1st AfroSAFE ACADEMY CONFERENCE 12-14 JUNE, 2024. DAR-ES-SALAAM, TANZANIA

ENHANCING ROAD SAFETY THROUGH TRAFFIC MANAGEMENT CENTRE IMPLEMENTATION: A CASE STUDY OF THE 8-LANE KIMARA-KIBAHA ROAD SECTION

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AFRO SAFE ACADEMY

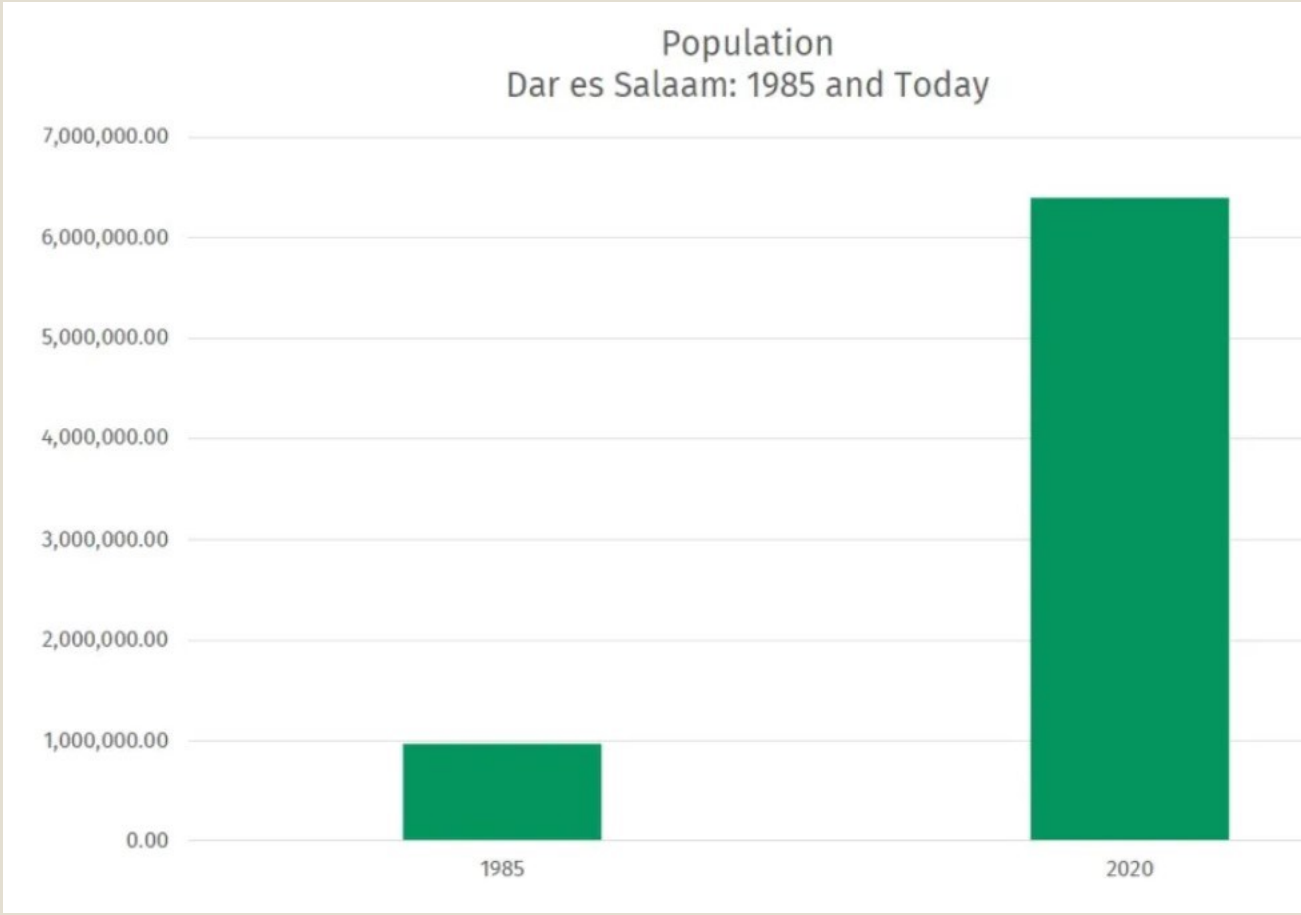
Presentation Outlines

- Background
- Introduction
- Objectives
- Methodology
- Results discussion
- Conclusions

