

# TACKLING HUMAN INFLUENCE ON RAIL SAFETY IN INDIAN RAILWAYS

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## SUMMARY

Spread over 17 Zones and having more than 1.305 million Employees, Sustainability of Indian Railways vitally depends on Quality and Influence of the Human workforce. Human Mistakes, Errors and Violations may generate Hazards, leading to Accidents.

There are different Safety Critical domains, where Nature and Environment of work are different. But, Human Fatigue and Organisational Factors are common in all of them. Due to continuous Reduction of Headway between successive Trains, the need of Non-stop alertness influences Stress. Railways need to mitigate Incidents due to Human Failures caused by Drivers, Guards, Train Controllers, Station Masters and Trackside Maintainers of Infrastructures like Track, Rolling Stock, Electrical and Signalling.

Bio-compatible Duty Roster, improved Infrastructure Environments, Medical and welfare Schemes and Employee Assistance Programme are some contributory Factors to tackle Human Influence on Rail-Safety. Indian Railways are aware of this and continuously monitor the Human Error Reduction Techniques.

**KEY WORDS** Competency Management, Fatigue Management, Conflict Management, Staff welfare schemes, Employee Assistance programmes.

## INTRODUCTION

A Complex analysis of the Human workforce is essential to mitigate Human Errors from turning Critical and Hazardous for Railway Systems.

Safety and Reliability of Discrete or Continuous Human Workplace Activities are negatively influenced by Undesirable Workloads, Work Environments, Aesthetics and Technical Complexity. Accident and Error Levels increase with Fatigue combined with Monotony.

Railway Safety Category Staff includes Drivers, Level Crossing Gatemen, Signalling Maintainers, Gang men, Workshop Staff and Station Masters.

Continuous lookout for Track-side Signals along with Monitoring of Instrument Panels, strain the Eyes of the Train Drivers. In Urban areas, Track-side Hutments increase chances of Run-over and Suicide. Number of Trains and Road Traffic passing through Level Crossing Gates have increased manifold causing Fatigue to the Gatemen.

Due to Excess utilisation of Line Capacity, Line-side Infrastructure Maintainers get insufficient time for schedule maintenance of Track, Points and Crossings, Track Circuits and Overhead Catenary Wires. To enhance Rolling Stock Safety, Wagons/Coaches after POH/IOH in Workshops, are examined intensively in Carriage Sheds before being brought out on Line. Due to more Trains in Trunk Routes, Station Masters and Train Controllers are under sustained and continued attention.

## INDIAN RAILWAYS

Indian Railways interconnects 28 States through its vast and diverse Rail network, which is one of the largest and busiest in the world. Spread over 63,000 route-km (82,000 running track-km), it transports over 25 million passengers (11.99 in Suburban and 10.54 in Non-Suburban areas) and more than 2.8 million tonnes of freight daily. It has more than 7,500 stations. 9,500 Locomotives, 59,713 Passenger Coaches and 2,29,381 Freight Wagons serve this gigantic task. Having a workforce of over 1.305 million regular employees, Indian Railways is a labour intensive industry. The Engineering Departments like Civil, Electrical, Mechanical and Signal & Telecommunication directly deal with running of the Trains and are associated with Safety. Non-Engineering Departments are Commercial, Finance & Accounts, Operating, Personnel, Stores and Security. Medical Department

looks after the health of the employees. Personnel and Medical departments are indirectly associated with Safety as they take care of Human resource part of Railways.

## **HUMAN INFLUENCE**

Safety Risk Management is equally dependent on Conditions of Equipment as well as Physical and Mental fitness in addition to competency of the Workforce. Undesirable Workload can negatively influence the Human Activities, Disintegrate the Behavioural Tendencies and as a result can negatively affect Safety and Reliability of Railways' performance. Workplace Environments and Technical and Aesthetic character indirectly affect the individual's Reliable Performance. In work environments requiring sustained Vigilance and Attentiveness, Error and Accident Probabilities increase with Fatigue levels.

