

AER Road Show Series

ASEANIZING ENGINEERS IN ASEAN

18 January, 2025, Fed. MES, Yangon, Myanmar

Analysis of Traffic Accidents with GIS Model for Future Traffic Planning in Yangon

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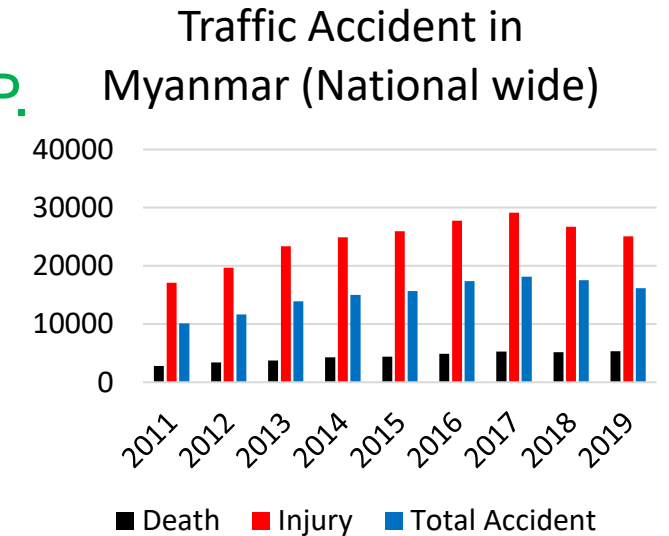
Yangon Technological University, Myanmar

Outlines of the Presentation

- 1) Background of Study
- 2) Objective
- 3) Study Area
- 4) Implementation Program of the Study
- 5) Identification of Black Spots Locations
- 6) Proposed Counter Measures
- 7) Conclusions
- 8) Recommendations for Future Research

1) BACKGROUND

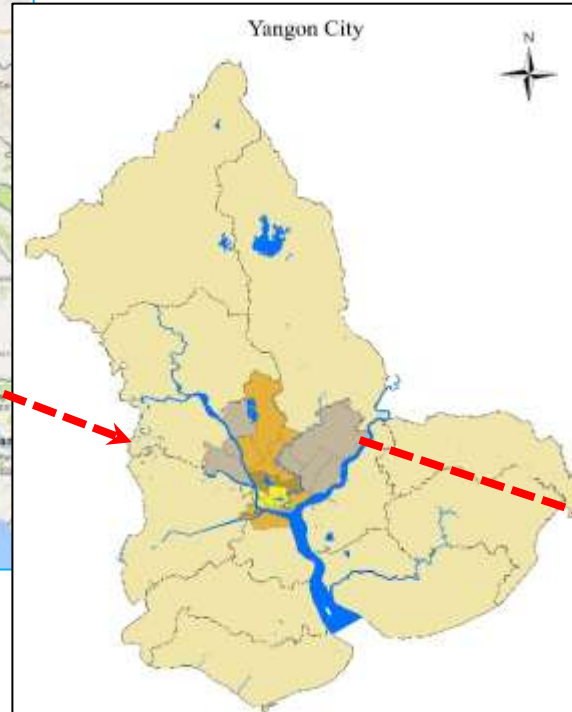
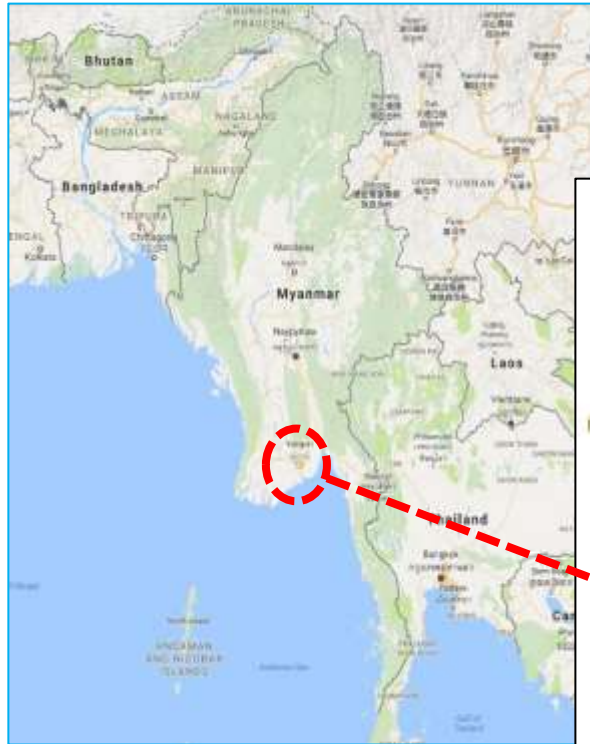
- Nowadays, road crashes become a growing worldwide problem and around 1.19 million deaths occurs around the world
- Two-thirds of road traffic fatalities occur in the working age group of 18 to 59, indicating that road traffic safety remains a major challenge for health and development.
- Road traffic accidents have a significant impact on the lives of people, as well as on their social and economic lives.
- One-third of all injuries were reported by hospitals are from traffic accidents in Myanmar
- Fatalities are expected to be reached 15,000 per year by 2025 if the situation remains unchanged.
- The annual cost of road accidents is estimated about 1.5% of GDP.
- And, it was on consequent rise in both injuries and in death.
- Therefore, it is obviously understood that some measures on road safety improvements must be designed urgently to reduce such fatal accidents.



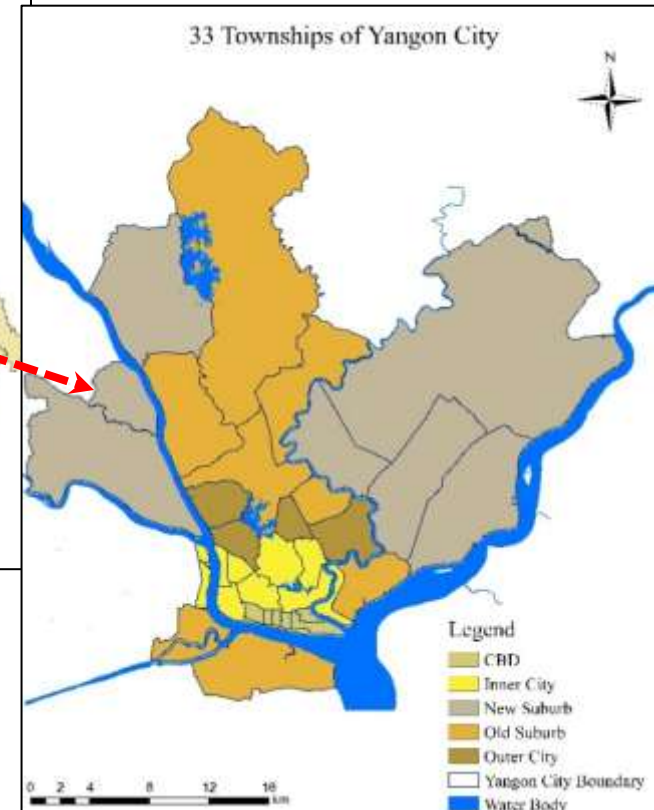
2) OBJECTIVES

- To study situation of road accidents before COVID-19
- To identify black spot location in study area
- To propose countermeasures for road safety improvement for the areas under study

3) STUDY AREA



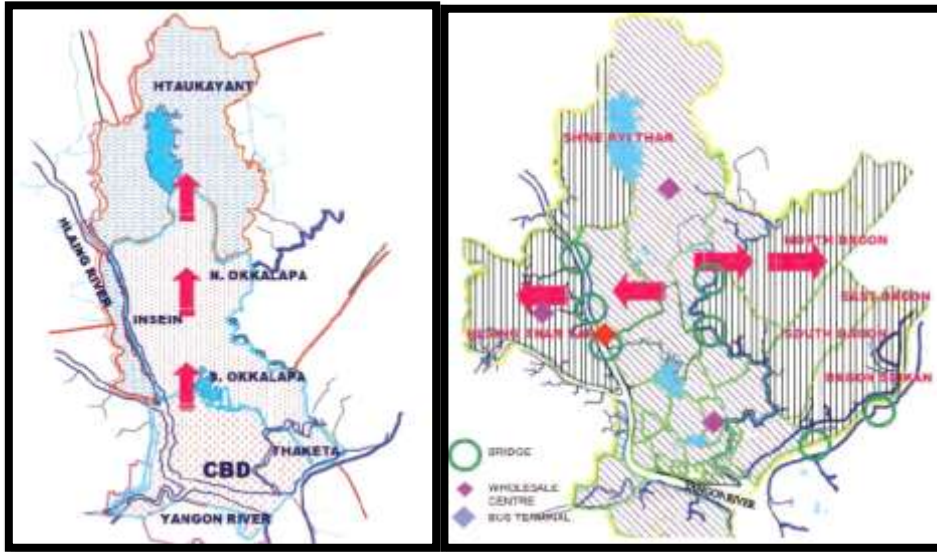
33 Townships in Yangon Division
Area = 598.750 km²
Population = 5.20 Million



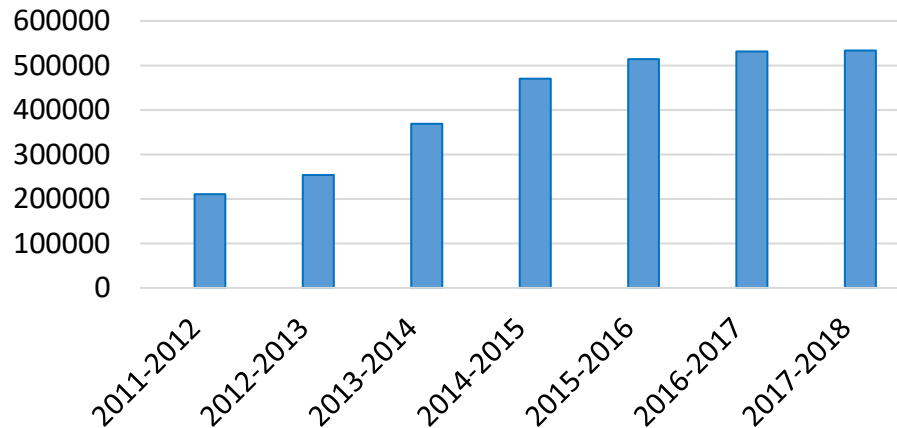
44 Townships in Yangon Division
Area = 10,276.7 km²
Population = 8,853,241 (2022)

3) STUDY AREA

Urbanized Areas of Yangon City before 1988 and after 1988

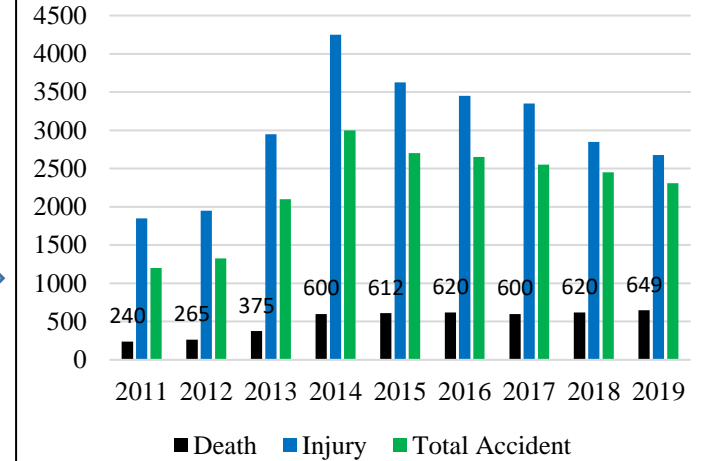


Vehicles Population in Yangon

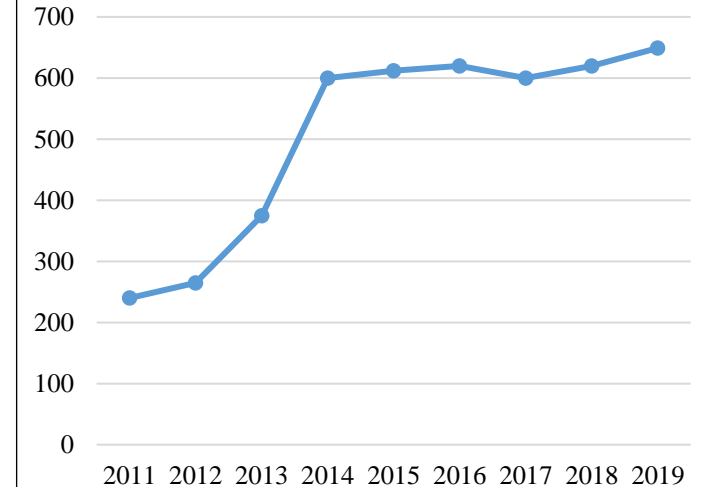


- As the number of motor vehicles and vehicle-miles of travel increase, the exposure of the population to traffic accident also increases.

