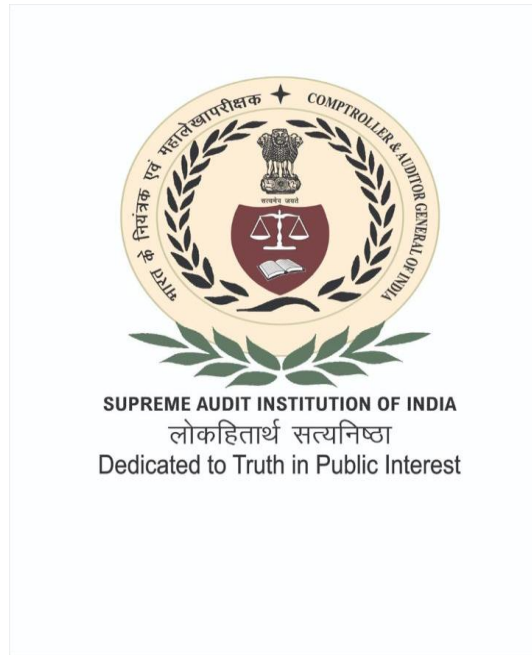


Case Study
on
Punctuality and Travel Time in Train Operations in Indian Railways



Regional Training Institute

Kolkata

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Preface

Regional Training Institute, Kolkata is the Knowledge Centre for Railway Audit. In pursuit of excellence in our designated areas of Knowledge Centre, we attempt to bring out cases of frauds/deviations from rules and regulations, inefficiency in functioning of the existing system and their reasons reported and reflected in the C&AG audit reports of Union Government/State Governments, as case studies.

The case study on ‘**Punctuality and Travel Time in Train Operations in Indian Railways**’ is based on the real audit experience and printed in the C&AG’s report (Paragraph No. 2 of Compliance Report No. 22 of 2021 of Union Government (Railways)). However, the facts and circumstances of the case have been modified keeping in view the classroom requirements.

Transport sector is major contributor of CO₂ emission while the rail mode is the least contributor in the transport sector. Target of 9.1 and 11.2 of Sustainable Development Goal focusses on sustainable transport with special attention to the needs of those in vulnerable situations, women, and children, persons with disabilities and older persons by 2030. Therefore role of railways in sustainable transport could be utilized properly and firmly so the share of rail transport would enhance helping our climate. Though the Gross Traffic Receipt of Indian Railway is more than 2 lakh crore, the goods/ passengers which are getting transported, in fact effect the GDP in much larger value both in quantity and quality. In fact, delay have greater impact on growth of GDP, therefore, this is a vital subject in future years also. The design of the case study attempts to bring awareness amongst the participants about various issues related to the operations of trains and hindrances which impacted punctuality and travel time both passenger and goods trains. The terminologies used in Indian Railways is also explained for the participants.

Disclaimer:

The information contained in this case study is to be used as a case study example for training purposes only. The information in this case study is both factual and fictional. Opinions formulated and materials provided are intended to stimulate fruitful class discussion.

I hope that the readers would benefit from this case study and share the other areas with the RTI for including newer areas in legal procedure for verification of payments. Suggestions, if any, are welcome for future development.

Atul Prakash
Principal Director

RTI, Kolkata
July, 2023

Section 1: Case Study for the Participants

1. Introduction:

1.1 The case study on ‘**Punctuality and Travel Time in Train Operations in Indian Railways**’ is based on the real audit experience and the paragraph was printed in the C&AG’s report (Paragraph No. 2 of Compliance Report No. 22 of 2021 of Union Government (Railways)). However, the facts and circumstances of the case have been modified keeping in view the classroom requirements.

1.2 The case study has been prepared to:

- (A) Aware the participants on various terminologies and issues related with punctuality and travel time of trains viz. Railways speed policy, actual speed of trains, monitoring of punctuality by the Indian Railways, issues/ hindrances to achieve the punctuality targets, expenditure made on the infrastructure development etc. with overall role in logistics.
- (B) Improving the participant’s ability to form (1) audit opinions, (2) anticipate responses to the audit opinions, and (3) collate or collect all essential evidences so that responses received from the auditee can be suitably analyzed and addressed.

2. Background

2.1 Efficient management of operations in running trains is critical to enhance efficiency of operations in Indian Railways which is a major stakeholder of logistic business. National Logistic Policy (September 2022) also envisages world class infrastructure, modern warehousing, digitalisation, regulations, tracing and tracking, ease of arranging shipment and Timeliness. Delay in running of Passenger trains results in poor quality of service to passengers leading to dissatisfaction. The share of railways in logistic sector has come down significantly over the last three decades due to delayed delivery by Goods trains. Therefore, ‘Punctuality’ and ‘Travel time’ are two important mobility outcome indicators for operations in Indian Railways. The audit exercise highlights the extent to which IR could have improved punctuality and reduced travel time within existing resources. Moreover, timeliness is the essence of Project Management which have three major components viz. money, manpower and materials and efficient project management would lead to creation of infrastructure in time resulting in fast running of trains. Reduction in logistic cost boost export significantly as per industry estimate. 65% share of cargo movement happens through road which has high input cost. Increasing timeliness of railway would increase the share of railways in logistics which will reduce the cost of goods in all markets. This would help the economic growth of our country tremendously.

2.2 Scope of Audit:

Member (Operations and Business Development), Principal Chief Operations Managers (PCOM) of the Zonal Railway and Senior Divisional Operations Managers (Sr. DOM) are directly involved with train operations. All other departments are entrusted with different roles to support the Operating Department.

The Operation Control system are currently divided into 17 zones, further subdivided into 73 divisions and also been extended to Area Control levels and more than 7000 stations¹.

Various IT systems are used for train operation and its monitoring viz. Integrated Coaching Management System (ICMS²), Control Office Application (COA), National Train Enquiry System (NTES), Freight Operations Information System (FOIS) consisting of two modules viz. Rake Management System (RMS) to handle the operation portion and Terminal Management System (TMS) for commercial transactions.

Audit analysed data of ICMS, FOIS, Data Warehouse and Complaint Management System and records of Operating, Engineering, Mechanical, Signal & Telecommunication and Electrical departments. Audit covered 2015-16 to 2018-19 and samples were taken for four months in different seasons viz. Summer, Rainy, Regular and Foggy (May, July, October, and January).

2.3 Audit objectives:

The audit objectives were to assess:

- i. Whether Indian Railways addressed all the critical factors commensurate to their criticality?
- ii. Whether there is any scope of improvement for Indian Railways to reduce travel time and improve punctuality within the existing resources?

3. Main Story

Indian Railways has invested ₹ 2.5 lakh crore on various track infrastructure works during the period from 2008 to 2019 for improving the mobility³ of the trains. Target of “Mission Raftaar” launched by IR in 2016-17 was to achieve the average speed of 75 Kmph for Mail/Express trains and 50 Kmph for Goods trains by the end of 2021- 22. However, the average speed of Mail/Express and Goods trains until 2019-20 was around 50.6 Kmph and 23.6 Kmph respectively. Moreover, out of 478 superfast (SF) trains, the scheduled speed of 123 SF trains (26 per cent) was less than the specified speed of 55 Kmph.

¹ Total stations 7321 in 2018-19. Station Master is in overall charge of the station.

² ICMS records the data related to the operation of coaching trains and for monitoring the punctuality performance of the trains. The reasons recorded therein for loss of punctuality are important inputs to Management to identify the major causes of hampering punctuality of the trains.

³ Punctuality and Travel Time are the two mobility outcome indicators

3.1 Indian Railways (IR) measures the punctuality of trains at the terminating stations. IR provides an allowance of 15 minutes delay with reference to the scheduled time for this measurement. However, the punctuality of mail/express trains over IR declined from 79 percent (2012-13) to 69.23 percent (2018-19). The ICMS captures all the incidents that caused the train operations' delay and these incidents are classified under 33 factors.

Audit found that out of those 33 factors 27 factors are controllable internal factors. Out of that 27 factors there are six major factors which contributed to the 65% loss of punctuality. Those factors are Out of path, Engineering, Rescheduling of trains, Delay from other Railways, Planned block open line and Traffic. Audit analyzed the internal factors viz., Path availability, Delay on Engineering account, Delay due to Traffic Block and Rescheduling of trains to assess the impact on the punctuality. Result of the analysis are detailed below:

(A) Train delay due to Allowances and Path Availability: - Path⁴ is the primary requirement for smooth running of trains. The trains starting on right time but get delayed due to non-availability of path which indicate inefficient monitoring mechanism. Following are the assessed causes of non-availability of path:

Deficiencies in Time-table preparation: In IR, time table is prepared on manual calculation and the existing timetables are modified based on needs. Allowances are extra time values factored in the time-table with the aim to maintain punctuality of operation in a Timetable. Engineering Recovery Allowance is additional time included in train schedules to cover the impact of planned temporary speed restrictions associated with engineering works on the network. Traffic Recovery allowance is provided to make up of train's delay due to line and block section occupancy in heavy traffic. Audit noticed that IR had prescribed yard stick for Engineering⁵ Allowance⁶ but no yardstick had been prescribed for "Traffic Allowance⁶". There were wide variations (between 7 to 38 per cent) in the allocation of Traffic allowances across trains and zones. As a result, similar trains with similar infrastructure had varied scheduled speeds in different zones across the route.

