



# **Human Interface in Railway Safety – A New Dimension**

**From:**

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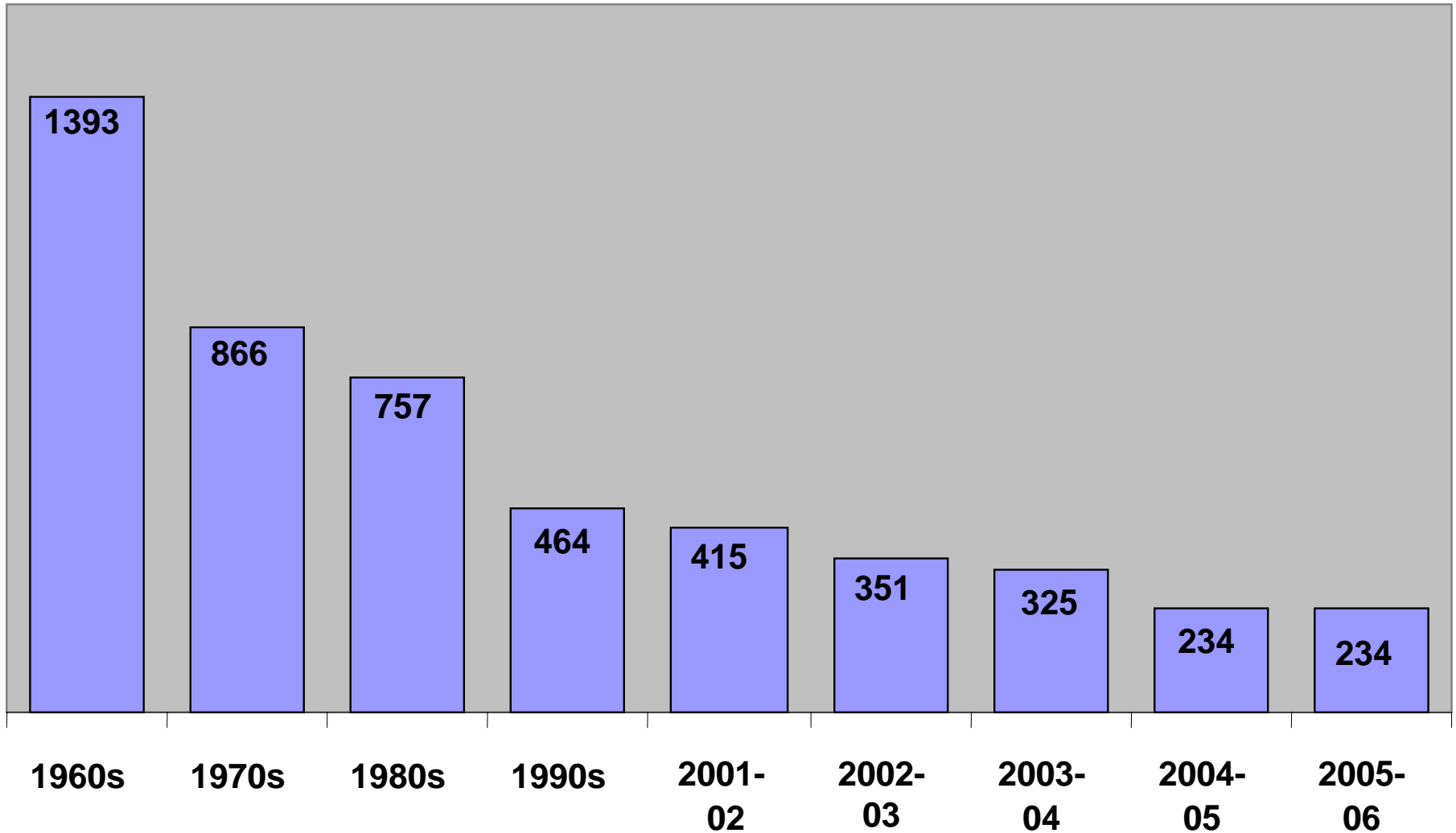
# Indian Railways- Mega-size

- 63465 route kilometers
- 48263 coaching vehicles
- 7910 locomotives
- 222 thousand wagons
- 7131 stations
- 1422 thousand work force