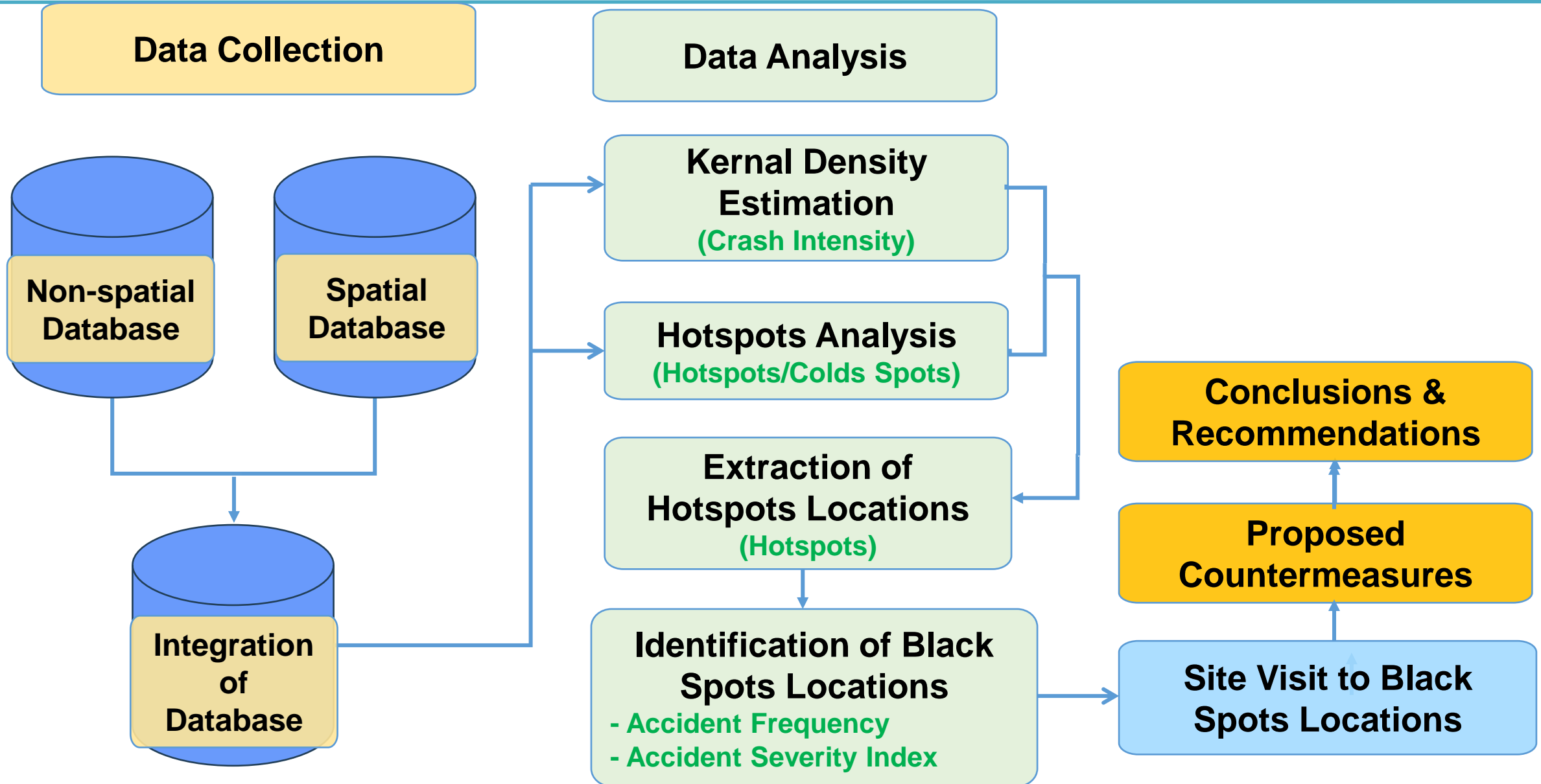
Traffic Accident in Yangon City



Yearly Fatalities in Yangon City



IMPLEMENTATION PROGRAM OF THE STUDY



Road Traffic Accident Data

- Provided from only No. (2) Office of Traffic Police, Yangon
- 2017 – 2018 – 2019 (3 years)
 - location of accidents,
 - date and time of occurrences,
 - gender of drivers & victims,
 - drink and drug conditions,
 - status on driving license (with or without),
 - numbers of vehicle in accident occurrences,
 - extent of damage of vehicle,

ID	Date	Time	Township	Gender_Driver	Victim Gender	Age_Driver	Victim Age	Veh_Type	Victim_Veh
O1	Thursday, October 1, 2020	19:30	Mayangone	US	M	US	20	US	pedestrian
O2	Friday, October 2, 2020	11:30	North Dagon	M	M	39	42	Motorbike	Motorbike
O3	Friday, October 2, 2020	11:05	South dagon	M	M	21	11	Motorbike	pedestrian
O4	Friday, October 2, 2020	13:30	Shwepyitar	M	F	31	24	Motorbike	Private car
O4	Friday, October 2, 2020	13:30	Shwepyitar	M	US	31	30	Motorbike	Private car
O4	Friday, October 2, 2020	13:30	Shwepyitar	M	US	31	25	Motorbike	Private car
O5	Saturday, October 3, 2020	16:00	Shwepyitar	M	M	30	32	Motorbike	Taxi
O5	Saturday, October 3,	16:00	Shwepyitar	M	M	30	8	Motorbike	Taxi

- person injured and/or fatality,
- types of collision and
- manners of occurrences
- types of vehicle involved,
- were used to identify black spot locations for all road accidents

Spatial Database



**Accident Locations in Yangon
(Total Accident Cases = 4714)**



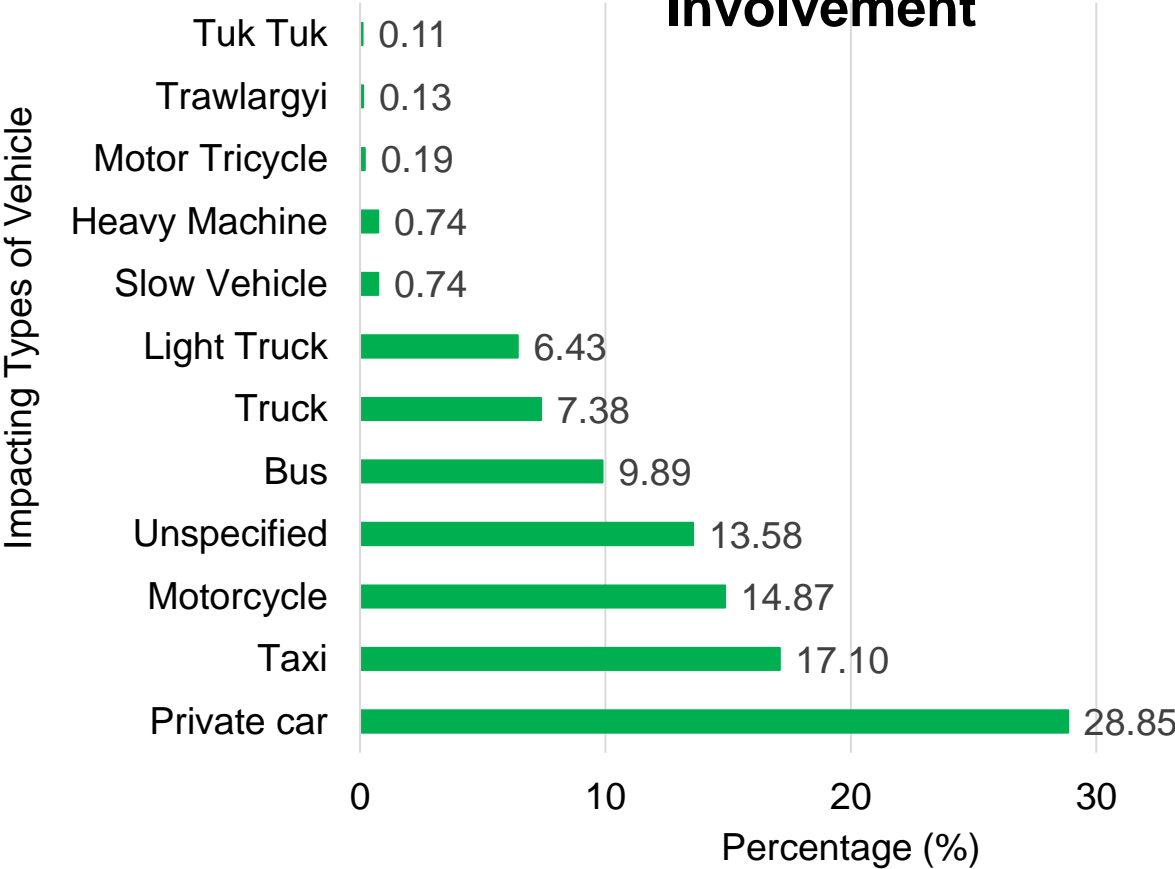
Severity Level Map in Yangon

Law 279 = PDO
Law 337 = Slight injury
Law 338 = Serious injury
Law 304 (A) = Fatality
Law 202 = Hit & Run