Studies have shown that Human errors dominate (63%) the contribution to incidents, but there are sufficient numbers of Management (30%) and Design errors (7%) to be considered too.

### Contributing Factors for Human Unreliability

As per the Contributing Factors Framework Manual of Rail Safety Regulator's Panel of Australia, published in 2011, the Ability of a Rail Safety Worker depends on:

- Personal Factors,
- Knowledge, Skills and Experience
- Task Demands
- Physical Environment
- Social environment
- Procedures
- Training and Assessment
- Equipment, Plant and Infrastructure
- People Management by the Organisation
- Organisational management and
- External Organisational Influences

Some of these factors are further elaborated as given below.

Personal Factors are Alcohol / Drugs, Expectation, Fatigue / Alertness, Health-related Conditions, Motivation / Attitude, Physical Limitations, Pre-occupation, Stress / Anxiety and Other Personal Factors.

Task Demands are Distractions, High Workload, Low Workload, Time Pressure and Other Task Demands.

Physical Environments are Air Quality, Housekeeping, Lack of Environmental Cues, Lighting / Visibility, Noise, Temperature / Humidity, Vibration, Weather Related Factors and Other Environmental Factors

There is another peculiar problem causing Human Error in India, which has 22 languages recognized by the Constitution. Employees from a particular region may get posted at a region with an entirely different Local language. When such persons have to work as Station masters or Loco drivers, there is always a chance of improper verbal communication affecting safety of train operations. Even though Hindi and English are used as the common link languages, there could still be communication problems since most of the Lower Category Staff are from the local areas, having knowledge of the local language alone. During Emergency, everyone tends to talk in Mother Language. Though Language can be pinpointed, any exchange of pleasantries during emergency, would be fatal. So, stipulated Sentences must be allowed, that can be uttered during Emergency and periodical monitoring must be done to check whether it is followed.

### Importance of Fatigue

Fatigue increases the likelihood of errors and adversely affects performance. People affected with Fatigue are often completely unaware that their performance is being reduced and is causing lapses in attention.

As per the HSE Document on Fatigue Risk Index, The key factors for Fatigue are:

- Development of Cumulative Fatigue
- Recovery provided by Breaks in Activity within a Shift
- Time of Day
- Time on Task
- Duration of a Duty period;
- Duration of the Rest between two consecutive duties;
- Fitness Recovery required after a long Sequence of Duties;
- Intensity of the Work undertaken;
- Direction and Speed of Rotation of Shifts
- Variability in the Work Pattern.

A Fatigue Risk Management Policy must be introduced with the preventive and protective measures to control risks from fatigue. This task is performed by

- Identifying Staff performing Safety-Critical Jobs
- Setting up Standards for preparing a Job Pattern Structure
- Monitoring that Fatigue Limit is not crossed
- Consulting with Staff expected to have Fatigue
- Taking actions when Fatigue Limit is likely to be crossed.

## **SAFETY RELATED STAFF**

Railway Safety Category Staff includes Train Drivers, Guards, Level Crossing Gatemen, Trackside Maintenance Staff of Permanent Way, Signal & Telecom and Electrical Departments, Workshop Staff and Station Masters. We will deal separately with the Duties and Possibility of Errors for each one of the categories.

### **Train drivers**

Duties of a Train Driver are :

- Observation and Action if Signal is at Danger or Caution
- Controlling Train Speed in Section and Stations
- SPAD and Accident Reporting
- Monitoring CAB Panels
- Understanding Written Movement Authority during Signal Failure, Minor Repairs
- Communication with Controller or Guard
- Checking of Train Faults or Chain Pulling situations
- Looking out for Hand Signals at LX Gates, Cabins and Stations
- Looking out for Trespassers and potential Suicides
- Controlling the Train during Adverse Environmental conditions
- During Shunting, the Driver should observe the Shunt Signal or Hand Signals of the Railway Staff conducting Shunting

The following Infrastructural and Operational parameters present potential of influencing the appearance of human errors while driving the Train.