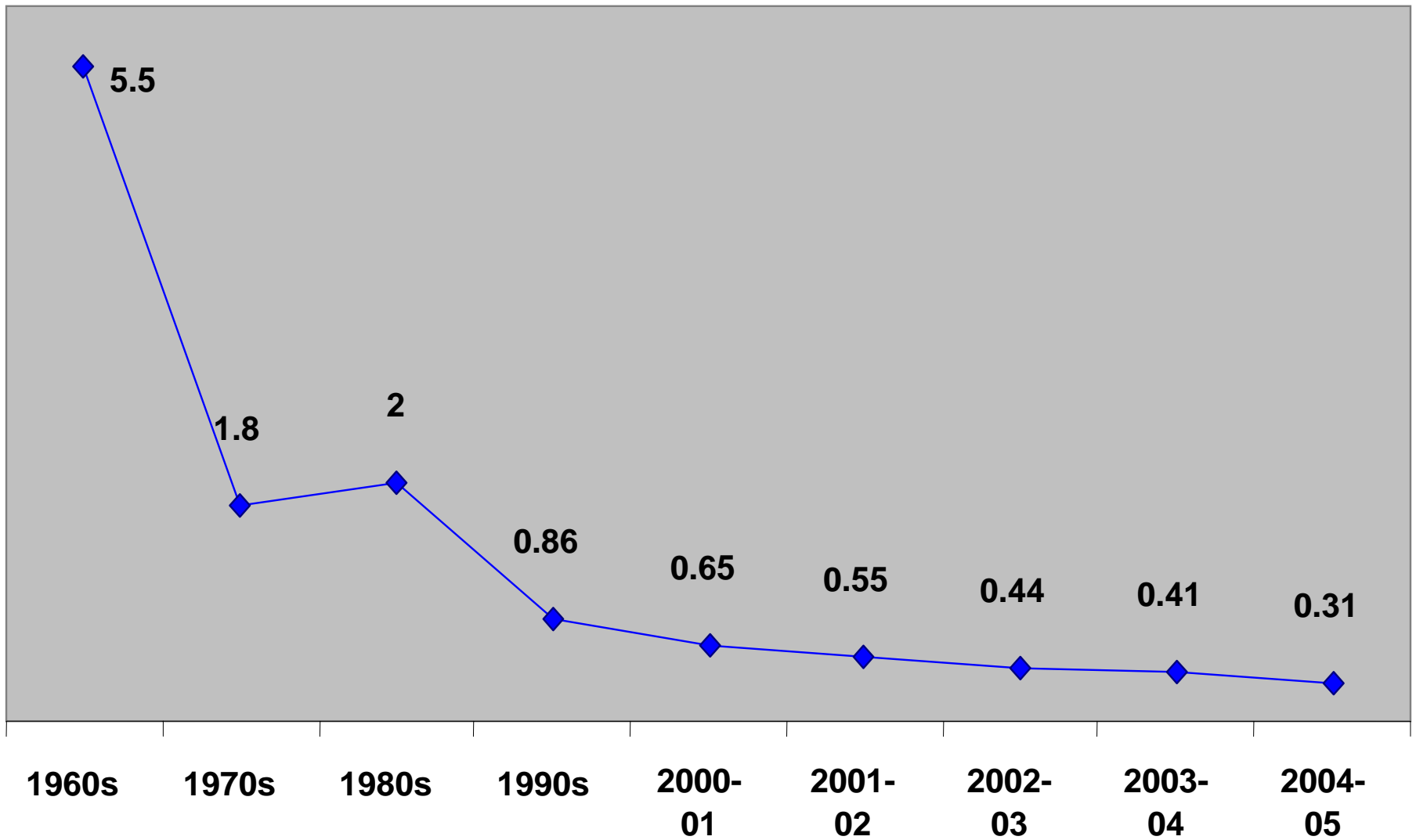
# Indian Railways- Daily Transport Output

- 2 Million Train Kilometers.
- 15 Million Passengers
- 1.8 Million Tonnes freight loading
- 16021 Trains Run
  - 9556 Passenger
  - 6465 Freight