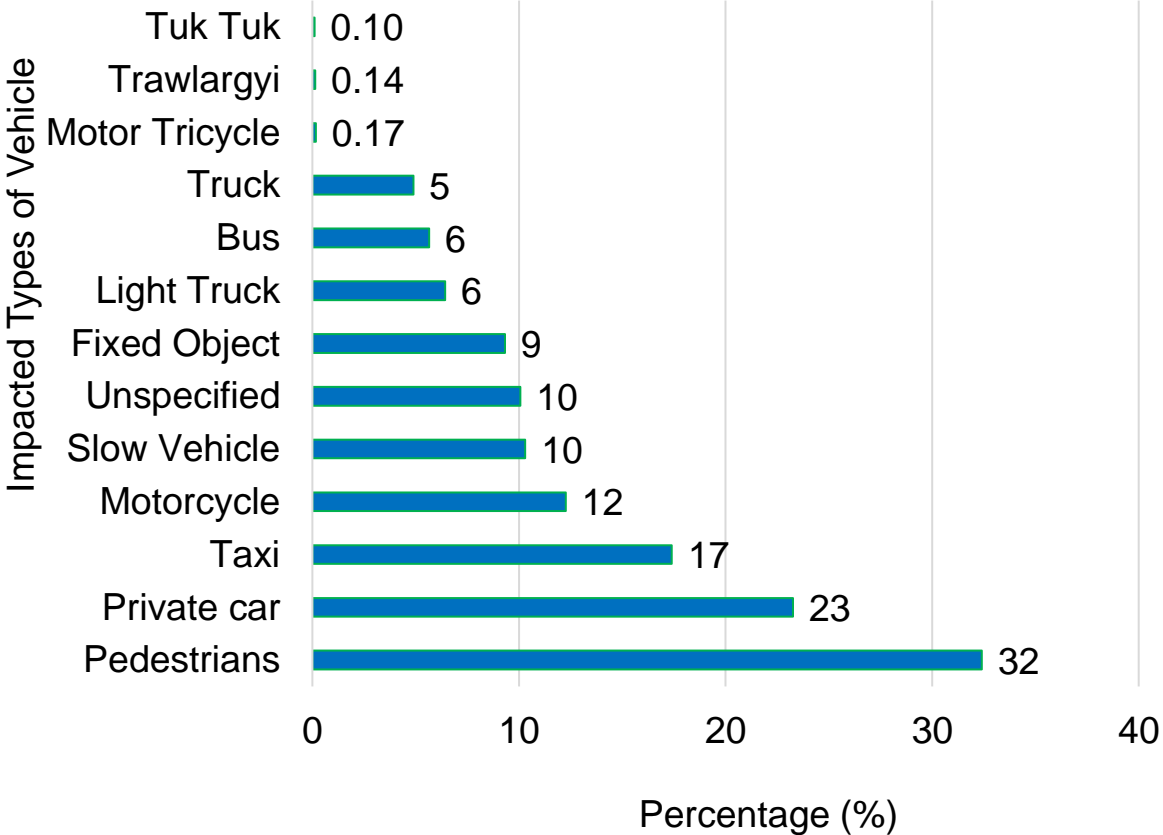
PDO = Property Damage Only

Accident Statics

Impacting Types of Vehicle Involvement

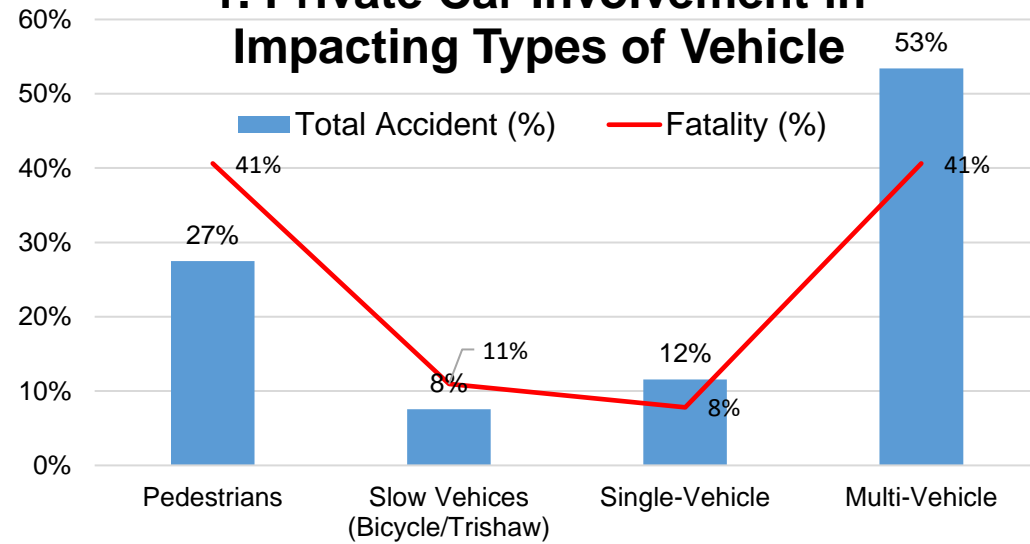


Impacted Types of Vehicle Involvement

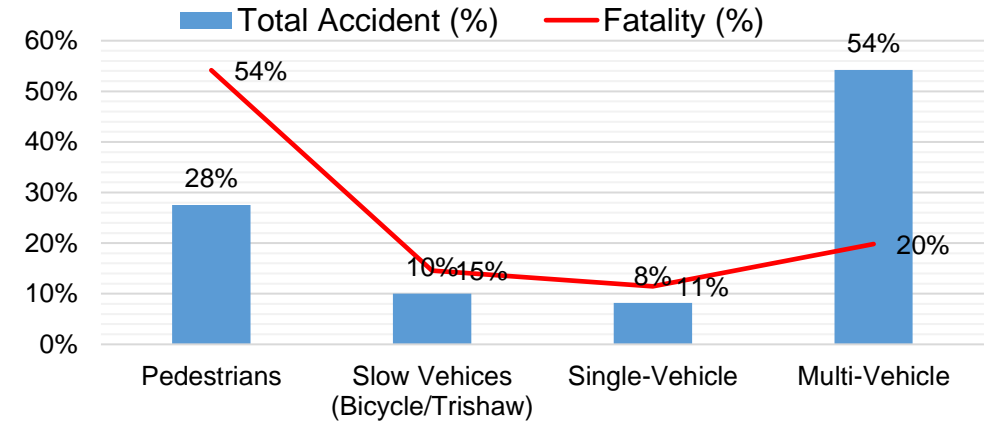


Accident Statics

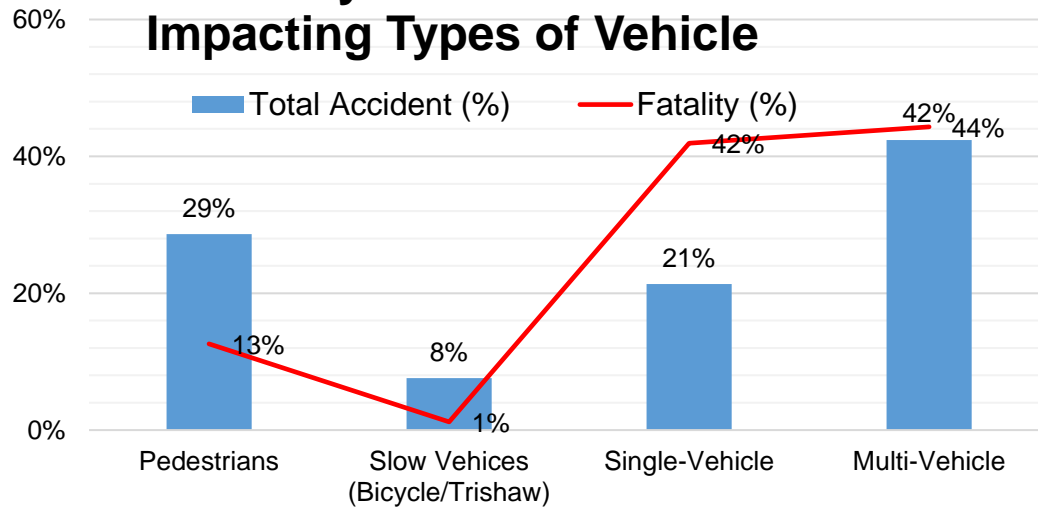
1. Private Car Involvement in Impacting Types of Vehicle



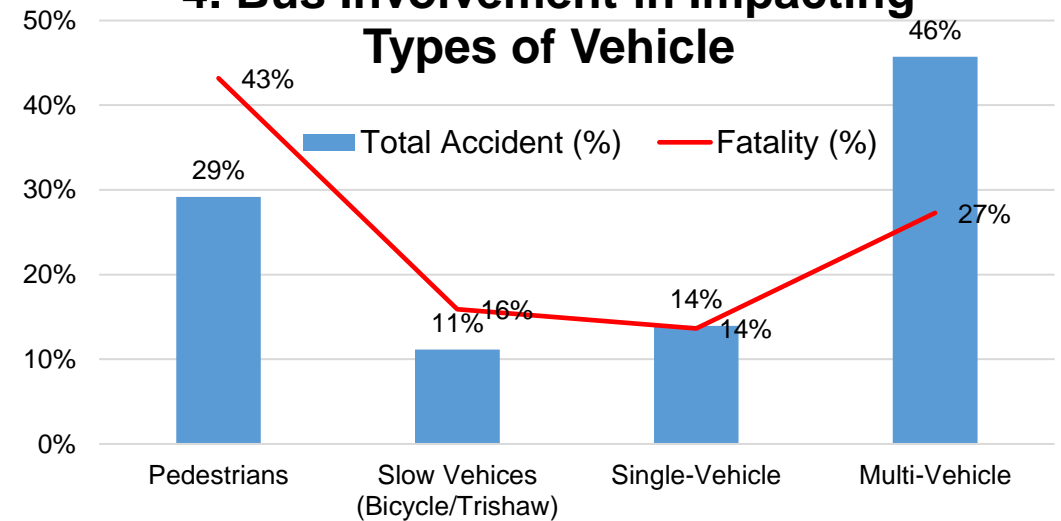
2. Taxi Involvement in Impacting Types of Vehicle



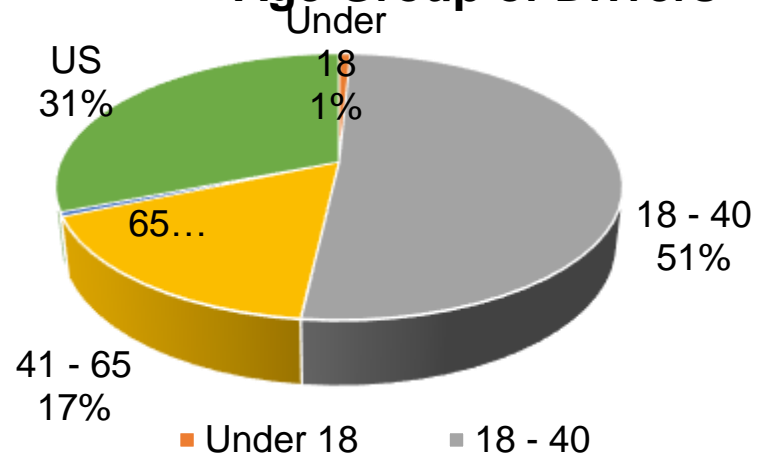
3. Motorcycle Involvement in Impacting Types of Vehicle



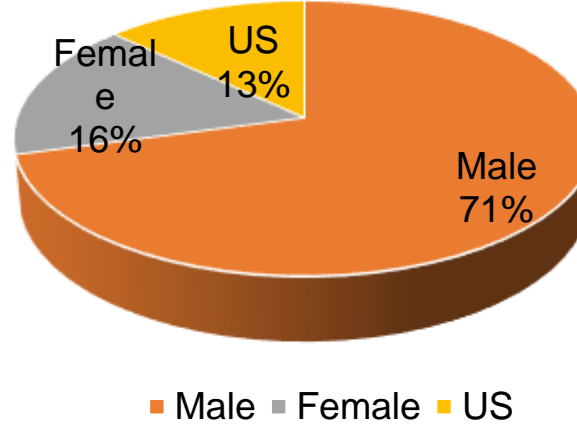
4. Bus Involvement in Impacting Types of Vehicle



