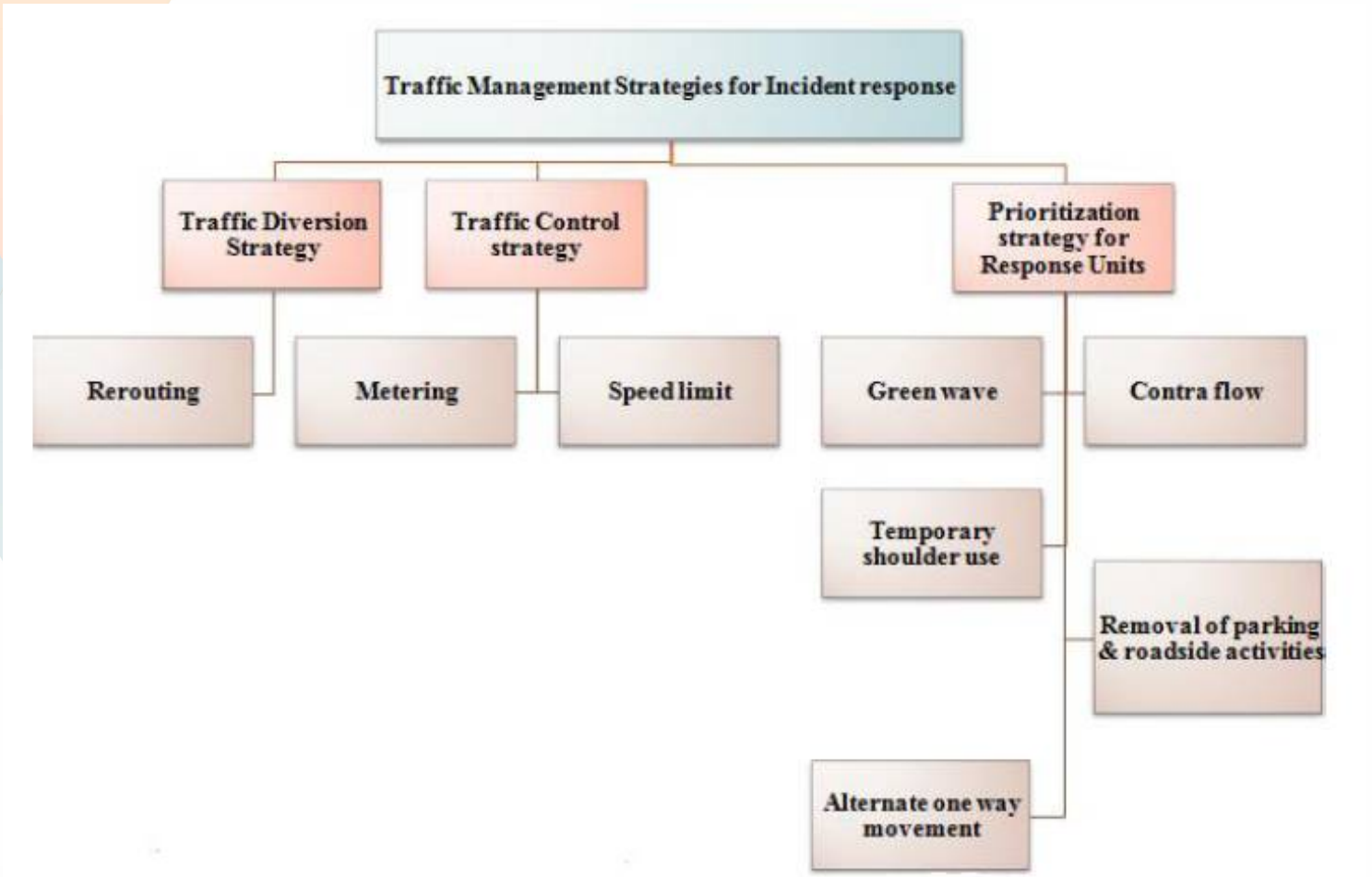
Incident Scenarios

1. Level A
   - Off Peak
2. Level A
   - Peak
3. Level B
   - Off Peak
4. Level B
   - Peak

Level A: Level 1 and Level 2 with upto 50% of lane closure

Level B: Level 3 and Level 4 with 50 – 100% closure

Traffic Management Measures for Incident Response



Proposed Traffic Management Measures

Scenario	Description	Measures
Scenario 1	**Level A** incident occurring in **Off-Peak** hours	1. Rerouting 2. Speed Limit 3. Contra Flow
Scenario 2	**Level A** incident occurring in **Peak** hours	1. Rerouting 2. Metering 3. Speed Limit 4. Green Wave
Scenario 3	**Level B** incident occurring in **Off-Peak** hours	1. Rerouting 2. Speed limit 3. Contra flow 4. Alternate one-way movement
Scenario 4	**Level B** incident occurring in **Peak** hours	1. Rerouting 2. Metering 3. Speed limit 4. Green wave 5. Temporary use of shoulder 6. Removal of parking and road side activities

Factors for Qualitative Assessment of Measures

- Effectiveness of the measure
- Ease of implementing the measure
- Financial cost of implementing the measure
- Impact of measure on other traffic
- Level of coordination among related agencies