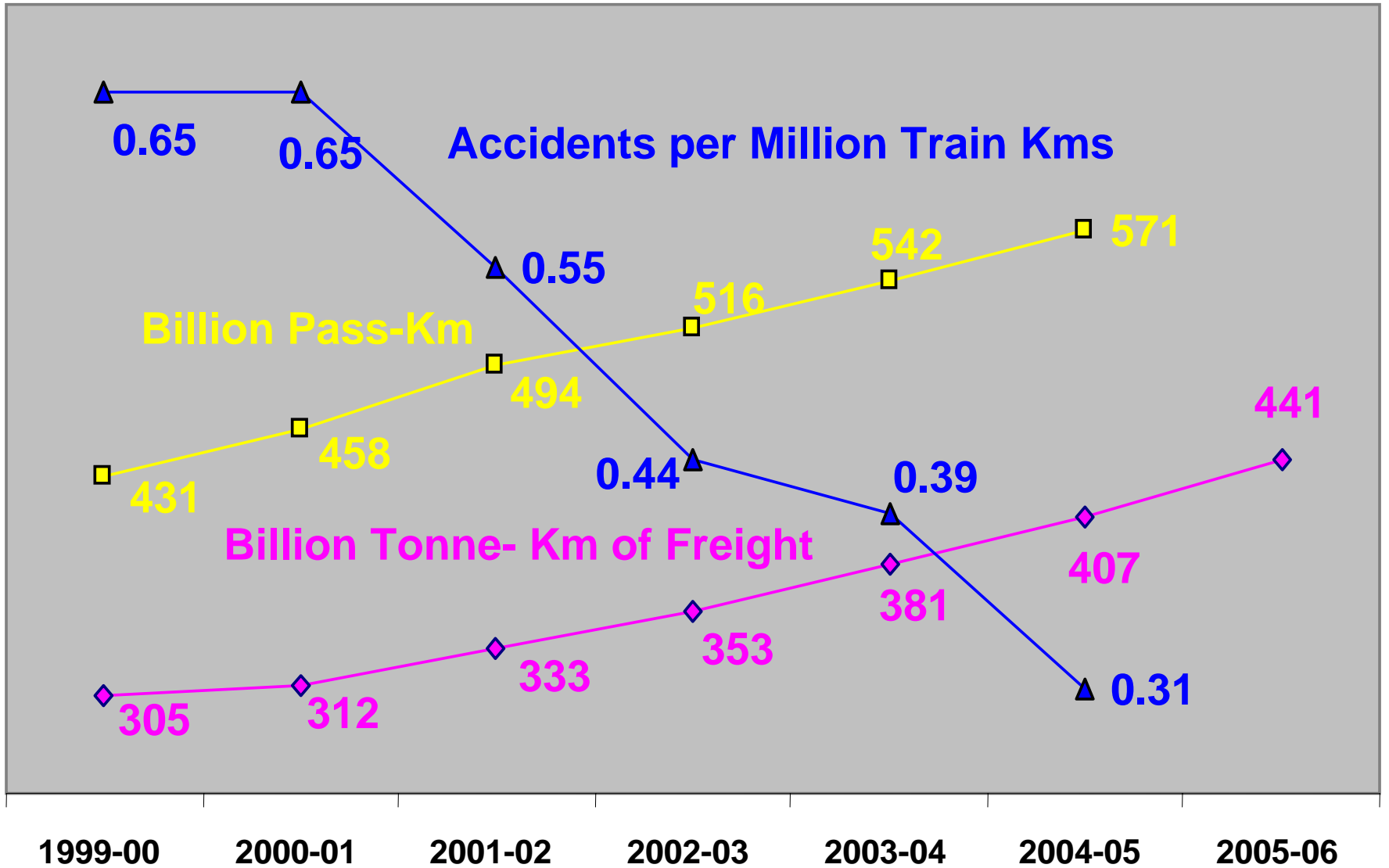
# Trend of Number of Train Accidents



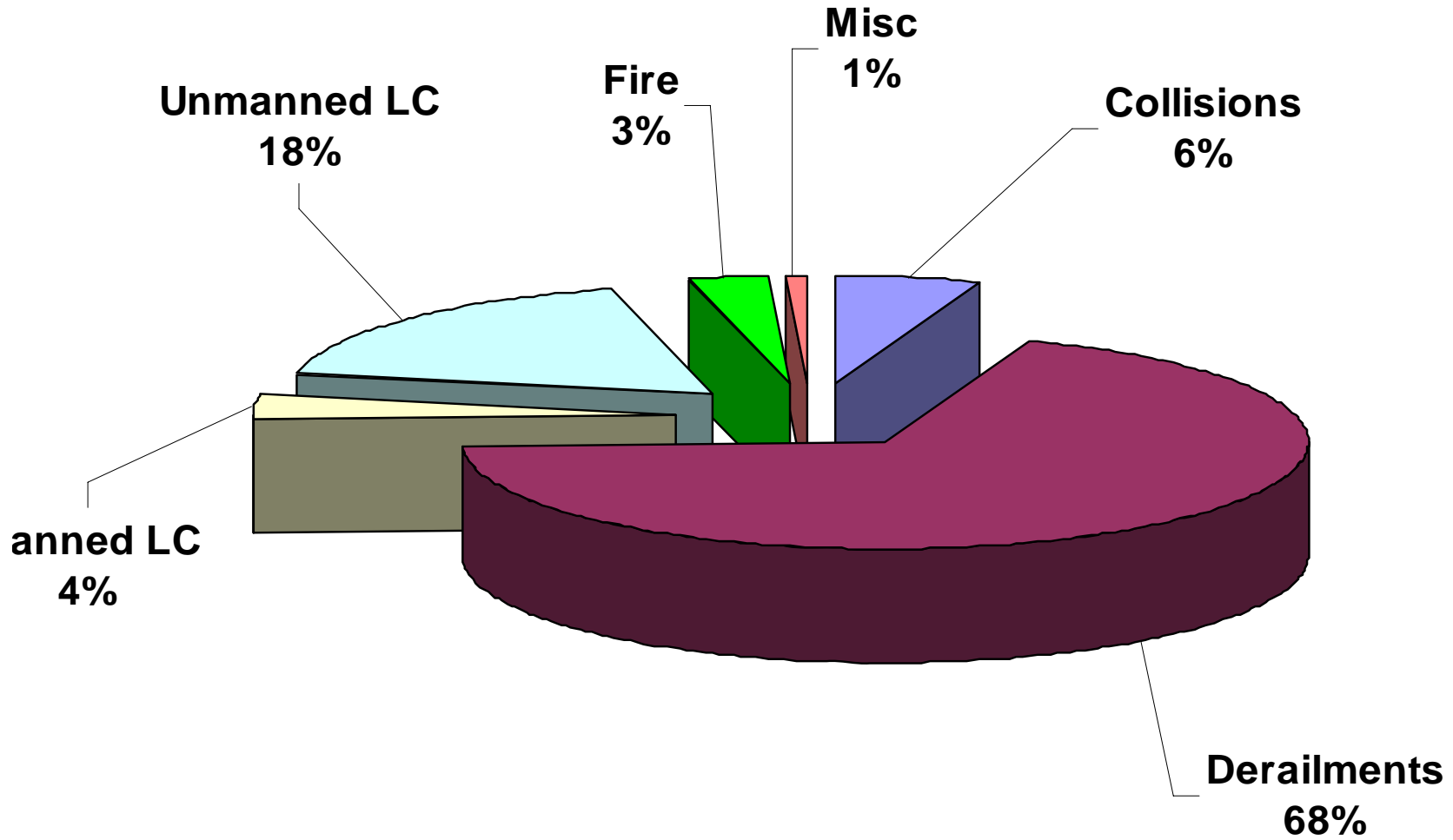
# Trend of Accidents per million Train Kms