BACKGROUND

Rapid urbanization has led to

- Increase in traffic interaction
- Congestion



BACKGROUND

Situation before expansion of Kimara-Kibaha Road section

- Infrastructure development

Kimara-Kibaha road section layout

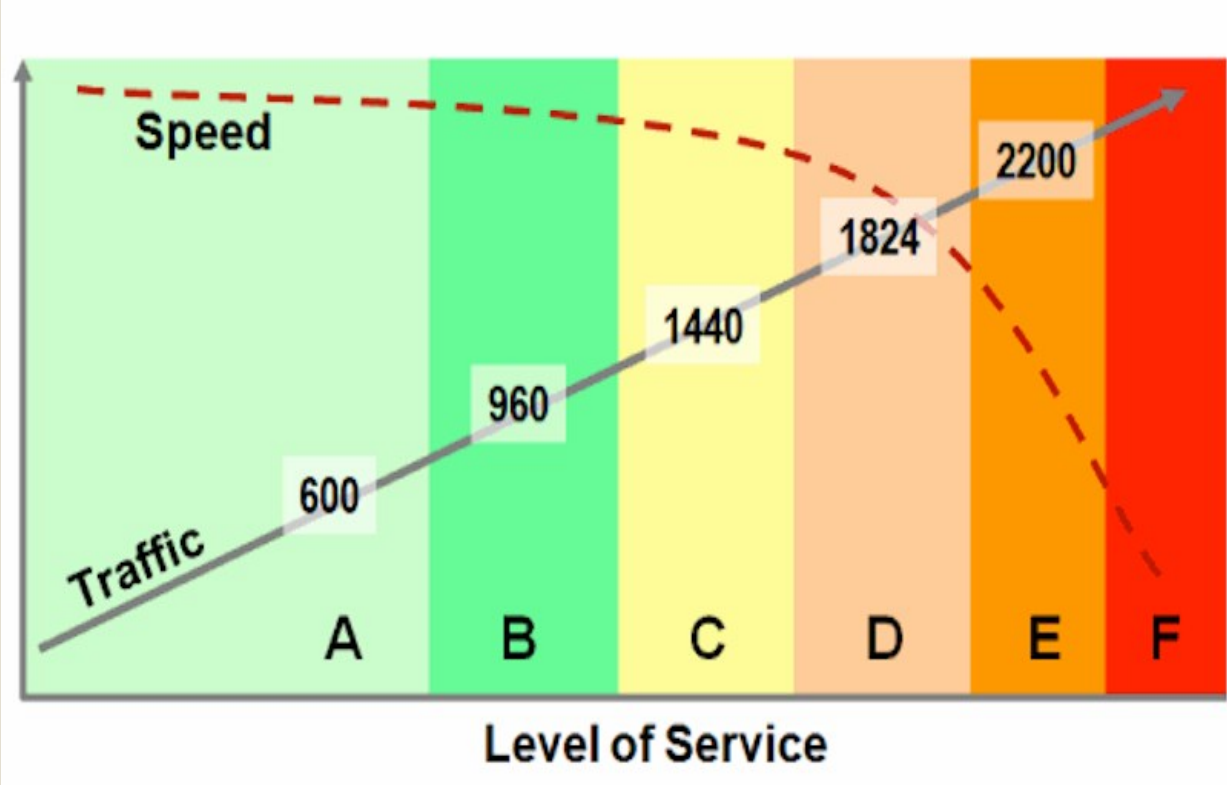
Geometric features of the expanded Kimara- Kibaha Road section.

- Number of lanes; 8
- Width; 34m
- Length; 19.2km

INTRODUCTION

Major safety issues associated with road expansion

- Potential for over speeding
- Pedestrian and cyclist safety
- Changes in driver's behavior



Relationship between LOS and Speed

INTRODUCTION (safety issues)

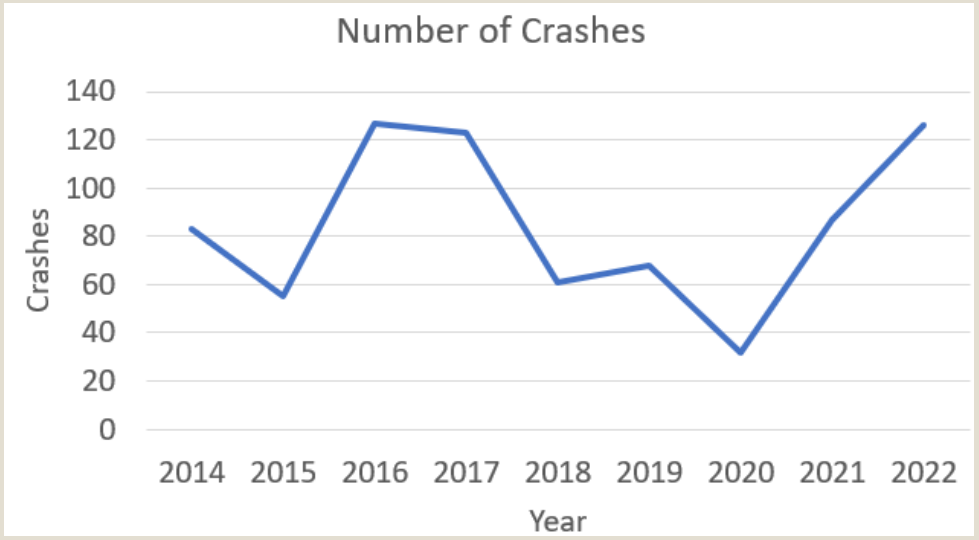
- Pedestrian crossing a wide road

- Run through red lights

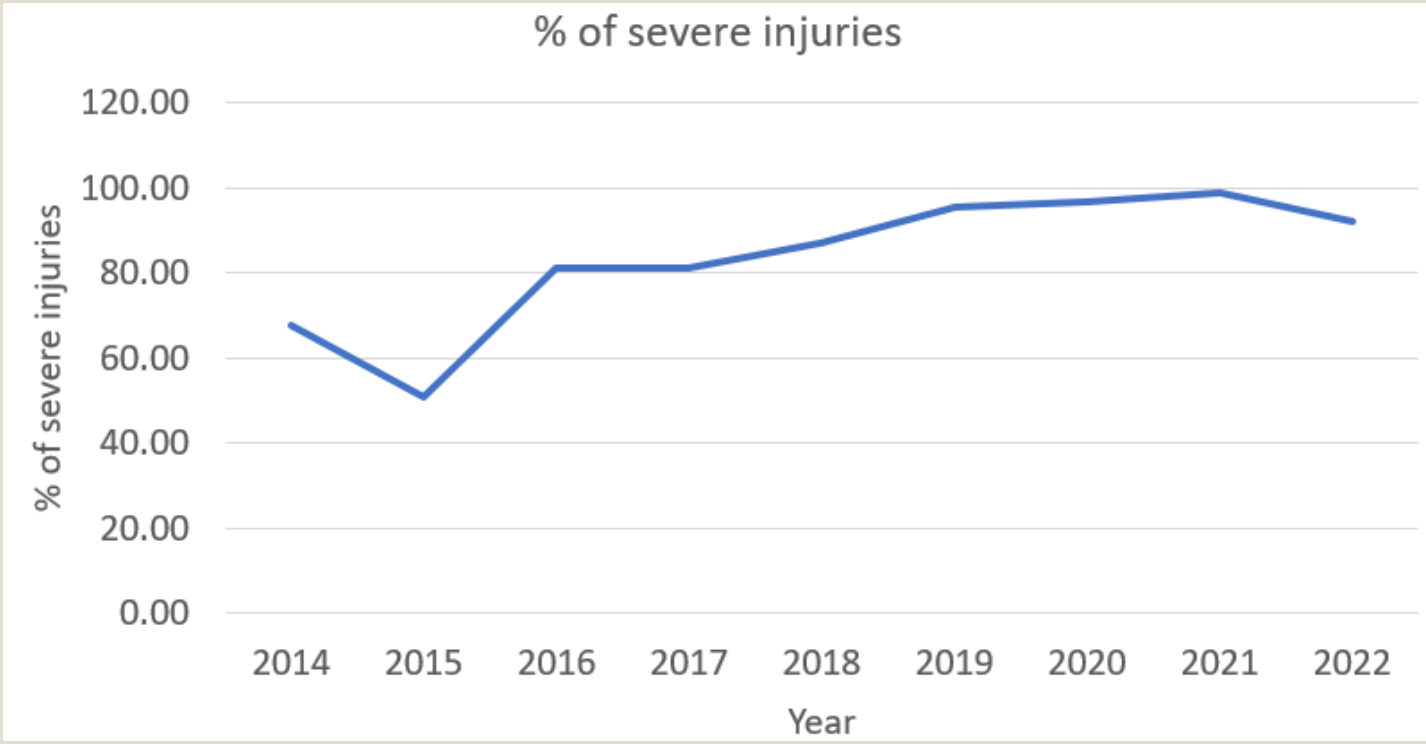
Accident data along Kimara-Kibaha road section