Conflicts in Time Table: - In order to ensure safety, only one train should run in a block section at a time. A Conflict occurs when more than one train are scheduled by Indian Railways in a block section to accommodate higher number of trains in the time table. A conflict results in providing precedence to one train over another and requirement of additional allowances Each precedence results in a loss of about 15 minutes in sectional capacity. Though IR has simulators but does not use the same for time table preparation. Audit carried out simulation analysis on RailSys software for the New Delhi - Howrah route with the help of external consultants. The results indicated 12,466 conflicts of coaching (passenger) trains running in the route.

(i) Congestion at Traffic Nodes: - Line capacity of sections has increased but the handling capacity of traffic nodes (Junction/yard) were not raised in proportion, resulting in bottlenecks. The junctions in saturated routes become a speed breaker and time saved in between sectional running does not result in overall reduction in travel time and/or

⁴ Occupancy free section i.e. no trains are running in that stretch of rail track

⁵ Engineering is a factor of punctuality loss. It includes delay on activities of Engineering department including block bursting, extra caution deployed, rail/ weld failure etc.

⁶ Traffic is a factor of punctuality loss. It causes delays due to precedence, crossing, freight convoy, waiting for signal/ platform, shunting, regaining etc.

improvement in Punctuality. Audit observed abnormal detention of loaded goods trains in various zones (average detention at the choking points of NCR was 01:22 hours to 50:45 hours in 2018-19; In Tondiarpet Marshalling yard of SR, 51 *per cent* of the trains were detained out of 3,362 trains during 2018-19; In Bondamunda yard of SER, the average detention in case of rake examination at the Marshalling Yard for loaded rakes were 4:00 hours in 2018-19).

(B) Train Delay on Engineering account: -

Detention on account of “Engineering” is classified under 12 categories and the major categories are ‘Extra caution deployed (due to Permanent and Temporary Speed Restriction⁷)’, ‘Block bursting’⁸, ‘Rail/Weld failures’, and ‘Waterlogging’. Audit found that number of trains delayed for extra caution drive increased from 1823 during 2016-17 to 51040 during 2018-19. Frequent cases of block bursting were noticed in the year 2018-19 in NCR, ER, ECR and NR. In the six divisions of NCR, ER and ECR falling in NDLS-HWH route, total 4659 trains were delayed on account of 1905 cases of block bursting. The average time of block bursting was ranged between 38 minutes and 103 minutes. The delay on account of engineering asset failure rose from 4.89 per cent in 2015-16, to 14.81 per cent during 2018-19.

(C) Planned Block for Maintenance Activities: -

Track is a basic requirement for train operations. Travel time and Punctuality of trains are directly affected with ongoing work of maintenance on the track. Audit noticed various deficiencies in this activity.

(i) **Not using of integrated corridor block by the departments of ZRs:** In 2016, the IR advised that Inspection/testing/maintenance of track/ signalling/railway electrification asset requires fixed time integrated corridor blocks⁹ for maintenance of asset or dedicated corridor blocks as per world railway practices. Audit observed that the integrated blocks taken by various departments in 11 Zones in March 2019 was 2.2 per cent only. Balance 97.8 per cent of the blocks were availed by departments in isolation. Further, against the prescribed norms i.e. one corridor block of 240 minutes or two corridor blocks of 150 minutes each, the Zonal Railways were either taking corridor blocks for more than the prescribed norms or less than the prescribed norms. The prime reasons for deviation from the provisions were the train's late running, introduction of new/special trains as well as running of all Goods trains without any scheduled timing.

(ii) **Trains are scheduled during corridor block:** Audit observed that during planning for the corridor block for maintenance, trains were scheduled for running during corridor blocks. This hampered the maintenance work, as corridor blocks could not be utilised due to these trains' running during the time of availability of corridor blocks.

⁷ Speed Restrictions (TSR) are imposed either on account of defects in track and related equipment or to facilitate repairs to the track and OHE and signalling installations. Caution orders are issued by the Operating Department to restrict the speed of the train for carrying out repairs to tracks.

⁸ When the blocks granted by the Operating Department for carrying out maintenance works are utilized over and above the fixed time limit, the block is said to have been burst.

⁹ Corridor Block is the fixed timing notified in the Working Time Table of Zonal Railways for maintenance works. Integrated blocks is when all departments take advantage of the block time.

(iii) **Block bursting**¹⁰: The extra time taken due to block bursting has a cascading effect on the train operations viz., detention to Rolling Stock, punctuality loss etc. Examination of data revealed that despite the daily provision of corridor block for maintenance, frequent cases of block bursting were noticed in the year 2018-19. In the six divisions falling in NDLS-HWH route, total 4,659 trains were delayed on account of 1,905 cases of block bursting. The main reason that bursting of planned block takes place due to lack of proper coordination between men, machine and materials.

(iv) **Improper Maintenance led to Asset Failures**: Maintenance are directly linked with Asset failures, which influence asset availability, i.e., asset uptime/downtime. Out of the 33 factors impacting punctuality, 10 factors¹¹ are directly/indirectly related to Asset failures. Asset failure is one of the reasons for the primary¹² and secondary delay. Due to the interdependence in railway systems, the primary initial delays of trains may cause a whole cascade of secondary delays¹³ of other trains over the entire network. In the year 2018-19, there were 4,10,059 cases of asset failures which occurred under the five classes (Blocks, Electrical, Engineering, Mechanical, Signal and Telecommunication) and 5,86,955 trains were delayed.

(D) **Rescheduling of Trains**: - IR initiated action for standardization of rakes to enable flexibility in train operations and improve Punctuality. As on 01 July 2019, 1000 rakes out of 2700 (37 per cent) have been standardized/integrated and no timeline has been fixed for complete standardization. Analysis of rescheduling cases in zonal railways revealed that in 86 per cent cases reason of rescheduling was late arrival of link rake at originating station.

3.2 Issues Pointed out by Audit in Travel Time of Trains: -

Travel time is the time taken by a passenger on the train from the originating point to the destination. It is in the endeavour of IR to reduce the travel time so that the passengers spend minimum time on the train. The result of the factors examined by Audit in respect of the Coaching Trains and Goods trains is detailed below: -

(A) Issues related to Coaching (Passenger) Train Operation:

(i) **Permissible speed for coaching trains**: - Indian Railways despite having the higher capacity of locomotives, rolling stock and track, had fixed the scheduled speed of coaching trains on lower side which was not at par with the rated capacity of the rolling stock and Maximum Permissible Speed of the section.

(ii) **Stoppages**: Longer and frequent stoppages create congestion at Junction points and enroute which reduce over-all speed of the railways. Increase in number of stoppages impedes the reduction of travel time. It increases operational cost, cycle of acceleration/deceleration, and precedence¹⁴. It also demands additional infrastructure viz. loops, Platforms and Signals at stations. Provision of Halt time at the junctions in the

¹⁰ Blocks are granted by the Operating Department to various departments for carrying out maintenance works and are granted for a fixed time period only. When the blocks that have been granted are utilized by the various departments over and above the time limit, the block is said to have been burst.

¹¹ DDLS, IDSL, DELC, IELC, DCW, ICW, OHE, ENG, ST and ELEC

¹² The Primary delays, also called initial delays or source delays, are those delays that are caused by a failure/disturbance.

¹³ Secondary delays, or knock-on delays, are delays which are caused by earlier delays.

¹⁴ Precedence is protocol of preference given to a train to overtake another train

working time table of coaching trains was analyzed in Audit and it was observed that the halts at junctions were not standardized and varied widely. Audit noticed that there were huge number of unjustified stoppages (SECR 113 SR: 30, SCR: 325, temporary stoppages (NEFR: 129 NWR: 35 SECR: 109), experimental stoppages (SECR: 125 ER: 10 long-distance Mail/Express trains at three stations) continued for long time in various zones.

(B) Issues related to Goods Train Operation: -

(i) **Slow Movement of Goods Trains:** Audit analysis revealed that the speed of the freight trains declined rapidly and majority of the rakes were operated in a lower speed range up to 20 Kmph. As per the prescribed parameters of Research Design & Standard Organisation (RDSO), the rated capacity of speed of wagons is 60-75 Kmph in loaded condition and 80-95 Kmph in empty conditions. Audit analysed the speed of Goods trains in loaded and empty conditions from the FOIS data with reference to the parameters prescribed by RDSO in six zonal railways and found that even the halfway mark of the prescribed speed for loaded and empty rakes was not achieved.