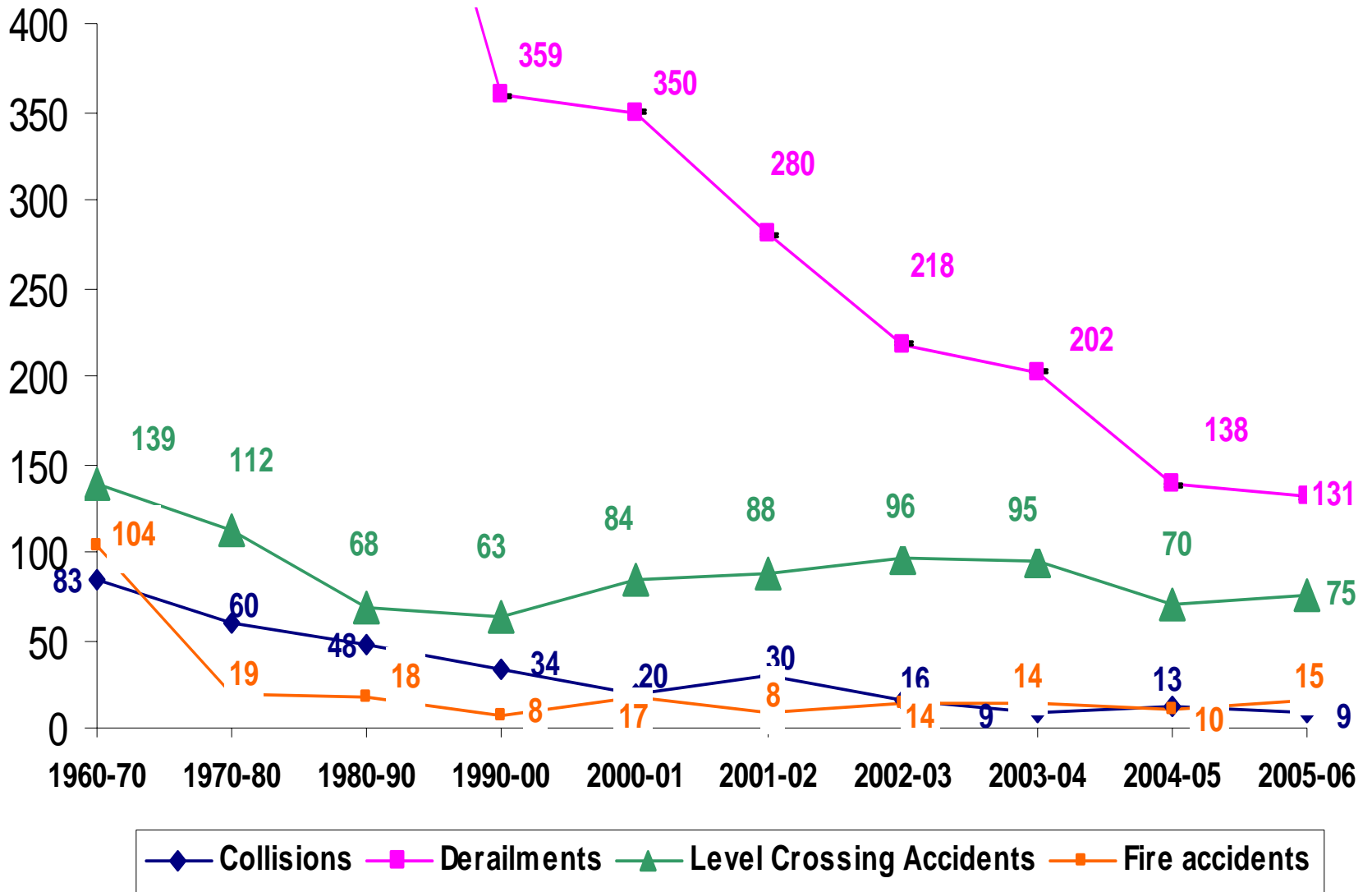
# IR Growth Vis-a-vis Safety Performance