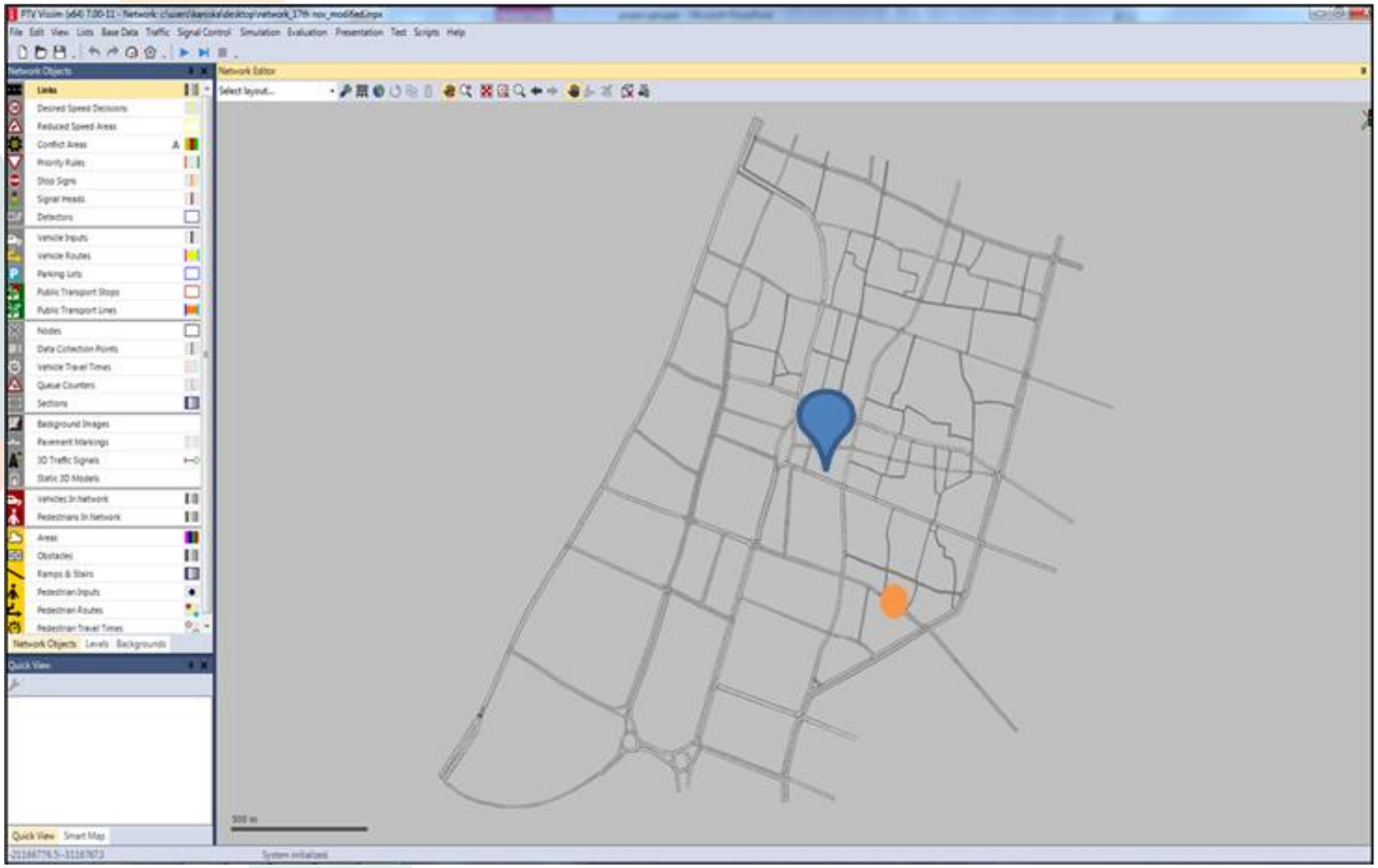
AHP Analysis

Factors	Weightage
Effectiveness	0.346
Ease of Implementation	0.163
Financial Cost of Implementation	0.177
Impact on other traffic	0.141
Level of coordination	0.173

Ranking of Measures

Scenario	Measures	Score	Rank
Scenario 1	1. **Contra Flow**	48.273	1
	2. Speed Limit	47.089	2
	3. Rerouting	40.241	3
Scenario 2	1. **Green Wave**	61.389	1
	2. Rerouting	57.821	2
	3. Speed Limit	55.693	3
	4. Metering	53.531	4
Scenario 3	1. **Alternate one-way movement**	58.195	1
	2. Contra Flow	53.775	2
	3. Rerouting	49.245	3
	4. Speed Limit	49.182	4
	5. Removal of parking and roadside activities	41.308	5
Scenario 4	1. **Green Wave**	52.607	1
	2. Speed Limit	51.466	2
	3. Temporary use of shoulder	49.694	3
	4. Removal of parking and road side activities	45.656	4
	5. Metering	42.642	5
	6. Rerouting	39.813	6