- Maximum speed and visibility of the Railway Line

A straight Railway Track can be operated with high speed and provides an easy and broad visibility, whereas curved railway lines with lower maximum speed allow a larger time frame but have less visibility.

- Station Infrastructure

The probability of Error increases not only by the complexity of station infrastructure with its number of signals, but also by the signal positions. Especially exit signals in parallel lines, particularly on Curves may lead to mistakes.

- Signalling System

If using a line-side signal system, the observance of the track and the signals can be synchronized. Where Cabin signalling is provided, the driver has to shift the attention to the cabin instruments, which disrupts line observation.

- Operational Mode

During Signal failures or for Shunting movements within a station area, the Train is not protected by any Signals forcing the Driver to be vigilant to keep the speed very low,

- Changes of timetable and track allocation

Changes of the timetable or track allocations for unscheduled events can lead to a demand for train driver's unusual activities, causing a higher stress level. If it is combined with, inadequate knowledge of handling the situation, it increases Human Error potential.

- Close intervals of Level Crossings

A tremendous physical and psychological pressure is on the Loco Drivers, who are required to constantly keep a watch on some possible trespass by Public.

Besides these, there are other problems which influence Train Driver's performance:

- Sleep disorder due to ever changing Duty hours and common Dormitory in Running Rooms
- Noise Level more than 100 dB inside Cabin
- Suffer from Stress related Disease e.g. hypertension, diabetes, frequent headaches etc.
- Work under pollution and high voltage electricity
- No calendar day rest provision to fulfil Family and Social obligations.
- All personal works to be done by availing leave, or during short spells between duties,
- Poor quality Driver's seat , normally without back rest provision
- No natural calls facilities since no Toilets are available
- Poor lighting and commonly no Air-conditioning in the Cabin.

For the Train drivers, the main error possible is Signal Passed At Danger (SPAD). This probability increases with Fatigue. Anti-Collision Devices are getting installed in Driver's Cabins to avert Head-on Collisions. Auxiliary warning system takes care of SPADs. Sometimes Drivers have the tendency of infringement of Speed Restriction in Curves or loop Lines, as was the recent case in Spain. Data Loggers in Stations are monitored to identify such cases and counsel such Drivers.

Train Drivers may get Acute Post-Traumatic Stress Disorder with feelings of helplessness, horror, guilt, and anxiety, when another person is killed or seriously injured due to Run over and Suicides on the Tracks. The symptoms included sleep disturbance, tremor, restlessness, and nightmares. One important point is that the Driver is to continue driving the Train immediately after

the Incident and many of them continue in Stress even after one month from the Incident. But Railway organisation or the Society do not always acknowledge them.

Of late, another disturbance to Drivers is growing due to Young People doing Heroics and Stunts in front of approaching Trains to emulate the acts by Actors shown in Films.

JR East has tried painting Rail Crossings bright green to alter the mind-set of would-be suicides. It has also cut back tree branches to deny trespassers their privacy, and increased the number of surveillance cameras along its route.

After a collision with a pedestrian, Drivers must be immediately replaced and be immediately counselled by a psychologist and then their performance must be evaluated. It is better to change the Route to avoid passing through the Accident Site.

Running Rooms should be provided with cubicle cabins with attached Toilets for a particular set of Running Staff so that their sleep is not disturbed by continuous movement of other Staffs throughout the night. Running Rooms should be provided with captive generator sets, and Centralised AC should be provided. So far food is concerned; food provided should conform to local habits.