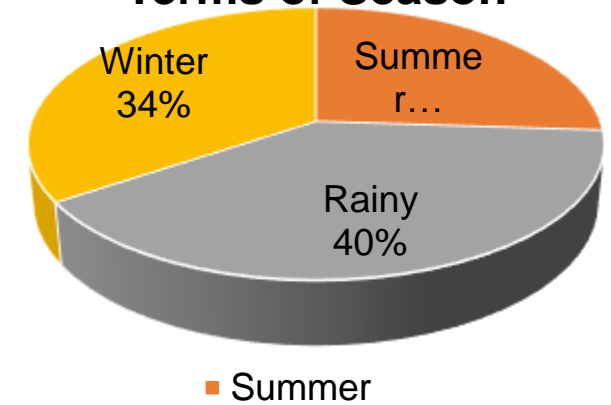
Age Group of Drivers



Gender of Drivers

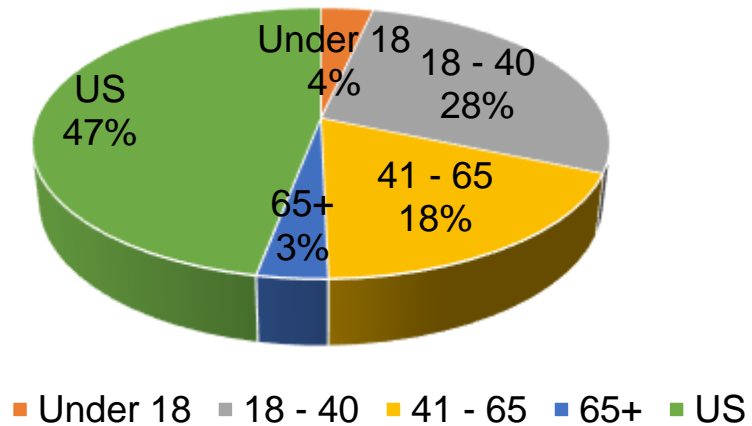


Road Accident in Terms of Season

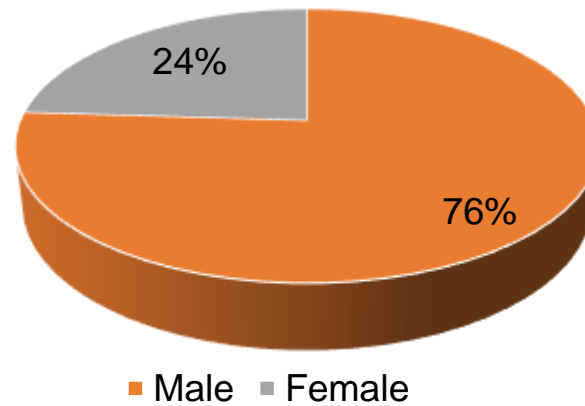


US= Unspecified

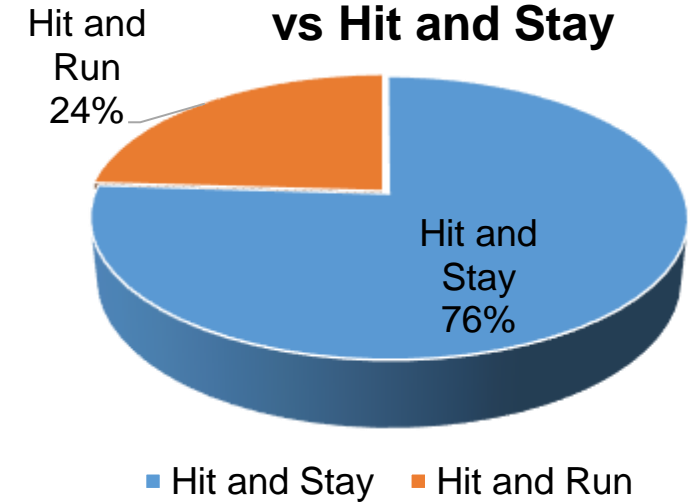
Age Group of Victims



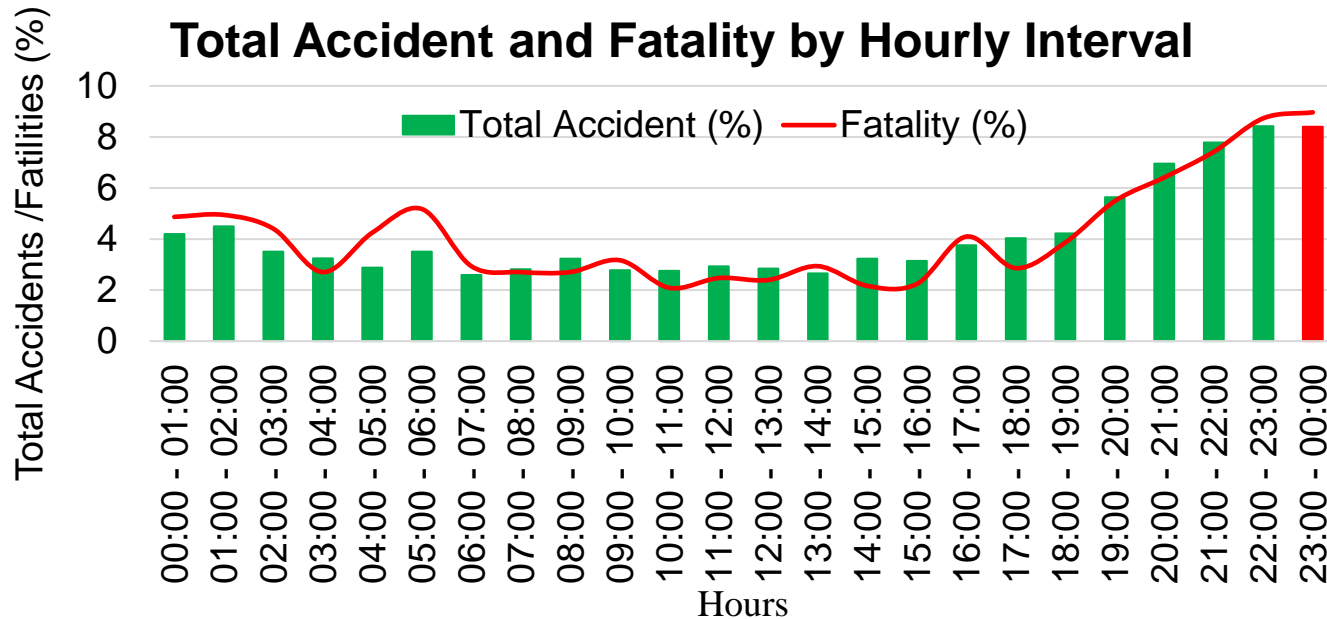
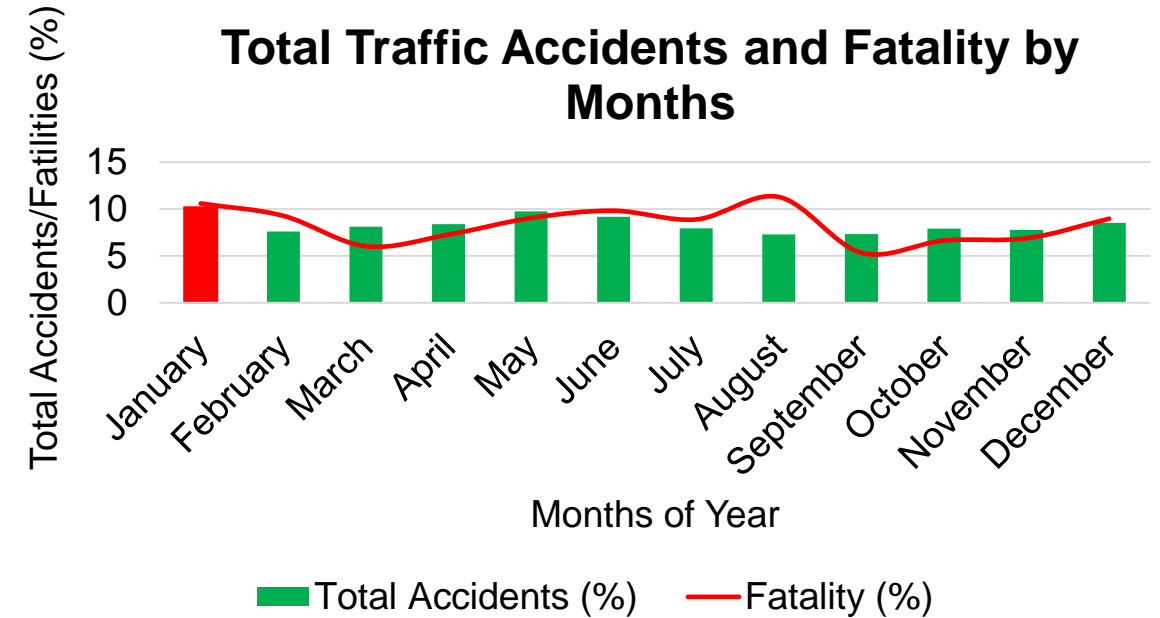
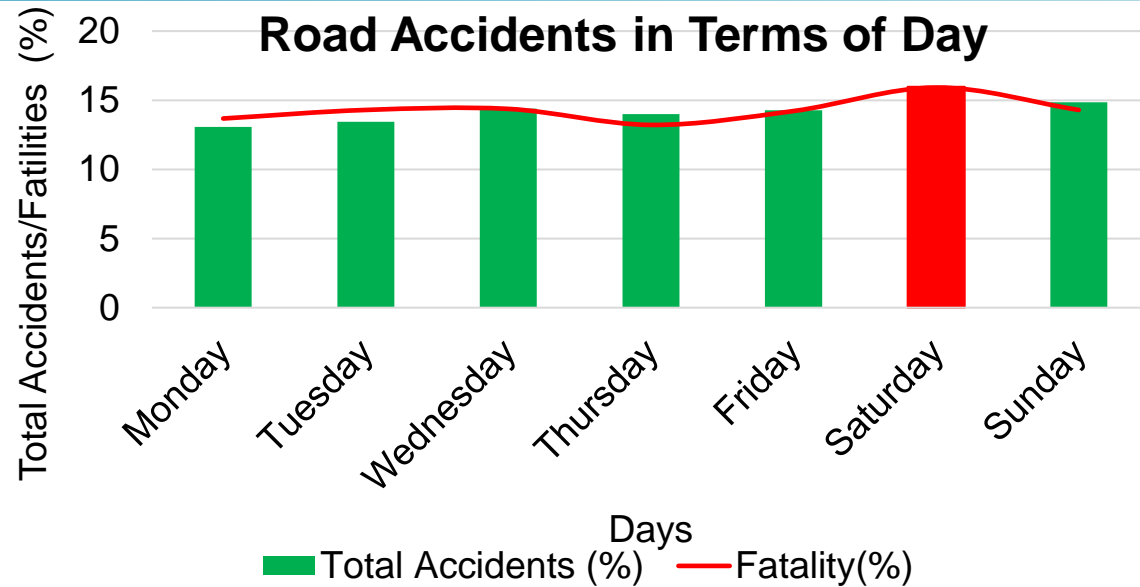
Gender of Victim



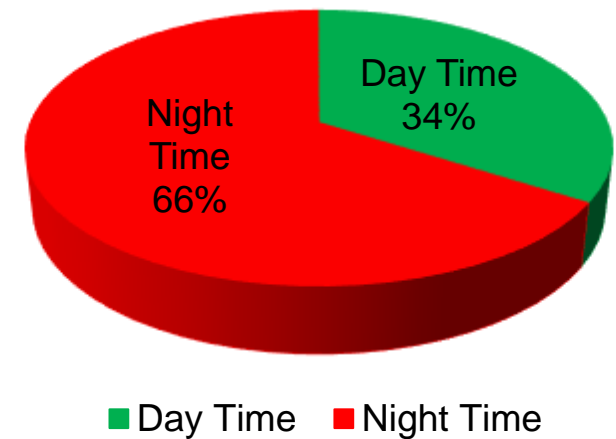
Accidents by Hit and Run vs Hit and Stay