Development of Micro-Simulation Model



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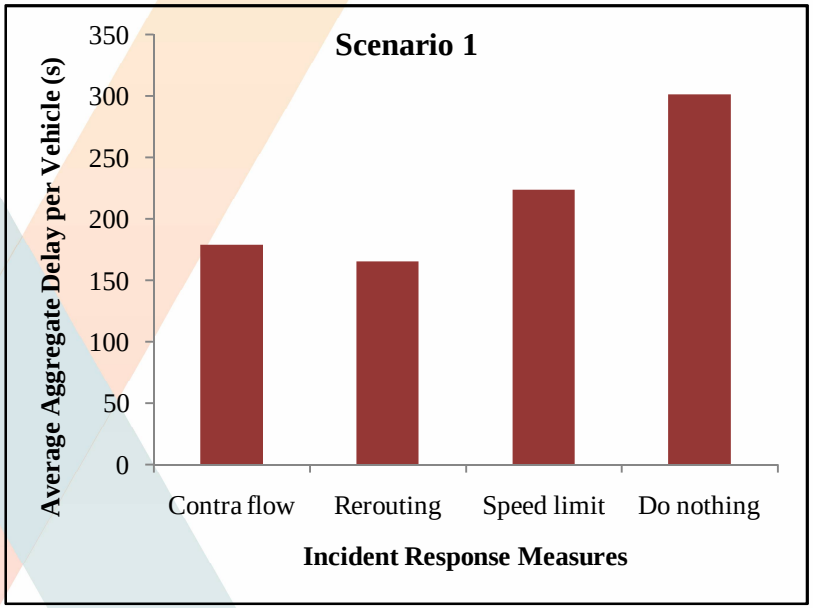
