

Introduction

Indian Railways: Background

Indian Railways (IR) has one of the largest and busiest rail networks in the world, transports over 18 million passengers and more than 2.2 million tons of freight daily. Indian Railways is the lifeline of the country, providing much needed connectivity and viable means of transport across the country. A look at the railway map reveals that it traverse the length and breadth of the country, covering 7025 stations over a total route length of more than 63,327 kilometers. Indian Railways plays a crucial role in social and economic development of the nation, providing most economical and environmental friendly means of transportation of goods across the country. It is the principal mode of transport for bulk freight movement.

Freight is the main source of revenue for the IR, comprising about 70% of the total revenues, cross-subsidizing the loss-making passenger operations. IR carries a huge variety of goods ranging from mineral ores, fertilizers, petrochemicals, agricultural produce, iron & steel and others.

Since the 1990s, competition from other mode of transport has seen a decline in share of freight traffic though in absolute terms overall freight

operations are grown at a steady rate. Factors like strain on the profitability, low operating ratio, growing challenges of the freight movement with growing economy in general prompted IR to make fundamental changes in their freight policy in recent past. Not surprisingly, IR came out with a combination of long term and short term policy measures focused towards improving freight operations. Short term measures included rationalization of freight structure, speeding up the turnaround times amongst others. The long term measure being, dedicated freight Corridors (DFC) connecting all four metros and segregate passenger traffic. A path-breaking initiative started in 2005 has allowed increase in Carrying Capacity (CC) limits for the system's 225,000 freight wagons by about 11%.

Challenges in Freight Operations

Average annual growth of the freight loading over IR had been 8.92% during 10th Five Year plan (2002-03 to 2006-07); whereas in the 11th plan so far it had been slightly lower at 7.99%¹. The operational efforts augmented with the overall industrial growth saw about 20% increases in freight revenues for the year 2004-05 to 2007-08. Encouraged by the recent initiatives to boost the freight traffic, the most talked about being increasing the wagon's carrying capacity, IR has now set for themselves an ambitious target of 1850 million tons of revenue earning freight traffic by the end of 2020². This would mean an

¹ Indian Railway Annual Report & Accounts (2007-08)

² Vision 2020, Indian Railway

average growth rate of about 10% for the next 12 years: an unprecedented target.

Figure 1.1 shows the achieved and future projected freight loading on IR. To achieve this phenomenal growth there will be huge demand to enhance resource utilization on the IR network, unless IR grows its infrastructure in a hurry, which seems distant. Significant augmentation of capacity is required both for the network (particularly the trunk routes) and in rolling stock assets (wagons, locomotives etc).

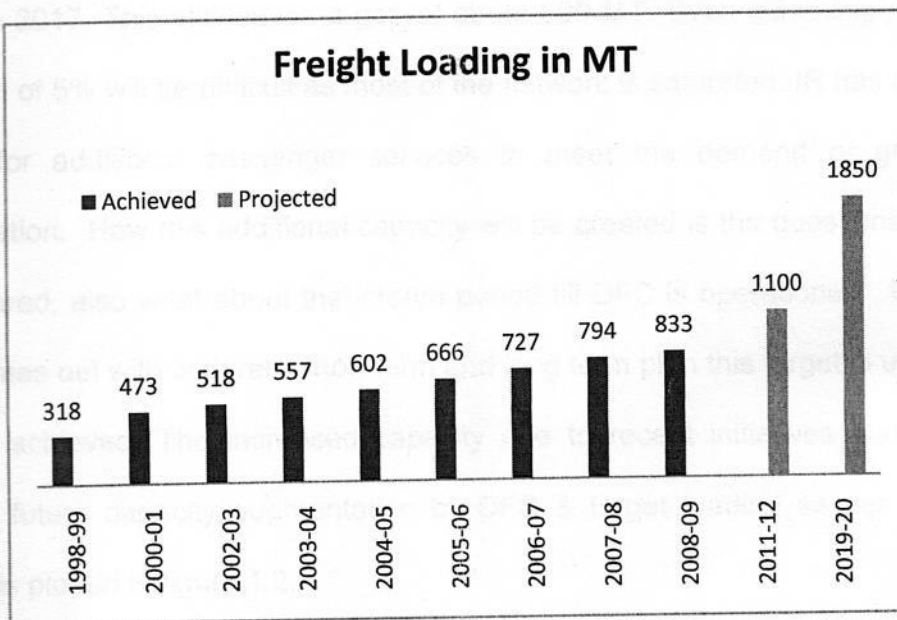


Figure 1.1 Freight Loading on IR, Achieved & Projected in Million Tonnes,
(Source: Fact & Figure Indian Railways & Vision 2020 Railway Board)