Year	Crashes	Severe	Fatal	Minor injury	Damage only	% of severe injuries
2014	83	56	24	3	0	67.47
2015	55	28	25	0	2	50.91
2016	127	103	22	0	2	81.10
2017	123	100	23	0	0	81.30
2018	61	53	8	0	0	86.89
2019	68	65	2	0	1	95.59
2020	32	31	0	0	1	96.88
2021	87	86	1	0	0	98.85
2022	126	116	9	1	0	92.06

Accidents recorded along Kimara-Kibaha road section



Accidents recorded along Kimara-Kibaha road section



Accident severity over time

EMERGING CALL FOR TRAFFIC MANAGEMENT

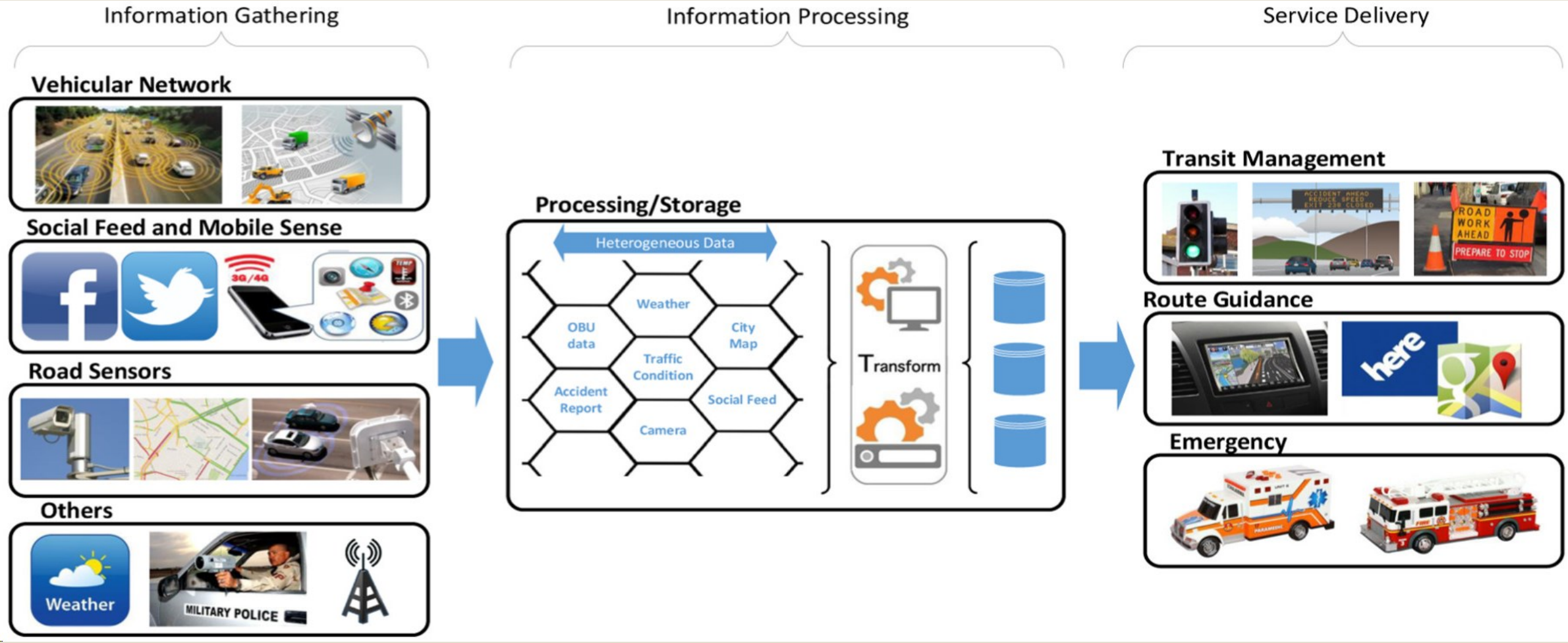
Infrastructure development leads to an increase in;

Preference by road users i.e. diverted and generated traffic

- Increase in traffic volume
  - Like-hood of incidents
    - Demand for traffic control
      - Automated traffic control
        - Traffic Management Centre (TMC)

A Traffic Management Centre (TMC)

TMC COMPONENTS



Objectives

- To determine the influence of traffic performance measures on road crashes
- To determine the potential of a traffic management center in improving road safety

METHODOLOGY

LITERATURE REVIEW

- To identify key traffic performance metrics
- To identify their influence in road crashes

SIMULATION USING VISSIM SOFTWARE

- How a TMC can improve safety through traffic monitoring

Key performance metrics that contribute to accidents

Road Performance metric	Influence on traffic safety	Source
Level of service of the road (LOS)	• Lower LOS: **aggressive maneuvers** like **tailgating,** and **unsafe lane changes** • Higher LOS, higher rates of crashes	The Impact of Level of Service on Traffic Safety" published by the Transportation Research Board in 2021.
Travel time	• Significantly increased travel time lead to **risky driver behaviors** e.g. over speeding	Federal Highway Administration (FHWA)
Delay	• Increase in delay can cause **risk maneuvers**	Federal Highway Administration (FHWA)

Influence of LOS to road accidents

LOS Description (SMATS, https://www.smatstraffic.com/,)

