International Road Federation – India Chapter

IRF-IC Lecture Series_2.0

Modern Methods of Accident/Crash Data Collection & Management

Venue: India International Centre Annexe (Room 1-2-3)
25 April 2024

President
Advisor
Intercontinental Consultants and Technocrats Pvt. Ltd, New Delhi, India

Prof. P. K. Sikdar, IRF & ICT, New Delhi
pksikdar@ictonline.com

Definition of an Accident/Crash

An accident or crash is a rare, multifactor event preceded by a situation wherein one or more road users **failed to cope with road environment** resulting in a collision.

Remember

A vast majority of these crashes are **avoidable and preventable** (proved by research) – by adopting some basic safety measures of various types

Driving skill and behaviour related problems

Motorcycle Accident

Infrastructure related problem

Crash Barrier into a Vehicle

NH-65 Hyderabad – Vijayawada (on 22.04.2024 at 6.30 AM)

ఢీకొన్న అనంతరం కంటెయినర్ కింద ఇరుక్కుపోయిన కారు

Concessionaire: GMR

Poor Infrastructure Management

Fault of Road Agency

Fault of Road Agency

Commonly Attributed Reasons for Road Crashes

- Dangerous or careless driving (u/s 184)
- Dangerous overtaking (u/s 189)
- Over-speeding (u/s 183)
- Driving under influence of drugs/ medicine (u/s 185)
- Drunken driving…….. (u/s 185)

That means, all road accidents happen due to one or other form of driver error. But, this conclusion is not good enough to alleviate the problem.

All based on incomplete/inaccurate data…

Therefore, let us stop blaming road users for all road accidents/crashes; and the road & the vehicle fails the road users to cope with the road environment

Often it is stated that

"95% of all accidents are due to Road Users' Fault" ……

It is surely not correct !!!!

(It is a borrowed statement from west, where it is likely to be correct)

Lot is yet to be achieved in Road Engineering and Enforcement…

Trend in Road Safety Status in India

Table 1.1: Total number of Accidents, Fatalities and Persons Injured during 2018 to 2022

Year	Accidents	% change over previous period	Fatalities	% change over previous period	Persons Injured	% change over previous period
2018	4,70,403	0.2	157593	5.1	4,64,715	-0.6
2019	4,56,959	-2.9	1,58,984	0.9	4,49,360	-3.3
2020	3,72,181	-18.6	1,38,383	-13.0	3,46,747	-22.8 *
2021	4,12,432	10.8	1,53,972	11.3	3,84,448	10.9 *
2022	4,61,312	11.9	1,68,491	9.4	4,43,366	15.3

Source: Road Accidents in India 2022, MoRTH, GoI

?2023?

190,000 ??? Very Scarry !!!!

*Pandemic Years

Table 2.9: Road Accidents and Fatalities on NH by Traffic Rule Violations

Category	2021		2022		% Change	
	Accidents	Fatalities	Accidents	Fatalities	Accidents	Fatalities
Over-speeding	95,785	40,450	1,10,027	45,928	14.9	13.5
% Share	74.4	72.2	72.4	75.2		
Drunken driving/consumption of alcohol & drug	2,949	1,352	3,268	1,503	10.8	11.2
% Share	2.3	2.4	2.2	2.5		
Driving on wrong side	5,568	2,823	7,330	3,544	31.6	25.5
% Share	4.3	5.0	4.8	5.8		
Jumping red light	555	222	707	271	27.4	22.1
% Share	0.4	0.4	0.5	0.4		
Use of mobile phone	1,997	1,040	2,479	1,132	24.1	8.8
% Share	1.6	1.9	1.6	1.9		
Others	21,971	10,120	28,186	8,660	28.3	-14.4
% Share	17.1	18.1	18.5	14.2		
All India	**1,28,825**	**56,007**	**1,51,997**	**61,038**	**18.0**	**9.0**

75.2% of all accidents on NH

Source: Road Accidents in India 2022, MoRTH, GoI

Present Scenario of Road Crashes

Table 4.4: Comparison of Persons killed in Road Accidents in terms of road user categories in 2022 over 2021