# Type wise Accidents per Year (1996-97 to 2005-06)

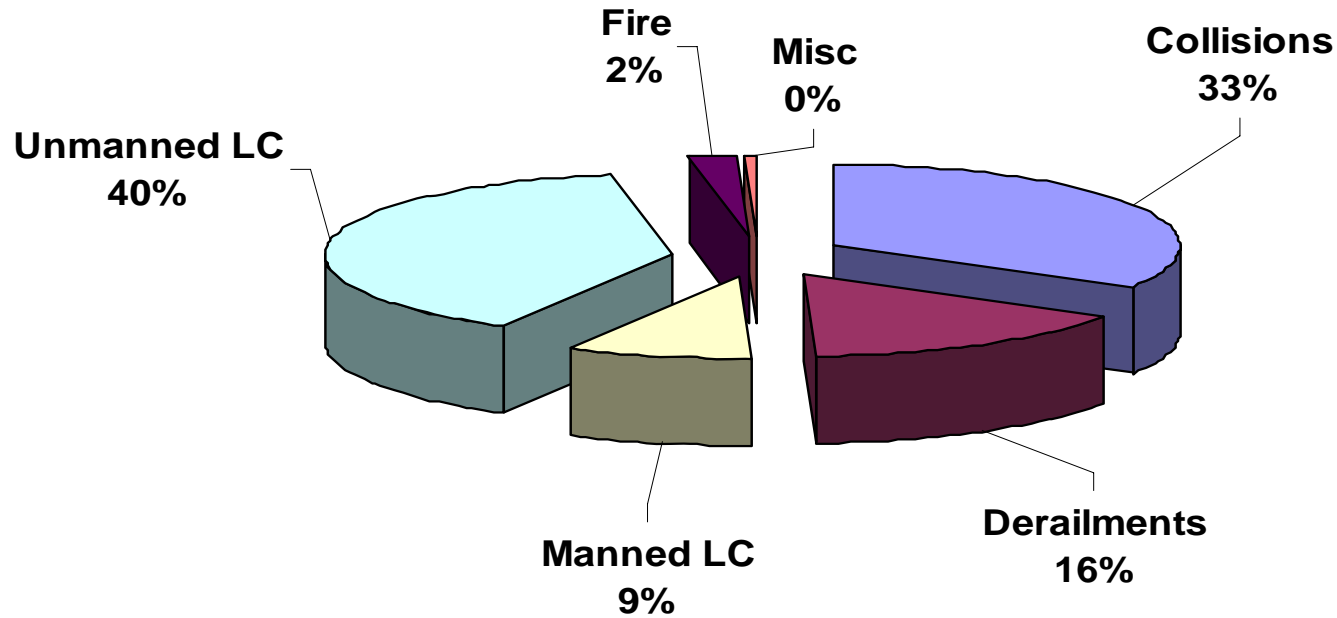


## Type wise Accidents on IR since 1960 to 2006

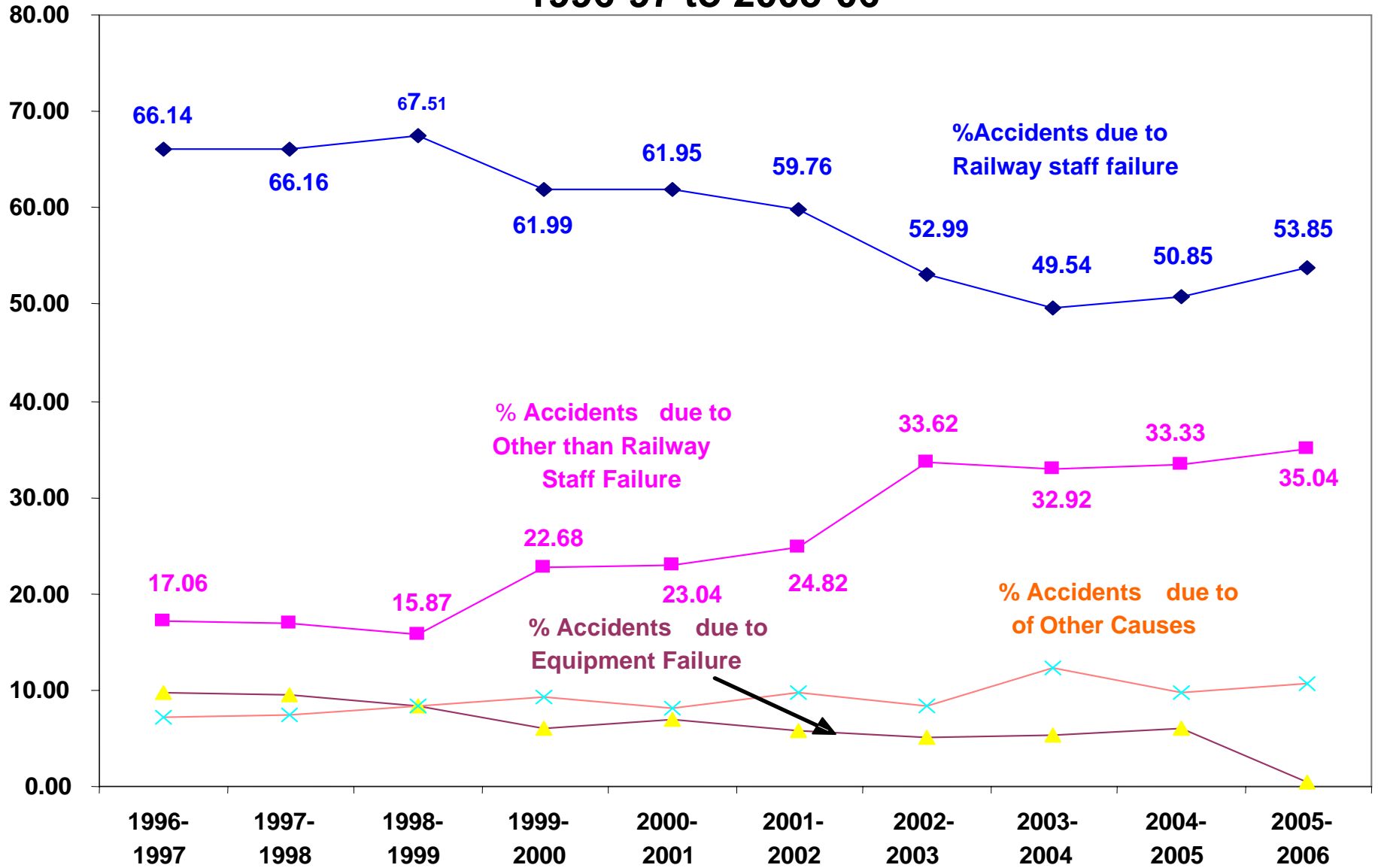


International Railway Safety Conference 2006, Dublin, Ireland

# Average Casualties in Train Accidents (1995-96 to 2004-05)



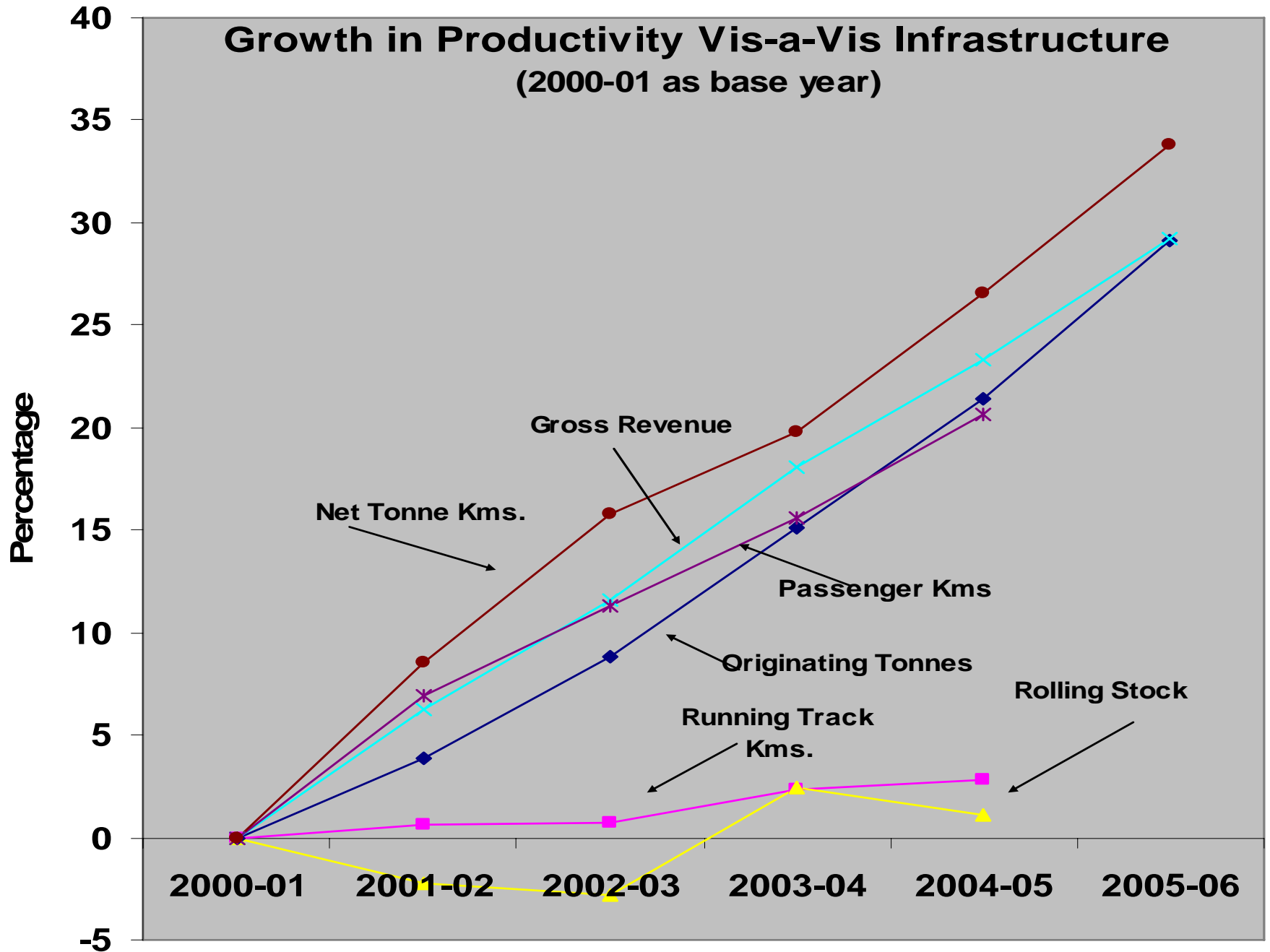
# Responsibility wise Analysis during 1996-97 to 2005-06



# Efforts on Human Resource Development

- **Better objectivity and transparency in the selection process.**
- **Psychological/Aptitude Tests at entry level.**
- **Strict enforcement of prescribed Refresher Courses.**
- **Crash Courses.**
- **Periodic Medical Examination both at the time of recruitment and while in service.**
- **Surprise inspections laying emphasis on night inspections and ambush checks to eradicate adoption of short cut methods.**
- **Periodical safety drives to check alertness of staff and to monitor and educate them on safety aspects.**
- **Reducing over hours working.**
- **Simulator aided training.**

# Growth in Productivity Vis-a-Vis Infrastructure (2000-01 as base year)



# Case Studies

# Case I – The Description

Head-on collision of 9112 Jammu Tawi Ahmedabad Express with 1 JMP Diesel Multiple Unit Passenger train between Bhangala and Mirthal stations of Northern Railway on 14.12.2004 at 11.53 hrs.