LOS	Average Space (ft^2/p)	Related Measures: Flow Rate (p/min/ft)[a]	Related Measures: Average Speed (ft/s)	Related Measures: v/c Ratio[b]	Comments
A	>60	≤5	>4.25	≤0.21	Ability to move in desired path, no need to alter movements
B	>40–60	>5–7	>4.17–4.25	>0.21–0.31	Occasional need to adjust path to avoid conflicts
C	>24–40	>7–10	>4.00–4.17	>0.31–0.44	Frequent need to adjust path to avoid conflicts
D	>15–24	>10–15	>3.75–4.00	>0.44–0.65	Speed and ability to pass slower pedestrians restricted
E	>8–15[c]	>15–23	>2.50–3.75	>0.65–1.00	Speed restricted, very limited ability to pass slower pedestrians
F	≤8[c]	Variable	≤2.50	Variable	Speeds severely restricted, frequent contact with other users

❖ **Recommendation from literature**: Design to balance LOS and safety

Contribution of Level of service of the road to road accidents

- Various literature have various views on relation between LOS and safety
- Some give a direct proportional relationship
- Others show the potential safety risks of a high LOS on roads, hence showing the relationship between LOS and safety being inversely proportion

Influence of travel time to road accidents

- Congestion
- Infrastructure issues
- Special events
- Weather
- Traffic lights/Stops
- Accidents
- Vehicle performance

Increase in travel time

More exposure to accidents

Increase in 1% travel time=0.3%increase in crashes Elvik (2009)

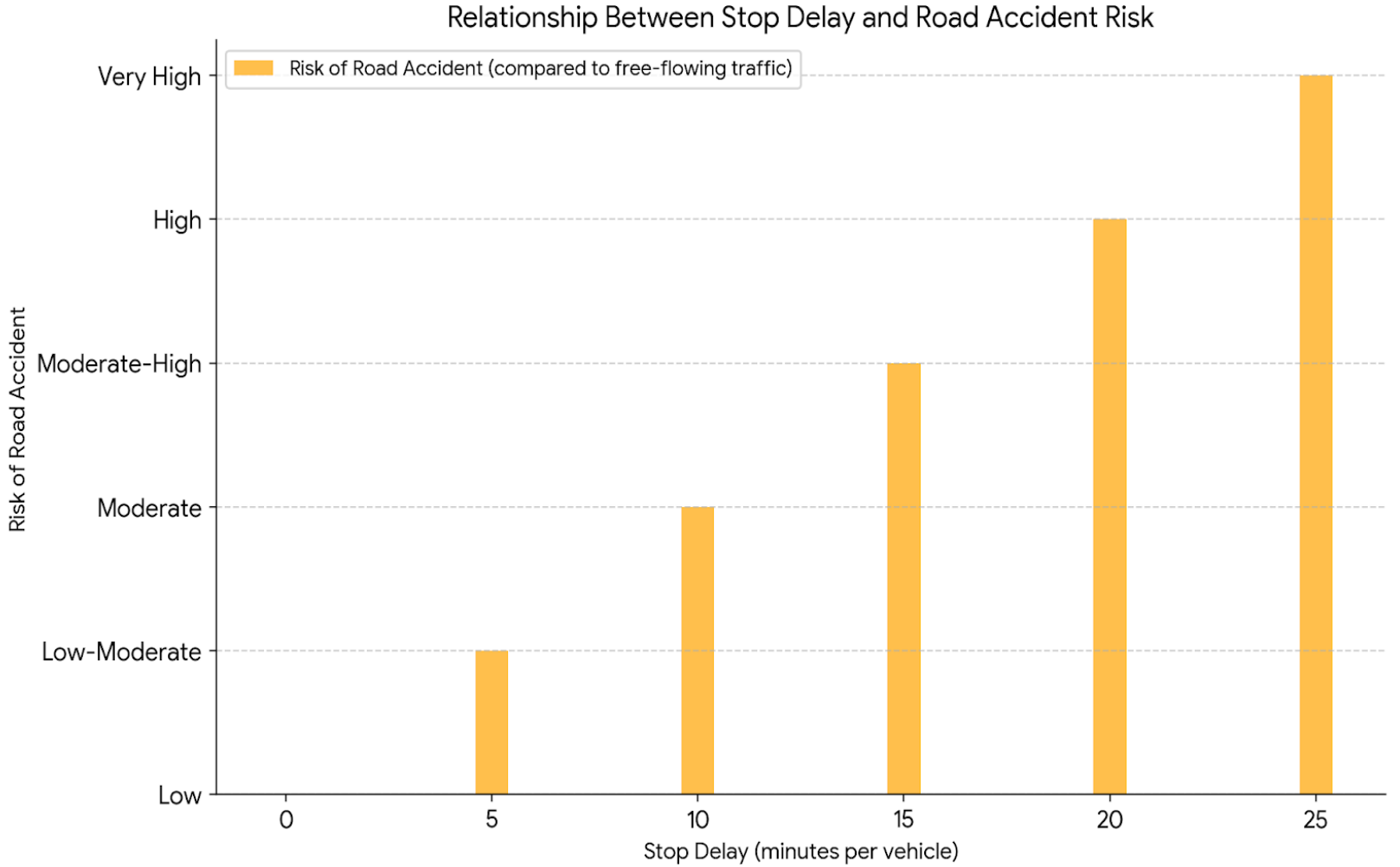
Influence of stop delay to road accidents