Road-user category	Persons killed 2021	Persons killed 2022	% Change 2022 over 2021
Pedestrian	29,124	32,825	12.7
share in Total	18.9	19.5	
Bicycles	4,702	4,836	2.8
share in Total	3.1	2.9	
Two-wheelers	69,385	74,897	7.9
share in Total	45.1	44.5	
Auto-Rickshaws	5,966	6,596	10.6
share in Total	3.9	3.9	
Cars, Taxis, Vans & LMVs	19,811	21,040	6.2
share in Total	12.9	12.5	
Trucks/Lorries	9,476	10,584	11.7
share in Total	6.2	6.3	
Buses	3,106	4,004	28.9
share in Total	2.0	2.4	
Other Non- Motor Vehicles (including e-rickshaw)	2,283	2,372	3.9
share in Total	1.5	1.4	
Others (other motor vehicles, animals drawn vehicle, cycle rickshaws, hand carts, & other persons)	10,119	11,337	12.0
share in Total	6.6	6.7	
Total	1,53,972	1,68,491	

VRU Fatality is 72.2%

About 5% of this also Totalling to > 75% in 2022

Source: Road Accidents in India 2022, MoRTH, GoI

Why Accident (Crash) Data ?

Factors contributing to road accidents should be known for necessary correct interventions

- Driver behaviour or fault
- Poor roadway design or traffic control
- Poor roadway maintenance
- Vehicle failure/defect

Existing accident data recorded by traffic police do not reflect the actual cause of road accident, and less useful for any scientific analysis

A comprehensive data collection is required to identify exact causes of accidents/crashes and for design of countermeasures/interventions

Road Safety Management System in Developing World

Commonly adopted approach is based on ad-hoc interventions alone

What is needed – is a data-led evidence-based intervention - focused on results of crash investigation

… And for crash investigation systematically collected data is required….

Data driven strategies are completely missing in our road safety actions ….

Reliable Crash Data is a big challenge….

Maybe we know only a small fraction of our total **road safety problem …**

Crash investigation to identify evidence can only direct the most appropriate intervention for any Road Accident/Crash

For this, we need smart and authentic data

We can see only the tip of the Iceberg

The problem is much bigger than we think (what we know is just tip of the iceberg ?)

Many injury and damage only accidents are not recorded in police statistics

5-10% ?

- **Unreported major/minor injury accidents could be as high as 1,500,000/year ?**
- **Unreported damage only crashes could be over 2,000,000/year ?**

1:15:70

International
1 death:85 injuries

India
1:2.6

USA	:	1:54
UK	:	1:67
Netherlands:		1:32

NOTE: As per 2022 data, Road Deaths = 168,491 and Injuries = 443,366

In USA, During 2019 there were 1,949,588 Injury Crashes with 36,096 Deaths

We need a Revolution in Scientific Road Crash/ Accident Data Collection & Management

Technology has brought about level playing field worldwide (Grab the opportunity and leap frog)

What we cannot measure……., we cannot manage……

(If you cannot measure road safety of the network, you cannot manage road safety….)

Problem with Crash Data in Developing Countries

- It is a crime record for adjudication purpose, not for correction in design/operation/control/behaviour
- No mechanism to share data with other Stakeholders
- Incomplete data collected by Police officers; and not good for any scientific investigation
- Cause of crash is attributed mostly to the driver fault or behavior
- Insufficient details such as exact location and road condition
- Collection method is laborious

Crash Data Collection

1. **Minimum Data**
   - I. Crash identification (a unique number-based system)
   - II. Time (the date, hour, minute, day of week)
   - III. Location (to create GIS enabled database)
   - IV. Crash type
   - V. Vehicles involved (number, type)
   - VI. Crash consequences (fatalities within 30days, injuries, material damage)
2. Road and Traffic Data
3. Additional Data

Crash Data Collection

1. Minimum Data
2. **Road and Traffic Data** – to relate crashes with the site condition
   - Geometric details of crash site
   - Specific places/objects – pedestrian crossing, rail crossing, bridge, tunnel, bus/tram stop, parking place, etc.
   - Road surface condition
   - Delineation at the site
   - Roadside hazards
   - Visibility conditions
   - Weather conditions
   - Traffic control features
   - Position of crash – travel direction, location - traffic lane, shoulder, roadside, etc.
   - Main causes of crash – speeding, overtaking, right of way details, etc.
3. Additional Data