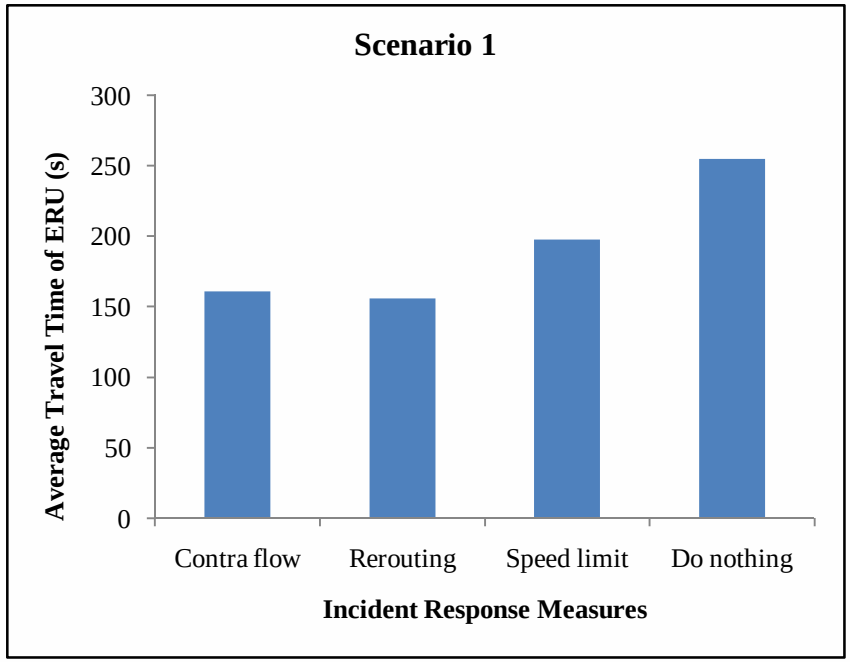
Analysis and Results





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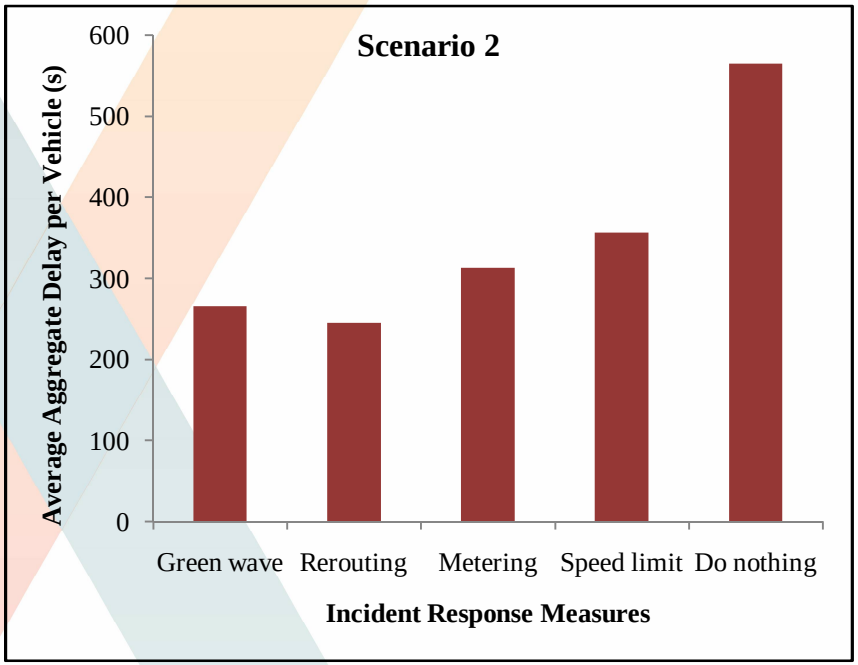