## **Guards**

Duties of Guard of a Train are:

- To monitor Passengers boarding the Train or getting down from it and giving Movement authority to Driver by Hand-lamp as well as Whistle.
- Fixing Last Vehicle Flashing Lamp at rear of the Last Vehicle.
- Protecting an unintentional stable Train in mid-section by fixing Detonators on Track at stipulated distances.
- To check the Brake continuity with Loco Pilot.
- Check the entire formation and monitor during journey for any abnormality
- To check and release Brake after Chain Pulling by Passengers.
- Exchange all right Signals with the Loco Pilot and Guard of the trains proceeding on adjacent line and with Station Master while passing through a Station.
- When passing a manned Level Crossing, the Guard shall look back to see if any signal is given by the Gateman to indicate that anything is wrong with the train.
- To use bell signals for communication with Driver, in case of Electric or Diesel Multiple Units,

An important disadvantage for the Guards in Goods Trains is that the Guard's Compartment is attached at the end of a very long Train and during night, if the Train stops at the Home Signal, the Driver at least can see the Station Lights, but the Guard feels absolutely isolated. Unlike the Drivers, who has an Assistant in the Cabin, Guards travel alone. This causes additional Mental Stress. Moreover, many a times Dead Bodies of Public killed in Run over or Suicide are loaded in Guard's Compartment and increases Trauma of the Guards.

Possible errors by the Guards are fitting Last Vehicle Flashing Lamps and fixing Detonators on Track for mid-section stable Train. The possibility of Error in the last case gets enhanced in inclement Weather and in Forest areas during night. Anti-Collision Devices are getting installed in Guard's Compartments to avert Rear-end collisions.

Seats, Lighting and Fan provisions are getting improved to provide better facilities. Running Room facilities are same for the Guards as in the case of Drivers.

In earlier days, Guards had to get down from their Cabin and use Emergency Control Phone to contact the Train Controller. This was much difficult during nights and particularly in forest and hilly areas. Introduction of Mobile Communication removed this problem.

Developed by Centre for Railway Information Systems (CRIS), a Crew Management System Software automates day-to-day real-time monitoring of crew movement and duty allocation.

## Level crossing gatemen

Having 31846 Level Crossings (18316 manned and 13530 unmanned) according to data of April 2012, across the 63,000 route-km of railway tracks, there is a Level Crossing at an average of every 1.97 km of track. Two, three, four and multiple wheeler Vehicles, Human as well as Animals cross them daily. Majority of Public have scant knowledge and regard for Road Safety Rules. Almost 42.5% of the Level Crossings are unmanned and without Gates. Of the balance 57.5% manned Gates, Interlocking with the Signals is available for only about 15%, leaving the rest of the Level Crossings to depend on the manual operation by the Gatekeeper. In the year 2011-12, out of total 131 Accidents, 61 i.e. 46.6% occurred at Level Crossing Gates.

Duties of a Gateman are

- Operating the Gate properly as per Station Working Rules for the passage of Trains and ensuring that no Train suffers any detention on account of late closing of the Gate.
- Ensuring that road traffic is not unnecessarily held up at the Gate.
- Keeping the channels of Check-rails clean and shall clean the Road within the Railway
- Reporting any defect in the Gate itself or Road Signal to the Station Master without delay.
- Protecting the Gate in the case of any obstruction, accident or damage to the gates, as per Instructions and Rules in force.

In addition to operating the Gates, the Gatemen are also to monitor whether the Last Vehicle Flashing Lamp of a Train is working properly. Even if they find some irregularity they could only inform the Station Master over Telephone, but not to the guard of the concerned train. A very serious Accident occurred at Gaisal in North Frontier Railway, where one Train passed two stations over wrong Track before the Accident. But now with the introduction of Mobile Communication, they can immediately inform the Guard of the concerned Train.

Closure of Gate for long duration, especially for Goods Trains, leads to resentment among the road users when the queues are long and the Gateman sometimes get assaulted by Public. This puts unnecessary Stress on the Gatemen and can be mitigated only by ensuring Safety Education through Schools and Colleges.