Crash Data Collection

1. Minimum Data
2. Road and Traffic Data
3. **Additional Data**
   - Driver details
   - Impairment of the driver
   - Use of restraint devices
   - Condition and behavior of the pedestrian involved in crash
   - Vehicle license plate number
   - Brand make of vehicle
   - Vehicle operator (private, commercial, public transport…)
   - Emergency service involvement

Data on Crash/Accident Details

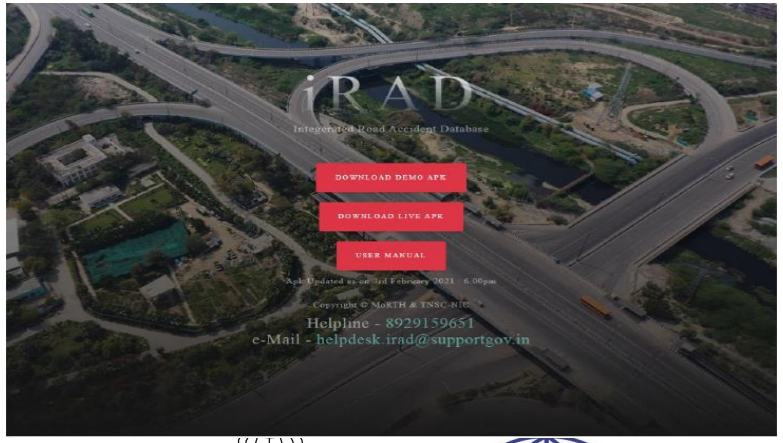
- **Timing of Accident**
  - Type of Area and Time of Day
  - Day/Date/Month of Year
- **Location of Accident**
  - Location Type
  - Location/Coordinates
- **Vehicle Details**
  - Number of Vehicles Involved
  - Type of Impacting Vehicles
  - Vehicle Type
  - Vehicle Defect
  - Vehicle Maneuvers
  - Age of Vehicle
- **Road Details**
  - Road Character
  - Road Type
  - Road Layout
  - Road Width
  - Road Works
  - Surface Condition
  - Horizontal Geometry
  - Vertical Geometry
  - Type of Ju ntrol
  - Surface Ty etc
- **Pedestrian/Passenger Details**
  - Pedestrian/Passenger under Influence
  - Pedestrian/Passenger Position
  - Pedestrian/Passenger Action
  - Age of Pedestrian/Passenger
- **Driver Details**
  - Driver Under Influence
  - Safety Devices
  - Sex of Driver
  - Type of Driving License
  - Educational Qualification
  - Possible Driver Error
  - Nature of Traffic Violations
  - Hit and Run
- **Victim Details**
  - Type of Victim
  - Age of Victim(including Driver)
  - Number of Fatalities
- **Other General Information**
  - Weather Condition
  - Light Condition
  - Type of Collision
- **Any Other Information**
  - Collision diagram, etc

Modern Systems Worldwide

- **APRAD** by UNESCAP (2001) – Asia Pacific Road Accident Database (MS-Access based) – made available to all ESCAP countries
- **CADaS** (Common Accident Data Set) by EU (2011), an updated one from CARE (of 1991)
- **ARDD** (Australian Road Death Database) – Bureau of Infrastructure, Transport and Regional Economics (BITRE - 1989) – death within 30 days is recorded
- **CAS** (Crash Analysis System) – New Zealand Transport Agency (NZTA)
- **IRTAD** (International Road Traffic and Accident Database) – shared by 32 OECD countries, and fed with 500 data items of road accidents
- **STRADA** (Swedish Traffic Accident Data Acquisition) – 2016 National Information System containing data on traffic accidents and injuries
- **RAIS** (Road Accident Information System) - Tanzania since 2015 now in whole country
- **RADaR** (Road Accident Dara Recorder) – First system with data collection by hand-held device
- **iMAAP** is new after MAAP since 1980 (by TRL) used in UK and worldwide
- In Australian Capital Territory (**ACT**), any normal accident reported by citizen by filling an Online Form of AFP (Australian Federal Police). AFP will be involved only when there is fatality or road is blocked or ambulance etc required
- **FARS** (Fatality Analysis Reporting System) of NHTSA USA (since 1975) for all 50 states of USA - data about crashes (death within 30 days)

