Railway Disaster: A Track Of Forensic Investigation

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Abstract:

Railway accidents are quite frequent nowadays across the world. There are variety of reasons which are responsible for these tragic incidents, including, human error, adverse environmental conditions, system failure, machinery fault or sabotage. The involvement of Forensic experts in the investigation of cause of incident is must to lead the investigation in efficient manner. It is mandatory to know the exact reason behind the occurrence of such incidents. This paper attempts to provide the information about how the investigation can be done and the significance of impartial investigation, causes of the accidents, railway injuries as well as the difficulties faced by the forensic as well as police officials during railway crime investigation. We have also discussed certain measures that would help in overcoming potential difficulties.

Keywords: Railway Accidents, Forensics, Sabotage, Railway Injuries, Digital Forensics, Challenges.

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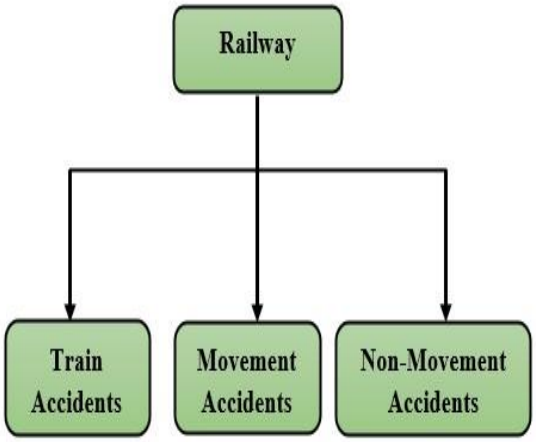
INTRODUCTION:

When the aspect of an economic and reasonable mode of transportation is appraised, the railway turns out to the one of the best mode that connects to almost every part of the country, but also leads to the hype towards in fatalities. The humongous spread of interconnected railway network across thousands of kilometres across the country including, urban, rural and forest sectors and increased railway traffic pose a major contributing factor responsible for increase in the railway related accidents causalities. [1,2] In the areas where railway traffic is higher deaths due to railway fatalities are also not negligible though the accidental deaths are mostly encountered due to the road traffic accidents. A train accident can be elucidated as a "derailment, collision, or any other event involving the operation of on-track equipment s." Fortunately, train accidents are seldom, but when they do, they can be extremely destructive and disastrous [1,3]. Due to various reasons, the investigation of railway incidents is quite complex procedure. There is immense difference between murder investigation and investigation of train crashes. As in investigation of murders, forensic scientists and police is involved but in train crash there is involvement of an expert who have deep knowledge regarding trains and railways. [4]

CLASSIFICATION OF RAILWAY ACCIDENTS:

Railway accidents are classified into three main categories. These are as follow: -

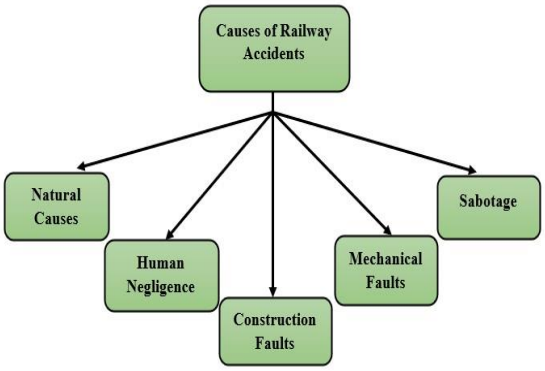
1. **TRAIN ACCIDENTS: -** Mainly due to trains and rolling stock on or affecting passenger's lines and failure of track and structures, rolling stock
2. **MOVEMENT ACCIDENTS: -** Majorly are the accidents to people caused by locomotion of vehicles



- NON-MOVEMENT ACCIDENTS: - Primarily are the accidents to people on railway premises platforms but not linked with movement of vehicles. [5]
  These include:
- Accidents amid people
- Accident to passenger
- Accidents to trespassers
- Accidents to staff

CAUSES OF RAILWAY ACCIDENTS:

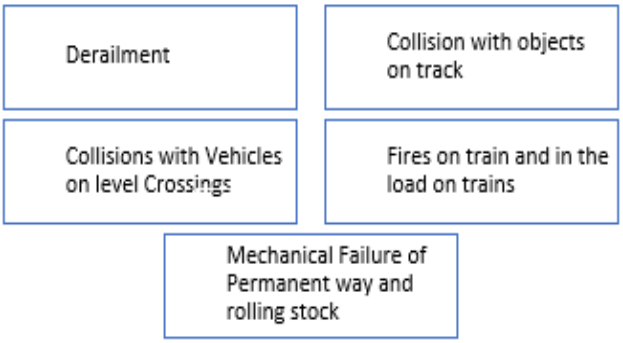
The level crossing accidents, collisions, fire in train accident, as well as miscellaneous accidents including suicides and personal errors are accountable for different type of railway accidents. In these accidents derailment accounts for the maximum percentage of large number of deaths. Secondly by the accidents at level crossings where people often show negligent behaviour i.e. people are in such a hurry that they seriously misjudge the speed of the train and eventually take them out of the world instead of taking them to their destination, disobey the gate signal and mob on the track. Moreover, of accidents account for very less percentage, i.e., fire in trains, less than 5% for collisions, and miscellaneous accidents. [1]. Human failure to equipment failure have been various causes of these accidents. Some of them are as follow: -