Stop delay

⇩

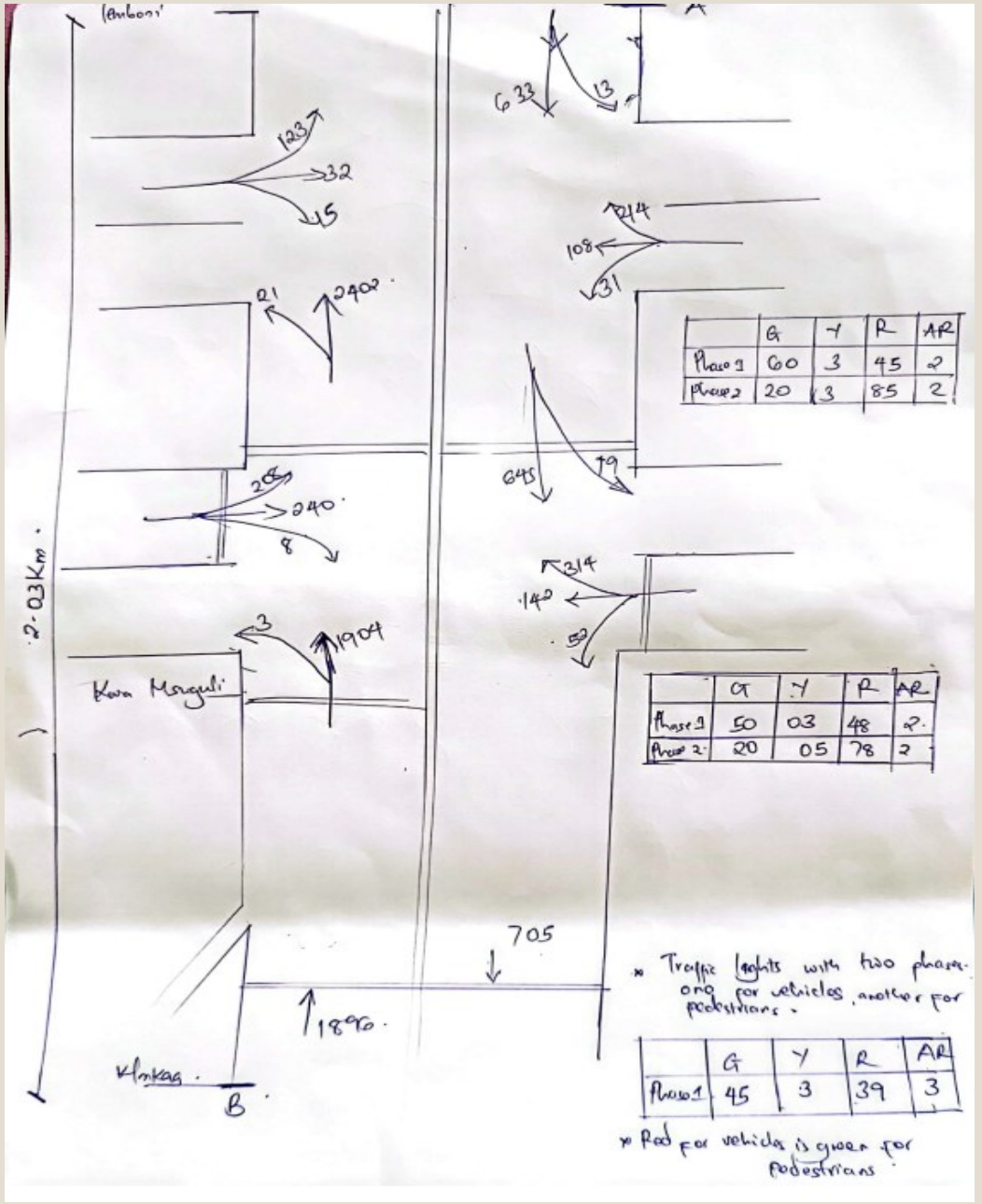
Red light violation

Contribution of stop delay to road accidents

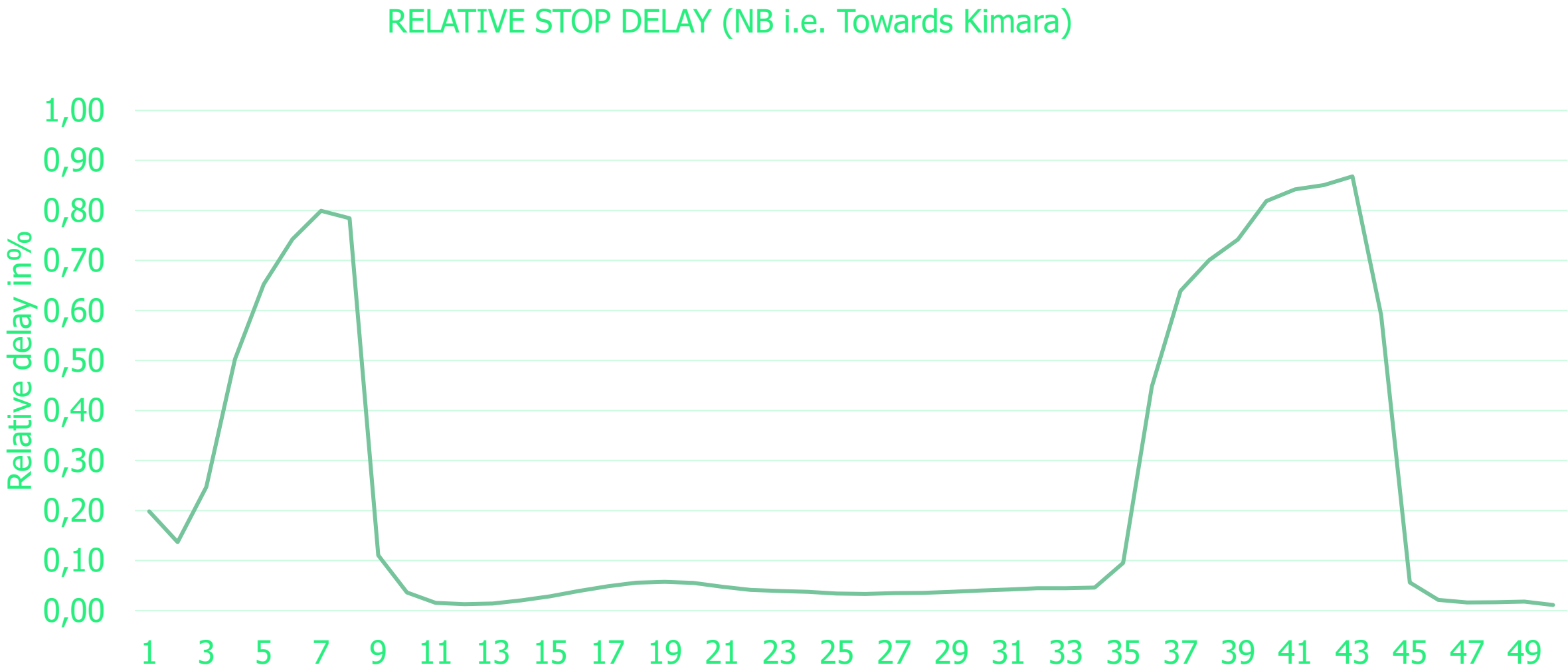


Data Collection

- Collected during the morning peak hour (7:00am to 8:am)
- Length of the section: 2.03km
- 2 signalized intersections i.e., Kimara Temboni, and Mbezi kwa Msuguli.