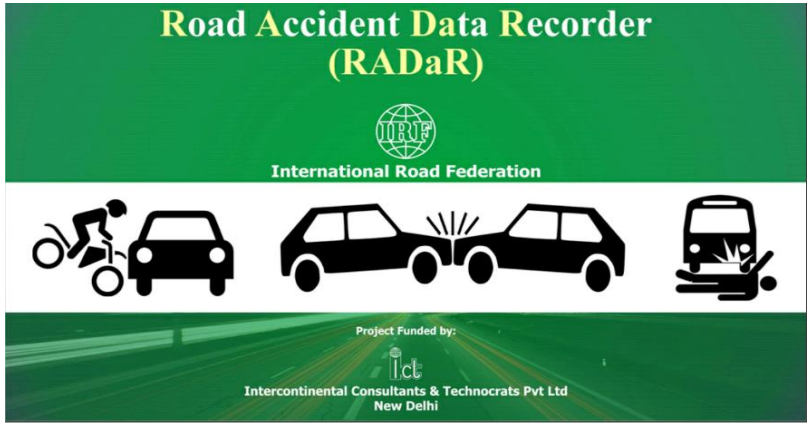
Modern Systems of Crash Data Collection in India

- Early development of **GeoKAM** in Kerala – GIS based - Never used later
- Highly acclaimed **RADMS** in Tamil Nadu from 2009 – Had some lacunae for the data
- Other developments in **Karnataka & Pune** (Maharashtra) – all disappeared soon
- Recent development in **Himachal Pradesh** (**iMAAP** based system developed by TRL) – Being used now by HP Police
- IRF-India Chapter developed **RADaR**, a simple and most modern system developed in 2010-11
- MoRTH with IITM developed **iRAD** (Integrated Road Accident Database)- gradually spreading in the country; there are issues
- Many other states tried to develop most sophisticated systems and failed to reach anywhere



Major Reasons for the Problems Faced:

1. Highly sophisticated system is attempted, and failed to sustain
2. Trying to do everything possible with the database
3. Skill required to sustain the sophisticated system is absent
4. Trying to change the road safety scenario overnight, which none in the world could do so



Merits of Modern Crash Data System: Benefits to All

- **Traffic Police** – the system will help in speedy data collection and in automatic FIR generation, which will help save time and cost; also better enforcement
- **Road authorities** – database will help to analyze the actual cause of road accidents, and to design the engineering measures to provide safer roads
- **Insurance companies** – the database will help to settle claims faster and will assist in the research for future insurance reforms using the trends
- **Vehicle Manufacturers** – the database will help to identify the cause of the injury relating to internal structure of the vehicles and will help assess possible pattern in injury.
- **Health authorities -** This may also help in future research and development in trauma care for road accident victims.
- **Data can be shared with Many Others** –
  - Policy Makers
  - Decision Makers
  - Lawyers
  - Education and Enforcement Groups
  - Researchers
  - Vehicle Manufacturers
  - NGOs and Community Groups

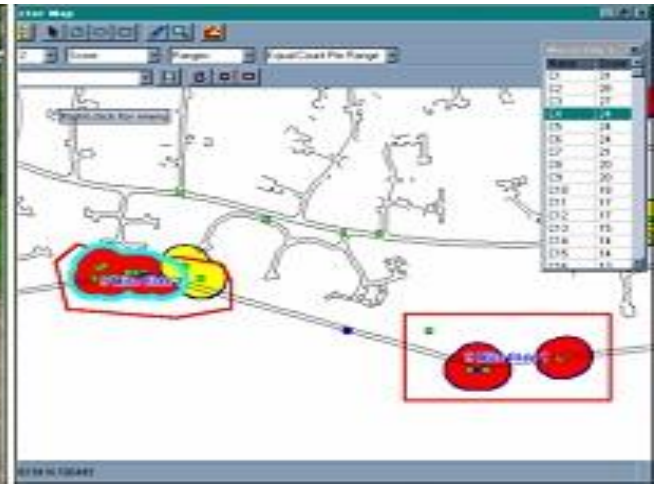
Capacity Building for Road Crash Data System Management