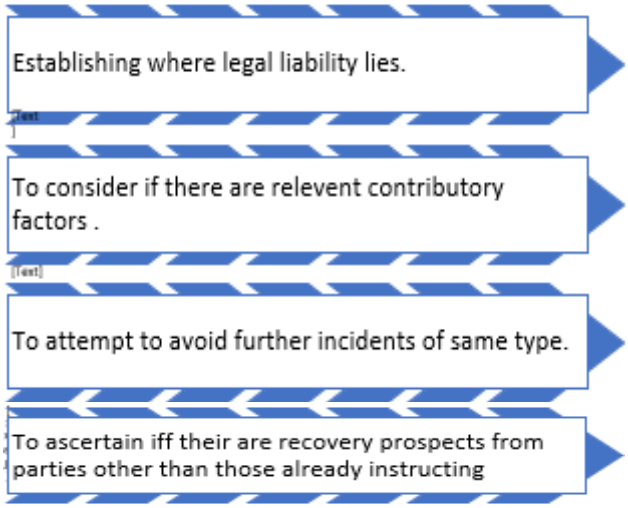
- Natural calamities viz. earthquakes, floods heavy rains, forest fires may damage or wash away the railway tracks quickly without giving any idea or judgement to the drivers for controlling the speed or cessation of the trains. The poor visibility due to the ground fog in winters, low clouds and dust storms can be another cause of railway accidents.
- Human errors/ negligence incorporating the over speed/ exceeding the speed limits by drivers, tailgating and wrong signals (where manual system of signals is operational)
- Brake failure and control system failures (Mechanical and construction failures), worn-out jaws of sleepers and loose spikes fixed between rails and sleepers which accounts to derailments. Derailment of trains may be caused by:
  - Use of wooden worn-out sleepers
  - Inappropriate size and dimensions of sleepers
  - Unequal spacing of sleepers.
- Railway sabotage which is defined as criminal intention to interference with any part of working machinery with an object so as to make it in-operational. The acts of sabotage can be as follow: -
  - Putting obstacles on railway track
  - Removal of Sleepers, rails and fishplates
  - Moving, unlocking Turning, diverting any points or machinery linked to railways.
- Other miscellaneous causes accountable for railway accidents may comprise: -
  - Increased passenger traffic.
  - Presence of slum areas near the railway tracks, where people frequently try to cross the railway tracks to reach to the other side of the track.

- Youth and teenaged who try to cross the track with earphones plugged in.
- Getting stuck between the gap provided between the track and platform.
- Run over or knockdown by trains while crossing the track.
- Falling down from running trains.
- Using shortcuts while crossing the railway track negligently and avoiding the use of foot over and over bridges
- Loss of balance by the passengers during boarding and de boarding the running trains. [1,3,5]

INVESTIGATIVE RAILWAY INCIDENTS:



Role of forensic scientist in Railway Accidents:



Process of Crime Scene Investigation:

In order to preserve & record evidence:

- Examination of ancient side, all scattered wreckage and any perishable evidence.
- Documentation of evidences in mandatory. All the perishable evidences should be photographed and collected carefully.
- Certain evidences such as signal & level crossing environmental conditions, equipment, temperature of brakes, tracks, wheels as well as bearings, position of other trains and vehicles in proximity should be recorded carefully.
- It is mandatory to photograph & document the positions of injured or deceased persons before their removal.
- Secure and protect the crime scene to avoid any damage or destruction of the evidences.
- Name, contact details and address of the witness should be noted down.
- If the injured person is ready to provide information regarding the incident, the full extent of all the injuries should be noted, it would help the investigators to estimate the speed of a train prior to impact. In case of deceased individuals, post mortem examination is must and full record should be maintained.

INJURIES PATTERN & DEATH MANNER IN RAILWAY ACCIDENTS:

Deaths accounted due to the railway accidents and cadavers found on railway tracks undergo for the postmortem examination/autopsy carried out by the medical officers/autopsy surgeons. Postmortem examination of the dead plays a vital role in the: -

- Study of characteristic and pattern of injuries in railway deaths.
- Estimation of the sex and age

- Demarcation of antemortem and postmortem injuries for better understanding the crime.
- Substantiate the identity and manner of death.