(ii) **Lack of Right Powering:** Right powering of freight trains to increase the average speeds of trains as well as to improve traffic throughput was accorded approval with Horsepower-Trailing Load (HP/TL) ratio close to 2.0. Appropriate HP/TL ratio saves about 10 to 12 minutes in the time taken to attain the maximum speed level. Internationally, the HP/TL ratio is between 2-2.25, whereas for IR the HP/TL ratio was 0.94- 1.13 in 2016. The lack of right powering led to usage of multi engines for hauling of rakes which could have been hauled by single engines and in some cases it also leads to stalling due to inadequate power. Audit noticed that lack of right powering in Zonal Railways led to stalling of goods trains. (During 2018-19, there were 64, 156 and 65 cases of stalling of Goods trains in ER, SECR and NCR respectively due to inadequate powering in hauling heavily loaded rakes; in NCR, 201 trains (110 coaching and 91 Goods) were delayed for 5,116 minutes due to 65 cases of stalling; In NWR's freight terminals, during May 2018, out of 141 freight trains, only six trains were running with right powering standards).

(C) Problems at Interchange Points: Audit noticed that huge cases of punctuality loss in handing over/ taking over of both coaching and goods trains at interchange points¹⁵. Average detention of coaching trains in Gudur (SR – SCR), Duvvada (SCR – ECoR) and Nagpur (CR-SECR) were 1384 min, 758 min & 482 min respectively. For goods trains, maximum detention was in Jharsuguda of SER – SECR (range 2- 11936 min), NKJ of SECR – WCR (range 171 -262 minutes), Bhadrak of ECoR – SCR (range 151-248 minutes).

4. Assignment Questions:

- What are the major critical factors impacting Punctuality in IR?
- What was the impact of Scheduled Speed & Average Speed of trains in IR?
- What are the adverse effects of stoppages introduced by IR?

¹⁵ Interchange points are the boundaries between Zones and Divisions

- What was the impact of Asset Failures?
- What were the deficiencies in Goods Trains operations by IR?
- What was the impact of investment made by IR to improve punctuality and travel time?
- What will be the possible replies of the Railways to the objections pointed out by Audit?

□

Section 2 – Teaching Notes for the Instructor

1. Synopsis:

In the instant case, audit scrutiny revealed that IR failed to improve on the mobility outcomes viz., punctuality and travel time reduction despite of investment over Rs.2.5 lakh crore on track infrastructure during 2008-09 to 2018-19. Failure by IR to control critical factors and continuation huge numbers of unjust stoppages had adverse effect on both punctuality and travel time. There was no assured delivery time by Goods consignments and actual speed of goods trains was very low and could not be improved for many years.

2. Teaching and Learning Objectives

2.1 To improve the ability of the participants to form audit opinions and anticipate the replies from the auditable unit and counter the replies through group discussion and presentation.

2.2 To make the participants gain knowledge of

- Major factors impacting punctuality of trains monitored through ICMS.
- Other important factors pointed out by Audit impacting punctuality and travel time
- Problems in travel time of Goods Trains
- Outcome analysis of expenditures made by IR for infrastructure development

2.3 Refining the skills of participants' in tackling responses from the auditable units to the audit observations. They will all learn and appreciate the need to collect reliable evidences so that responses from the auditable units can be suitably refuted.

3. Target Audience

The case study is prepared for the auditors which include Auditors cadre as well as Group A and Group B officers' of IA&AD.

4. Relevant Readings

Following topics/documents are relevant to the case study, which requires to be studied and disseminated to the participants' for better understanding of the case study:

(A) Documents related to IA&AD

- Performance Audit Guideline
- Paragraph no. 2.1 of Compliance Audit Report no. 22 of 2021 of Union Government (Railways)

(B) Documents related to Department specific other than IA&AD

- Indian Railways Vision 2020 (December 2009);
- Mission Raftaar (2016);

- Indian Railways policy letters
- Operating manual of Indian Railways and
- Trains at a glance July 2019
- National Logistic Policy, 2022

4.1 Failure of internal control and lacuna in policy of Indian Railways.

- Despite knowing the critical internal factors through ICMS which impacted the punctuality of trains, IR failed to take adequate action to minimize those factors.
- Stoppage Policy of IR has not been reviewed and sometime decision taken has not been implemented
- Speed Policy of IR has not been changed much despite introduction of new types of locos and rolling stock.
- Problems in handing over/ taking over of trains at Interchange Points was well known to IR but action has not been taken to solve this issue at ground level.
- Right Powering of Locos have not been done by IR.
- Time Table preparation process has not been changed for long time and age old manual system was followed although IR have two systems viz. SATSANG & RailSys which could be used for preparing time tables.

5. Assignment Questions

Instructor may encourage the participants to raise questions during the presentation and the following are vital audit questions that need to be raised:

(I) Questions relating to requirement of records/documents to be collected from auditable entity:

- What is the speed policy of IR?
- What is stoppage policy of IR?
- How the time table is prepared?
- What are the reports generated through ICMS?
- How much expenditure was made in various infrastructure works?

(II) Questions that requires audit analysis:

- What are the major critical factors impacting Punctuality in IR?
- What was the impact of Scheduled Speed & Average Speed of trains in IR?
- What are the adverse effects of stoppages introduced by IR?
- What was the impact of Asset Failures?
- What were the deficiencies in Goods Trains operations by IR?
- What was the impact of investment made by IR to improve punctuality and travel time?

(III) Question on logistic policy and SDG:

- What are targets till 2030?
- Which target in SDG goal are linked to transport?

6. Teaching Plan:

6.1 Time allotment:

Particulars	Time allotted
Introduction and Setting up the situation	15 minutes
Discussion of background	10 minutes
Evaluating the alternatives	25 minutes
Discussion of “what happened”	15 Minutes
Case wrap-up	10 minutes

6.2 At first, the instructor will describe the background and facts of the event of the case study through a presentation (**Annexure VII**). Then, the participants will have an opportunity to study the case and present their audit opinions. Lastly, the instructor will conclude considering the views of the participants.

6.3 Then, the participants may be divided into two groups (Team A and Team B). Team A may present their views as an auditor and Team B may present their views as an auditable entity on the above case. The instructor may be the mediator and give his/her opinions and views on the audit opinions formed by Team A and replies of Team B.

6.4 Give a break to the participants and ask them to form opinions from the perspective of the auditor and Auditable Entity. Ask the participants to note down the records/evidences that need to be checked/collected for the above audit paragraph.

6.5 After the break, ask the participants to name the records/evidences that need to be checked/collected. The participants may name a few items from the list below. Spell out the left out records and discuss each of the following documents, along with their importance:

6.6 Thereafter, ask participants one by one from Team A to form an audit finding, based on the evidences collected and from Team B to counter/give a suitable reply to the audit finding till most of the possible audit findings and replies have been brought out and discussed.

6.7 The instructor may be the mediator throughout the process and give his/her opinion on each of the audit finding and reply. He/She could also suggest the possible audit findings and replies, if the participants are unable to bring forth all the possible findings/replies.

7. Suggested/possible answers to assignment questions:

(I) Questions relating to requirement of records/documents to be collected from auditable entity:

Sl. No.	Question	Suggested reply
(I) Questions relating to requirement of records/documents to be collected from auditable entity		
1	What is the speed policy of IR?	The Working Time Table of Indian Railways is the source from where speed of trains can be compiled. Speed policy framework for IR has been described in RB's letter dated 12/8/2018 (Annexure I).
2	What is stoppage policy of IR?	IR has policy letters on this issue which can be given by Zonal Railways/ Divisions Operating Department; it may be available in the website also.
3	How the time table is prepared?	Records related to this are available in Zonal Railways/Divisions Operating Department;
4	What are the reports generated through ICMS?	Viewing rights of ICMS (ID & Password) is required to generate reports; it is provided by the Zonal Railways Operating Department with the consent of CRIS.
5	How much expenditure was made in various infrastructure works?	Plan Head wise expenditure booked can be collected from the Zonal Railways' Accounts Department.
Questions that requires audit analysis:		
1	What are the major critical factors impacting Punctuality in IR?	Detention Reports in ICMS on 33 critical factors have to be checked and emphasis may be given to the 6 internal critical factors affecting punctuality.
2	What was the impact of Scheduled Speed & Average Speed of trains in IR?	ICMS reports have to be checked to find out the punctuality performance of zonal railways. Train wise data have to be checked to find out the actual travel time.
3	What are the adverse effects of stoppages introduced by IR?	Justification of stoppages is to be checked with reference to the policy guidelines of IR.
4	What was the impact of Asset Failures?	ICMS data regarding Asset Failures have be checked.
5	What were the deficiencies in Goods Trains operations by IR?	Detention data of Junctions/Yards, interchange points of goods trains has to be collected and analyzed.

6	What was the impact of investment made by IR to improve punctuality and travel time?	To be checked with the Actual Average Speed, Punctuality and Travel Time.
Question on logistic policy and SDG		
1	What are targets till 2030 in National Logistic Policy?	➤ Reduce cost of logistics in India to be comparable to global benchmarks by 2030. ➤ Logistics Performance Index ranking – endeavor to be among top 25 countries by 2030, and ➤ Create data driven decision support mechanism for an efficient logistics ecosystem.
2	Which target in SDG goal are linked to transport?	Target of 9.1 and 11.2 of Sustainable Development Goal focusses on sustainable transport with special attention to the needs of those in vulnerable situations, women, and children, persons with disabilities and older persons by 2030.