1. Accident data collection and investigation

- A simplistic easy and less cumbersome data collection method is required which can be used by trained police officer to collect the data. Moreover, the most significant information required for investigation shall be collected and it should be through use of modern electronic devices to make it free from any corruption.

2. Accident reconstruction

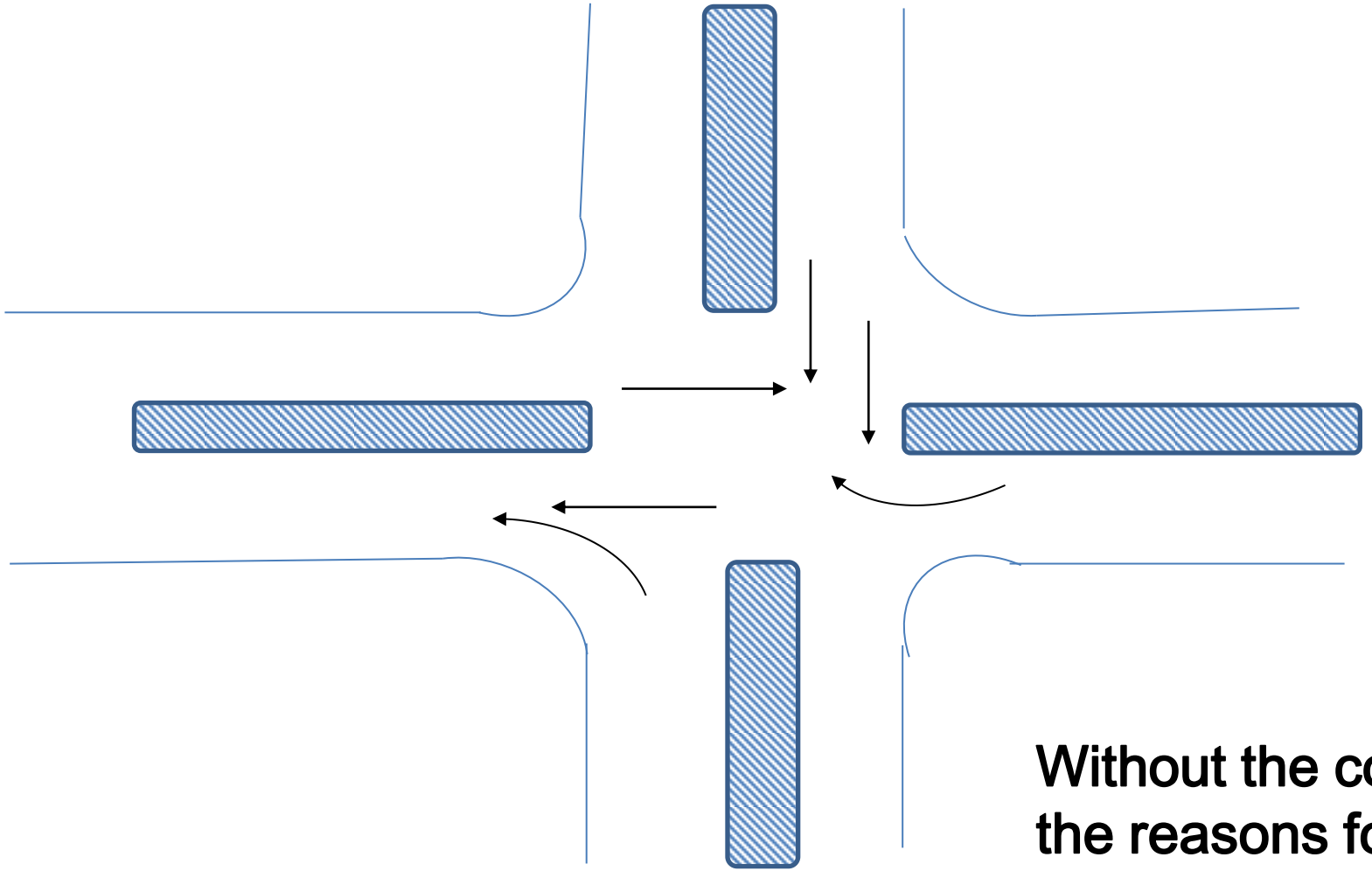
- The scientific method of accident reconstruction using the accident data should be possible to link the causal factors so as to guide the correction in the system of road design, enforcement and road use behaviour.