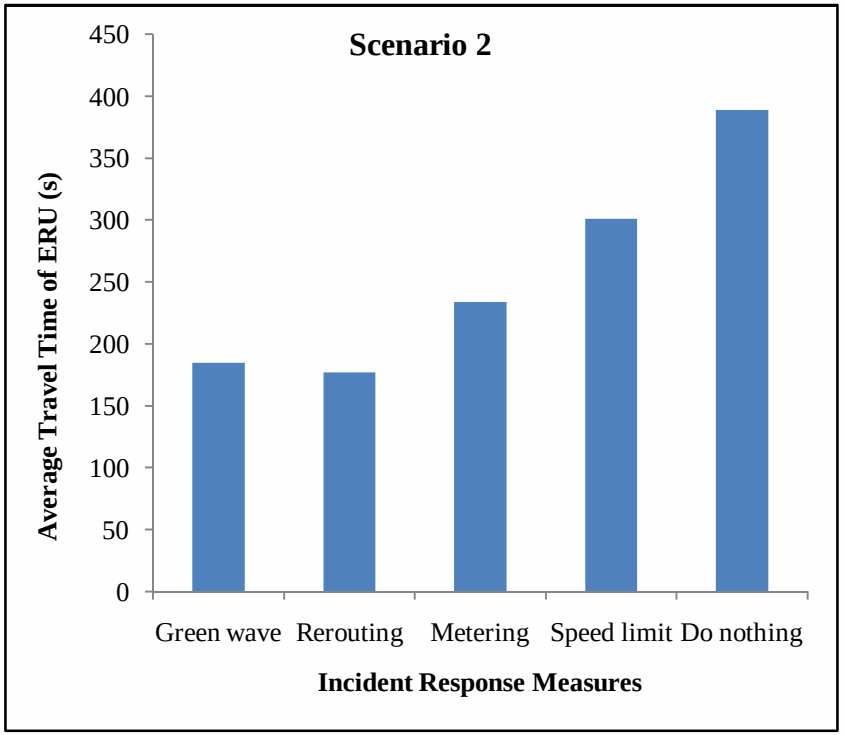

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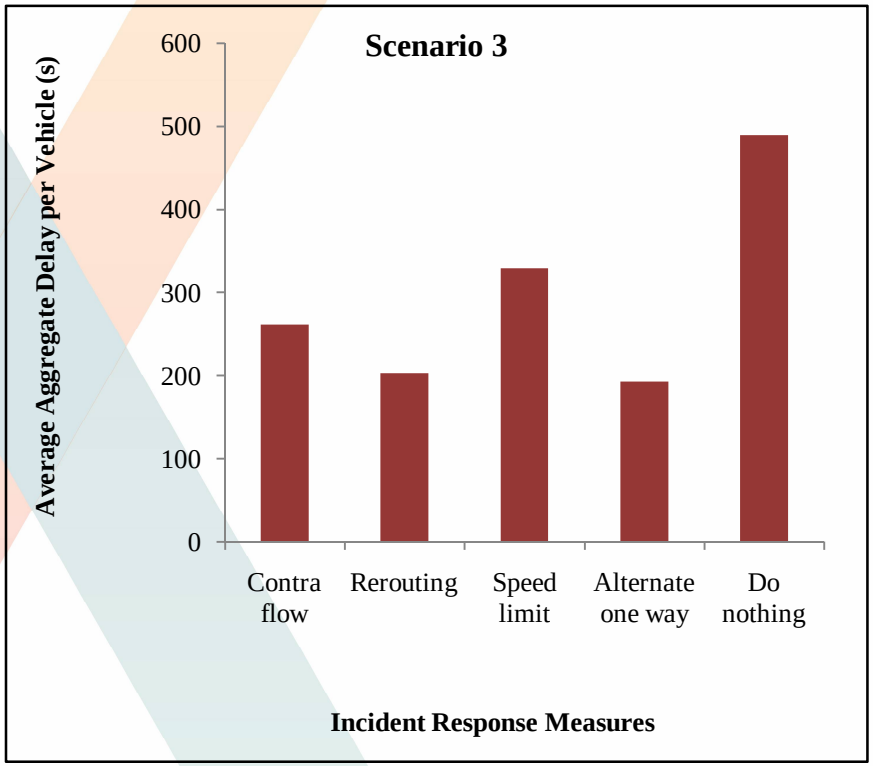

