Traffic Engineering
Professor Bhargab Maitra
Department of Civil Engineering
Indian Institute of Technology, Kharagpur
Lecture 60
Road Safety Engineering and Crash Data

Welcome to module I, lecture 2. In this lecture, we shall discuss about Road Safety Engineering and Crash Data.

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In lecture, I.1, we discussed about global safety scenario, road safety scenario globally and also within India. Then what are the causes of road crashes, common risk factors of road crashes and fatalities, what are the causes of road crashes as per the available data in India, what are the factors affecting human characteristics the driver vehicle road systems, the physical and psychological or environmental characteristics that influence the human characteristics or which are important as a part of human characteristics as well in the context of human characteristics and the other factors human which are also influencing human characteristics.

Now, with that background first, today, we shall focus on the road safety engineering aspect and the crash data then. Road Safety Engineering is the competence and experience in the investigation and analysis of crash locations where the crashes are happening and or potential crash locations it could be location where as per the data available without authority, we know that significant number of crashes are happening is happening or it has the potential to be a crash high crash location in the future based on certain identified deficiencies and the design of effective remedial engineering treatment.

So, competence and experience in the investigation and analysis of crash locations or potential crash locations and then the design of effective remedial treatment, all the components are included. It is a multidisciplinary subjects and the elements may include crash investigation, crash reduction, crash prevention all may be included and understand that both prevention and cure should be inherent element of an overall road safety management system. Cure is one-part cure means, you have a problem which is already identified. So, we know the problem. So, we have to offer the medicine for that cure it also the prevention not only the cure, but also the prevention. So, prevention and cure both should be inherent element of an overall road safety management system.

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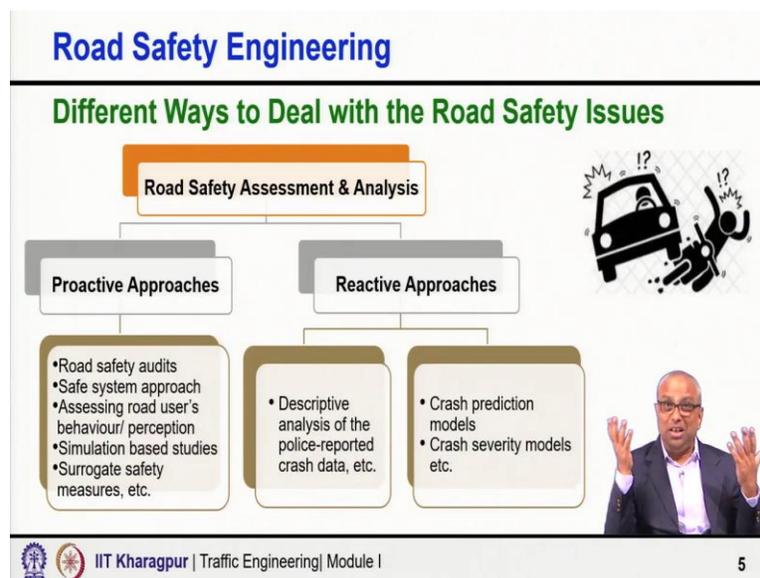
What are the different ways to deal with the road safety issues? We said about various road safety issues in the previous lecture, but what are the different ways to deal with the road safety issues through the eyes of road safety engineering. There are broadly two approaches, proactive approaches, and reactive approaches. What is reactive? What is proactive?

Of course, the meaning can be you can understand probably the meaning, but let me tell you reactive means the problems are happening, crashes are happening, fatalities are happening, the recorded data showing that such kind of problems are occurring, occurring more frequently than what is expected more statistically higher rate of occurrence at certain locations then other

locations then you are you know that there is a problem, it is a problematic location or there is some issue.

So, now you try to address that problem, try to find out why it is so, what is really causing it and what kind of medicines or countermeasures I can do to solve it. So, that is basically the reactive approach, that means it may include one way the descriptive analysis of the police reported crushed it. So, you have data available normally in every country, the quality may vary one country to another country one, you can state to another state or one region to another region but some data is available and even in a good if the data recording system is very good database is good, you may have quite exhaustive data.