Increase in delay as vehicles approach signalized



The simulation process

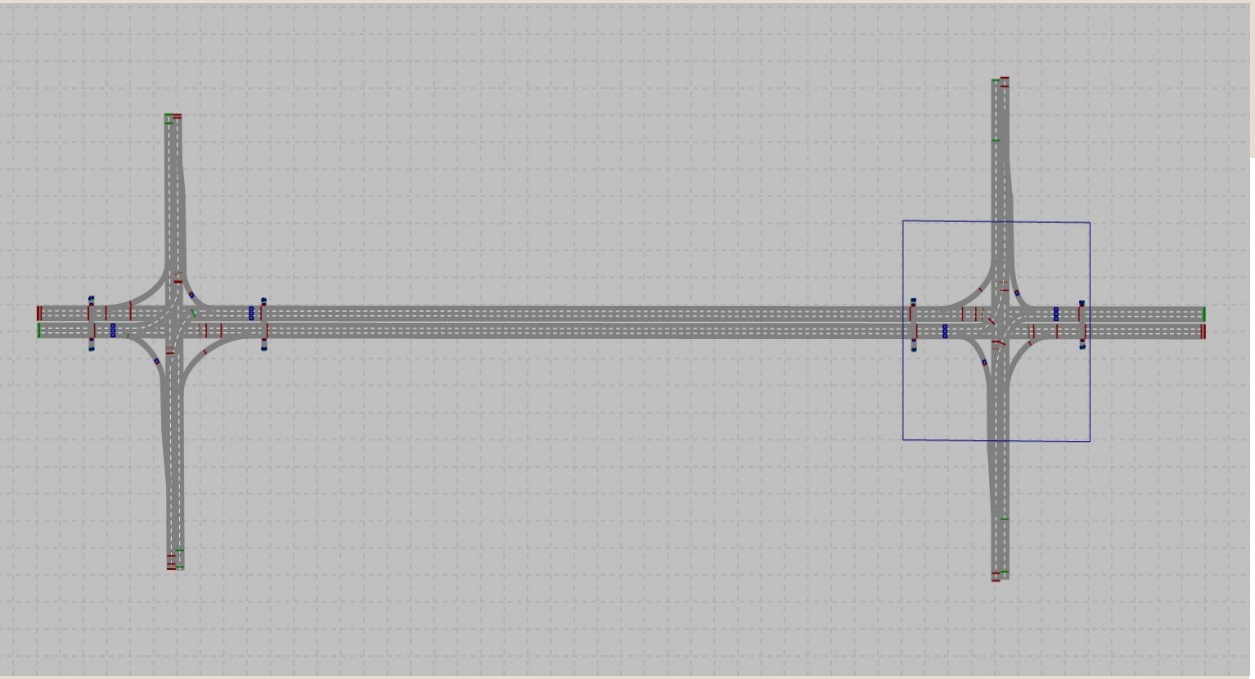
TMC Use Case → Traffic Control

Real time traffic management approach used → Ramp metering system adaptation

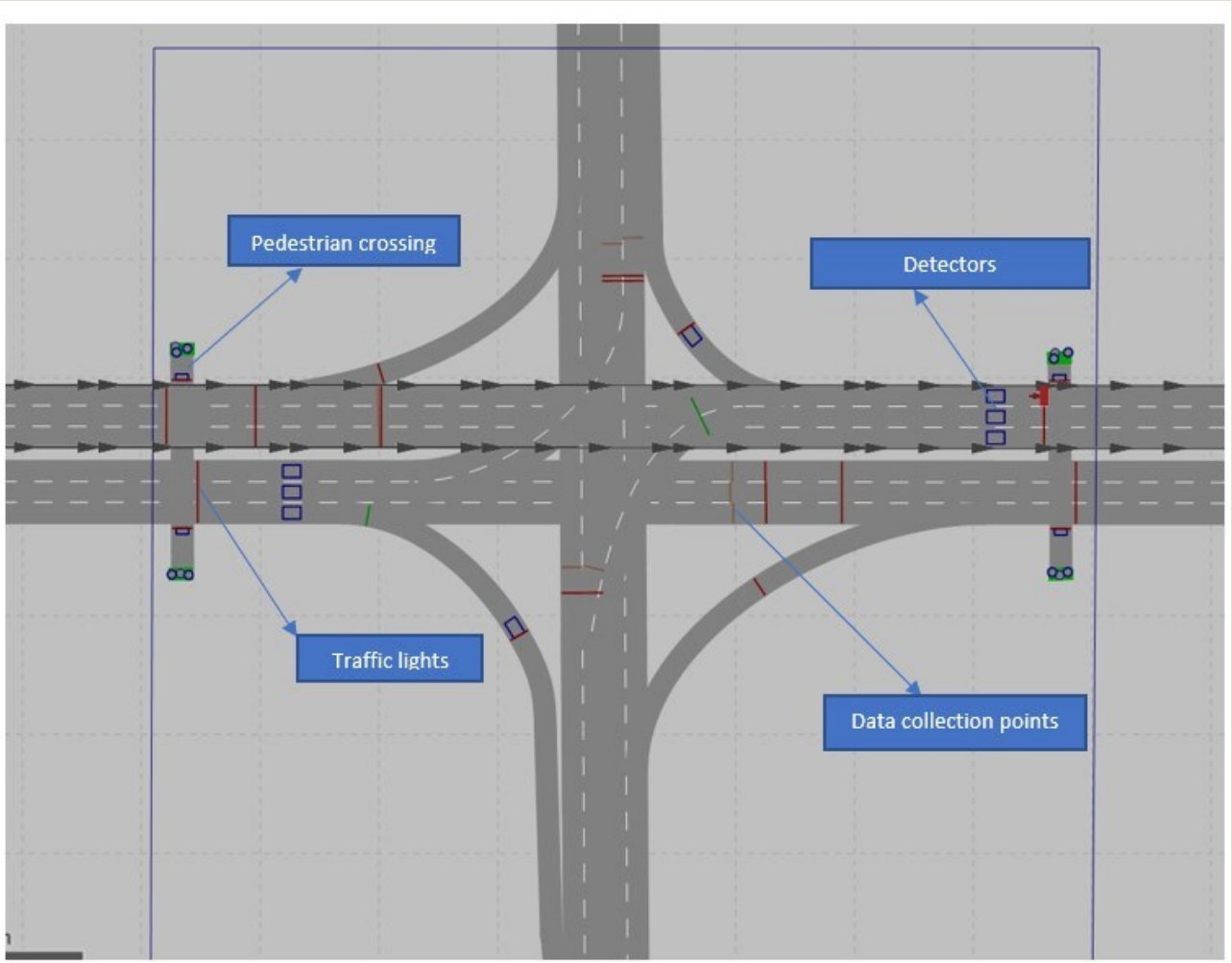
- Study area: Kimara-Kibaha Road Section