Complete Accident/Crash Data to be Collected

- Accident data to be collected not as crime record and only for FIR – it is required for data-led interventions for improvements
- The required information for the FIR shall be part of all the data collected (FIR can be prepared automatically)
- The hospital which treats the victims should fill a format as part of Data System for the accident (i.e. Injury Report of Victims)
- Vehicle inspection data will also be available from mechanical engineer's (Vehicle Inspection Report)
- All other information about the driver and vehicle are directly collected/available from "Vaahan" and "Sarathi" databases of the State/Central Government web-linked databases.

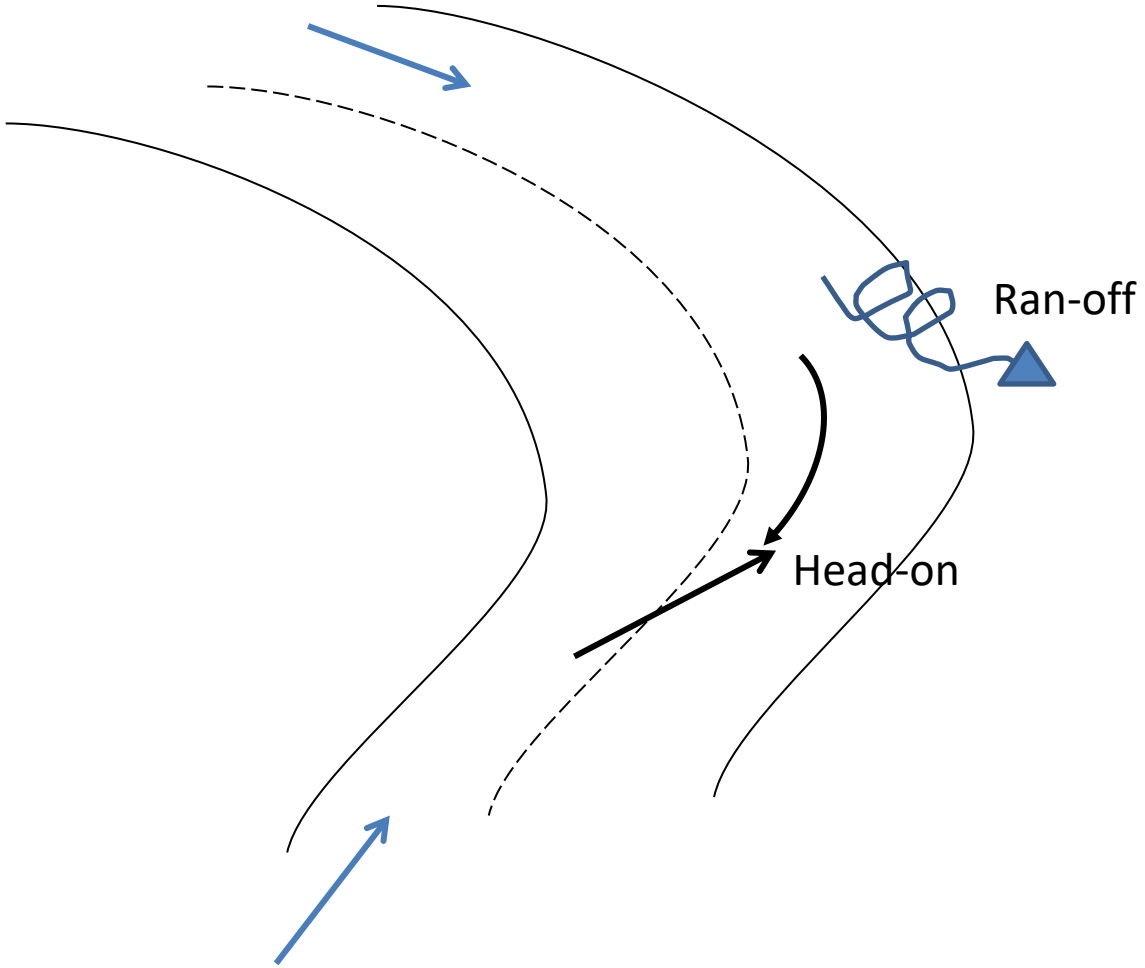
Accident at a Junction



Without the collision diagram, the reasons for collision cannot be ascertained

Accident at a Curve

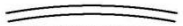
Two-way Traffic on an Undivided Road



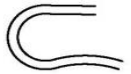
ROAD LAYOUT

INTERMEDIATE/ SINGLE LANE


Single/Intermediate lane
Straight Section


Single/ Intermediate lane
Curved Section


Single/Intermediate lane
S-curved section

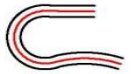

Single/Intermediate lane
Hair pin bend

TWO LANE


Two lane
Straight section


Two lane
Curved section

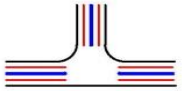

Two lane
S-curved section

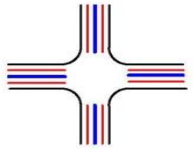

Two lane
Hair pin bend

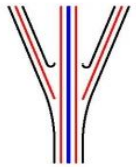
FOUR LANE


Four lane
Straight Section

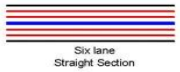

Four lane
Curved Section

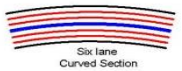

Four lane
T - Junction

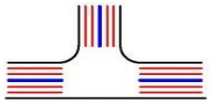

Four lane
Four legged Junction

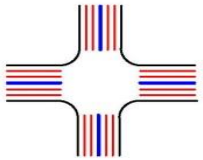

Flyover - Four lane

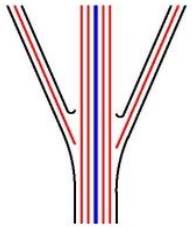
SIX LANE


Six lane
Straight Section

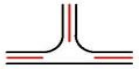

Six lane
Curved Section

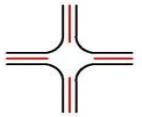

Six lane
T - Junction


Six lane
Four legged Junction