8. Suggested teaching methods

- Presentation by instruction with PowerPoint for making the participants' aware of the case objectives.
- Group Discussion of the case along with reference documents.
- Self-reading to improve the understanding of functioning of IR with respect to Punctuality and Time travel.
- Questionnaire.
- Presentation by the participants.

9. What happened subsequently

9.1 Interim Replies given by the Auditee Entity (Indian Railways):

(A) Ministry of Railways replied that IR regularly monitors and takes corrective action for cases of punctuality loss at Divisional, Zonal and Railway Board levels. The decline in performance is to be seen with respect to the reasons on case to case basis. Further, there has been an exponential increase in the number of passenger services, with IR on an average introducing around 200 trains per year, without commensurate enhancement of the infrastructure works. All out efforts are being made out to speed-up and improve the punctuality of the trains within the existing infrastructure. Further, exercise of rationalization of Time Table is an ongoing process on Indian Railways. 362 passenger trains have been converted into Mail/Express trains by speeding up while 120 Mail/Express have been converted into superfast service. An increase of 5 per cent in the average speed of passenger train services has been achieved, by rationalization of Time Table.

The reply is not convincing as punctuality performance which was 79 per cent during 2012-13 decreased to 75.69 per cent during 2019-20; Six internal factors, which contributed to 66 per cent and could have been controlled well by IR, were not addressed adequately. Audit is of the view that the increase of only 3.5 per cent of average speed in over 10 years is not a perceptible achievement despite upgradation of track infrastructure, rolling stock and signalling system..

(B) Ministry of Railways replied that block bursting takes place due to lack of proper coordination between men, machine and materials. Zonal Railways have been instructed to schedule integrated maintenance activities involving all the maintenance departments, within the stipulated corridor block period, in order to achieve optimal output.

(C) Ministry of Railways replied that a thorough review of all stoppages, including experimental stoppages, existing over Indian Railways, is being undertaken, stoppages having low footfall are being identified and proposed for withdrawal.

(D) Ministry of Railways replied that the recommendations, as made by the Audit, for improvement in average and maximum speed, punctuality and other aspects of trains operation have been noted. Indian Railways would make sincere efforts within its infrastructure / resources for betterment of its services, both passenger and freight operations. As regards target date for achieving the desired increase in the average and maximum speed of Passenger and Freight trains, it is stated that improvement in average speed and other related issues is an ongoing process & subject to availability of resources including rolling stock, locomotives & infrastructurelike tracks, OHE, signalling gears etc

(E) Ministry of Railways replied that at present, preparation of time-table of trains are done manually on master chart. However, in current time tabling exercise help of IITB and SATSaNG software of CRIS has been taken for framing of time table. This has resulted in increased time for maintenance corridor from 2 hours to 3 hours on main lines and also increased number of freight path.

9.2 Final Reply Auditee Entities (Indian Railways):

(a) Ministry of Railways replied (November 2021) that the recommendations, as made by the Audit, for improvement in average and maximum speed, punctuality and other aspects of trains operation have been noted. Indian Railways would make sincere efforts within its infrastructure / resources for betterment of its services, both passenger and freight operations. As regards target date for achieving the desired increase in the average and maximum speed of Passenger and Freight trains, it is stated that improvement in average speed and other related issues is an ongoing process & subject to availability of resources including rolling stock, locomotives & infrastructurelike tracks, OHE, signalling gears etc.

(b) Ministry of Railways replied (November 2021) that at present, preparation of time-table of trains are done manually on master chart. However, in current time tabling exercise help of IITB and SATSaNG software of CRIS has been taken for framing of time table. This has resulted in increased time for maintenance corridor from 2 hours to 3 hours on main lines and also increased number of freight path. However, capacity constraint are due to 'Junction Nodes i.e. junction and cross movement of trains'. The infrastructural inputs are required on these nodes on priority.

9.3 Audit Conclusion

At the end of the discussions, the instructor can frame following audit conclusion by summarizing the audit observations, replies and counter replies:

- (A) Despite having higher capacity of rolling stock/infrastructure, the scheduled speeds of coaching trains are not commensurate with their potential. Provision of higher allowances resulted into longer travel time and sub-optimal use of infrastructure.
- (B) Longer and frequent stoppages created congestion at Junction Points and enroute which reduced the overall speed.
- (C) Six main internal critical factors contributing 66 *per cent* of total detention of trains were identified as controllable. Indian Railways did not address these critical factors commensurate to their criticality.
- (D) Asset failures had an increasing trend over the previous years. Despite the provision of integrated corridor blocks in the working time table, maintenance activities were not integrated.
- (E) Indian Railways has no guaranteed delivery time for Goods consignment. This was due to non-scheduling of Goods trains operation. Non-availability of path, congestion at traffic nodes, conflict of paths, longer hour of run in the scheduled Goods paths, delay of through trains in crew change, lack of right powering etc. are the major reasons which resulted in slow speed of Goods trains and adversely affected delivery of freight services.
- (F) Indian Railways despite investing 2.5 lakh crore on track infrastructure during 2008-09 to 2018-19 have failed to improve on the mobility outcomes viz., punctuality and travel time reduction. The average speed of Mail/Express and freight trains is still around 50 Kmph and 23 Kmph, respectively. There has been insignificant improvement in speed of Shatabdi and Rajdhani since their induction in 1970s. Out of 478 superfast trains of Indian Railways, the scheduled speed of 123 superfast trains (26 *per cent*) was less than the specified speed of 55 Kmph.
- (G) Audit conducted a simulation exercise using established software with the assistance of an external expert. It revealed that the current Working Time Table for the New Delhi-Howrah route has around 12,466 conflicts. Simulation indicated that there were significant differences between line capacity utilization figures claimed and those obtained in simulation, indicating over pitching of line capacity utilization. Thus, there is a significant scope of improvement to reduce travel time and improve punctuality within the existing resources.

GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS
(RAILWAY BOARD)

No. 2017/Mobility/2/3

Date: 08/06/18
12

General Manager, All Indian Railways/PUs, NF (Const.), CORE
DG/RDSO/Lucknow, DG/NAIR
CAOs, DMW/Patiala, WPO/Patna, COFMOW/NDLS, RWP/Bela, CAO/TROAF
Director-IRICEN, IRITM, IRIMEE, IRIEEN, IRITM, IRISSET
CMD/MD of all PSUs

Sub: Speed Policy framework for Indian Railways

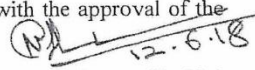
With a view to achieve goals of Mission Raftaar by 2022, a comprehensive review of various speed raising initiatives has been done by the Board. It has been noted that benefit of many such speed raising initiatives has not been fully realized as initiatives taken by various departments/zonal railways were not in sync thus restricting the maximum permissible speeds by the most limiting factor.

In order to align various speed raising initiatives, Board has now approved following speed policy framework:

- GQ and Diagonal routes (and any other identified routes) should be upgraded seamlessly for speed potential of 160kmph.
- All other remaining routes on BG network should be upgraded seamlessly for speed potential of minimum 130kmph.
- For speeds above 160kmph, only exclusive corridors should be considered. Such corridors could also be considered on PPP mode.
- Speed upgradation initiatives should be taken on route wise basis keeping all inputs of fixed infrastructure (track, signalling, OHE etc.) and rolling stock (coaches, locomotive) in sync with the targeted speed potential of that route.
- For new line construction, track geometry should be for 160kmph and minimum MPS on opening should be 130kmph. There should be no level crossings on new lines. For Gauge Conversion/ Doubling/ 3rd line etc. minimum MPS should be 130kmph with no unmanned level crossings.

Zonal Railways may take appropriate action for compliance.

This issues in supersession of all previous instructions on this subject with the approval of the competent authority.