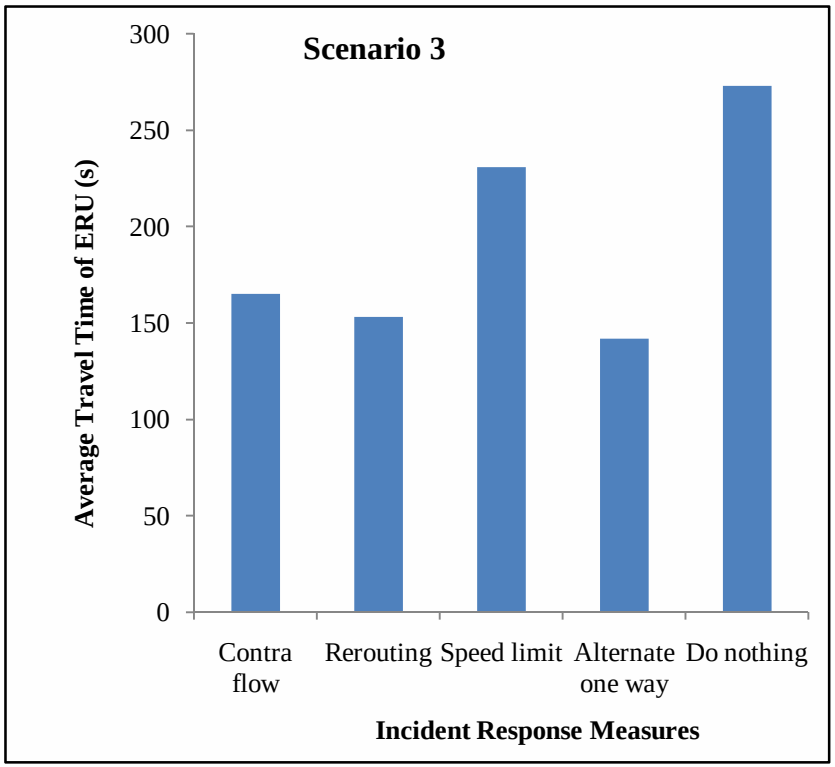

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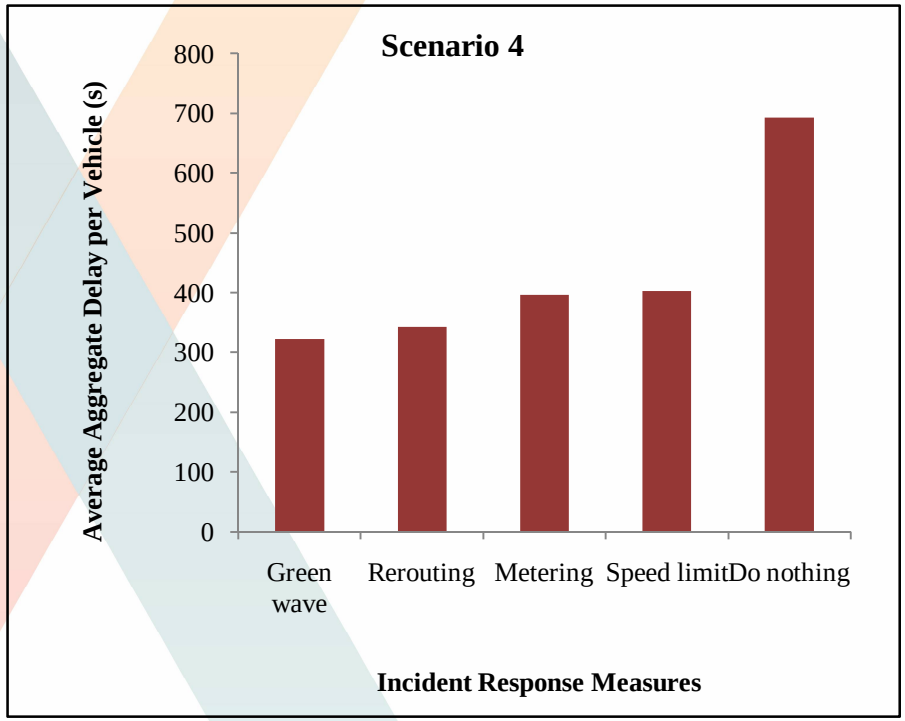