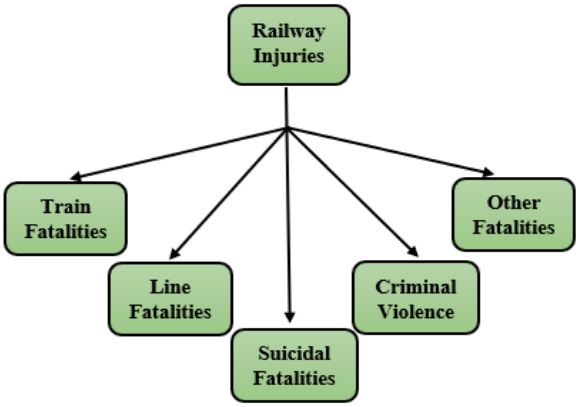
The deaths and pattern of injuries due to the railways inevitable as it is very important to differentiate between the other injuries and railways injuries. Most of the times deaths due to the railways are either accidental or suicidal and moreover railway tracks may be used to obliterate the homicides. These are on the rise due to various factors like: -

- Unsymmetrical level crossings
- Unavailability safety precautions during entraining or detraining
- Lack of good infrastructure
- Inadequate safety measures etc.

A significant number of the dead bodies track down as a result of railway accidents are in mutilated form, which makes it mandatory for the careful evaluation of the primary, secondary impact injuries. For an instance, primary injuries are seen on the lateral portions of head and shoulders when the person is crossing line, when the person is bending down, the primary injuries are seen on the posterior regions and buttocks and secondary injuries on the face and anterior of the body. In addition to that, in homicide cases the differentiation of antemortem and post mortem injuries played a vital role in, as the same were made by the identification of restraint, offensive and defensive injuries or they were restrained and tortured before forcing them on the railway track. To understand the manner and cause of death diligent examination of the cadaver by autopsy surgeon for primary and secondary injuries apart from defensive or offensive injuries, witness, technical evidence, psychiatric history of the deceased and other circumstances surrounding the dead is essential. [1,2,8]

Railway injuries are result of the kinetic energy imparted by a motile train to a person and dependent upon the mass (m) and velocity (v) of the moving train (Kinetic Energy = $1/2mv^2$). The massive blunt force injuries onto the body of a person are observed when struck with train because mass of a train combined with the velocity results an enormous amount of kinetic energy which get transferred. [8] Traumatic separation of head and a clean decapitation are the ubiquitous injuries case of suicidal fatalities. In some instances passengers may sustain only fatal mechanical injuries mainly over the head, mostly head strikes any overhead structure like an over bridge when the train passes through tunnel. High mutilation and severe injuries are encountered due to the hitting or over rolling by the railway vehicle. The injuries are caused partly by blunt forces (engine's front and ground, spoiler), partly by semi-sharp force exerted by wheels. Apart from the pattern of the injuries the presence of dirt and grease at skin injuries at cut-offs are equally demonstrate the railway collision. [7]

Accordingly, railway injuries are divided into five main categories. These are as follow:



Additionally, the injury findings are not only substantiated by the type of collision but also by the position of the body in relation to the track and train's impact velocity.

DIFFICULTIES IN INVESTIGATION / EXAMINATION

The identification unknown reported cases which the mutilated bodies is one of the major problem faced by the investigating officer and medico legal expert. If there are signs or suspicion of killing the person somewhere else and keeping the body on railway track so that the injuries may be obliterated doubles up the challenges for the forensic experts. [3] The major difficulties in identifying the victims in mass casualty incidents are like: -

- Piles of bodies
- Extreme deformity of the body due to mutilation cause hindrance in identification the dead body.
- Carbonization and early decomposition changes and due to multiple injuries.

- Unavailability of efficient procedure with the police personnel to trace out the unknown.
- Complex methodology
- Difficult to track down the solo travellers
- Muddled information
- Social and media pressure [3,9]

MEASURES TO REDUCE RAILWAY ACCIDENTS

- Systematic and consistent maintenance of tracks by the contractors.
- Prohibition of Unofficial maintenance and repairs for any blocks and regular inspection if tracks by the officials and superiors of Railway Division.
- Inspection of tracks should be carried out by automated derailment detection devices based on movement and tilt sensors to detect the possibility of train derailment before it happens.
- Automated signal boxes should be used of rail traffic control as these signal boxes operate at various signals and checkpoints, creating a safe path for each time thus avoiding the rail collisions
- The use of Smart Railway Systems that display the train velocities for drivers and outline the speed back to Central Control Systems that employ the safety switches, use track conditions, and the presence of other trains to determine the need to stop a train or reduce its speed automatically is another important measure for Railway safety.
- Human errors or human negligence accountable for train accidents can be tamed by organising campaigns and workshops to aware the people residing near the track about the importance of Railway safety rules and regulations.
- Increasing the amount of foot over bridges and under bridges for their safety and wellbeing.
- Implementation of heavy penalties on the trespassers and consideration of trespassing of tracks as a serious crime by government so that people do not walk on the tracks without any fear or guilt. [1,5]