So, you know that in the past how accidents have occurred, it may not be location specific, as I said only while I was trying to describe the active presence it may not be only specific locations, but you know the causes, you know the data about road, about traffic, about violation of rules if any and weather condition and everything and you will know what kind of crashes happen and how the fatalities have been because of those.

So, you have quite good amount of data is available and you do some kind of analysis of that data to understand the relations the internal relations the role of different factors and then use the knowledge to make policies, make methods that is one aspect which is also reactive because based on the accident data we are doing something, the second could be crash prediction models. The other way you can develop crash prediction models, if you can know that thing.

The descriptive analysis is one part, then modelling you can do you can develop crash prediction model again your results are known, variables are known, why is known the outcome, the type of crash or whether it is fatal, whether it is severe injury or whether it is property damage that way the type of crash whether it is head on collision or the site crash or what kind of rear end collision that way also you can think.

So, basically have exhaustive database which is available with you, and you can actually try to develop using those databases, you can try to develop crash prediction models, or even the crash severity model I said both way, type of crash, head on collision, real and collision, site crash or

also the severity whether it is minor injury, whether it is major injury, property damage only or even the fatality.

So, all sorts of descriptive analysis, modelling understanding the relationships, understanding the role of each factor, which is contributing how each independent variable or attribute is contributing to the overall why or the outcome, the outcome could be type of crash, severity of crash, number of crash, overall crash, it could be anything what analysis you will do and or cross classify the data and develop different descriptive analysis, all sorts of things you can do, but all based on available accident data.

That is what is the reactive approach, I react to accidents or crashes, crashes are happening, fatalities are happening I am reacting to that, so I am looking at the database and also location specific I can do I can even find out the high crash locations and then do some specific investigation to find out the causes all are actually reactive accident investigation also is reactive approach that way location specific I can do investigation, because the data overall showed that at some places, more accidents are happening statistically more accidents that happen as compared to other locations.

So, there must be something wrong with those locations. So, we try to investigate try to find out and take corrective action. So, a variety of things, a variety of analysis. So, many ways descriptive analysis, crash prediction model cap severity model, accident investigations, you can do location specific, identifying the high crash location, all number of things can be done, but these are all proactive reactive approach, using the accident data.

Second is proactive approach. We do not wait for the accident data. We do not wait for the accidents to occur and we do not wait also for the accident data. If it is available, we are using it somewhere that is a different thing, but predominantly, we are not waiting for the accidents to occur. Proactive, before it occurs, we are taking the measures or you can say that reactive approaches could be once the problem is known, then you are analyzing, trying to understand why it is happening. The proactive approach is something like a health check, before it happens also you are trying to understand that what actions I can take in advance to avoid that problem.

Anyway, so road safety audit comes under that safe system approach it is known globally known globally accepted. So, you take that subsystem approach, assessing road users behavior, perception and then trying to see that how they are going to react and how they behave and therefore, given context, what could be the issues, simulation with studies. I do not wait for the crash to occur.

But any future proposed system I can simulate, simulate in a realistic manner to see if there are certain issues certain challenges certain problems. Work out with the surrogate safety measures, it may not be the crash but directly, but I can work with surrogates safety measures. So, for example, post encroachment time, PET or even the number of conflicts in an intersection, suppose if I am reducing able to reduce the number of conflicts in an intersection, obviously the overall safety level is expected to be better.