Accident Statics

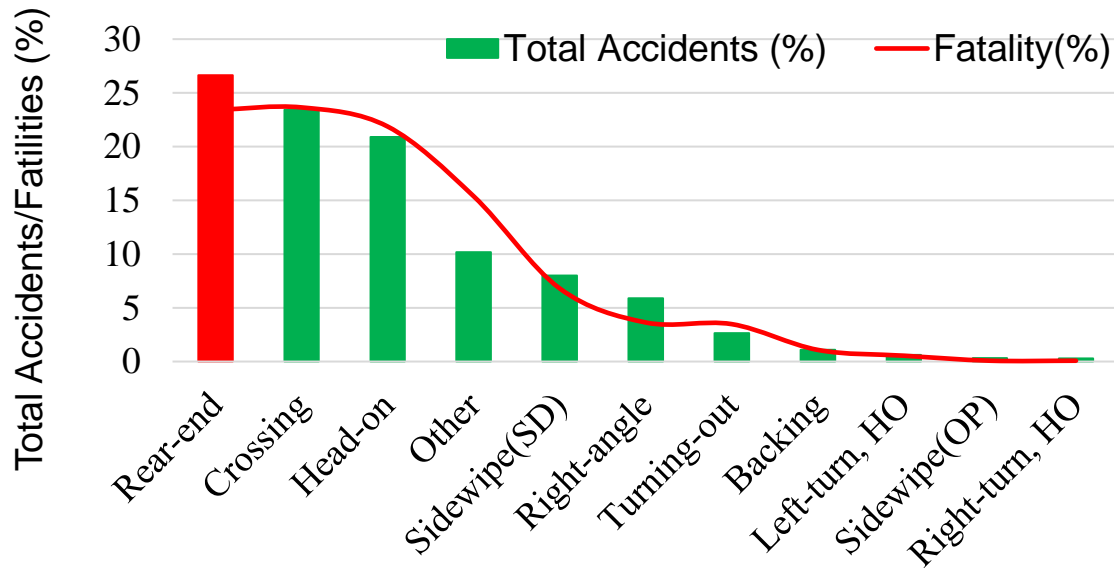


Total Accidents by Time of Day



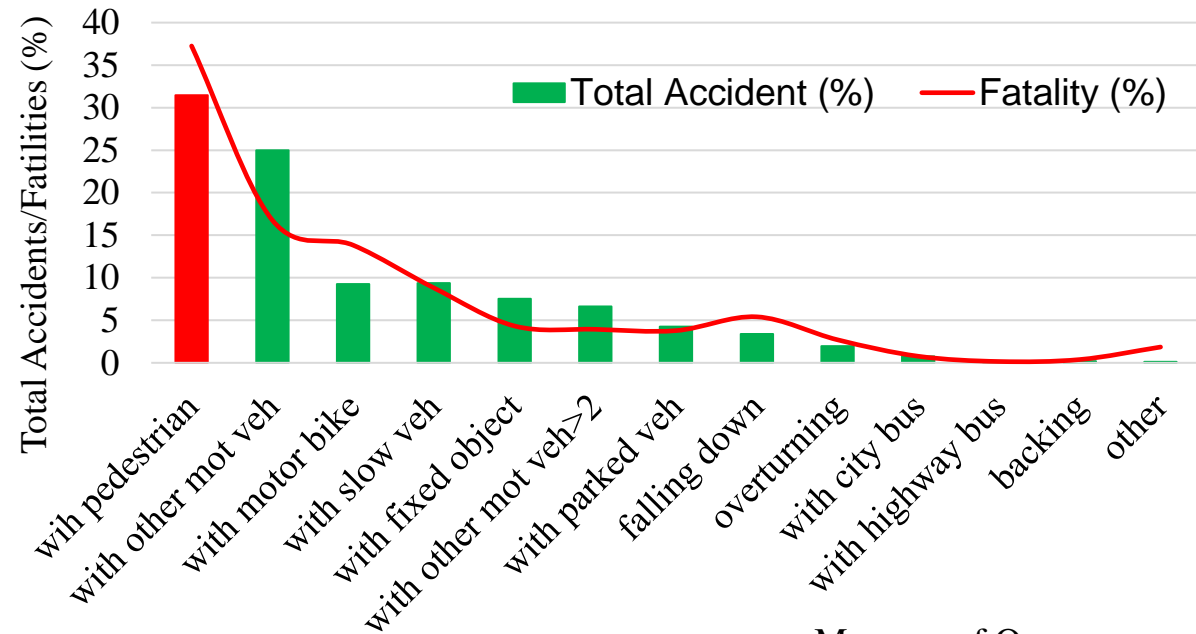
Accident Statics

Types of Collision



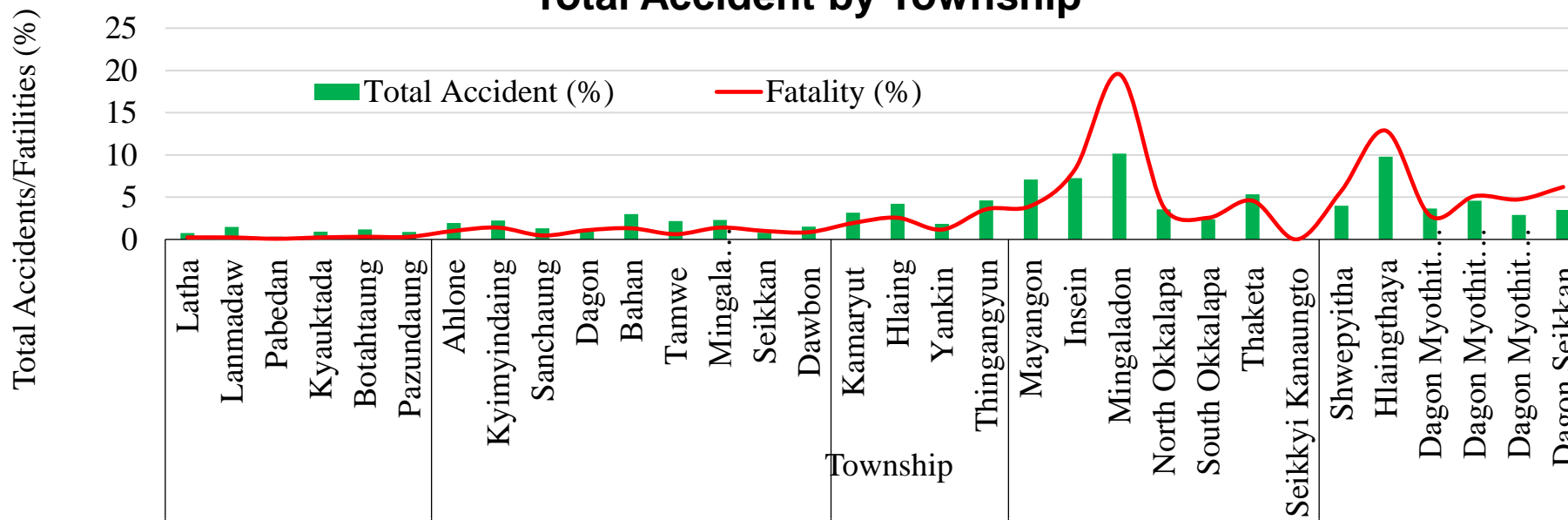
Types of Collision

Manners of Occurrence



Manners of Occurrence

Total Accident by Township



Township

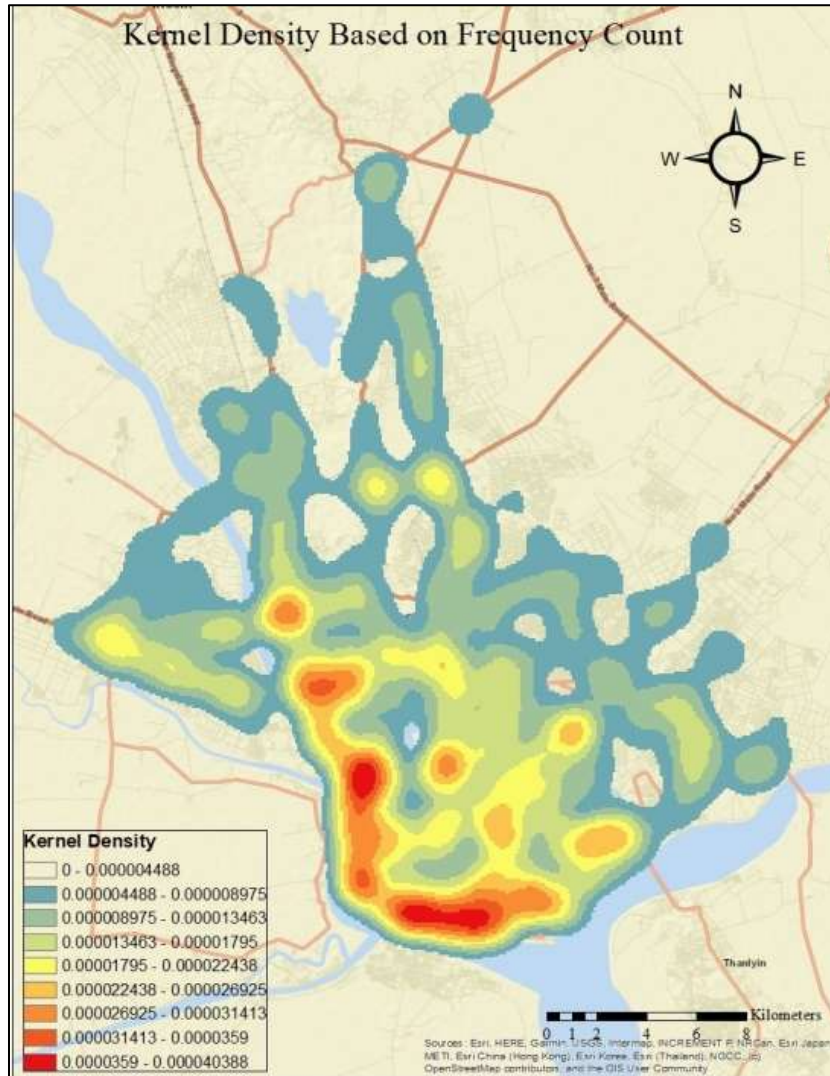
Accident Statics

Severity Index & Population-based Rates

Year	Fatality	Total Accident	Severity Index	Population	Fatality per 100,000 Area Population (33 Townships)
			(Fatality per Accident)	(33 Townships)	
2017	523	1723	0.30	3157754	16.56
2018	415	1616	0.26	4551245	9.12
2019	356	1375	0.26	4635284	7.68
2017-2019	1294	4714	0.27		

5) IDENTIFICATION OF BLACK SPOTS LOCATIONS USING GIS MODEL

Kernel Density Estimation



Kernel Density Estimation (KDE)

- Spatial techniques for estimating crash intensity to identify hotspots
- KDE allows for the visualization of high-risk areas where accidents are more likely to occur.
- Cell size = 100 m
(determine the image resolution of the accident area & smaller cell size results in a sharper image)
- Radius (bandwidth) = 1500 m
(only the accident areas within a radius of 1500 m are considered when defining hotspots)

Kernel Density Map Based on Accident Frequency

Hotspots Analysis

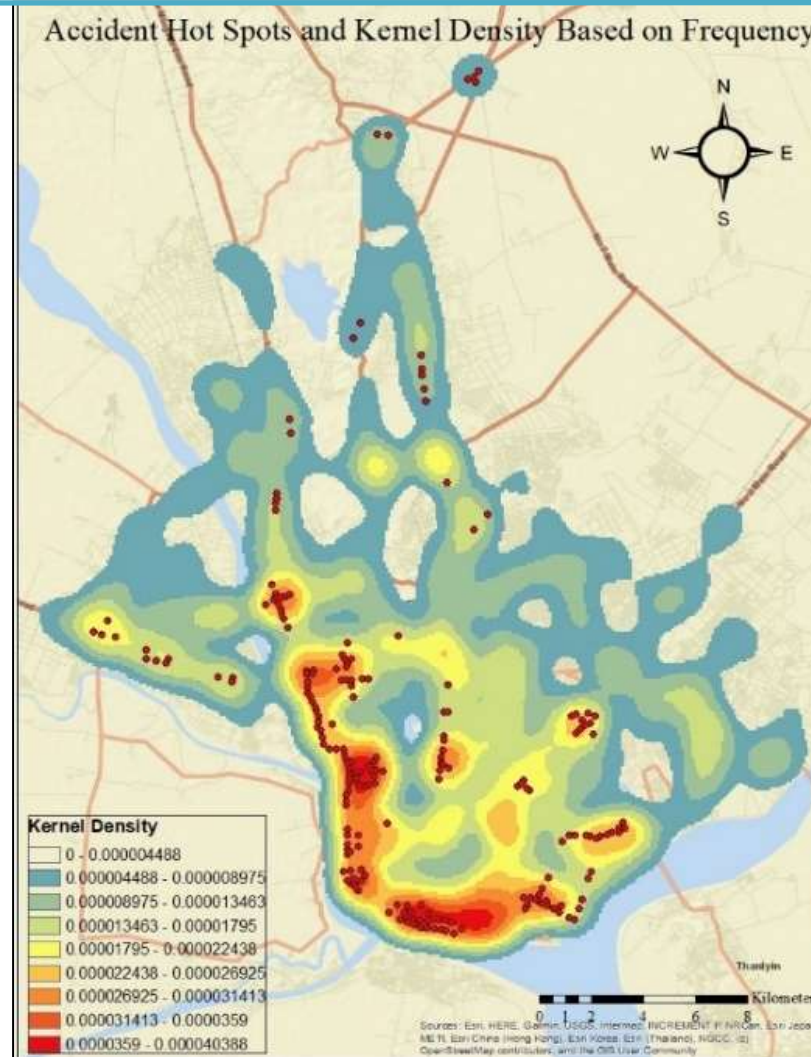
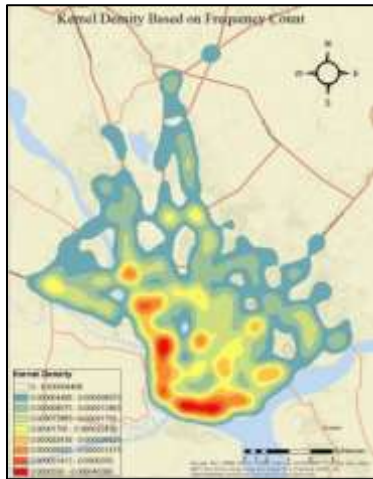


Hot spot analysis (spatial clustering analysis)

- is a method used in Geographic Information Systems (GIS)
- to identify statistically significant clusters of high or low values (hotspots and cold spots) within a spatial dataset.
 - ✓ hotspot - A location with a high accident frequency.
 - ✓ Cold spot - A location with a low accident frequency.

Accident Hot Spots & Cold Spots Map

Extracting Accident hotspots Locations



- Overlaying kernel density with identified accident hotspots to pinpoint areas of concentrated incidents.

Hotspots Locations Map Based on Accident Frequency

34 Hotspots Locations Based on Accident Frequency

Sr. No.	Location Based on Severity	Township
1	Bayint Naung Road/Hlaing River Road Intersection	Insein
2	Bayint Naung Road/Narnataw Road/Kyimyindaing Kanner Road	Kamaryut/Kyimyindaing
3	Pyay Road/University Avenue Road/Hledan Road/Insein Road Intersection	Kamaryut
4	Yangon-Pathein Road	Hlaingtharyar
5	Kyimyindaing Kanner Road and Ahlone Road Intersection	Ahlone
6	Kabaraye Pagoda Road and No.1 Industrial Road Intersection	Mayangone/Yankin
	Kabaraye Pagoda Road and Thitsar Road Intersection	
7	Yamonnar Road, Min Nandar and Mahabandula Road Intersection	Dawbon/Thaketa
8	Bayint Naung Road /Thamine Train Station Road	Mayangone/Hlaing
9	Aye Yar Wun Main Road (Near Thaketa roundabout)	Thaketa
10	Lower Mingalardon Road (Near Aung San Market)	Insein
11	Yangon-Pathein Road	Hlaingtharyar
12	No.3 Road and Yangon-Mandalay Highway Road	Mingalardon
13	No.3 Main Road	Mingalardon
14	Bayint Naung Road	Hlaing
15	Thanthumar Road and Lay Daung Kan Road Intersection	Thingangyun
16	Insein Road and Parami Road Intersection	Mayangone/Hlaing
17	Kyimyindaing Kanner Road	Kyimyindaing

Sr. No.	Location Based on Severity	Township
18	Mahabandula Road	Latha
19	Lay Daung Kan Road and Waizayandar Road Intersection	Thingangyun
20	Lower Mingalardon Road (Near City Mart-Shwepyithar Branch)	Shwepyithar
21	Aye Yar Wun Main Road (Near Thaketa roundabout)	Thaketa
22	Anawyathar Road	Lanmadaw/Latha
23	Strand Road	Seikkan
24	Bayint Naung Road	Hlaing
25	Shuukhinthar Myopath Road	Dawbon
26	Lower Kyimyindaing Road	Mingalardon
27	Pyay Road (Near Hlaw Gar Park – Tit-Numpad bus stop)	Mayangone
28	Parami Road and Kabaraye Pagoda Road (Near AD Intersection)	Mayangone
29	Strand Road	Seikkan
30	Thamine Train Station Road, Insein Road and Kyaik Wine Pagoda Road Intersection	Mayangone/Hlaing
31	Shuukhinthar Myopath Road	Dawbon
32	Bo Gyoke Aung San Road	Lanmadaw/Latha
33	Kyimyindaing Kanner Road and Ahlone Road Intersection	Hlaingtharyar
34	Baho Road	Kamaryut

20 road segments
14 intersections

Identification of Black Spots

1. Accident rate
2. Accident frequency
3. Severity index parameters

Black spot location → High Risk traffic accident locations.