(Naveen Kumar Shukla)
PED(Mobility)

1. PS to MR, PS to MOS(S), PS to MOS(G); OSD/MR
2. For kind information of CRB, FC, ME, MTR, MS, MT, MRS, SECY, DG(S&T), DG(Stores), DG(Pers)
3. All AMs & PEDs Railway Board: To take action for harmonizing their respective policy letters, codes and manuals in accordance with the above policy framework

Annexure-II**Details of 33 critical factors in ICMS affecting Punctuality of Indian Railways**

Sr.	Code	Description	Sub code	Sub code desc.
1	ACP	ALARM CHAIN PULLING	DACP	DIRECT ALARM CHAIN PULLING
			REPER_P	REPERCUSSION OF PAST RUNNING DELAY
			IACP	INDIRECT ALARM CHAIN PULLING
2	MA	MISCREANTS ACTIVITY	ODAC	OTHER THEN PASSENGER DECOITY
			OTFT	OTHER THEN PASSENGER THEFT
			PDAC	PASSENGER DECOITY
			PTFT	PASSENGER THEFT
			REPER_P	REPERCUSSION OF PAST RUNNING DELAY
3	AGT	AGITATION		
4	ACC	ACCIDENT	REPER_P	REPERCUSSION OF PAST RUNNING DELAY
5	DDSL	DIESEL LOCO (DIRECT)	DSDF	DIESEL LOCO DIRECT FAILURE
			DSL T	DIESEL LOCO LATE TURNOUT FROM SHED
			DSRC	DIESEL RUNNING CREW LATE TURN UP OR MISSMANAGED BY CREW
			DSRF	DIESEL RUNNING FUELING ACCOUNT
			DSRL	DIESEL RUNNING LINE BOX
			REPER_P	REPERCUSSION OF PAST RUNNING DELAY
			SNWWE A	SANDER NOT WORKING/WEATHER
			OTH	OTHERS
6	IDSL	DIESEL LOCO (INDIRECT)	IDSF	DIESEL LOCO INDIRECT FAILURE
			REPER_P	REPERCUSSION OF PAST RUNNING DELAY
			IDSR	DIESEL RUNNING INDIRECT
			SNWWE A	SANDER NOT WORKING/WEATHER
			UDDMU	UNIT DEFECT DMU

7	DELC	ELECTRIC LOCO (DIRECT)	DSDF	ELECTRIC LOCO DIRECT FAILURE
			DSLTT	ELECTRIC LOCO LATE TURNOUT FROM SHED
			DSRC	ELECTRIC RUNNING CREW LATE TURN UP OR MISMANAGEMENT BY CREW
			DSRF	ELECTRIC RUNNING FULING ACCOUNT
			DSRL	ELECTRIC RUNNING LINE BOX
			REPER_P	REPERCUSSION OF PAST RUNNING DELAY
			SNWWE A	SANDER NOT WORKING/WEATHER
			OTH	OTHERS
8	IELC	ELECTRIC LOCO (INDIRECT)	IDSF	ELECTRIC LOCO INDIRECT FAILURE
			IDSR	ELECTRIC RUNNING INDIRECT
			REPER_P	REPERCUSSION OF PAST RUNNING DELAY
			SNWWE A	SANDER NOT WORKING/WEATHER
9	INC	INCIDENT	REPER_P	REPERCUSSION OF PAST RUNNING DELAY
10	OTH	OTHERS	DODIV	DISRUPTION IN OTHER DIVISION
			REPER_P	REPERCUSSION OF PAST RUNNING DELAY
			MISC	MISCELLANEOUS
11	DCW	CARRIAGE AND WAGON (DIRECT)	ACO	ANGLE COCK OPERATED
			HP	CONTINUITY PIPE DISCONNECTED
			OTH	OTHERS
			PAR	PARTING
			PT	PRESSURE TROUBLE
			REPER_P	REPERCUSSION OF PAST RUNNING DELAY
			HA	HOT AXLE
12	ICW	CARRIAGE AND WAGON (INDIRECT)	ACO	ANGLE COCK OPERATED
			REPER_P	REPERCUSSION OF PAST RUNNING DELAY
			HP	CONTINUITY PIPE DISCONNECTED
			PAR	PARTING

			PT	PRESSURE TROUBLE
			OTH	OTHERS
			HA	HOT AXLE
13	OHE	OHE/GRID FAILURE	ATF	AT FAILURE
			BBOHE	OHE BLOCK BURST
			CT	OHE THEFT
			GRID	OHE GRID FAILURE
			OHE	OHE FAILURE
			OTH	OTHERS
			REPER_P	REPERCUSSION OF PAST RUNNING DELAY
			WEA	WEATHER
14	ENG	ENGINEERING	BB	BLOCK BURSTING
			BF	BANNER FLAG
			CD	EXTRA CAUTION DEPLOYED
			GM	GATEMAN
			GTF	GLUED JOINT FAILURE
			NPM	NIGHT PATROL MAN NOT TURNED UP
			OTH	OTHERS
			REPER_P	REPERCUSSION OF PAST RUNNING DELAY
			RF	RAIL FAILURE
			WF	WELD FAILURE
			WL	WATER LOGGING
			TRB	TONGUE RAIL BROKEN
15	ST	SIGNAL AND TELECOM	REPER_P	REPERCUSSION OF PAST RUNNING DELAY
			SF	SIGNAL FAILURE(OTHER THAN ADV STARTER AND HOME)
			HSF	HOME SIGNAL FAILURE
			ADF	ADVANCE STARTER FAILURE
			AUF	AUTOMATIC SIGNAL FAILURE
			GF	GATE SIGNAL FAILURE
			IBSF	INTERMEDIATE BLOCK SIGNAL FAILURE
			BIF	BLOCK INSTRUMENT FAILURE
			BACF	BLOCK AXLE COUNTER FAILURE
			TCF	TRACK CIRCUIT FAILURE
			PTF	POINT FAILURE
			RRIPF	RRI/PI FAILURE
			SSIF	SSI FAILURE
			SPEF	SIGNAL POWER EQUIPMENT FAILURE

			CCF	CONTROL COMMUNICATION FAILURE
			BB	BLOCK BURST
			CT	CABLE THEFT
			ET	EQUIPMENT DAMAGE/THEFT BY OUTSIDER
			WEA	WEATHER
			LIG	LIGHTENING
			OTH	OTHERS
16	ELEC	ELECTRIC DEFECT	DAC	AC PLANT DEFECT OR NOT WORKING
			DTL	TRAIN LIGHTING PROBLEM
			ENG.EL	ENGG.ELEC
			OTH	OTHERS
			REPER_P	REPERCUSSION OF PAST RUNNING DELAY
			UDMU	UNIT DEFECT OF EMU
17	WEA	BAD WEATHER	CY	CYCLONE
			FL	FLOOD
			FOG	FOG
			LD	LANDSLIDE
			REPER_P	REPERCUSSION OF PAST RUNNING DELAY
18	RUNO	RUN OVER	CRO	CATTLE RUNOVER
			HRO	HUMAN RUNOVER
			REPER_P	REPERCUSSION OF PAST RUNNING DELAY
19	CNST	CONSTRUCTIO N	ELEC	ELECTRICAL
			ENG	ENGINEERING CNST
			IRCON	CONSTRUCTION BY IRCON
			IRSDC	CONSTRUCTION BY IRSDC
			OHE	OVER HEAD
			REPER_P	REPERCUSSION OF PAST RUNNING DELAY
			UTES	CONSTRUCTION BY UTES
			RVNL	CONSTRUCTION BY RVNL
			ST	SIGNAL CNST
20	TFC	TRAFFIC	D	PRECEDENCE
			E	CROSSING
			FC	FREIGHT CONVOY
			GM	GATEMAN
			K	WAITING FOR SIGNAL
			PF	FOR PLATEFORM
			REPER_P	REPERCUSSION OF PAST RUNNING DELAY

			RGNG	REGAINING.
			SHNT	SHUNTING.
			TFC	NORMAL TRAFFIC
21	COM	COMMERCIAL	CP	CHART PASTING
			LD	LOADING
			OTH	OTHERS
			REPER_P	REPERCUSSION OF PAST RUNNING DELAY
			RES	RESERVATION
			TKT	TICKETING
			ULD	UNLOADING
22	PATH	OUT OF PATH	REPER_P	REPERCUSSION IMPACT DUE TO PAST DELAYED RUNNING
23	ORL	FROM OTHER RAILWAY	LINEC	LINE CLEAR
			REPER_P	REPERCUSSION OF PAST RUNNING DELAY
			OS	OUTSIDE STATION
			SLOWC	SLOW CLEARANCE
			WF	WRONG FEEDING
			TOS	TRAIN ON SECTION
24	LO	LAW AND ORDER	B	BANDH
			LOP	LAW AND ORDER PROBLEM
			RALLY	RALLY
			REPER_P	REPERCUSSION OF PAST RUNNING DELAY
			SEC	SECURITY THREATS
25	LC	LC GATE	BR	BOOM BROKEN
			RD	HEAVY ROAD TRAFFIC
			REPER_P	REPERCUSSION OF PAST RUNNING DELAY
			V DASH	VECHILE DASHED
			VD	VECHILE DISABLE
26	RL	RE-SCHEDULING OF TRAIN RUNNING WITHIN RAILWAY	LALR	LATE ARRIVAL OF LINK RAKE
			LO	DUE TO LAW AND ORDER
			OTH	OTHER THAN LAW AND ORDER
			REPER_P	REPERCUSSION OF PAST RUNNING DELAY