So, surrogate methods, not directly the crash data. But some of the methods which you can quantify relatively easily from the field or from video graphic data or even do some kind of field measurements and then you can compare that my system is now this and I am making this improvement even without waiting for the accidents or crashes to occur. And therefore, I am able to reduce or improve this performance, expect the performance to be even better. So, lot of things you are able to do without waiting for the accident to occur, that is the proactive approach. So, both proactive and reactive approaches are there as a part of all the ways you can handle the road safety issues.
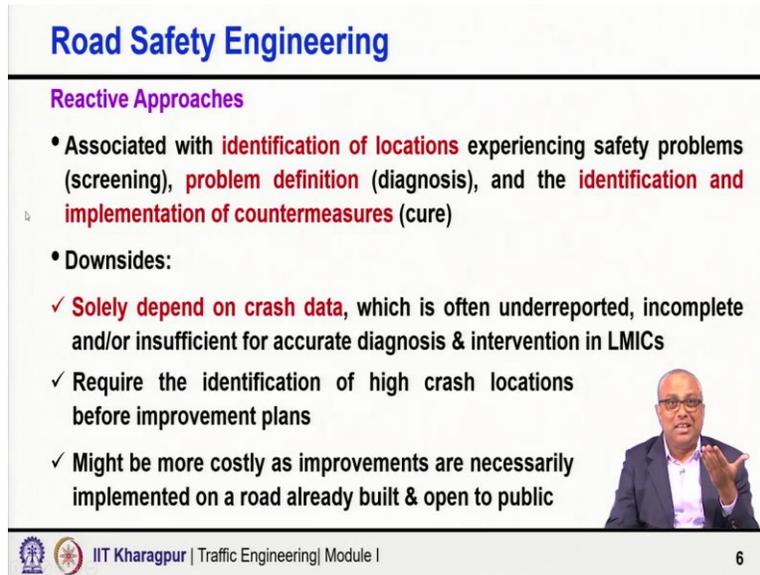
As I have mentioned already, the few slides are there reactive approaches associated with identification of locations experiencing safety problem that is cleaning, we call it a screening. Identifying locations which are experiencing safety problems, how to do the screening, it includes screening, then the problem definition, that is referring to the diagnosis part of it, so screening, diagnosis and then I have to treat also you cannot say only you have a problem with detail the medicine. So, the identification and implementation of counter measures, that is the cure.

So, reactive approaches are associated with screening, diagnosis and cure all the three stages. There are certain downsides of this reactive approaches as I have already told, but let me just quickly go through it once again, solely depend on crash data depending on depending too much on the test data and understand that crash to data itself is a big issue especially in low and medium income countries, the systematic data may not be available, the right data may not be available in right format or required format all the information that are relevant may not be recorded.

All sorts of issues are there, so you are depending so much on the crash data where availability of the correct and complete crash data itself is a big challenge in LMICs. Second, required the identification of high crash location before improvement plans. Suppose you want to treat something you want to first identify the high crash locations, identify the specific intersections or specific locations along a highway where the statistically more crashes or more fatalities are happening as compared to other locations.

And overall, the treatment following these reactive approaches might be costly, more expensive in every sense, first of all, you are accidents have occurred, so people have suffered, deaths have happened, injury has happened, property damage has happened. So, already the loss has happened so much loss and also the treatment later on is also expensive. Why? Because your, we have already built the system and already open to traffic.

After opening to traffic, you are experiencing crashes and therefore, you are trying to identify what are the results, what are the problems and trying to take action. So, you are essentially any interventions, if at all, you can do some cases, you may not be able to do all the intervention. So, your solution space will often get very restricted because you cannot probably rebuild the entire thing, you have issues, crash issues like the land acquisition related issues or so, but even if you are able to do something, you were actually interfering with the system you are trying to redo or partially evade or doing some intervention on a system which is already built and to traffic. So, the anything you want to do is obviously going to be more expensive.

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On the other hand, the proactive approaches associated with prevention of the safety problem, how I can prevent before the accident occur. So, associated with the prevention of safety problems before they manifest themselves in the form of a pattern of crash occurrence obviously, as compared to the reactive approaches, the proactive approaches will have definite advantages, which may include first, the crash prevention, it is not necessary for crashes to occur before crash

prevention measures are taken you do not wait for the crash to happen or people to get killed to before you take the action.

We will look at the potential safety and accident or crash or crash potential. You do not wait for the crash to happen, but you assess the try to assess the crash potential based on available scientific knowledge, evidences and expertise available expertise and obviously this will have lower cost because many cases you will take the interventions before we have actually implemented and executed the project.

So, you have not built an intersections and then getting accidents more or crashes and then trying to see what is wrong between before you will probably at the design stage itself you can audit and you can probably see it what is wrong and there is an issue of sight distance and then based on the land use this kind of pedestrian movement requirements will be there heavily.

