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Indian Railways: Recent Trends in Control Accidents and Safety Measures for Passengers

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Abstract

Indian railways has been regularly in the news albeit for the wrong reasons. The frequency with which train accidents have been taking place has led to serious doubts in the public mind about the safety of rail travel and also the health of the network. Against this background, an attempt is made in this paper to assess the trends in railway accidents for the period from 2000-01 to 2009-10. The paper also highlighted the various measures taken by IR to prevent accidents to ensure safety to the public.

Keywords: Accidents, Anti-collision Device, Collisions, Compensation, Derailments, Indian railways, Level crossings, Light Emitting Diode, Research Design and Standards Organization, Road over bridges, Road under bridges, Safety Directorate, Train protection warning system.

1. Introduction

Transport industry is the only one of its kind where an accident in the course of its working results in loss of lives and properties of its valued customers. In all other industries, providing any kind of service to the general public, an accident generally affects workers of that industry alone and not its customers. In view of the somewhat unusual implication of a railway accident, safety in IR has always had a special significance for travelling public. As such, IR accords top priority to safety in train operations. This is primarily because of the realization that accidents not only cause loss of valuable lives and properties but also results in loss of transport capacity due to traffic disruption, which can never be effectively recouped. In Railway terminology, the term "accident" envelops a wide spectrum of occurrences which not only affects safety but also cause interference with normal working. These occurrences which may not necessarily mean a mishap, include failures of railway equipment such as engines, rolling stock, permanent way, signals etc.

2. Main Text

2.1. Classification of Accidents

Accidents fall into various categories such as collisions, derailments, accidents at level crossings, fire in trains etc. A train accident is defined as an accident involving a train when running under a particular number of distinct name from a fixed point of departure to a fixed point of destination. Train accidents have been classified as "consequential" or indicative. Consequential train accidents include collisions, derailments, manned level crossing gate accidents,

unmanned level crossing gate accidents, fire in trains while indicative accidents include averted collisions, breach of block rules and passing the signal at danger.

2.2. Category-Wise Train Accidents

The safety performance of Indian railways can be measured in terms of number of consequential train accidents (accidents with serious repercussions in terms of loss of human life or injury or damage to railway property or interruption to railway traffic beyond the defined threshold level). Train accidents are restricted mainly into five categories such as collisions, derailments, accidents at level crossings, fire in trains, and other specified types of miscellaneous train mishaps or accidents. The trends in accidents reveal that accidents due to collisions, derailments and fire in trains have come down significantly. While accidents at level crossings have declined marginally accidents happened due to other causes have been doubled during the period under consideration. However, notwithstanding the trend of improvement, a number of significant challenges still remain. Interruption to traffic due to accidents is a cause of concern. Table-I presents the category-wise train accidents for the period from 2000-01 to 2009-10.

<Table 1> Category-wise train accidents

Year	Collisions	Derailments	Accidents at level crossings	Fire	Other causes	Total
2000-01	20	344	83	15	2	464
2001-02	30	279	88	9	8	414
2002-03	16	216	96	14	7	349
2003-04	9	197	95	14	5	320
2004-05	13	136	70	10	3	232
2005-06	9	130	75	15	4	233
2006-07	8	96	79	4	8	195
2007-08	8	100	77	5	4	194
2008-09	13	85	69	3	7	177
2009-10	9	80	70	2	4	165

Source: Indian Railways year books

2.3. Causes of Train Accidents

Train accidents take place due to a number of causes and the causes are: human failure, equipment failure, sabotage, and other miscellaneous causes. But the major cause of accidents continues to be human failure, compared to other causes. However, there has been a significant improvement as the total number of accidents has declined from 464 in 2000-01 to 165 in 2009-10. It is to be noted here that accidents due to various causes such as human failure, equipment failure etc. have come down considerably while accidents due to sabotage have declined marginally. Table-2 presents the causes of train accidents during the period under consideration.