27	RF	RE- SCHEDULING OF TRAIN RUNNING WITH IN DIFFERENT RAILWAY	LALR	LATE ARRIVAL OF LINK RAKE
			LO	DUE TO LAW AND ORDER
			OTH	OTHER THAN LAW AND ORDER
			REPER_P	REPERCUSSION OF PAST RUNNING DELAY
28	RE	RAILWAY ELECTRIFICATI ON	CT	CABLE THEFT
			OHE	OHE
			OTH	OTHERS
			REPER_P	REPERCUSSION OF PAST RUNNING DELAY
			ST	SIGNAL AND TELECOM
29	CONNI	NON INTERLOCKIN G WORKING CONSTRUCTIO N	PENG	NON INETRLOCKING WORKING PLANNED ENGGN
			POHE	NON INTERLOCKING WORKING PLANNED OHE
			PST	NON INTERLOCKING WORKING PLANNED S AND T
			PTR	NON INTERLOCKING WORKING PLANNED TRAFIC
			REPER_P	REPERCUSSION OF PAST RUNNING DELAY
			UPENG	NON INTERLOCKING WORKING UNPLANNED ENGGN
			UPOHE	NON INTERLOCKING WORKING UNPLANNED OHE
			UPST	NON INTERLOCKING WORKING UNPLANNED S AND T
			UPTR	NON INTERLOCKING WORKING UNPLANNED TRAFFIC
30	PRONI	NON INTERLOCKIN G WORKING PROJECT	PENG	NON INTERLOCKING WORKING PLANNED ENGGN

			POHE	NON INTERLOCKING WORKING PLANNED OHE
			PST	NON INTERLOCKING WORKING PLANNED S AND T
			PTR	NON INTERLOCKING WORKING PLANNED TRAFFIC
			REPER_P	REPERCUSSION OF PAST RUNNING DELAY
			UPENG	NON INTERLOCKING WORKING UNPLANNED ENGGN
			UPOHE	NON INTERLOCKING WORKING UNPLANNED OHE
			UPST	NON INTERLOCKING WORKING UNPLANNED S AND T
			UPTR	NON INTERLOCKING WORKING WORKING UNPLANNED TRAFFIC
31	OPLNI	NON INTERLOCKIN G WORKING OPEN LINE	PST	PLANNED SIGNAL AND TELECOM
			REPER_P	REPERCUSSION OF PAST RUNNING DELAY
			PENG	PLANNED ENGINEERING
			POHE	PLANNED OHE
			PTR	PLANNED TRAFFIC
			UPST	UNPLANNED SIGNAL AND TELECOM
			UPENG	UNPLANNED ENGINEERING
			UPOHE	UNPLANNED OHE
			UPTR	UNPLANNED TRAFFIC
32	PBOL	PLANNED BLOCK OPEN LINE	PBELOL	PLANNED BLOCK ELECTRICAL
			PBEOL	PLANNED BLOCK ENGINEERING
			PBOHEO	PLANNED BLOCK OHE
			PBSTOL	PLANNED BLOCK S AND T
			PBTOL	PLANNED BLOCK TRAFFIC
			REPER_P	REPERCUSSION OF PAST RUNNING DELAY
33	PBC	PLANNED BLOCK CONSTRUCTIO N	PBEC	PLANNED BLOCK ENGINEERING
			PBELC	PLANNED BLOCK ELECTRICAL
			PBOHEC	PLANNED BLOCK OHE
			PBSTC	PLANNED BLOCK S AND T

			PBTC	PLANNED BLOCK TRAFFIC
			REPER_P	REPERCUSSION OF PAST RUNNING DELAY

Annexure-III

List of Zonal Railways in India

Sl. No	Zonal Name	Abbr.	Headquarters	Divisions
1.	Central	CR	Mumbai	Mumbai, Bhusawal, Pune, Solapur, Nagpur
2.	East Central	ECR	Hajipur	Danapur, Dhanbad, Mughalsarai, Samastipur, Sonpur
3.	East Coast	ECoR	Bhubaneswar	Khurda Road, Sambalpur, Visakhapatnam
4.	Eastern	ER	Kolkata	Howrah, Sealdah, Asansol, Malda
5.	North Central	NCR	Allahabad	Allahabad, Agra, Jhansi
6.	North Eastern	NER	Gorakhpur	Izzatnagar, Lucknow, Varanasi
7.	North Western	NWR	Jaipur	Jaipur, Ajmer, Bikaner, Jodhpur
8.	Northeast Frontier	NFR	Guwahati	Alipurduar, Katihar, Lumding, Rangia, Tinsukia
9.	Northern	NR	Delhi	Delhi, Ambala, Firozpur, Lucknow, Moradabad
10.	South Central	SCR	Secunderabad	Secunderabad, Hyderabad, Guntakal, Guntur, Nanded, Vijayawada
11.	South East Central	SECR	Bilaspur	Bilaspur, Raipur, Nagpur
12.	South Eastern	SER	Kolkata	Adra, Chakradharpur, Kharagpur, Ranchi
13.	South Western	SWR	Hubli	Hubli, Bangalore, Mysore
14.	Southern	SR	Chennai	Chennai, Madurai, Palakkad, Salem, Tiruchchirapalli, Thiruvananthapuram
15.	West Central	WCR	Jabalpur	Jabalpur, Bhopal, Kota
16.	Western	WR	Mumbai	Mumbai Central, Ratlam, Ahmedabad, Rajkot, Bhavnagar, Vadodara

Slide 1

Case Study

Punctuality and Travel Time in Train Operations in Indian Railways

Slide 2

Introduction

The case study on '**Punctuality and Travel Time in Train Operations in Indian Railways**' is based on audit paragraph printed in the C&AG's report (Paragraph No. 2 of Compliance Report No. 22 of 2021 of Union Government (Railways).

- The case study has been prepared to:
 - Aware the participants on various terminologies and issues related with punctuality and travel time of trains viz. Railways speed policy, actual speed of trains, monitoring of punctuality by the Indian Railways, issues/ hindrances to achieve the punctuality targets, expenditure made on the infrastructure development etc. with overall role in logistics.
 - Improving the participant's ability to form (1) audit opinions, (2) anticipate responses to the audit opinions, and (3) collate or collect all essential evidences so that responses received from the auditee can be suitably analyzed and addressed.

Slide 3

Background

Efficient management of operations in running trains is critical to enhance efficiency of operations in Indian Railways which is a major stakeholder of logistic business. National Logistic Policy (September 2022) also envisages world class infrastructure, modern warehousing, digitalisation, regulations, tracing and tracking, ease of arranging shipment and Timeliness. Delay in running of Passenger trains results in poor quality of service to passengers leading to dissatisfaction. The share of railways in logistic sector has come down significantly over the last three decades due to delayed delivery by Goods trains. Therefore, 'Punctuality' and 'Travel time' are two important mobility outcome indicators for operations in Indian Railways.

Slide 4

Background...CONTD

The audit exercise highlights the extent to which IR could have improved punctuality and reduced travel time within existing resources. Moreover, timeliness is the essence of Project Management which have three major components viz. money, manpower and materials and efficient project management would lead to creation of infrastructure in time resulting in fast running of trains. Reduction in logistic cost boost export significantly as per industry estimate. 65% share of cargo movement happens through road which has high input cost. Increasing timeliness of railway would increase the share of railways in logistics which will reduce the cost of goods in all markets. This would help the economic growth of our country tremendously.

Slide 5

Scope of Audit

- Member (Operations and Business Development), Principal Chief Operations Managers (PCOM) of the Zonal Railway and Senior Divisional Operations Managers (Sr. DOM) are directly involved with train operations. All other departments are entrusted with different roles to support the Operating Department.
- The Operation Control system are currently divided into 17 zones, further subdivided into 73 divisions and also been extended to Area Control levels and more than 7000 stations.
- Various IT systems are used for train operation and its monitoring viz. Integrated Coaching Management System (ICMS), Control Office Application (COA), National Train Enquiry System (NTES), Freight Operations Information System (FOIS) consisting of two modules viz. Rake Management System (RMS) to handle the operation portion and Terminal Management System (TMS) for commercial transactions.
- Audit analysed data of ICMS, FOIS, Data Warehouse and Complaint Management System and records of Operating, Engineering, Mechanical, Signal & Telecommunication and Electrical departments. Audit covered 2015-16 to 2018-19 and samples were taken for four months in different seasons viz. Summer, Rainy, Regular and Foggy (May, July, October, and January). Total stations 7321 in 2018-19. Station Master is in overall charge of the station.

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Scope of Audit...CONTD

- ICMS records the data related to the operation of coaching trains and for monitoring the punctuality performance of the trains. The reasons recorded therein for loss of punctuality are important inputs to Management to identify the major causes of hampering punctuality of the trains.

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Audit objectives

The audit objectives were to assess:

- (i) Whether Indian Railways addressed all the critical factors commensurate to their criticality
- (ii) Whether there is any scope of improvement for Indian Railways to reduce travel time and improve punctuality within the existing resources?

Slide 8

Analysis of the critical factors that affect punctuality and travel time

- Indian Railways has invested ₹ 2.5 lakh crore on various track infrastructure works during the period from 2008 to 2019 for improving the mobility of the trains. Target of “Mission Rafiar” launched by IR in 2016-17 was to achieve the average speed of 75 Kmph for Mail/Express trains and 50 Kmph for Goods trains by the end of 2021-22. However, the average speed of Mail/Express and Goods trains until 2019-20 was around 50.6 Kmph and 23.6 Kmph respectively. Moreover, out of 478 superfast (SF) trains, the scheduled speed of 123 SF trains (26 per cent) was less than the specified speed of 55 Kmph. Punctuality and Travel Time are the two mobility outcome indicators.
- Indian Railways (IR) measures the punctuality of trains at the terminating stations. IR provides an allowance of 15 minutes delay with reference to the scheduled time for this measurement. However, the punctuality of mail/express trains over IR declined from 79 percent (2012-13) to 69.23 percent (2018-19). The ICMS captures all the incidents that caused the train operations' delay and these incidents are classified under 33 factors.