So, I need to provide it when I am widening the roads or so, and then you build it in the make appropriate changes in the design itself and the construction is done accordingly. So, you are actually saving cost one way saving life saving the damage because we are not waiting for the accidents to occur. The other way the implementation part is also very easy, it is less expensive as compared to the previous approach, where you have already built the system and open to traffic.

Effective Road Safety Management Program should exercise an optimal balance between reactive and proactive strategies you should have both normally we everything you cannot really assess even proactive using the proactive approach. There could be restrictions there are limitations. So, it is also necessary to work how we build good database because many things are possible, not only location specific treatment, but many understanding and insights can be developed based on the actual accident data or actual crash data. So, the actual data database, crash database, very sound crash database with all related information accurate database, that has got an immense value also.

So many other things can be done, that is important. Also, at the same time, if need to follow the proactive approaches, because not everybody will wait for the things to happen and people to get killed or people to get injured, and so many crashes to occur before you wake up and start doing some intervention. So, imbalance of optimal balance of both reactive and proactive strategies.
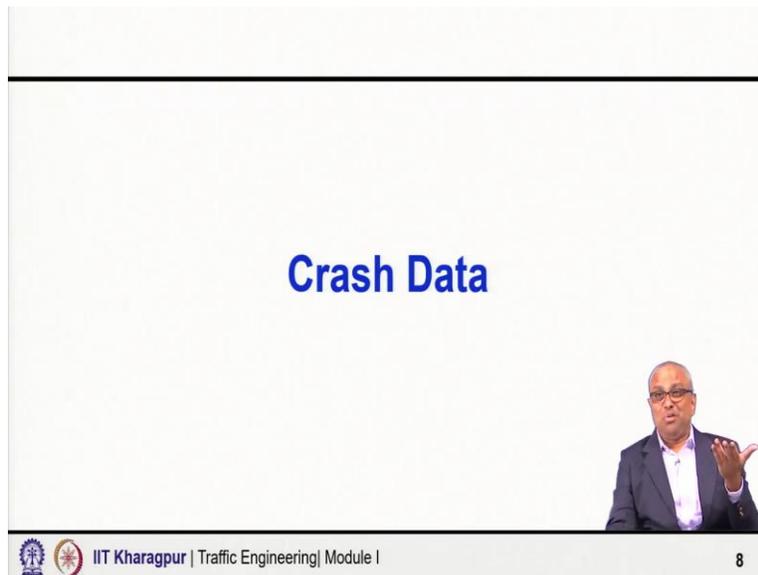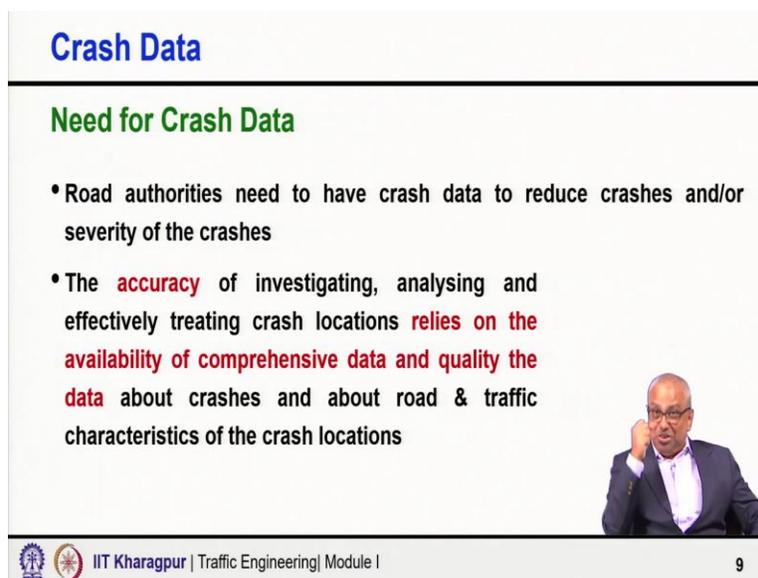
Now, going to the crash data, which is I said very important for the specially the reactive approaches, why we need crash data? Because road authorities need to have crash data to reduce crashes and severity of crisis, I must know where the crashes are happening. That is the first thing any authority would be interested because that is the reality not a speculation or not an assessment or anything, but that is the real data, the real data always will have a big strength I must do whatever I have done, is it actually reducing the number of crashes? Maybe you have done an intervention?