- all three criteria do not need to be met in identification of black spot locations.
- a reason for this is that sections showing high accident rates do not often have many accidents.
- and, sections having many accidents do not often have high rates.
- each of these values is compared with a critical value.
- thus, the **accident rate** is compared with one critical value,
- the **accident frequency** with another critical value and
- the **severity value** with a third critical value.
- if a certain road section shows higher values than the critical ones, the section is considered to be a black spot.
- a road section is defined as **one kilometre of road in this study.**

Accident Frequency

- The accident frequency method is a statistical approach used to estimate the likelihood of accidents.
- A road section is considered to be a black spot, from the accident frequency point of view, if:

$$A_j > A_c,$$

where,

The critical value,

$$A_c = F_{ave} + k_\alpha \sqrt{\frac{F_{ave}}{L_j} - \frac{0.5}{L_j}}$$

A_c is the critical value for accident frequency (= number of accidents).

L_j is the length of the road section. Here, L_j is assumed to be 1 km.

F_{ave} is the average accident frequency for all road sections.

A_j is the number of accidents on section j during a certain time period.

k_α is a constant that is chosen for the significance test. It is determined from a normal distribution and selected to give a certain significance level:

$\alpha = 10\%$ gives $k_\alpha = 1.282$ (for 90% confident interval)

Accident Severity Index

- The Severity Index is calculated by multiplying the number of injuries in each category by their respective weightage and then summing the result.
- The road section is considered to be a black spot, from the severity point of view, if:
 $Q_j > Q_c$,

the critical value, $Q_c = Q_{ave} + k_\alpha \sqrt{\sigma^2} - 0.5$

$$Q_{ave} = \frac{\sum_{i=1}^n S_i}{\sum_{i=1}^n A_i}, \sigma^2 = \frac{1}{n-1} \sum_{i=1}^n (Q_i - Q_{ave})^2, k_\alpha = 1.282, Q_j = S_j / A_j$$

Severity value for road section $(S_j) = 6X_1 + 3X_2 + 1.2X_3 + 0.8X_4$

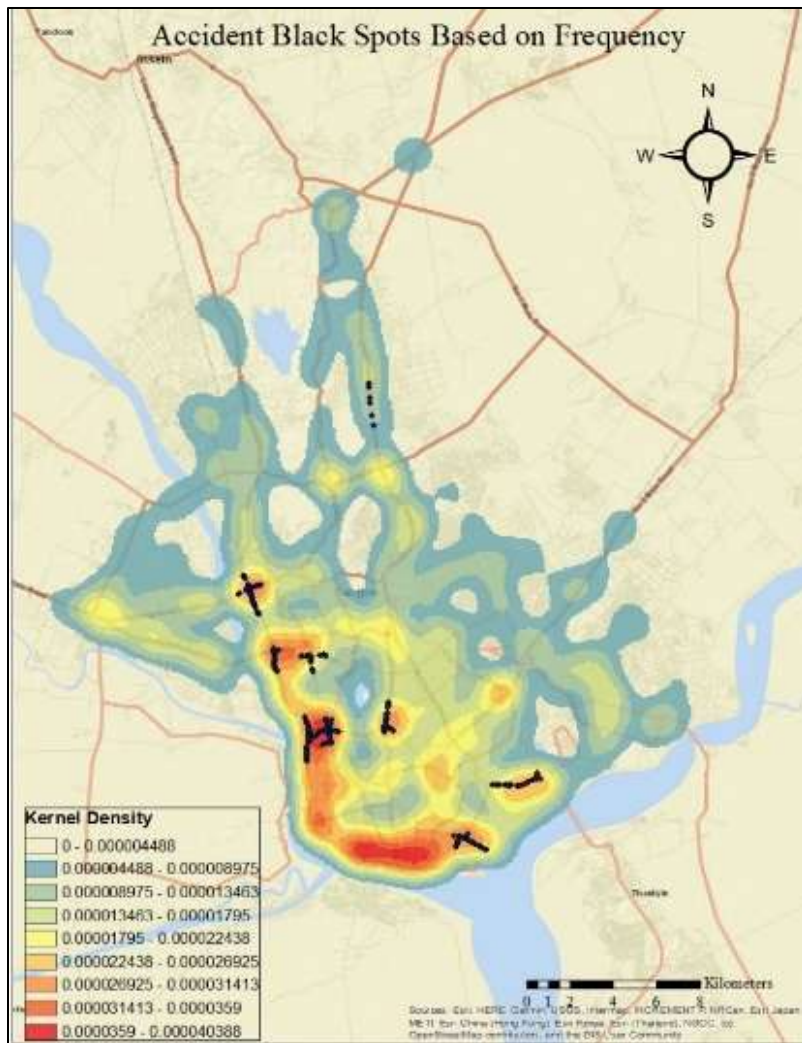
X_1 = total number of fatal injury (F)

X_2 = total number of serious injury (SE)

X_3 = total number of slight injury (SL), and

X_4 = total accident cases for property damage only (PDO)

S_j = the severity value for one road section



Black Spots Locations Based on Frequency

(8 intersections & 2 road segments)

10 Black Spot Locations Based on Frequency

Sr. No.	Location Based on Frequency	Township	Ranking
1	Bayint Naung Road/Hlaing River Road Intersection	Insein	1
2	Bayint Naung Road/Narnataw Road/Kyimyindaing Kanner Road	Kamaryut/Kyimyindaing	2
3	Pyay Road/University Avenue Road/Hledan Road/Insein Road Intersection	Kamaryut	3
4	Yangon-Pathein Road	Hlaingtharyar	4
5	Kyimyindaing Kanner Road and Ahlone Road Intersection	Ahlone	5
6	Kabaraye Pagoda Road and No.1 Industrial Road Intersection	Mayangone/Yankin	6
	Kabaraye Pagoda Road and Thitsar Road Intersection		
7	Yamonnar Road, Min Nandar and Mahabandula Road Intersection	Dawbon/Thaketa	7
8	Bayint Naung Road /Thamine Train Station Road	Mayangone/Hlaing	8
9	Aye Yar Wun Main Road (Near Thaketa roundabout)	Thaketa	9
10	Lower Mingalardon Road (Near Aung San Market)	Insein	10

Black Spot Locations Based on Accident Frequency

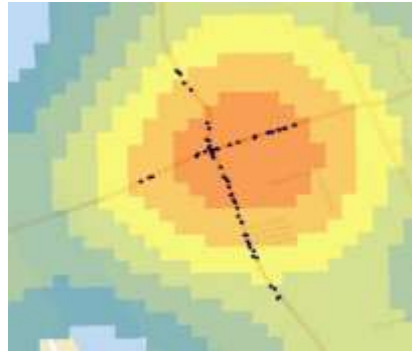


Fig. 1. Bayint Naung Rd/Hlaing River Rd (Insein)

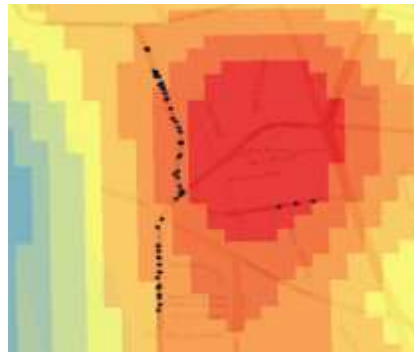


Fig. 2. Bayint Naung Rd/Narnataw Rd/Kyimyindaing Kanner Rd (Kamaryut/Kyimyindaing)

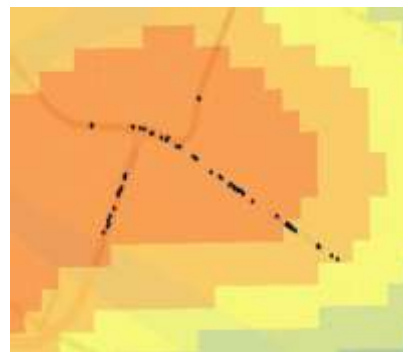


Fig. 3. Yamonnar Rd/Min Nandar/Mahar Bandula Rd (Dawbon/Thaketa)

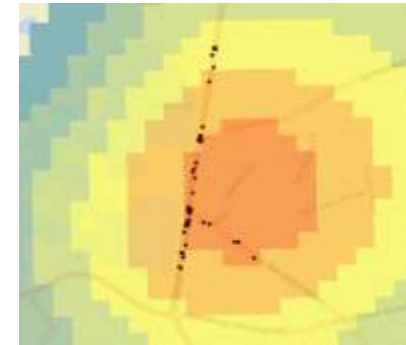


Fig. 4. Kabaraye Pagoda Rd/No.1 Industrial Rd (Mayangone/Yankin)

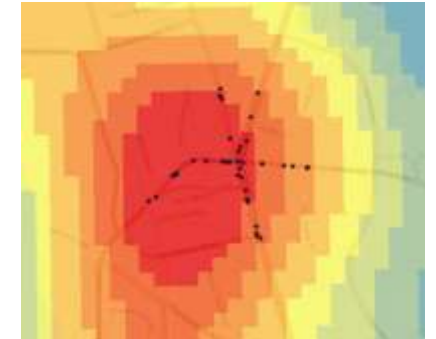


Fig. 5. Pyay Rd/University Avenue Road/Hledan Rd/Insein Rd (Kamaryut)

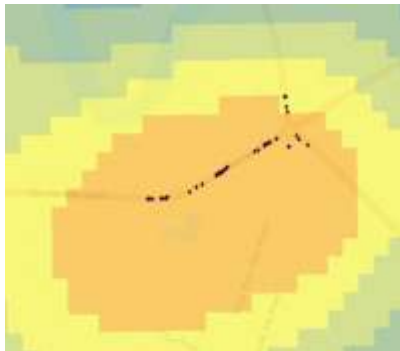


Fig. 6. Aye Yar Wun Main Rd, Near Thaketa roundabout (Thaketa)

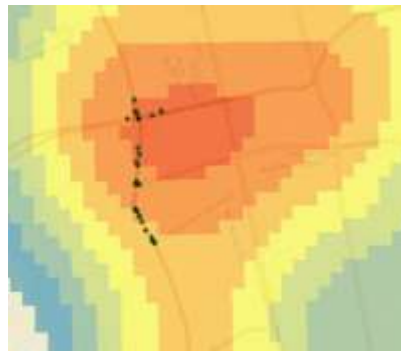


Fig. 7. Bayint Naung Rd /Thamine Train Station Rd (Mayangone/Hlaing)



Fig. 8. No.3 Main Road (Mingalardon)