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Analysis of the critical factors that affect punctuality and travel time...CONTD

- Audit found that out of those 33 factors 27 factors are controllable internal factors. Out of that 27 factors there are six major factors which contributed to the 65% loss of punctuality. Those factors are Out of path, Engineering, Rescheduling of trains, Delay from other Railways, Planned block open line and Traffic. Audit analyzed the internal factors viz., Path availability, Delay on Engineering account, Delay due to Traffic Block and Rescheduling of trains to assess the impact on the punctuality. Result of the analysis are detailed below:
 - (A) **Train delay due to Allowances and Path Availability:** - Path is the primary requirement for smooth running of trains. The trains starting on right time but get delayed due to non-availability of path which indicate inefficient monitoring mechanism. Following are the assessed causes of non-availability of path: Occupancy free section i.e. no trains are running in that stretch of rail track

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Analysis of the critical factors that affect punctuality and travel time...CONTD

- **Deficiencies in Time-table preparation:** In IR, time table is prepared on manual calculation and the existing timetables are modified based on needs. Allowances are extra time values factored in the time-table with the aim to maintain punctuality of operation in a Timetable. Engineering Recovery Allowance is additional time included in train schedules to cover the impact of planned temporary speed restrictions associated with engineering works on the network. Traffic Recovery allowance is provided to make up of train's delay due to line and block section occupancy in heavy traffic. Audit noticed that IR had prescribed 'yard stick for Engineering Allowance' but no yardstick had been prescribed for "Traffic Allowance". There were wide variations (between 7 to 38 per cent) in the allocation of Traffic allowances across trains and zones. As a result, similar trains with similar infrastructure had varied scheduled speeds in different zones across the route.
- **Conflicts in Time Table:** - In order to ensure safety, only one train should run in a block section at a time. A Conflict occurs when more than one train are scheduled by Indian Railways in a block section to accommodate higher number of trains in the time table. A conflict results in providing precedence to one train over another and requirement of additional allowances. Each precedence results in a loss of about 15 minutes in sectional capacity. Though IR has simulators but does not use the same for time table preparation. Audit carried out simulation analysis on RailSys software for the New Delhi - Howrah route with the help of external consultants. The results indicated 12,466 conflicts of coaching (passenger) trains running in the route.

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Analysis of the critical factors that affect punctuality and travel time...CONTD

- **Conflicts in Time Table:** -
 - (i) Congestion at Traffic Nodes - Line capacity of sections has increased but the handling capacity of traffic nodes (Junction/yard) were not raised in proportion, resulting in bottlenecks. The junctions in saturated routes become a speed limiter and time saved in between sectional running does not result in overall reduction in travel time and/or improvement in Punctuality. Audit observed abnormal detention of loaded goods trains in various zones (average detention at the checking points of NCR was 01:22 hours to 50:45 hours in 2018-19. In Yeshpurat Marshalling yard of SR, 31 per cent of the trains were detained out of 3,362 trns during 2018-19. In Dushanmudi yard of SBR, the average detention in case of rake examination at the Marshalling Yard for loaded rakes were 4:00 hours in 2018-19).

(B) Train Delay on Engineering account:-

- Detention on account of "Engineering" is classified under 12 categories and the major categories are 'Extra caution deployed (due to Permanent and Temporary Speed Restriction)', 'Block bursting', 'Rail/Weld failures', and 'Waterlogging'. Audit found that number of trains delayed for extra caution drive increased from 1823 during 2016-17 to 51040 during 2018-19. Frequent cases of block bursting were noticed in the year 2018-19 in NCR, ER, ECR and NR. In the six divisions of NCR, ER and ECR falling in NDLS-HWH route, total 4659 trains were delayed on account of 1905 cases of block bursting. The average time of block bursting was ranged between 38 minutes and 103 minutes. The delay on account of engineering asset failure rose from 4.89 per cent in 2015-16, to 14.81 per cent during 2018-19.

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Analysis of the critical factors that affect punctuality and travel time...CONTD

(C) Planned Block for Maintenance Activities:-

- Track is a basic requirement for train operations. Travel time and Punctuality of trains are directly affected with ongoing work of maintenance on the track. Audit noticed various deficiencies in this activity.
 - (i) **Not using of integrated corridor block by the departments of ZRs:** In 2016, the IR advised that 'Inspection/testing/maintenance of track/ signalling/railway electrification asset requires fixed time integrated corridor blocks for maintenance of asset or dedicated corridor blocks as per world railway practices. Audit observed that the integrated blocks taken by various departments in 11 Zones in March 2019 was 2.2 per cent only. Balance 97.8 per cent of the blocks were availed by departments in isolation. Further, against the prescribed norms i.e. one corridor block of 240 minutes or two corridor blocks of 150 minutes each, the Zonal Railways were either taking corridor blocks for more than the prescribed norms or less than the prescribed norms. The prime reasons for deviation from the provisions were the train's late running, introduction of newspecial trains as well as running of all Goods trains without any scheduled timing. Corridor Block is the fixed timing notified in the Working Time Table of Zonal Railways for maintenance works. Integrated blocks is when all departments take advantage of the block time.

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Analysis of the critical factors that affect punctuality and travel time...CONTD

(C) Planned Block for Maintenance Activities: -

(ii) **Trains are scheduled during corridor block:** Audit observed that during planning for the corridor block for maintenance, trains were scheduled for running during corridor blocks. This hampered the maintenance work, as corridor blocks could not be utilised due to these trains' running during the time of availability of corridor blocks.

(iii) **Block bursting:** The extra time taken due to block bursting has a cascading effect on the train operations viz., detention to Rolling Stock, punctuality loss etc. Examination of data revealed that despite the daily provision of corridor block for maintenance, frequent cases of block bursting were noticed in the year 2018-19. In the six divisions falling in NDLS-HWH route, total 4,659 trains were delayed on account of 1,905 cases of block bursting. The main reason that bursting of planned block takes place due to lack of proper coordination between men, machine and materials. Blocks are granted by the Operating Department to various departments for carrying out maintenance works and are granted for a fixed time period only. When the blocks that have been granted are utilized by the various departments over and above the time limit, the block is said to have been burst.

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Analysis of the critical factors that affect punctuality and travel time...CONTD

(C) Planned Block for Maintenance Activities: -

(iv) **Improper Maintenance led to Asset Failures:** Maintenance are directly linked with Asset failures, which influence asset availability, i.e., asset uptime/downtime. Out of the 33 factors impacting punctuality, 10 factors are directly/indirectly related to Asset failures. Asset failure is one of the reasons for the primary and secondary delay. Due to the interdependence in railway systems, the primary initial delays of trains may cause a whole cascade of secondary delays of other trains over the entire network. In the year 2018-19, there were 4,10,059 cases of asset failures which occurred under the five classes (Blocks, Electrical, Engineering, Mechanical, Signal and Telecommunication) and 5,86,955 trains were delayed.

(D) **Rescheduling of Trains:-** IR initiated action for standardization of rakes to enable flexibility in train operations and improve Punctuality. As on 01 July 2019, 1000 rakes out of 2700 (37 per cent) have been standardized/integrated and no timeline has been fixed for complete standardization. Analysis of rescheduling cases in zonal railways revealed that in 86 per cent cases reason of rescheduling was late arrival of link rake at originating station.

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Analysis of the critical factors that affect punctuality and travel time...CONTD

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- Details of the Asset Failure of IR over the years is furnished below for information:

Asset failure over IR						
Year	Rail/ Weld fracture	Loco failure	Coach Detachment	Hot axle	OHE	Signal
2012-13	5781	5035	1335	955	368	1,68,259
2015-16	3237	4638	916	726	378	1,38,985
2018-19	5391	24,147	1755	572	2759	1,14,368

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Zone wise details of rescheduling due to late arrival of link rake					
Zonal Railways	Total rescheduling 2018-19	Rescheduling cases due to late arrival of link rake 2018-19	Zonal Railways	Total rescheduling 2018-19	Rescheduling cases due to late arrival of link rake 2018-19
NIR	13198	12279	NWR	1686	1510
ECR	8793	7976	NFR	1667	1395
NER	8049	7188	WR	1509	1241
NER	6394	5919	ECOR	1241	838
WCR	3893	3176	SECR	1146	785
ER	3169	2778	SR	1488	791
CR	2417	1836	SCR	1074	777
SER	2172	1644	SWR	778	590
Total cases in IR				58674	50723 (86 per cent)

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Issues Pointed out by Audit in Travel Time of Trains:-

Travel time is the time taken by a passenger on the train from the originating point to the destination. It is in the endeavour of IR to reduce the travel time so that the passengers spend minimum time on the train. The result of the factors examined by Audit in respect of the Coaching Trains and Goods trains is detailed below:-

(A) Issues related to Coaching (Passenger) Train Operation:

(i) **Permissible speed for coaching trains:-** Indian Railways despite having the higher capacity of locomotives, rolling stock and track, had fixed the scheduled speed of coaching trains on lower side which was not at par with the rated capacity of the rolling stock and Maximum Permissible Speed of the section.