<Table 2> Cause-Wise Analysis of Accidents

	00-01	01-02	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10
Human Failure (i) Failure of Railway staff	284	248	184	161	119	120	85	86	76	63
(ii) Failure of person other than railway staff	109	103	118	107	78	86	84	81	75	75
2. Equipment	16	11	6	6	5	1	4	4	-	3

section (i) Rolling stock										
(ii)Track	17	13	11	7	7	6	6	3	-	3
(iii) Electrical	-	-	1	1	2	-	-	-	-	-
(iv) S&T	-	-	-	2	-	1	-	1	-	-
3. Sabotage	19	14	10	18	4	5	8	7	13	14
4. Combination of factors	4	-	2	-	1	-	1	-	4	1
5. Incidental	11	20	15	15	14	11	6	8	5	4
6. Cause not established	4	5	2	2	2	2	-	1	4	2
7. Under investigation	-	-	-	1	-	1	1	3	-	-
Total	464	414	349	320	232	233	195	194	177	165

Source: Indian Railways year books

2.4. Casualties in Indian Railways

Train accidents as mentioned earlier lead to loss of valuable human lives or grievous hurt to passengers. Further, it causes huge damage to the railway property. The accident record of IR shows that the number of passengers killed has increased from 55 to 67 while the number of passengers injured has declined from 281 to 253 during the period under consideration. More or less, the same trend has been observed in case of other people who were either killed or injured due to accidents. However, a significant decline is noticed in the causalities of railway employees. Table-3 presents the details.

<Table 3> Casualties in Indian Railways

Year	Passengers		Railway employees		Others	
	Killed	Injured	Killed	Injured	Killed	Injured
2000-01	55	281	8	27	153	175
2001-02	114	595	14	38	168	175
2002-03	157	658	29	45	232	279
2003-04	84	279	3	28	155	159
2004-05	35	86	5	8	181	209
2005-06	168	483	9	31	138	113
2006-07	38	227	6	24	164	151
2007-08	9	245	10	26	172	135
2008-09	52	257	12	22	145	165
2009-10	67	253	4	9	167	135

Source: Indian Railways Year books

2.5. Incidence of Accidents

Accidents per million train kilometers is the universally accepted index of safety. In IR, the accidents per million train kilometers has steadily declined from 0.65 percent in 2000-01 to 0.17 percent in 2009-10. The trend shows that accidents in IR have come down phenomenally during the period under consideration. Table-4 presents the details.

<Table 4> Incidence of accidents per million train kms

Year	Accidents per million train kms per cent
2000-01	0.65
2001-02	0.55

2002-03	0.44
2003-04	0.41
2004-05	0.29
2005-06	0.28
2006-07	0.22
2007-08	0.21
2008-09	0.19
2009-10	0.17

Source: Indian Railways year books

2.6. Cost of Damage

IR incurs huge loss due to accidents. This is because the rolling stock as well as the permanent way (railway track) will get damaged leading to heavy financial loss. Table-5 brings out the details of cost of damage. The table shows that the cost of damage to rolling stock moved between 1,416.1 lakhs and Rs. 5011.95 lakhs while the cost of damage to permanent way (track) varied between Rs. 303.3 lakhs and Rs. 1,831 lakhs during the period under consideration. To sum up the cost of damage to rolling stock is far more than that of the damage caused to permanent way.

<Table 5> Cost of Damage due to Accidents

(Rs in lakhs)

Year	Rolling stock inclusive of engines	Permanent way
2000-01	3,693	1,831
2001-02	3,082	1,643
2002-03	3,297	759
2003-04	4,029.8	816
2004-05	1,416.1	303.3
2005-06	3,249.2	935.1
2006-07	2,321.7	871.3
2007-08	2,970.00	1085
2008-09	5,011.95	1052.88
2009-10	4,126.48	1244.99

Source: Indian Railways Year Books

2.7. Compensation Paid to Accident Victims

Accidents cause huge financial loss to railways due to the fact that it has to pay huge compensation to the victims and the quantum of compensation payable depends upon the severity of the injury or the mortality of the passenger. Table-6 presents the details. The table shows that the compensation paid to victims moved between Rs. 121.37 lakhs in 2007-08 and Rs. 757.07 lakhs in 2003-04 and the percentage of change fluctuated between a low of (-) 75.77 percent in 2007-08 and a high of 126 percent in 2006-07.

<Table 6> Compensation paid to Train Accident Victims

(Rs. In lakhs)

Year	Compensation paid	Percent of change
2000-01	286.12	-
2001-02	482.46	68.62
2002-03	505.40	4.75
2003-04	757.07	49.80
2004-05	513.63	(-) 32.15
2005-06	221.63	(-) 56.85
2006-07	500.89	126.00
2007-08	121.37	(-) 75.77
2008-09	218.94	80.39
2009-10	265.81	21.41

Source: Indian Railways year books

2.8. Safety Organization

Safety Organization in IR was created in pursuance of the recommendations of Kunzru Committee in 1962. It was further strengthened based on the recommendations made by Wanchoo Committee in 1968. At present, the safety organization is functioning in a 3-tier structure at Railway Board, Zonal headquarters, and Divisional level. At the apex level, Safety Directorate exists in the Railway Board under the control of an Executive Director who reports directly to the Chairman. The Safety Directorate analyzes long term trends of accidents, and makes recommendations to promote safety. It also coordinates the efforts of zonal railways in the area of safety that have inter-railway ramifications. Besides the above, it promotes safety consciousness among staff and public through mass media.