# Case I – The Cause

The two Station Masters did not exchange messages properly on VHF sets to repeat prior three train movements before seeking permission during failure of block working and dispatched trains in the same block section from opposite directions on a single line section.

# Case I – Key Observations

- **Quad cable was damaged due to construction activity causing failure of Block instruments and block phones at both the stations about 24 hours prior to the accident and trains between Mirthal and Bhangala were being worked on paper line clear (PLC).**
- **PLC cannot be issued to the driver unless line clear has been obtained through section controller. However, even though communication with controller was working, line clear was being obtained through VHF sets, which is the last permitted option in order of priority in case of failure of communication.**
- **Rules for obtaining the line clear through the controller indirectly or on inter-wire stipulates for obtaining train numbers with their description and private numbers of previous 3 trains passed over the block section, from the person competent to grant line clear.**

# Case I – Key Observations

- As a measure of abundant precaution, the Station Masters while using the VHF sets for paper line clear working, should have followed the system of taking the train numbers with their description and Private Numbers of three previous trains passing over the block section, to ensure that reply to line clear enquiry was emanated from an authorized persons competent to grant line clear.
- Both the Station Masters dispatched trains from their respective stations towards each other in the same block section by granting line clear on VHF sets exchanging private numbers and issuing PLC.

# Case I – Key Observations

- Poor supervisory and managerial intervention was continuing in this most unsafe and accident prone condition. The control office was well aware that VHF sets were being used for line clear despite control phones were in working condition.
- Work of locating and rectifying the fault was not undertaken on an emergency basis and was postponed for the next day to avoid night working. The rectification work could not take off even before this accident on the next day.
- This is a saturated section handling both passenger and freight traffic to full capacity. It is quite strenuous to operate even under normal circumstances.

# Case I –Human Element

- Human element came into vulnerable functioning after the technical failure i.e. the cutting of quad cable supporting control circuits during excavation of earth.
- Both the Station Masters adopted the least cumbersome process of granting line clear after the failure of Block instruments and block phones i.e. VHF communication over controller communication being easy to use. Despite VHF communication being more vulnerable to outside interference, the prescribed safeguard for ensuring that reply to the line clear inquiry is emanating from the authorized person competent to grant line clear was not adopted by Station Masters.

# Case I –Human Element

- Though the practice of granting line clear using VHF communication had been going on for about 24 hours for several trains in both the directions, by which time this abnormal working had lost its alert value in the minds of individuals involved and a lapse was bound to take place at the level of Station Masters.

# Case I –Discussion

- Last string of frontline action coming from the two Station Masters.
- Role of maintenance agencies can not be overlooked in causing the vulnerable situation of train operation for prolonged period which ultimately manifested into this accident.
- Certain prescriptions like imposing speed restriction under vulnerable situations like PLC working could have offered favorable opportunities under this unusual operating situation.

# Case I –Multi layer failure

<b>Cause</b>	<b>Description</b>	<b>Possible Preventive Action</b>
<b>Direct Cause</b>	<b>Station Masters did not follow proper procedure of exchange of messages on VHF sets and dispatched both the trains in the same block section towards each other on paper line clear tickets.</b>	<ul style="list-style-type: none"><li>•<b>Better training of station masters.</b></li><li>•<b>More tolerant management attitude in case of hold ups in operations in case of failures</b></li><li>•<b>Counseling to staff to follow procedures regardless of delays.</b></li></ul>

# Case I –Multi layer failure

Cause	Description	Possible Preventive Action
<p><b>Contributory Causes</b></p>	<ul style="list-style-type: none"> <li>• Failure of regular mode of communication for about 24 hours.</li> <li>• Prescribed procedure for alternate modes of communication was too cumbersome.</li> <li>• Loose ends in stipulating procedure to be used as alternative mode of communication (VHF sets).</li> <li>• Heavy traffic was being handled on the Section.</li> <li>• Efforts needed for proper manual procedures were too demanding and tiring.</li> <li>• Inadequate management intervention</li> <li>• Successful past experience of short cuts without any penalty.</li> </ul>	<ul style="list-style-type: none"> <li>• Co-coordinated working at the construction site.</li> <li>• Emergent action to set right failed Equipment.</li> <li>• Strengthening of staff availability.</li> <li>• Safe and simple prescription of alternatives needing human intervention.</li> <li>• Slow down operations in view of vulnerability.</li> </ul>

# Case II – The Description

Collision of 9168 Up Sabarmati Express with  
stabled goods Train at Samlaya Junction  
Station of Western Railway  
on 21.4.05 at 03.10 hrs.