SIMULATION PROCESS

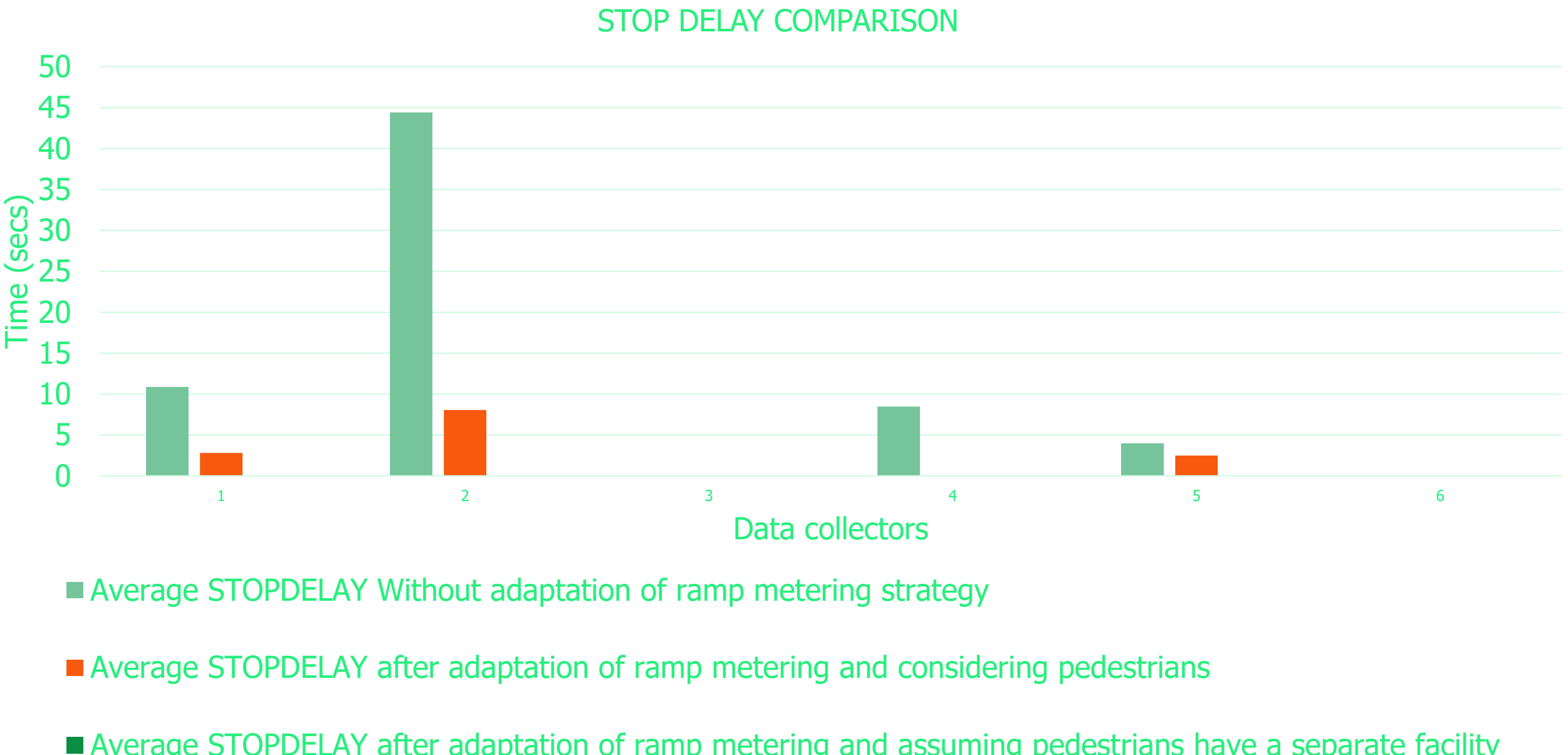
- Simulation link layout



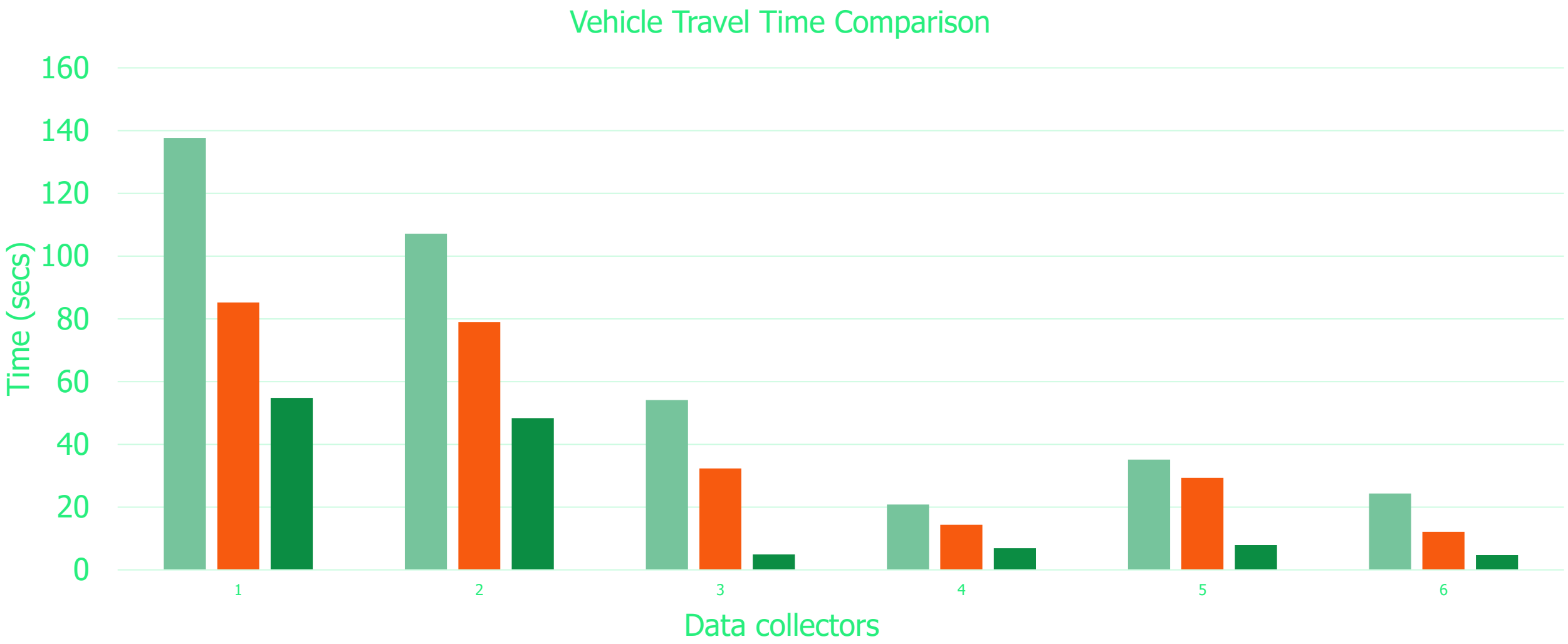
- Simulation node layout



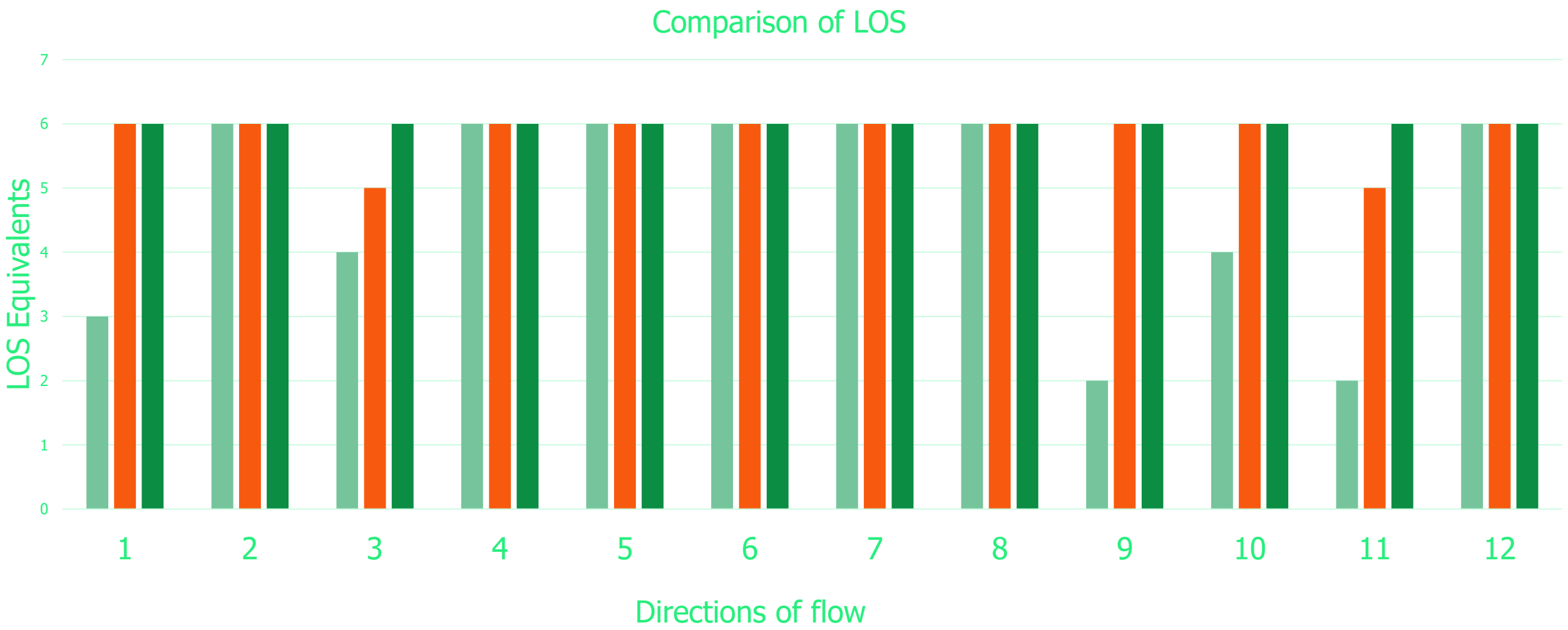
DECREASE IN STOP DELAY



DECREASE IN TRAVEL TIME



IMPROVEMENT OF LOS



Role of TMC in enhancing safety through traffic control

By minimizing delay, travel time and improving LOS, accidents and accident severity can be minimized through:

- Reduced secondary accidents
- Faster emergency response
- Improved maneouverbility due to improved LOS
- Decrease in driver's fatigue
- Decrease in unsafe lane changes

Role of a TMC in enhancing road safety cont…….

Also, a TMC can enhance safety through

- Real time monitoring (e.g. incident detection)
- Timely Incident management
- Traffic control (e.g. change in signal timing, variable speed limits)
- Surveillance and law enforcement
- Data analysis and planning

Conclusion and recommendations

- To enhance safety for a wide multilane highway, pedestrians and cyclists should be provided with **separate facilities.**
- TMC has great **potential to improve safety** through traffic control, traffic monitoring, law enforcements and surveillance.
- TMC enables **inter departmental coordination** (i.e. Road planning and designing department, police, health and emergency),
- TMC provides reliable data essential in **planning and implementing safety measures.**
- Technological solutions like TMC should be prioritized to improve road safety by **real time traffic monitoring**.

Thank you for your undivided attention.

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