How effective is that intervention? Is it working properly? Is it really giving me the result? I must know I must have the crash data, the accuracy of investigation analysis and effective treatment whatever you want to do at crash location relies on the availability with availability of comprehensive data and quality of the data, how comprehensive is the database and what is the quality of the data? Do I have all the information's available? Road related, vehicle related, weather related, driver related all information I have available and we have the correct information.

So, it has got a value everywhere you cannot use only you cannot depend only on the proactive approaches you can also cannot depend only on the reactive approaches and a combination or an optimal balance is important and therefore the crash data is also very important because your any output will be as good as your data because if the data is wrong data is incomplete the outcome also will have less confidence on the outcome, whatever it is the outcome is coming based on the analysis.
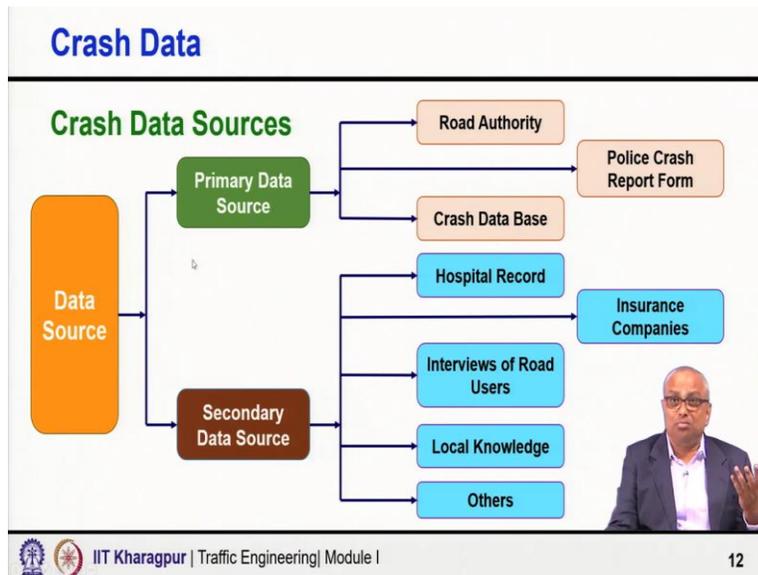
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Now, good crash data is the necessity, if you have good crash data, so many things can be possible, what are the characteristics of good crash data? When we can say that, my database is good, first I should be able to some points I have stayed not all crash locations I should be able to pinpoint, I know where the at what which location the crash has happened, I should be able to pinpoint that location, in traditional says you will say it happened somewhere near this, near this it could be anywhere, you do not know exactly where it happens, so it may be difficult, but if I am using a

system where the GPS coordinate exactly is getting located tells me right at this location it happened.

The sequence of event in a crash are properly mentioned, how occurrence how it led to this one maybe it started raining and then it was nighttime and then this was the type of vehicle and the whole thing you should be able to get that then the contributing factors in the crash or group of crashes are mentioned. I should be able to identify that all those data are available the contributing factors in a class or the group of cash that mentioned and all relevant information regarding a crash are included.