Drivers have to keep Whistling frequently and continuously. As per the manual, the whistle sounded at the Gate Approach must give a Sound Level of 85 dB at the Gate. Naturally the Sound Level when the Loco is very near to the Gate will be more than 100 dB. At the same time, unruly Road Traffic sounds Horn as soon as the Gate is opened creating chaos. These Sound pollution leads to additional mental Fatigue and Stress related Diseases.

## Train controllers

Duties of a Train Controller are :

- Monitoring and Recording Train Movements between Stations and Detentions.
- Arranging Crossing of Trains as per judicious precedence.
- Authorising Movements of Departmental and Material Trains.
- Arranging proper Movement of Assisting /Banking / Light Engines.
- Arranging Engineering and / or Power Blocks with minimum disturbance to Train Running.
- Clearing sick Wagons from Roadside Stations.
- Maintaining Yard Fluidity by Flow Control of Rakes and Wagons.
- Arranging Speedy Relief in case of Accidents.
- Giving time signal to all stations on the section daily at appointed time
- Fulfilling Staff Relief / Interchange commitment.

Due to the ever increasing number of Trains, the duties of the Train Controllers are continuously increasing their stresses. Since a Controller keeps track of Train Movements over a long Section having several Stations, they are subject to almost non-stop Talk and Listen process with no period of inaction and no scope for relaxation. This situation aggravates in the case of any Incident or irregularity in the train schedules. For this reason their duties are restricted to six hour shifts.

Controllers also can have Post Traumatic Stress Disorder, if any severe Accident is caused during their shift since in some cases, they might feel guilty of misjudgement.

### **Station masters**

Duties of a Station Master are :

- Route Setting.
- Communication protocols with Controller, Adjacent Stations, Driver or Guard.
- Communication with Trackside Staff and Level Crossing Gatemen.
- Issuing Caution Orders to Train Drivers.
- Keeping Records of Train Movements.
- Reporting Accidents, Fault or Problems
- Station staff Administration.
- Hand-signalling for through Trains
- Other Miscellaneous Tasks

Capacity utilization of almost all the Trunk Routes has gone beyond 100% and is crossing 120% in a number of cases. The Trains passing SM / ASM work on these Routes using either Panel Interlocking or Route Relay Interlocking Cabins and are required to remain under sustained and continued alertness because of excessive high frequency of Trains, with no period of inaction and any scope for relaxation.

Non-Interlocking Working means temporary disconnection of points, signals, track circuits, axle counters and other signaling gadgets for any designated works. This kind of working is normally resorted to during over hauling of lever frames, yard remodelling, introduction of Panel or Route Relay Interlocking etc. An interlocked station when points and signals become defective, Station becomes non-interlocked for the purpose of working. The responsibility and Stress of the Station Masters increase whenever periodical Non-Interlocking of the Station is in process. Human error in the part of Station Master in Monitoring Train Location caused Gaisal Accident.

### **Trackside staff**

Duties of a Track side Staff (Permanent Way, Signal & Telecom and Electrical Dept.) are :

- Track / Overhead Electrical Alignment / Signalling Equipment Maintenance
- Track / Overhead Electrical Alignment / Signalling Equipment Repair or Renewal, if needed
- Using Engineering and / or Power Block judiciously
- Reporting Accidents, Fault or Problems
- Communication protocols with Station Master
- Following Safety Rules when using Trolley or Lorry
- Special Activities after Accidents

Trains running over Railway Tracks cause degradation of the Track components e.g. Rail, Rail fastenings, Rail pads, Sleepers, Ballast, Switch and Crossings etc.

As per the ProRail Report of Dutch Railways, there are 75 different wear and degradation phenomena of the mechanical parts of a Switch or Crossing. Of all Track components, the most complicated and costly replacement is that of a complete Switch or Crossing. But, restoration is mostly possible by proper Preventive Maintenance and adjustments, when needed.