Flyover - Six lane

NORMAL JUNCTIONS


Two lane
T - Junction


Two lane
Four legged Junction

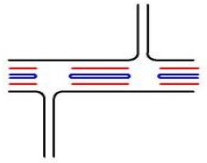

Two lane
Y - Junction

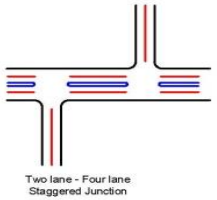

Single/Intermediate lane
T- Junction

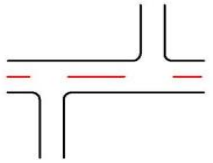

Single/Intermediate lane
Four legged Junction

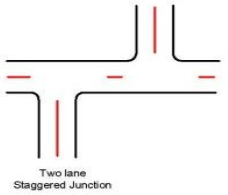

Single/Intermediate lane
Y - Junction

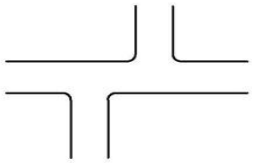
STAGGERED JUNCTION


Single/Intermediate lane - Four lane
Staggered Junction

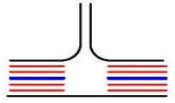

Two lane - Four lane
Staggered Junction

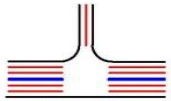

Single/Intermediate lane - Two lane
Staggered Junction

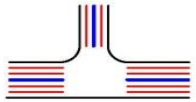

Two lane
Staggered Junction

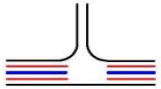

Single/Intermediate lane
Staggered Junction

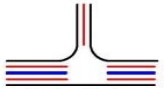
OTHERS

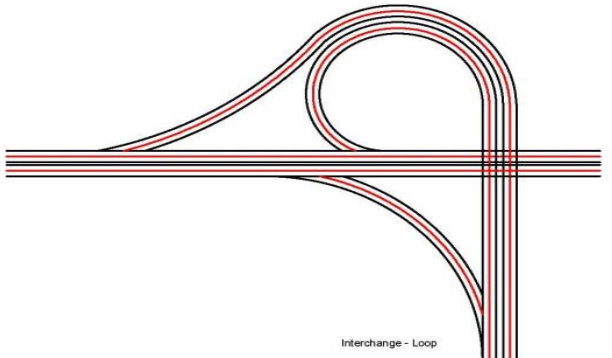

Single/Intermediate lane - Six lane
T - Junction


Two lane - Six lane
T - Junction


Four lane - Six lane
T - Junction


Single/Intermediate lane - Four lane
T - Junction


Two lane - Four lane
T - Junction


Interchange - Loop

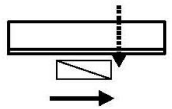
ROUNDABOUTS

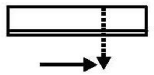

Major Roundabout
4-arm

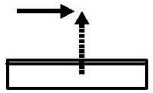

Major Roundabout
3-arm

Collision Types

Pedesterian


Emerging from footpath


Crossing from near Side

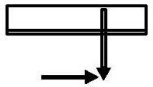

Crossing from far side


Walking along with traffic


Walking against traffic


Standing on the road

Cyclists


Crossing the road


Cycling along with traffic


Cycling against traffic

Junction


Through - Right

Through - Through

Through - Left


Right - Right


Right - Left


U turn - Straight

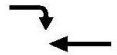

Left turn side swipe


Right turn side swipe


Left Left

Vehicles- Opposite Direction


Head-on


Right - Through


Right - Right


Right - Left


Left - Right

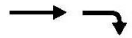

Side swipe