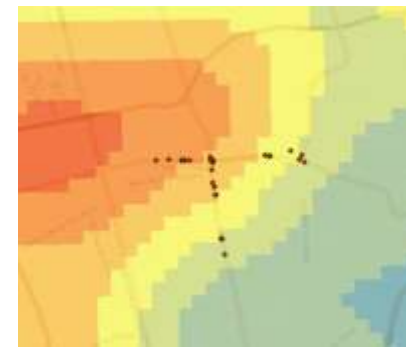


Fig. 9. Insein Rd/Parami Rd

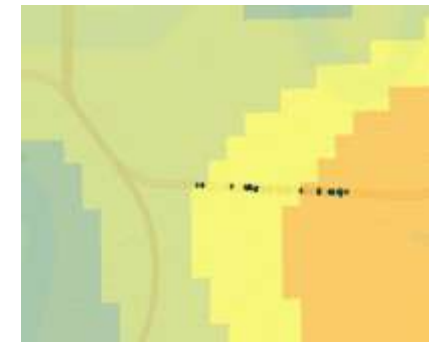
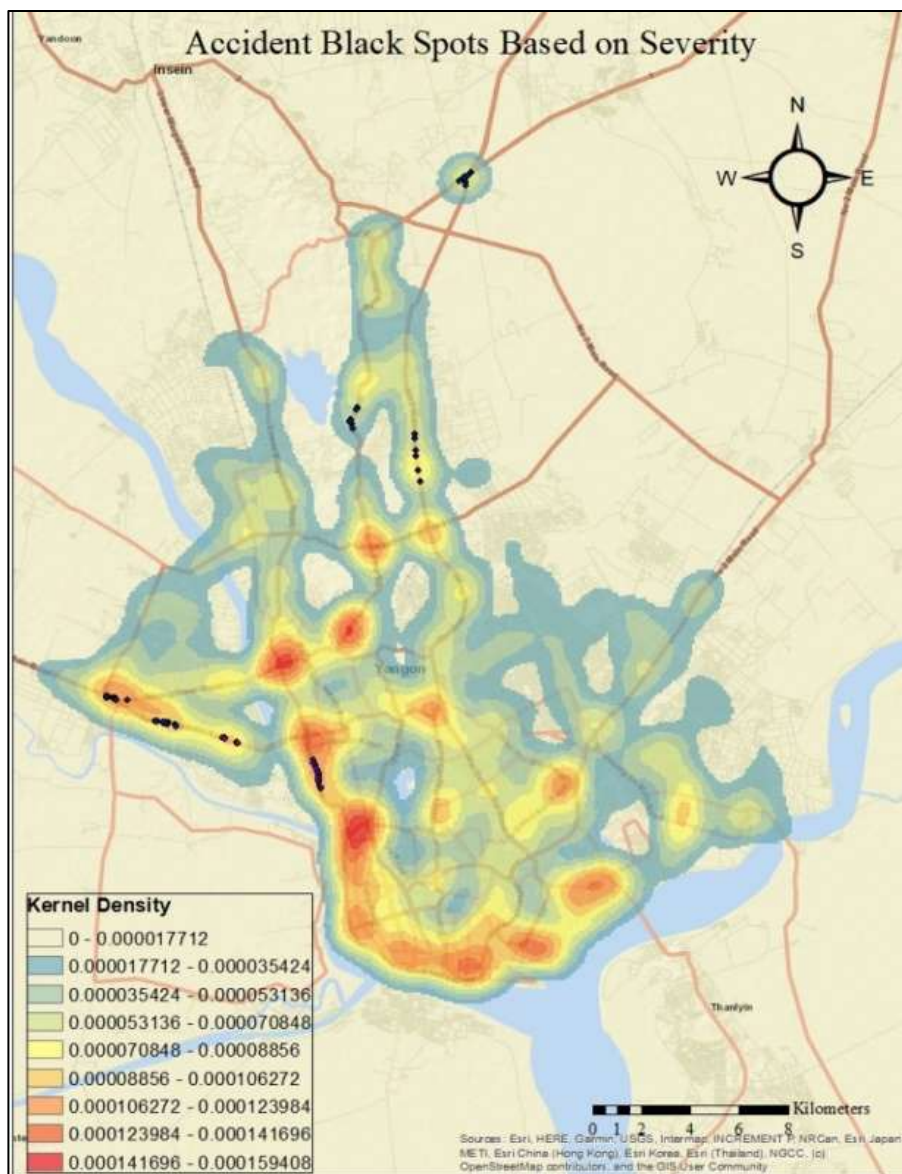


Fig. 10. Aye Yar Wun Main Rd, Near Thaketa roundabout (Thaketa)



**Black Spots Locations
Based on Severity Index**

Black Spot Locations Based on Severity Index Value

Sr. No.	Location Based on Frequency	Township	Ranking
1	No.3 Road /Yangon-Mandalay Highway Road	Mingalardon	1
2	No.3 Main Road	Mingalardon	2
3	Yangon-Pathein Road	Hlaingtharyar	3
4	Yangon-Pathein Road	Hlaingtharyar	4
5	Yangon -Pathein Road	Hlaingtharyar	5
6	Pyay Road (Near Hlaw Gar Park – Tit-Numpad bus stop)	Mingalardon	6
7	Bayint Naung Road (In front of Thirimingalar Market)	Hlaing	7

(1 intersection & 6 road segments)

Black Spot Locations Based on Severity Index



Fig. 1. No.3 Rd/Yangon-Mandalay Highway Rd (Mingalardon)

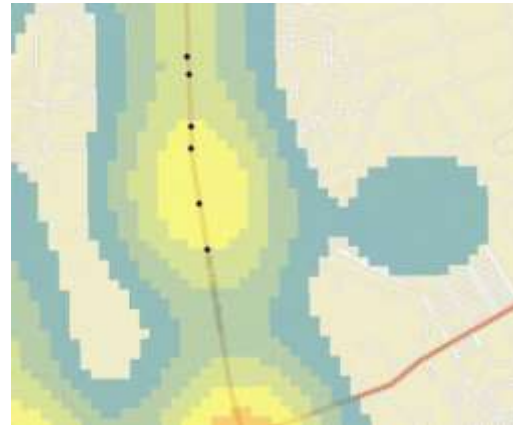


Fig. 2. No.3 Main Road (Mingalardon)

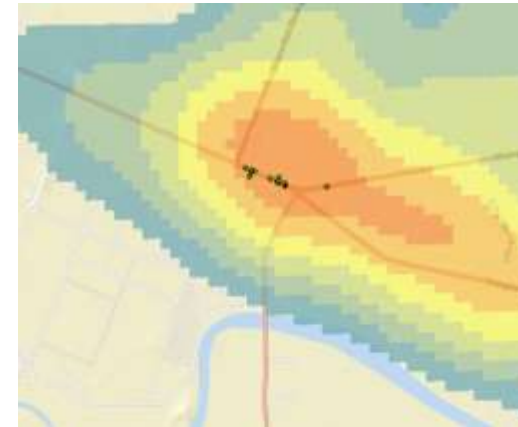


Figure 3. Yangon-Pathein Rd (Hlaingtharyar)

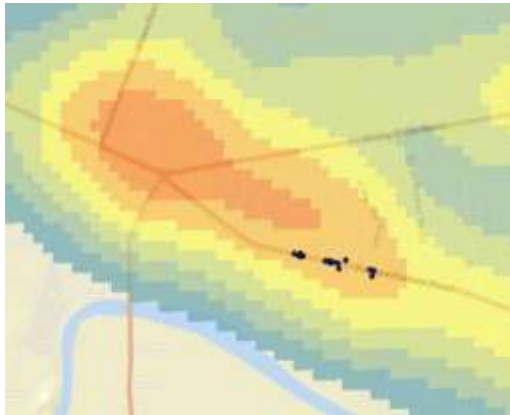


Fig. 4. Yangon-Pathein Rd (Hlaingtharyar)

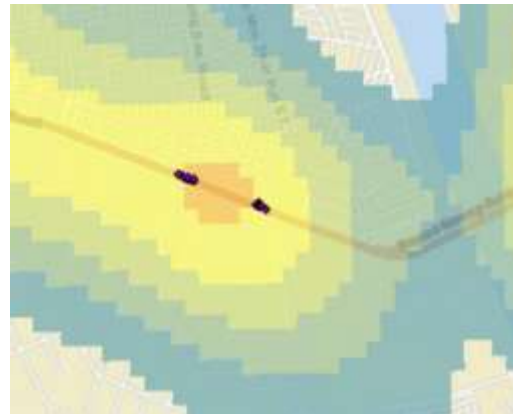


Fig. 5. Yangon -Pathein Rd (Hlaingtharyar)



Fig. 6. Pyay Rd (Near Hlaw Gar Park – Tit-Numpad bus stop, Mingalardon)

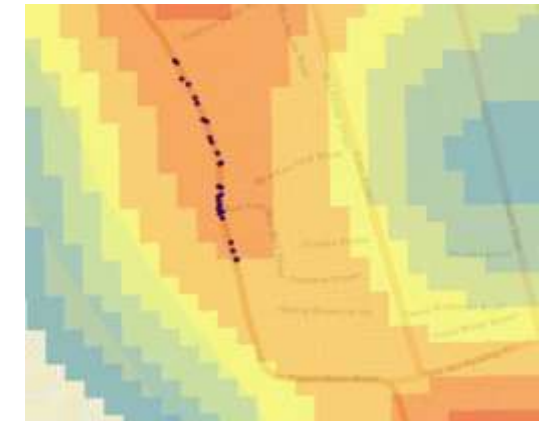


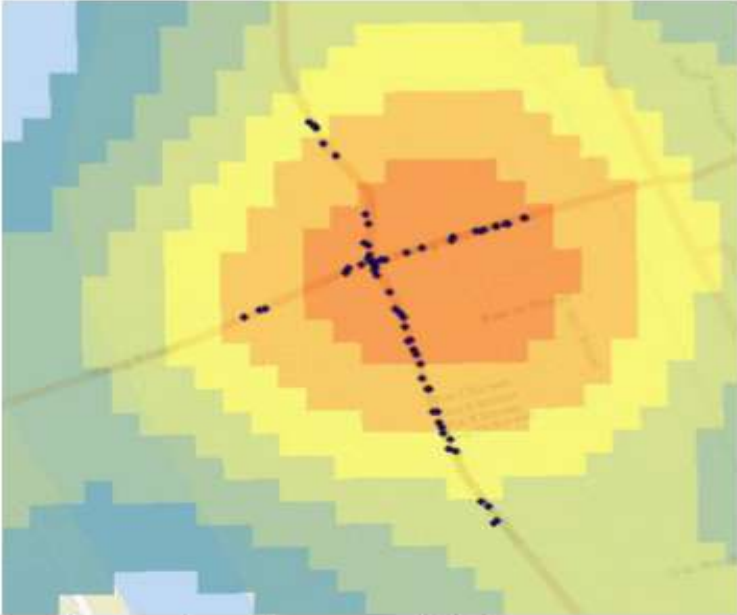

Fig. 7. Bayint Naung Rd (In front of Thirimingalar Market)

Site Visit



- Physical and environmental conditions of black spots locations
 - Geometric features of the site
 - All controls (location of signs, markings, crosswalk, signals and signal timing, lighting, etc.)
 - Roadside environments (location of objects, land uses and so on.)



Rank 1 → Bayint Naung Road/Hlaing River Road Intersection (Insein Tsp.) (Based on Accident Frequency)

Section Characteristics	Description of Accident Condition	Photo	Proposed Improvement
 <ul style="list-style-type: none"> Located at Commercial Area Mixed traffic usage Faded Pedestrian Crossing at intersection Illegal usage of motorcycle Classification – Collector/ Distributer Two-way, six-lanes, divided road Signalized Intersection 	<ul style="list-style-type: none"> 71 accident cases Severity level PDO=17, SL=11, SE=29, F=14 Manner of Occurrence V/V=17, V/SL=4, V/P=16, V/FO=1, V/M=6, M/M=1, M/FO=1, M/V=5, M/B=1, M/P=6, M/SL=1, B/V=1, B/SL=1, B/P=3, Other/P=2, Other/M=3, Other/SL=2 Time <ul style="list-style-type: none"> Night Time =63% Day Time =37% Season <ul style="list-style-type: none"> Summer=35% Rainy=39% Winter=26% Collision Type <ul style="list-style-type: none"> Rear-end=35%, Pedestrian=28%, Head-on=17%, Side to side=15%, Fixed objects=1%, Other=3% 	 <p>Bayint Naung Road/Hlaing River Road Intersection</p>	<ul style="list-style-type: none"> Repainting of faded pedestrian crossing Installation of warning signs of intersections and crosswalks Should improve sufficient roadway lighting Should provide pedestrian signal Conduct awareness campaigns to educate about crosswalk exercises Installation of skid warning signs Ensuring proper drainage system and road maintenance works to prevent the road surface from slipping Thermoplastics etc. should be used for road markings more visible in the rainy season Should install reflector sign along the median

Rank 1 → Yangon-Mandalay Highway Road/No. 3 Road (Mingalardon Tsp.) (Based on Severity Index)

Section Characteristics	Description of Accident Condition	Photo	Proposed Improvement
 <ul style="list-style-type: none"> • Located at congested area • Mixed use traffic • No sign of restrict motorcycle usage • Classification – Principal Arterial Road • Two-way six-lanes, divided road • T type intersection • Unsignalized intersection 	<ul style="list-style-type: none"> • 21 accident cases • Severity level <ul style="list-style-type: none"> • SE=10, SL=2 • F=9, • Manner of Occurrence <ul style="list-style-type: none"> • V/FO=2, V/M=2, V/O=1, M/M=3 • M/FO=2, M/V=3, M/P=1, B/FO=1 • B/M=2, O/P=2, SL/FO=1 • Time <ul style="list-style-type: none"> • Night Time=67% • Day Time=33% • Season <ul style="list-style-type: none"> • Summer=43% • Rainy=5% • Winter=52 • Collision Type <ul style="list-style-type: none"> • Rear-End=24% • Nose to Side=10% • Pedestrian=20% • Head-on=29% • Fixed Objects=5% • Other=14% 	 <p>Yangon-Mandalay Highway Road/No.3 Road</p>	<ul style="list-style-type: none"> • Improve sufficient roadway lighting • Install reflector at median • Install signs indicating restrictions on illegal motorcycle usage • Provide bike lane • Assess the feasibility of installing traffic signals or enhancing existing signals at the T-type intersection • Consider redesigning the intersection layout or adding turning lanes • Ensure clear and visible lane markings to guide drivers and prevent confusion • Launch campaigns to educate drivers, pedestrians, and motorcyclists about intersection safety

6) PROPOSED COUNTER MEASURES

- ✓ Since private cars are the most common type of vehicle involved in traffic accidents,
- road safety awareness campaigns should be prioritized for private car drivers.