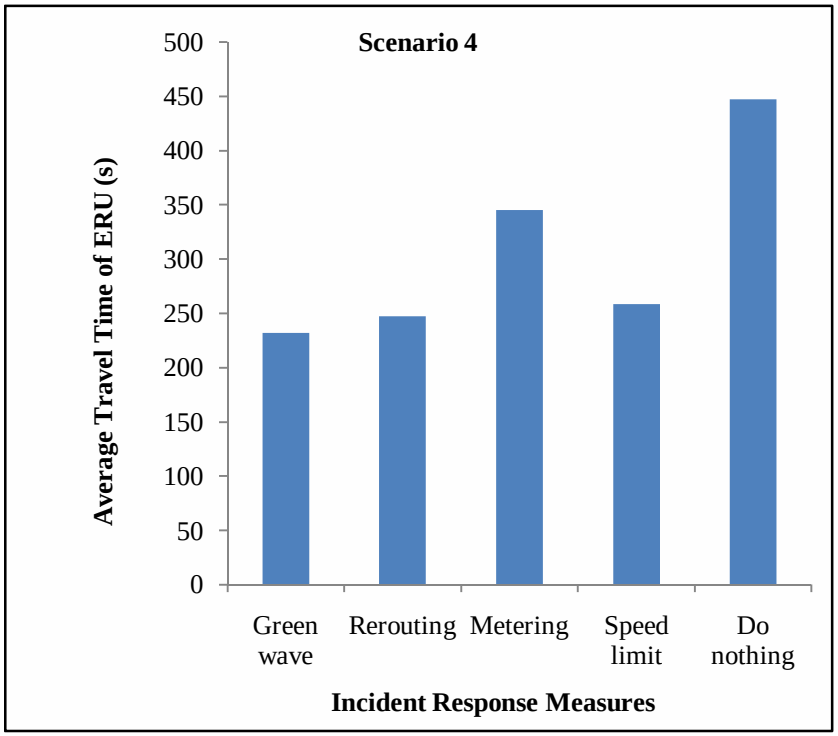

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Conclusions

- The results as provided by AHP-fuzzy analysis and micro-simulation are in agreement with slight variations.

Scenario	AHP-Fuzzy	Simulation
Scenario 1	Contra Flow	Rerouting
Scenario 2	Green Wave	Rerouting
Scenario 3	Alternate One-way	Alternate One-way
Scenario 4	Green Wave	Green Wave

Conclusions

Statistical Comparison between Simulation and Expert Opinion Analysis

- Wilcoxon signed-rank test
- Asymp. Sig. (2-tailed) value of >0.05 between the samples
- The rankings are not significantly different

Scopes of Further Study

- Study of strategies (combinations of various response measures) and their effectiveness for different scenario.
- More incident scenarios may be considered by considering more than one categorizing variable.
- Simulation analysis with more than one incident location and ERU deployment location.
- Land use pattern and on-street parking may also be considered in the simulation analysis.

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