# Case II – The Cause

Signaling and Operating staff at Samlaya station failed to follow the procedure prescribed for failure of signal as result of which 9168 Up Sabarmati Express, which was planned to pass through main line, entered loop line and collided with the stable goods train.

## Case II - Key Observations

- **The linkage for the operation of the culprit point had been attended on the previous evening and proper fixing of the linkage was not ensured thereafter which resulted in failure of the signal.**
- **Signal failure register had an entry of failure of indication of the culprit point. Control chart also had an entry to this effect.**
- **Station Master had prepared a memo addressed to Electric Signal Maintainer (ESM). Both original and carbon copies were available in the memo book. Original copy was in detached condition.**
- **Prescribed form for authorizing the driver of 9168 Sabarmati Express to pass the Signal in Red condition was found prepared by Station Master with both the copies of the authority available in the book.**

## Case II - Key Observations

- Cabin Relay rooms are double locked with each of the keys remaining in the safe custody of Station Master and Electrical Signal Maintainer. Key of Station Master's lock of the cabin relay room (wherefrom the culprit point/signal are operated) was in Station Master's key box and there was no entry for issue of this key on the date of accident.
- It was the time of grouping of important trains and failure of signal could cause detention as the prescribed procedure for dealing with a failed signal consumes extra time.

## Case II – Human Element

- Human element came into vulnerable functioning after the technical failure i.e. malfunctioning of Up main line home signal.
- The Station Master prepared the prescribed documents for advising the signal failure to the Electrical Signal Maintainer but later preferred to advise ESM on VHF set instead of sending the written advice. Electric Signal Maintainer alongwith his Assistant proceeded to the Cabin Relay Room and opened both the locks without having taken the key of Station Master's Lock and without making an entry into the signal failure register. Without checking the condition of the point causing failure of signal, Electric Signal Maintainer bypassed the relay interlocking the point with the signal so that the signal could be turned on without setting of the culprit point. The rectification of signal was communicated on VHF set to the Station Master by the ESM. 9168 Up Sabarmati Express was thus given pass through signal for the main line whereas the culprit point was still set for the loopline and thus the train entered the loopline and collided with stabled train.

## Case II - Discussion

- **The lapse occurred due to non observance of prescribed procedure to deal with the signal failure as per which a written advise is to be sent to the ESM by the Station Master regarding signal failure and signal is considered fit only after the receipt of written advise back from the ESM. During the intervening period, written advice is issued to the drivers of the trains for overlooking the aspect of the failed signal which costumes extra detention to trains.**
- **The Station Master had the intention of following the prescribed procedure for dealing with a failed signal. However, the urgency of running trains without causing extra detention took the front seat of thought and short cut of verbal communication was resorted to by the station Master which was further compounded by the negligent working by ESM and his assistant who bypassed the interlocking relay instead of fixing the defective point which would have taken lesser time.**

## Case II - Discussion

- From the report of the railway administration after the accident, it was observed from the readings of the counters fitted on the relay rooms at other stations that several other relay rooms had been opened without the opening the station Master's lock. This unsafe practice seems to have been persisting to prevent detentions. It is suspected that concerned officials were perhaps shy of reporting such failures and owning the detentions.

# Case II –Multi layer failure

<b>Cause</b>	<b>Description</b>	<b>Possible Preventive Action</b>
<b>Direct Cause</b>	<b>Signaling and Operating staff failed to follow the procedure prescribed for failure of signal.</b>	<ul style="list-style-type: none"><li>•<b>Better training.</b></li><li>•<b>More tolerant management attitude in case of hold ups in operations in case of failures</b></li><li>•<b>Counseling to staff to follow procedures regardless of delays.</b></li></ul>

# Case II –Multi layer failure

Cause	Description	Possible Preventive Action
<b>Contributory Cause</b>	<ul style="list-style-type: none"><li>•<b>Poor attention to the associated linkages of involved point.</b></li><li>•<b>Heavy flow of traffic consisting of prestigious super fast trains which were likely to be detained.</b></li><li>•<b>Pressure from section controller to hurry up.</b></li><li>•<b>Expectedly intolerant management of the associated delay affecting punctuality of many trains.</b></li><li>•<b>Successful past experience of adopting short cuts without any penalty.</b></li></ul>	<ul style="list-style-type: none"><li>•<b>Better maintenance practices.</b></li><li>•<b>Intense super checks for non compliance of laid down procedures and Penal action in case of non compliance not resulting in accidents.</b></li></ul>

# Changed Scenario

- Intense utilisation of assets
- Proliferation of Technology
  - design, manufacture and standard related issues.
- Significant impact of asset failures on train operation
- More complicated Human intervention during failures
- Poor Management Tolerance to delays
- Social and psychological factors

# Conclusion

- Human failures resulting into accidents are complex phenomenon driven by several internal and external features.
- Accidents investigations need to look through these contributory factors to propose rational holistic solutions.
- Best of the HRD efforts may not pay dividend-  
Training to handle unusual has limitations.

# Possible Solutions!

- Slow down... . . . . in case of failures.
- Abstain from prescribing rules for human intervention under all abnormal conditions.
- Simple prescriptions- easy to practice.
- Deploy dedicated teams to manage operations during failures.

# Thanks