Chief Safety officer heads the safety organization at the zonal level who reports directly to the General Manager. The main functions of the Safety organization at zonal level are conducting on the spot checks to detect unsafe practices with a view to eliminate them, and also to identify the weak links in the system to take remedial measures. Further, it organizes safety campaigns to promote safety consciousness among staff and public. At the divisional level, the safety organization is headed by a senior Divisional Safety Officer who reports directly to the Divisional Railway Manager. The main functions of the safety organization are to carryout preventive and spot checks, counseling of staff on safety, monitoring the quality of refresher courses of all staff connected with train operation, dealing with accident cases and implementing the various recommendations made by various committees. To sum up, the main functions of safety organization are:

Framing of proper rules and regulations for the running of trains
Proper training for running staff
Proper training for safety staff of other departments
Timely medical / night vision, psychological testing etc.
Provision of essential safety equipment
Ensuring the maintenance of assets in good fettle
Installation of mechanical / electronic safety devices
Technological upgradation and innovations
Identifying unsafe practices in the system
Monitoring, counseling and periodic screening of staff.
Conducting various types of inspections
Conducting ambush checks and surprise night inspections
Launching of periodic safety drives
Preventing carriage of inflammable / explosive materials in trains.
Monitoring follow-up action on recommendations made
Statistical analysis of long-term trends in accidents
System improvements

2.9. Corporate Safety Plan

With view to accelerating the pace of safety drive, IR formulated a 10-year Corporate Safety plan, which was presented to the National Parliament in August, 2003. This plan envisages the following broad objectives:-

To achieve reduction in rate of accidents per million train kilometers from the present level of 0.44 to 0.17 by the year 2013.
Implement measures to reduce passenger fatalities substantially in consequential train accidents by 2013.
Focus on development of manpower through major improvements in working environment and training to reduce the accidents attributable to human failure by 40% by 2013.
Achieve safety culture on all fronts including maintenance depots, worksites, stations etc.
Progressively achieve an environment of “Fail-proof” from the present “Fail-safe” system of asset failures by upgrading the systems by 2013.
Prioritization of safety related projects
Implementation of the recommendations of Railway Safety Review Committee, 1998 at an accelerated pace.

2.10. Measures to Prevent Accidents

IR as a part of corporate safety plan has initiated several measures to prevent train accidents. For instance, it has continuously implemented 'Action plans' with a view to reduce accidents caused by human errors. It has adopted a multi-pronged approach with a focus on the introduction of newer technologies, mechanization of maintenance, early detection of flaws etc., so as to reduce human dependence. Further, it has been upgrading the skills of human resources continuously to prevent accidents. In this regard, the various measures taken by IR to prevent accidents has been presented hereunder.

2.11. Measures to prevent collisions

IR has installed Anti-Collision Device (ACD) to prevent cases of collision and also to minimize the extent of damage due to caused collisions. The device has already been installed on 1,736 route kilometers of Northeast Frontier Railway. Further, it is planning to install improved ACD system with revised specifications on Southern, South Central and South Western railways covering 1,600 route kilometers.

Fouling mark to fouling mark track circuiting was completed on the entire 'A', 'B', 'C', 'D' and 'D special' routes where the permissible speed is more than 75 km per hour.

IR introduced last vehicle check by Axle counter in 257 block sections.

The auxiliary warning system has been successfully functioning in the Mumbai suburban sections. It is also making trials to develop an improved version of the system so as to introduce in the North Central and Southern Railways.

IR designed and developed 'Train Protection Warning System' (TPWS) and in this regard, it has already sanctioned two pilot projects. The first pilot project was commissioned in 2008 on 50 route kilometers of Southern Railway. The work on second pilot project-Delhi-Agra section (200 route kms) is in progress. The TPWS has also been approved for deployment on high density networks covering 895 route kms of 5 zonal railways namely North, Central, Eastern, South Eastern, and Western at an estimated cost of Rs. 599 crore.

IR has replaced filament type signals by long life durable LED signals to improve the reliability and visibility of signals.