I have the road geometric features, I have the other external factors, crash location, type of vehicle, time of the day, weather condition, everything is there because many cases many times you will find the details available but you have not you do not have the complete data it is somewhat incomplete.
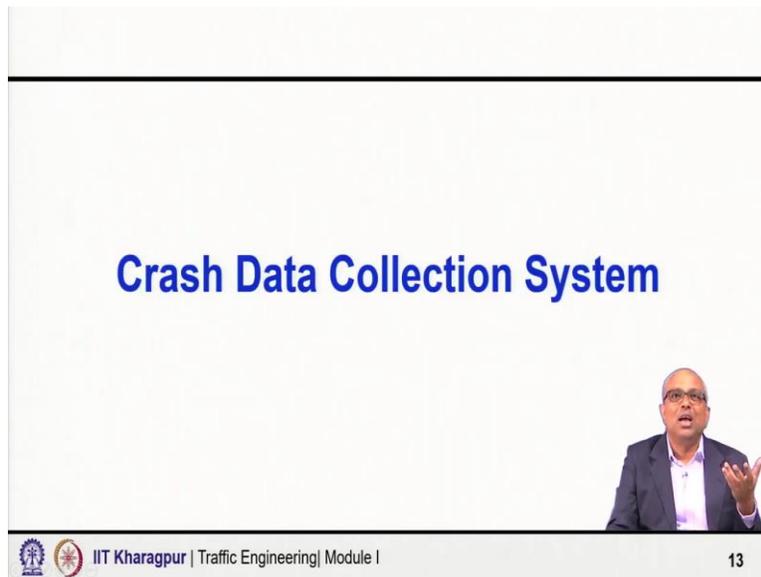
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Now, if we have the good crash data, as I said, what are the characteristics some predominant characteristics, but if we have those type of data then what we can do a lot of things, common risk factor across a number of crashes can be identified, not only location specific, but you can see it a little bigger sense that what are the common risk factors across a number of crashes, is the speeding coming always or is the poor road geometry, is the weather condition, whatever it is, it can be identified.

The cost of consequences of a single crash, all crashes at one location or several crashes with common factors can also be identified, because you have the data saying that because of crash or crashes, what exactly happened? Fatality, severe injury, property damage, maybe multiple people also died in a crash. So, the cost consequence of a single crash all crashes at one location or several crashes with common factors can be identified. Similarly, several crash sites can be identified and you can also rank them, every tech major so, many junctions are bit blocked every kilometer or half a kilometer small sections you can save where the more things that are happening. So, you can rank them, you can rank them and then you can pick up one by one and then try to see what is happening at locations which are having higher crashes than expected.

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The crash data source where from we can get the crashed data? You can get it from primary data source, you can also get it from secondary data source some of the things complementary because so many data you can get from the primary source. So, for example, road authority they will have the crash data police crash report form so, many things police FIR they are writing so many things, crash database sometimes could be there in many of the states in Indian also including the State of West Bengal we have very good database it has improved a lot.

So, the statewide database also nationwide database also will be available. Now, it is even the national is also there is a lot of effort to develop an update the database, lot of things are happening in truly positive directions, we have problems, we are number one in terms of fatality all over the world. But lots of good things are also happening.

So, I am sure the future will change picture will be able to address our concerns effectively. Secondary data source may include hospital record, fatality did not happen immediately but maybe after that after hospitalization. So, hospital record can tell you many thing. Insurance companies because insurance claims are linked interview with road user, local knowledge, many other source could be there. So, these are all secondary source, which also sometimes give you a lot of valuable and important information.

Coming to cash data collection systems, the traditional methods, what is being followed in India, majority of the cases what we used to follow earlier case also, the police reported FIR, though crash data recorded in police FIR with at least one eyewitness report. And the summer is prepared by the police stations and finally, aggregated data sent to Morth on annual basis that used to be their condition.

So, you can see how the FIR looks like, so used to go and take the copy of FIR, go through it and then extract information, create a digital database many times it was only hardcopy handwritten

things that were available. So, is to go to the police station, collect those FIR copies, come back to the lab and then note down the things sometimes they will not allow you to also take a copy. So, you have to sit there and record the information what you want, but that is the traditional way.

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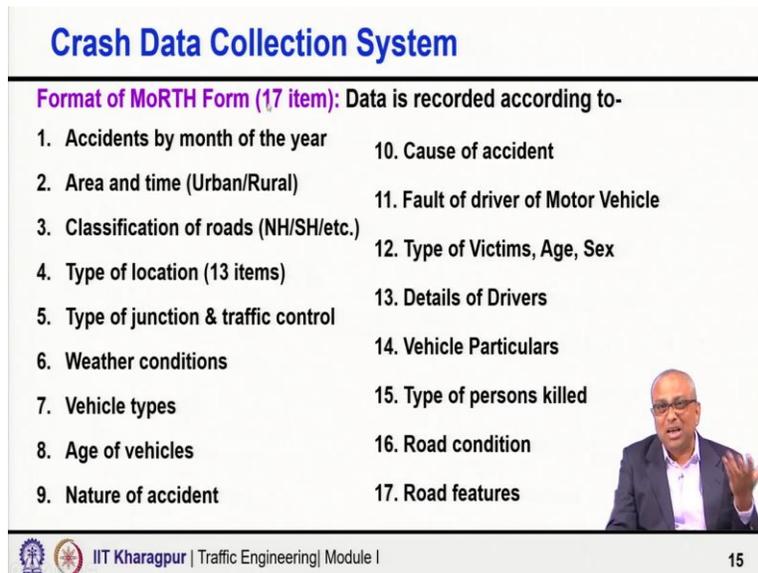
Crash Data Collection System