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Table showing Scheduled Speed of Trains:

Scheduled speed of 2011 Express trains - "Trains at a Glance 2"	
Range of speed (kmph)	Number of Express trains
Below 30	107 (1.9 per cent)
30 to 40	239 (7.42 per cent)
40 to 50	653 (11.86 per cent)
50 to 55	318 (10.36 per cent)
55 to 75	1089 (17.42 per cent)
Above 75	62 (2.1 per cent)

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(ii) **Stoppages:** Longer and frequent stoppages create congestion at Junction points and enroute which reduce over-all speed of the railways. Increase in number of stoppages impedes the reduction of travel time. It increases operational cost, cycle of acceleration/deceleration, and precedence. It also demands additional infrastructure viz. loops, Platforms and Signals at stations. Provision of Halt time at the junctions in the working time table of coaching trains was analyzed in Audit and it was observed that the halts at junctions were not standardized and varied widely. Precedence is protocol of preference given to a train to overtake another train.

Audit noticed that there were huge number of unjustified stoppages (SECR: 113 SR: 30, SCR: 325, temporary stoppages (NEFR: 129 NWR: 35

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SECR: 109), experimental stoppages (SECR: 125 ER: 10 long-distance Mail/Express trains at three stations) Stoppage-wise analysis is indicated below:

Stoppage-wise analysis of all Express trains of "Trains at a Glance"(2019)			
Number of stoppages	No of trains	Average stoppage time (H:MS) during a single trip	Acceleration and Deceleration cycle time in minutes (@5 minutes per stoppages
0-5	181	0:16:05	25
6-10	468	0:37:40	30-50
11-20	954	1:18:39	55-100
21-50	1166	3:04:49	105-250
51-75	139	5:36:58	255-375
76-100	33	7:09:31	380-500
More than 100	10	9:18:36	500+

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(B) Issues related to Goods Train Operation:-

(i) Slow Movement of Goods Trains: Audit analysis revealed that the speed of the freight trains declined rapidly and majority of the rakes were operated in a lower speed range up to 20 Kmph. As per the prescribed parameters of Research Design & Standard Organisation (RDSO), the rated capacity of speed of wagons is 60-75 Kmph in loaded condition and 80-95 Kmph in empty conditions. Audit analysed the speed of Goods trains in loaded and empty conditions from the FOIS data with reference to the parameters prescribed by RDSO in six zonal railways and found that even the halfway mark of the prescribed speed for loaded and empty rakes was not achieved.

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The average speed of Goods trains (both outward and inward traffic) for the selected months of May, July, October and January of the year 2015-16 and 2018-19 in seven zonal Railways is detailed below:-

(a) In NCR, ECR and ER, 82 per cent to 95 per cent of the loaded rakes moved with an average speed range of 1-20 Kmph during 2015-16 which increased in NCR and ER to 87 per cent and about 98 per cent during 2018-19. Similarly, in the case of empty rakes, 67 to 80 per cent was running with average speed of 1 -20 Kmph in 2015-16 which was increased in NCR to 74 per cent and in ER to 88 per cent in 2018- 19.

(b) In four zones (SER, ECoR, SCR and SR), 70 per cent of the total rakes moved with average speed range of 1-20 Kmph during 2015-16 which was increased to 75 per cent in 2018-19. 29 per cent of rakes were moved with average speed range of 20-40 Kmph during 2015-16 which was declined to 24 per cent during 2018-19.

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(c) The percentage of rakes in the lowest speed range of 1-20 Kmph increased from 86.01 per cent (2015-16) to 88.17 per cent (2018-19) in NWR, 82.92 per cent (2015-16) to 88.39 per cent (2018-19) in NER, 69.02 per cent (2015-16) to 78.83 per cent (2018-19) in NEFR and 74.05 per cent (2015-16) to 76.06 per cent (2018-19) in WCR. However, slight improvement in case of SER i.e. 81.30 per cent (2015- 16) to 70.70 per cent (2018-19) in the same speed range was noticed

(ii)Lack of Right Powering: Right powering of freight trains to increase the average speeds of trains as well as to improve traffic throughput was accorded approval with Horsepower-Trailing Load (HP/TL) ratio close to 2.0. Appropriate HP/TL ratio saves about 10 to 12 minutes in the time taken to attain the maximum speed level. Internationally, the HP/TL ratio is between 2-2.25, whereas for IR the HP/TL ratio was 0.94- 1.13 in 2016. The lack of right powering led to usage of multi engines for hauling of rakes which could have been hauled by single engines and in some cases it also leads to stalling

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due to inadequate power. Audit noticed that lack of right powering in Zonal Railways led to stalling of goods trains. (During 2018-19, there were 64, 156 and 65 cases of stalling of Goods trains in ER, SECR and NCR respectively due to inadequate powering in hauling heavily loaded rakes; in NCR, 201 trains (110 coaching and 91 Goods) were delayed for 5,116 minutes due to 65 cases of stalling; In NWR's freight terminals, during May 2018, out of 141 freight trains, only six trains were running with right powering standards).

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(C) Problems at Interchange Points: Audit noticed that huge cases of punctuality loss took place in handing over/ taking over of both coaching and goods trains at interchange points which is clear from the table below:

Goods train delayed in Interchange Points		
Name of the interchange point	Zones	Range of detention during 2018-19
Jharsuguda	SER – SECR	2-11936 minutes
BHC	ECOR – SCR	151-248 minutes
Odisha	SR – SCR	3-40 minutes
Nkl	SECR – WCR	171-262 minutes
Gadur	SCR – SR	2-213 minutes
ITR	SECR	66-186 minutes
Coaching train delayed in 2018-19 at Interchange point		
Gadur	SR - SCR	1384
Davvada	SCR - ECR	758
Nagpur	ECR - SECR	682

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Assignment Questions

- What are the major critical factors impacting Punctuality in IR?
- What was the impact of Scheduled Speed & Average Speed of trains in IR?
- What are the adverse effects of stoppages introduced by IR?
- What was the impact of Asset Failures?
- What were the deficiencies in Goods Trains operations by IR?
- What was the impact of investment made by IR to improve punctuality and travel time?
- What will be the possible replies of the Railways to the objections pointed out by Audit?

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Auditable Entity's Reply and Conclusion

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Auditable Entity's Reply

- Ministry of Railways replied (November 2021) that the recommendations, as made by the Audit, for improvement in average and maximum speed, punctuality and other aspects of trains operation have been noted. Indian Railways would make sincere efforts within its infrastructure / resources for betterment of its services, both passenger and freight operations.
- As regards target date for achieving the desired increase in the average and maximum speed of Passenger and Freight trains, it is stated that improvement in average speed and other related issues is an ongoing process & subject to availability of resources including rolling stock, locomotives & infrastructure like tracks, OHE, signalling gears etc.

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Auditable Entity's Reply... contd

- Ministry of Railways replied (November 2021) that at present, preparation of time-table of trains are done manually on master chart. However, in current time tabling exercise help of IITB and SATSaNG software of CRIS has been taken for framing of time table.
- This has resulted in increased time for maintenance corridor from 2 hours to 3 hours on main lines and also increased number of freight path. However, capacity constraint are due to 'Junction Nodes i.e. junction and cross movement of trains'. The infrastructural inputs are required on these nodes on priority.

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Audit Conclusion

At the end of the discussions, the instructor can frame following audit conclusion by summarizing the audit observations, replies and counter replies:

- Despite having higher capacity of rolling stock/infrastructure, the scheduled speeds of coaching trains are not commensurate with their potential. Provision of higher allowances resulted into longer travel time and sub-optimal use of infrastructure.
- Longer and frequent stoppages created congestion at Junction Points and enroute which reduced the overall speed.
- Six main internal critical factors contributing 66 per cent of total detention of trains were identified as controllable. Indian Railways did not address these critical factors commensurate to their criticality.

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Audit Conclusion...contd

- Indian Railways has no guaranteed delivery time for Goods consignment. This was due to non-scheduling of Goods trains operation.
- Indian Railways despite investing 2.5 lakh crore on track infrastructure during 2008-09 to 2018-19 have failed to improve on the mobility outcomes viz., punctuality and travel time reduction.
- The average speed of Mail/Express and freight trains is still around 50 Kmph and 23 Kmph,

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Audit Conclusion...contd

- Audit conducted a simulation exercise using established software with the assistance of an external expert. It revealed that the current Working Time Table for the New Delhi-Howrah route has around 12,466 conflicts.
- Simulation indicated that there were significant differences between line capacity utilization figures claimed and those obtained in simulation, indicating over pitching of line capacity utilization.
- Thus, there is a significant scope of improvement to reduce travel time and improve punctuality within the existing resources.