CASE STUDY

- A 42 years old female while de-boarding, the train suddenly started to move and she fell down accidentally and her both legs were cut off by the wheels of the train at Nekkonda village on the side opposite to that of platform due to mob on the platform. The cause of the death was the traumatic amputation of both lower limbs and its complications. [3]
- On 11/02/15 between Borabanda and Hitech city railway stations, 56 years old male railway employee was found dead while performing his duties. The body was track downed near the track and investigation unveiled that the manner of death was accidental. The cause of death by choking and head injury associated with left ventricular hypertrophy. [3]

CONVENTIONAL TO DIGITALIZED VERSION OF RAILWAYS:

The conventional well planned railway architecture primarily incorporates three levels viz. the train detection component, first and lowest level (signal and lone side electronic units); the second level comprises of technology oriented interlocking systems which control the trains by determining which track train will run and that are vital when the aspect of the safety is considered and the third level is Operating center (OC) which supervises the traffic and manages interlocking systems and monitors the entire functionality of the railways. As the matter of course the existing solutions have been executed in railways were based on theory of black box, absolute closure to external system and the vendor's concept.

The ongoing digitization process in the world have not sidestepped the railways, with the advent of the digitization and modernization in technologies the systems in railways have hyped towards the systems which are more safety and security oriented. The main concept and idea of modernization and digitization of railways include shift of mechanical, electro – mechanical relay, electronic and at present interlock systems (crucial part of every railway system) to new well planned digital system. Not only are the interlocking systems, the communication systems given equal priority when digitization and modernization is considered. The whole concept is to move from 2G technology to LTE or 5G, for transmission of the voice data and to dodge the use of expensive cables. The technologies such as Radio block centers, automated train operation, satellite

localization, CT cloud are being developed and integrated to modern solutions.

MAJORCHALLENGES:

with the advent of the technology in railways the cyber security and digital forensic comes to existence. The advancements in the new services and digitization brings new questions and challenges viz robustness of the system soft wares, forensic analysis of black box and the integrity of gathered evidences. Retrospective studies unveiled that in 2010 hackers manipulated the railways computers, moreover British rail networks and railway operators in Germany were hit by several cyber-attacks. SIXGILL in 2019 was found to be selling the admin panel of Chinese rail control systems. Due to the complex and widely interconnected networks, variety of architecture, closeness of the hard ware and dense environment, the forensic digital analysis of the railway domain systems is very complicated. The cyber maturity is very stubby in transportation sector and no special attention was given in digital analysis as no serious attacks on railway systems were inspected by experts.

In the railway domain there is no such imitation of digital forensic investigation. Inductively the process in digital investigation includes the analysis of Information and Communication Technologies (ICT) components majorly PC and hardware, sometimes there is need for collection of data from the industrial control systems and supervisory control and data acquisition. However, the forensic investigation of digital systems is very complicated as the digital rail domain systems PLS and DCS systems are vendor dependent software, proprietary systems and data retrieval. It is not possible for the engineers to works on specific systems which sometimes leads to the chip off analysis. Due to the involvement of shareholders and persons which is dreadful, as the digital evidence is **"just a digital data"**.

Digital evidence is very delicate, can easily be manipulated, deleted, moved and simply can ghost: first responders, forensic investigators, specific domain experts court expert witness, law enforcement personnel, suspect, passer-by, vendor- engineers, police officer (crime inspectors), CSI personnel,, victim, judges, prosecutors, board members are the individuals who may come into contact with digital evidence. Because of the composite environment emanated due to the life cycle of digital evidence, numbers of stakeholders, personnel who will be involved, system complexity, another aspects and variables (collection time, collection reason, collection method collection place, etc.) it can be culminated that ensuring integrity and chain of custody of digital evidence is not so an easy task. In every of the stages, in this digital investigation process, this "piece of data" is exposed to external factors.

CONCLUSION:

Forensic investigation has proved to be a commendable tool in analysing the nature and cause of crime. Investigations rely basically on Forensic techniques in solving various cases such as homicide, suicide, mass disasters. In this paper, we have discussed the forensic aspects in the railway accidents, how experts make use of forensic principles in investigating the railway incidents to interpret nature and cause of the happening. Moreover, the aspects of railway injuries as well as the transformations in railways has been discussed. Railway Forensics is emerging field and there is requirement of awareness in this discipline. Proper protocols should be made so that the Forensic investigation can become unchallenging.

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