Format of MoRTH Form (17 item): Data is recorded according to-

1. Accidents by month of the year
2. Area and time (Urban/Rural)
3. Classification of roads (NH/SH/etc.)
4. Type of location (13 items)
5. Type of junction & traffic control
6. Weather conditions
7. Vehicle types
8. Age of vehicles
9. Nature of accident
10. Cause of accident
11. Fault of driver of Motor Vehicle
12. Type of Victims, Age, Sex
13. Details of Drivers
14. Vehicle Particulars
15. Type of persons killed
16. Road condition
17. Road features

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Then ministry came out with a format MORTH Ministry of Road Transport and Highway Government of India. It came out with a format 17 items broadly there are many but I have broadly grouped them like 17 items, all these attributes, some kind of uniformity and consistency all over the country. So, it is MORTH format you use for collecting data, they include like accidents by month of the year and then area or time when in which month it happened, then which area, urban, rural at what time classification of road whether it is NH national highway, state highway, MDR other district road village road type of location there are 13 items.

So, you can say that which what is the location how you describe the location, type of junction and traffic control, weather condition, vehicle types, what age of vehicle what is the nature of accident, what is what are the causes of accidents when there is a fault of driver of motor vehicle, what is the type of victim, motorcycle bicycle user or the pedestrian, what is the age what is the gender, the details of drivers the vehicle details also type of persons killed, road condition, road feature, quite comprehensive, quite comprehensive and satisfactory. So, the next attempt is uniform format, people were not recording every item in FIR or so now you will accident data information recordings procedure format use that get all the data in the prescribed format.

So, you have IRC codes also which tells you also related to this I am not going into details of it the IRC codes are also available.
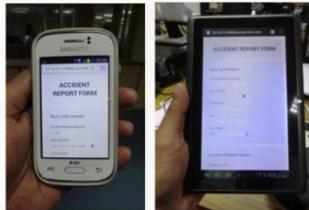
Then, slowly the shift is happening, we have smartphone, we have mobiles and smartphone and GPS things are available, so many small simple equipment's are also coming in the market. So, the modern methods aim data acquisition at source through mobile device. In fact, some of the

initiatives were also taken by IIT Kharagpur my colleagues who developed such kind of things that using a smartphone you can actually.

So, if you go to a location coordinates are available GPS will tell you where exactly it is and then many information you can fit there itself. So, data acquisition at source through mobile device so you can do the visualization and such kind of things you can get. So, you can more reliable data you can get and it will ask you to fill up every input so you can do that.

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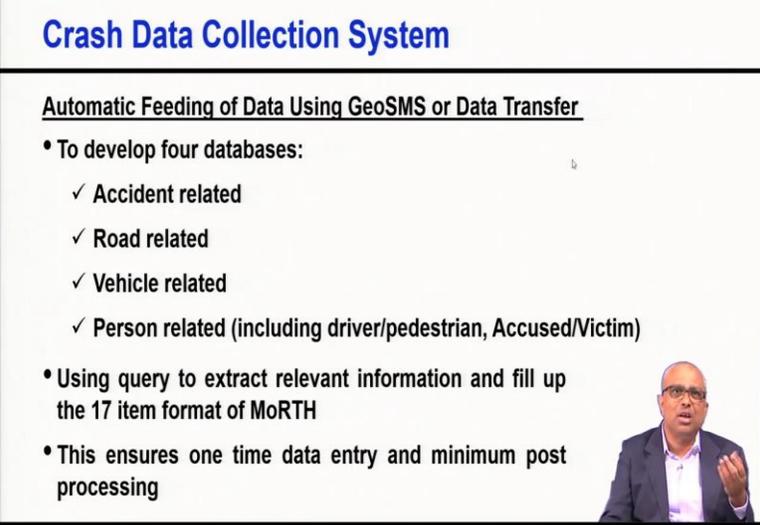
And so automatic feeding of data using GeoSMS or data transfer to develop four database, one is accident related, then road related, vehicle related, person related including driver, pedestrians, accused, victim. So, these are the broad components, so using query to extract relevant information and fill up the 17-item format of MORTH what I said here. So, there are 17 items so this ensures one-time data entry and minimum post processing time.