2.12. Measures taken to prevent derailments

IR has continued its efforts to eliminate fish-plated joints by welding single rails into long welded rails to improve the reliability of assets. Further, during the construction of new lines or gauge conversions, long welded rails are laid on concrete sleepers. Besides the above, turnouts are also being improved systematically.

IR relies more on technology to prevent derailments. For instance, it has been using Tie-tamping and ballast cleaning machines for track maintenance. All the same, sophisticated track recording cars, ultrasonic flaw detectors, self-propelled ultra-sonic rail testing cars, oscillograph cars and portable accelerometers are being used progressively.

IR adopted modern bridge inspection and management system which include non-destructive testing techniques, under water inspections, mapping unknown foundations and integrity testing.

Patrolling of railway track including night patrolling is made a continuous process at vulnerable locations.

To minimize the effects of accidents, coaches with Center Buffer Coupler (CBC) are being manufactured with anti-climbing features.

Passenger coaches are designed and developed in such a way that they can withstand the crash during accidents. Further derailment prone 4-wheeler tank wagons are being gradually phased out.

2.13. Measures taken to prevent level crossing accidents

IR has undertaken publicity campaigns to educate the road users about the need for safety at unmanned level crossings. The publicity campaigns include quickies on television, cinema slides, posters, radio, newspapers, street plays etc.

IR used to conduct joint ambush checks with the help of civil authorities to nab erring road users under the provisions of the Motor Vehicle Act, 1988 and the Indian Railways Act, 1989.

The construction of 80 road over bridges / road under bridges was completed during 2009-10. Further 137 ROB/RUBs have been sanctioned for the year 2010-11.

IR has delegated adequate powers to Zonal Railways to sanction limited height subways wherever feasible with a view to reduce the number of unmanned level crossings. It has already identified 727 level crossings for replacement by Limited Height Subways, out of which 577 were sanctioned in 2009-10. Against the target of 160 limited height subways in 2009-10, 102 have already been completed.

IR has progressively converted unmanned level crossings into manned level crossings in a planned manner. This is reinforced by the fact that during 2009-10, 377 unmanned level crossings were manned.

2.14. Measures taken to prevent fire in trains

The coach manufacturing units of IR started manufacturing fire retardant coaches by using fire retardant furnishing materials such as PVC flooring, interior paneling, ceiling, upholstery etc.

IR provided portable fire extinguishers in the guard-cum-brake vans and AC coaches in all trains to meet the emergencies due to fire accidents. Further, action is also underway at Research Design and Standards Organization (RDSO) for conducting trials of a comprehensive fire and smoke detection system in one rake of Rajdhani Express before considering universal application.

IR started undertaking intensive publicity campaigns to prevent the travelling public from carrying inflammable articles.

2.15. Train Safety Mission- Zero Tolerance for Accidents

IR's vision-2020 aims at making railway operations free of accidents. It plans to achieve this through a combination of technological and HR interventions. Renewals, replacements, upgradation and technological aids for early detection of flaws, integrated maintenance of both track and rolling stock would be planned and managed from the standpoint of attaining goal of zero derailments. Further, advanced signaling technology like automatic verification of train movement and line occupation through track circuiting, train protection systems and anti-collision devices would be used in combination with training of station and running staff to eliminate collisions. Communication, inter-locking and warning devices at manned level crossing gates would be improved. Unmanned level crossing gates would be progressively manned or replaced by subways, road over bridges / and road under bridges. Security in stations and running trains and patrolling of track in vulnerable areas would be beefed up to safeguard passengers and rail users from the threat of accidents arising from miscreant activities.

3. Conclusion

The safety performance of IR in terms of consequential train accidents (accidents with serious repercussions in terms of loss of human lives or injuries or damage to railway property or interruption to railway traffic beyond the defined threshold level) has improved significantly. Accidents per million train kilometers have also improved. Remarkably, the improvement is even more marked in respect of the more serious types of accidents like collisions and fire in trains. Notwithstanding the steady trend of improvement, a number of significant changes still remain. Interruption to traffic due to accidents is a cause of concern. A large number of derailments as well as failure of

railway staff as a major contributory cause of accidents show that considerable room exists for improvement. In other words, a lot more work needs to be done by way of technological upgradation, HR interventions of right recruitment, promotion, training and motivation of employees before preventable accidents are eliminated from the railways. Further, ongoing initiatives like manning of busier level crossings and pre-warning and education of road users at unmanned level crossings need to be scaled up to minimize the mishaps at level crossings. Safety is a challenge but a close to zero accident goal is attainable. This issue has to be addressed with proper planning and determination.

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