Awareness campaign in Seoul



Road Safety and Traffic Awareness Campaign News and activities, Darshan University

- public bus and rail transport services should be upgraded to reduce the use of private cars and encourage private car users to switch to public transport.



Travelling with a baby on public transport



6) PROPOSED COUNTER MEASURES

✓ private cars

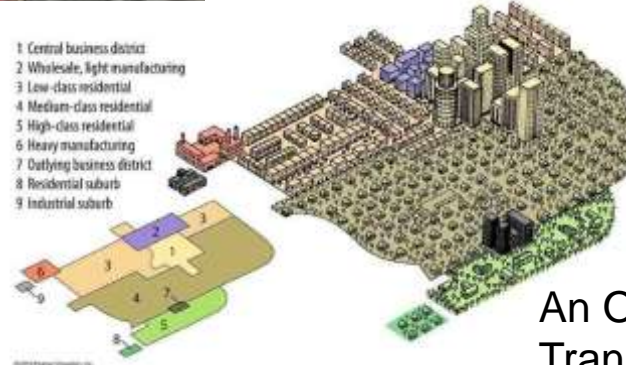
- Providing separate lanes for bus traffic will reduce travel time and increase bus user.

- Telecommunications (online) should be substituted for travel to reduce the number of people traveling to their destination using private cars.



Transit Lanes & Transitway

- Land use plans should be systematically placed to meet the needs of travelers in one place to reduce travel distances.



Source: UPD



Billing System

Microsoft 365 for Telecommunications

An Overview of the Integrated Land-Use Transportation Modeling Process

i.e. Exposure control strategy (Long term planning & mass investment)

6) PROPOSED COUNTER MEASURES

✓ It was found that pedestrians were the most affected group, and collisions with moving vehicle and pedestrians are the most common and the percentage of fatalities is also the highest.

➤ measures to reduce the risk of collisions with pedestrians should be emphasized,



providing pedestrian crossings



placing warning signs of pedestrian crossings



installing traffic lights for pedestrians



repainting the faded markings



providing pedestrian islands



educating pedestrians to cross only at pedestrian crossing

6) PROPOSED COUNTER MEASURES

✓ pedestrians



- Pedestrian facilities should be provided, such as providing sufficient platforms for pedestrians



- providing protection between platforms and traffic lanes to prevent traffic accidents.



6) PROPOSED COUNTER MEASURES

- ✓ Since the age group between 18 and 40 years old of drivers and victims involved in traffic accidents is the largest,
 - these age group should be given priority in road safety education.
 - Those with “bad” driving records should be given licenses, revoked, and
 - drivers who have not had a crash for a specified number of years should be given awards.



Traffic education in China



Vehicle Accident Stock Photo



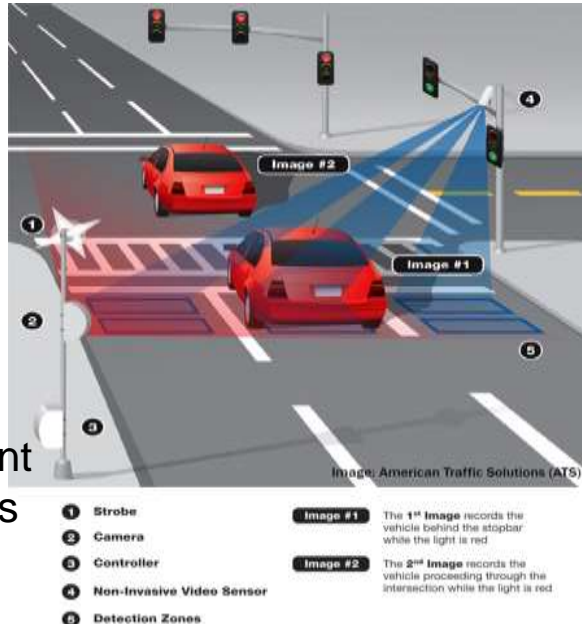
2 honored for saving driver from fiery crash

6) PROPOSED COUNTER MEASURES

- ✓ age group between 18 and 40 years old of drivers and victims,
 - automated speed enforcement for speeding, and
 - automated systems for ticketing drivers for red lights should be implemented.
 - emergency medical technicians, emergency medical services, and rapid notification measures should also be emphasized to reduce the severity of traffic accidents.
 - for the middle-aged age group, education should be accelerated by connecting with universities, colleges, factories, workshops, and youth organizations.



Automated Photo Enforcement Program - Red Light Cameras



Road accidents and how to help safely



Post-Impact Stability Control-automated driving beyond the normal limits of vehicle control

6) PROPOSED COUNTER MEASURES

- ✓ Although driving under the age of 18 is prohibited, minors are still involved in a small number of accidents.
- It is necessary to take into account the needs of drivers under the age of 18,
- to make laws and regulations more effective and
- to provide education through relevant schools and colleges.



The Maharashtra government has also ordered that underage drivers found guilty will be prohibited from getting a licence until age 25.



School Safety Stock Photo

6) PROPOSED COUNTER MEASURES

- ✓ Since hit-and-run accidents account for about a quarter of all accidents,
 - drivers should be educated and investigated more responsibly and not to hit-and-run after a crash.



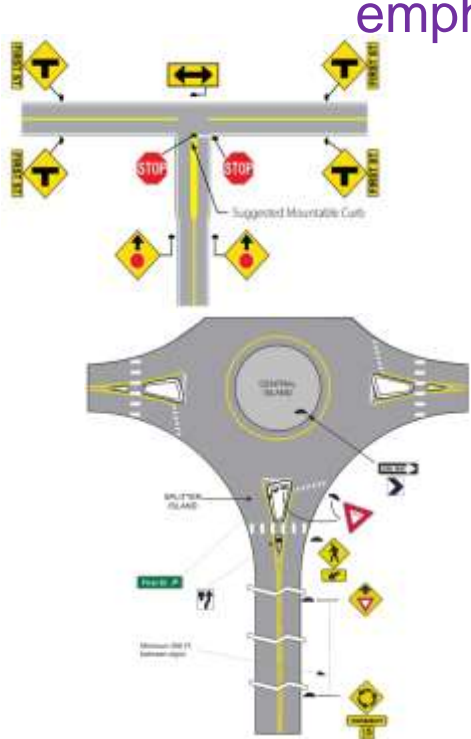
hit-and-run accidents



Driver Education

6) PROPOSED COUNTER MEASURES

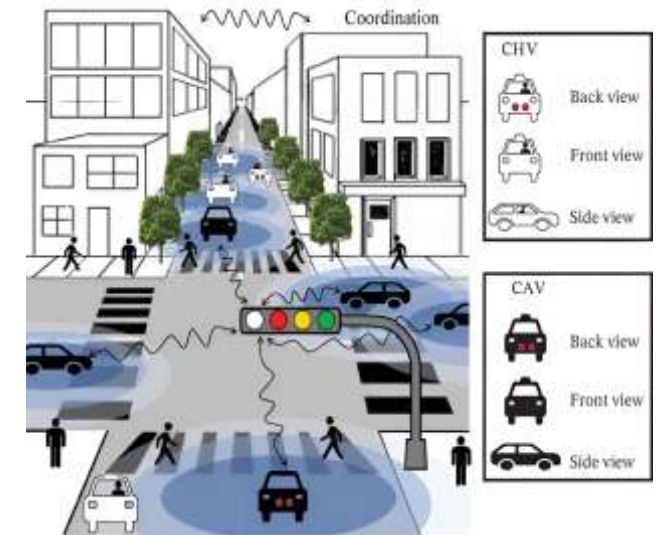
- ✓ Rear-end collisions are the most common type of collision and cause the highest percentage of fatalities.
- Rear-end collisions are usually caused by driving at high speeds on busy roads, poor visibility at traffic lights, and the need to stop due to sudden signal changes.
 - installing intersection warning signs to slow down and
 - providing sufficient signal times for the number of vehicles passing by should be emphasized.



Rear-end collisions



Example of a Warning Beacon accompanying an overhead warning sign



New traffic signal would improve travel time for both pedestrians and vehicles

6) PROPOSED COUNTER MEASURES

- ✓ The most dangerous traffic accidents occur at night, and
 - ✓ the number of accidents and fatalities increases as the night progresses.
- During these hours, drivers are more likely to be drowsy, have poor lighting, and drive at higher speeds when traffic is light.



One dead, one injured in head-on collision on I-95 in Portsmouth



Drowsy Driving



Poor Lighting

6) PROPOSED COUNTER MEASURES

✓ at night time accidents



- Improving adequate street lighting,

- Providing reflectors on medians,



- Installing speed limits sign



- Installing rumble strips

6) PROPOSED COUNTER MEASURES

✓ It was found that the death rate is highest in August, the rainy season.



more attention should be paid to road safety measures during the rainy season



installing skid warning signs



installing speed limit signs



road maintenance during the rainy season to prevent skids



using paints (thermoplastics, etc.) to make road markings more visible during the rainy season



Providing proper drainage systems

6) PROPOSED COUNTER MEASURES

- ✓ Although traffic accidents occur every day, it has been found that the percentage of traffic accidents and deaths is higher on Saturdays and Sundays, which are holidays.



- more attention should be paid to traffic safety activities during holidays.

- ✓ The percentage of traffic accidents and fatalities were found to be highest in Mingalardon Township and second highest in Hlaingthaya Township.

- more attention should be paid to traffic safety measures in these townships.



Mingalardon Township



Hlaingthaya Township

7) CONCLUSIONS

Strategies

- Exposure control
- Accident prevention
- Risk control
- Injury control
- Law enforcement
- Post injury management

- ✓ To reduce the number of the vehicle-miles of travel by motorists (Exposure control) → Long Term Investment
 - improvement of public transportation
 - land use plan
 - use of high occupancy lane (bus lane)
 - telecommunication (applying of online)
- ✓ To reduce number of accidents (Accident prevention)
 - driver and pedestrian training, Education program, awareness campaigns
 - removal of drivers with “bad” driving records
 - provision of better highway designs and improvement of traffic control devices such as traffic sign, marking and signal
- ✓ To reduce the *severity* of an accident (Risk control)
 - protection of roadside and median environments such as proper guardrail

CONCLUSIONS

- ✓ To increase crash survivability of occupants in a vehicular accident (Injury control)
 - Require law enforcement to ensure the wearing of seat belts.
- ✓ Law enforcement
 - use of automated systems for ticketing drivers who violate red lights
 - automated speed enforcement
 - Education program, awareness campaigns and law enforcement
- ✓ Post injury management (3 critical time periods → during the accident occurrence or within one minute, Within one to two hours, Within 30 days of admission to the hospital)
 - speedy notification of emergency services,
 - fast dispatch of appropriate equipment to the site,
 - well-trained emergency medical technicians, and
 - well-staffed and equipped trauma centers at hospitals.
- ✓ Road lighting
- ✓ Full pedestrian access
- ✓ Dedicated lanes for slow-moving vehicles

also play an important roles in making the road safety.

7) CONCLUSIONS

- To reduce the risk of serious accidents, engineers should work to improve the areas that need urgent repair and achieve better results.
- After the proposed countermeasures are implemented, it is necessary to continue monitoring.
- The purpose of this is to determine whether the countermeasures have eliminated (or at least reduced) the problems (hazards) and to ensure that no new hazards have arisen.
- The monitoring process also includes collecting information, which needs to be recorded over time, both before and after the repair of the road and vehicle characteristics.
- This study will provide information to the **policy makers** as well as **transportation planners** about the **proper counter measures and road safety improvements** **which** can be provided for **the reduction of crashes**.

8) RECOMMENDATION FOR FUTURE RESEARCH

- Black spots location for during and post COVID-19 will be analyzed in future study.
- The modeling process and respective models will be included to achieve more precise and advanced results.
- Specific vehicle types will be analyzed which can provide a more detailed understanding of respective accident characteristics and improve the effectiveness of proposed interventions.
- Systematic accident record should always be made available at all times.

The collection and maintain a record of accident, traffic and highway data is a prerequisite for the improvement of the road safety.

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