Left - Through

Vehicles- Same Direction


Rear end collision


Rear end - Left turn

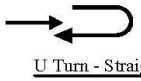

Rear end - Right turn


Side swipe right - Parallel lanes


Side swipe left - Parallel lanes

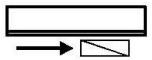

Side swipe left - Changing lanes

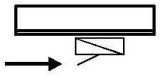

Side swipe right - Changing lanes

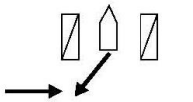

U Turn - Straight


Parallel lanes

Parked Vehicles


Parked Vehicle


Opened door of Parked Vehicle


Reversing from Parking Bay


Collision while leaving Parking


Reversing in Traffic

Run-Off or Hit object /animal


Run off Road

Object on Road

Run off road and hit object

Hit Median

Hit Culvert/Bridge

Reversing on to fixed object

Hit Animal

Overtaking

Head on

Run off

Cutting-in

Overtaking - Right turn

Pulling out

Railway Crossing

Level Crossing

Hit Railway Furniture

Passengers

Passenger within Bus/Car

Passenger getting in/off

Falling from Goods Vehicle

Miscellaneous

Object Falling

Hit breakdown vehicle

In Summary: Success Depends on Data & Ingenuity

- Lack of appropriate data is the biggest challenge in most developing countries – safety cannot be enhanced without data
- Casual approach of “let us do something now” without any back-up data and any evidence-base; all such interventions are wasteful
- To maximize the return on investment, the engineering interventions shall be based on data-led investigations alone (evidence-based)
- Systematic collection and analysis of crash data is prudent for effective Road Safety Management
- Do not fall into the “Trap” of developing the “world’s best” crash database system – Suggestion is: be modest and simple, but most modern (use latest technology) for the data system
- Do not ask for the “moon” in the database system, where there is nothing at this time; incrementally and quickly go to the “moon”

"Knowing is not enough;
we must apply.
Willing is not enough;
we must do."

- Goethe

Thank You

pksikdar@ictonline.com
9810914051. 9205821131