As a result of excessive utilisation of line capacity, high incidence of Rail Fractures in running lines grows to be a potential hazard to the safety of Train operation. Gang men foot-patrol the Track and attend to regular Preventive Maintenance of Track along with monitoring of Bridges and Culverts, Cuttings and Drainage facilities and Switch and Crossings. But adverse Weather or Fatigue of the Gang men may cause overlooking some potential Hazardous Failures.

Besides Foot Patrolling by the Gang men, manual Ultra Sonic Flaw Detector (USFD) testing, though slow and subjective, is accompanied by periodical visual Inspection by the Supervisors for

checking Rail conditions. But, USFD testing is extremely strenuous if carried out in continuous stretches, which could affect its Reliability.

Mechanised maintenance of Track is one of the measures adopted to improve the condition of Track and enhance permanent way safety. A self propelled vehicle called Track Tamping Machine is used to adjust the Track geometry mechanically. The Self Propelled Ultrasonic Rail Test (SPURT) Car is a faster and more objective method of ultrasonic testing of rails. It, however, has the in-built limitation of using only ultrasonic information which has to be backed up by subsequent visual examination. The average rate of testing by Car is 80 km. per day.

Signal & Telecommunication Staff maintains Track circuits, Axle Counters, Block Instruments, Point Machines, Line-side Signals and Interlocking equipment. Though all of these are designed on Fail-safe Philosophy, any fatigue or lack of Attention of the Staff may cause Safe Failure to affect Availability of train services. Most dangerous situation is violation of Rules to keep Availability during System Failures. Remote Condition Monitoring of Switch with Point Machine and Track Circuits are being thought of to reduce Human Influence.

A Checklist is being prepared for the Trackside Staff to monitor and quantify Maintenance Tasks. Checking of Competence during Inspections by Officers also helps in keeping the Staff tuned to their Tasks.

An unsafe condition can be created by the Trackside Staff, who use Push Trolley in the face of an approaching Train. Trolley must be taken off the Track and kept at a sufficient distance. In a Section having Cutting, Trolley Stands must be used to keep the Trolley. When the Trolley is stabled in a Station, they must be kept chained. If not chained, Trolley must be kept parallel to the Track to prevent it from rolling towards Track.

### **Workshop staff**

Wagons / Coaches turned out from the nominated Sick lines and Workshops after POH / IOH repairs are to be subjected to intensive examination by Neutral Control Wing (NCW), before being brought out in service. In 2011-12, 519 Diesel Loco, 338 Electric Loco, 26,62 Passenger Coaches and 42,205 Goods Wagons were Overhauled in various Loco sheds and Workshops of Indian Railways.

Pit-lines are provided for intensive examination of under-gear of Coaching Trains at Carriage Sheds. In order to enhance the safety of rolling stock by preventive maintenance, the Railway Board directed Zonal Railways (In June, 1989) to ensure pit-line examinations for primary and secondary maintenance. The need for providing adequate pit-line facilities has also been repeatedly highlighted by the Commissioner of Railway Safety.

### **Footplate Inspections by Officers**

Footplate Inspections during Day as well as Night in both Clear and Inclement Weathers (when Visibility is Poor) are carried out by Officers of Mechanical, Electrical (Running), Permanent Way and Signalling branches, travelling on the Loco of running Trains for observing and checking certain aspects of Loco performances along the Track and at the Stations. Just like the Drivers, these Officers can also have Post Traumatic Stress Disorder, in the case of a Run over or Suicide. They must also undergo Counselling.

### **Competency and training management**

Competency is needed at the lowest level in Appreciation of the requirements of the Task plus limited experience of applying it. Then gradually, Good Knowledge and then, In-depth Knowledge are needed at the Mid Level. Persons at these Levels would require limited or No Supervision. Specialists must have competence in fundamental understanding of the principles and key issues of the Task plus Significant Experience of applying it.