So, then what is happening now is something in the same direction further proceeding further is use of IRAD (Integrated Road Accident Database) it is the Government of India has recently launched the central accident database management systems 6 states had initially included in the project, now the number has increased also the IRAD mobile application what is developed actually will enable police personnel to enter details about a road accidents along with photos, videos and following which a unique idea will be created for the accident and therefore engineers from PWD or the other local body receive an alert and everybody from their part they input the data.

So, ultimately you get a very comprehensive data, you get alerted all concerns will get alerted and then everybody they fill up their portion and visit the site and finally you have a comprehensive database. You can see lot of more information, lot of information about the IRAD is also available in the public domain. So, simply just open up the website in your Google you can type IRAD you can say IIT Madras also has got lot of contribution they developed this thing Indian Government of India is quite actively working trying to implement this and different states are also coming and under this IRAD system so eventually every state has to come into this system probably and you will find that these are all very positive news and because all this will help the country to have a very good and reliable database in the future.

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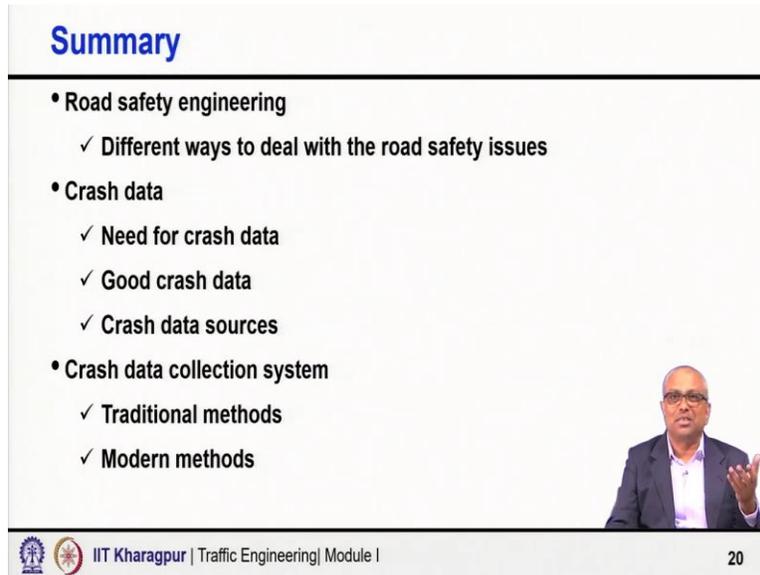
So that is what is required necessary. So what we discussed today is the what is road safety engineering and what are the different ways to deal with the road safety issues, proactive, reactive, why what are the advantages and disadvantages and then finally saying that a balance combination of both proactive and reactive strategies and then the importance of the crash data, why we need it, what should be the general characteristics of the crash data, how what are the things I should be able to do and what I should be able to achieve if to say that it is a good crash data, then what are the sources.

And then the data collection method traditional to modern methods and even the development of IRADs contribution of IIT Madras and the Indian Governments initiative and then more and more states are coming and using the same platform the homogeneity people using similar platform or same platform in so many ways very advantageous.

And what is important the national level all across the country such a big country length and breadth wise so many states so many different geographical regions, if we all following a systematic and unified approach and contributing to the development of very reliable complete and comprehensive database, accident database at the national level that can add a lot and can help the country to address the concerns related to road safety in an effective and efficient manner. So, with this, I close this lecture, thank you so much.