Access to Internet and Mobile Communications has changed Training Methodology from an Instructor-led, content-based activity to a self-directed, work-based process. An increasingly important role is played by Interaction with the immediate in-charge, who is much responsible for



Career Development and Promotion of Staff and supporting informal, On-the-job learning. Continuous Competency based Training improves existing competence and equips the Staff with new Functional, Behavioural and Core competencies.

Individual Departments handle Skills Management, Competence and Performance Appraisal and provide workforce training and development through their own Central Training Institutes for Officers and Zonal Training Institutes for Supervisors and Technicians. Safety culture with risk awareness is part of Training.

Training Centres improve the competency of the Employees by imparting quality Training with Current Contents of Practical Values, aimed at bridging Competency Gap in Trainees,

### Organisational Responsibilities

Railways as an Organisation must plan and execute several tasks to achieve Safety and Reliability of the System. Some of the Activities are indicated below.

- Business Planning and Asset / Resource Planning
- Communication and Consultation Process
- Competence of Senior Personnel
- Compliance
- Contractor / Interface Management
- Information Management
- Interface Management
- Monitoring, Review and Validation
- Organisation Design
- Risk and / or Change Management
- Other Organisational Management Factors

The Railway Organisation should study the probability of failures due to Management Errors as well as Design Errors. Performance Shaping Factors causing Railway Incidents due to Management and Design Errors are

- Management are Inadequate Maintenance
- Errors in content and availability of Task Procedure
- Non-availability of Competence Guidelines.
- Planning and Scheduling of Work and Task Planning
- Verbal and written Information
- Line side Design of Signage for Drivers, Trackside Staff and Level Crossing Gate users
- Train Engineering without Human Interface
- Track Engineering without Human Interface
- Train Controller Workstation
- Driver In-Cab Interface

### Psychological Assessment during Recruitment and Service

Community of European Railway and Infrastructure Companies identified Psychological Assessment parameters used to identify someone having appropriate knowledge, skills, and abilities to become an effective safety related railway Worker. The Parameters to be applied for selecting them are -- Speed of Reaction, Gestured coordination, Attention, Concentration, Perceptive capability, Reasoning, Memory Power, Communication capability, Self Control, Behavioural Reliability, Conscientiousness and Autonomy.

### Staff Welfare

Indian Railway's Staff Welfare schemes cover activities in areas of Medical, Child education, Housing, Sports, Recreation and Catering. Various types of Leave are granted to Railway employees for relaxation and to handle other requirements.

Various kind of Leaves, Free Passes for Journey throughout India, Allowances keep the Staff in good Health both Physically and Mentally. Staff Welfare Centres encourage team spirit, cultural activities, sports and holiday excursions. Economic burdens are minimised through various types of Employees co-operative banks and Staff Benefit Funds handled by administration.

Introduction of Mobile Phones force employees to feel that they are always under close vigil. Moreover, with more number of Trains, employees remain more alert, which increases Stress. Thus the role of Medical department in providing best treatment has grown.

Retirement Benefits and benefits even after Death (for the Family) keep the Staff assured of surviving at old age

## **CONCLUSION**

This paper shows that Indian Railways is very much concerned with the effect of Human Errors in Safety-critical domain and plans and implements Mitigation Policy for the same by Competency, Training, Management of Fatigue Risk and various other welfare schemes. Importance of Human Error Risk analysis and Bio-compatible Duty hour schedules are being studied for implementation. Competence is monitored regularly and Trainings are arranged for, accordingly. RDSO continuously upgrades Safety procedures in design and development of machines as well as for human interfacing. New maintenance policy guidelines are issued to improve confidence of employees. Staff Welfare Schemes take care of the Staff, their family members and retired employees are also taken care of.

Further Research is needed to find Solutions to the problems below.

- 1) What if driver is fatigued while driving ?
- 2) What if driver is not interested in his job ?
- 3) What if driver is distracted due to shipments near the tracks ?