"Growth in the last few years has been achieved through operations, innovations and some low hanging fruits like permitting higher axle loads... in future such measures by themselves will not be adequate. The key lies in augmenting capacity in terms of line capacity, Terminal & Rolling Stock."³

Above comments summarized the issues Indian Railways is facing today and highlights the relevance of the study. The existing capacity with a normal growth pattern with recent initiatives like increasing wagon loading capacity will reach upto about 1000 MT by 2020. Eastern & Western DFC corridor will add about 235 MT projected capacity⁴, but will not be functional before 2017. This still leaves a gap of about 500 MT. Even achieving normal growth of 5% will be difficult as most of the network is saturated. IR has also to plan for additional passenger services to meet the demand of growing population. How this additional capacity will be created is the questions to be answered, also what about the interim period till DFC is operational? Unless IR comes out with concrete short term and long term plan this target is unlikely to be achieved. The increased capacity due to recent initiatives started in 2005, future capacity augmentation by DFC & target loading as per Vision 2020 is plotted in figure 1.2.

³ Mathur, Vinoo (2010). Challenges Ahead as IR Returns to High Growth. *Rail Business*, Focus India

⁴Gupta Jeevan, Jha Amrendra, Raja Ray (2010). Dedicated Freight Corridor on Indian Railways : A Catalyst for Industrial Growth, *RITES Journal* (Jan 2010)

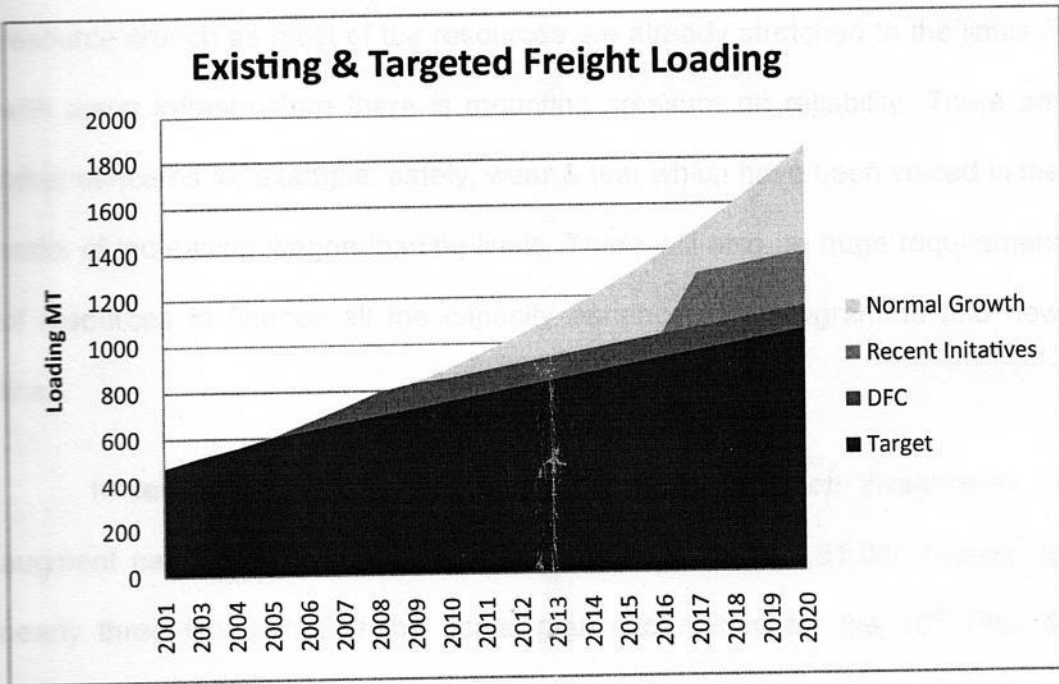


Figure 1.2 Existing, Targeted Freight Loading & Capacity Projection

Source: Data at Appendix XII

Despite being similar in track kilometers Chinese Railways move 4 times more freight traffic than IR⁵. In a nutshell, utilization of existing assets on IR has already reached peak & further increase in throughput is only possible by removing bottle-necks, increasing speeds on existing network and by augmenting infrastructure. Even after desired augmentation in capacity materializes, there will be pressure on IR for efficient utilization of resources.

As IR gears up to quantum leap in the projected growth of its freight operations it is looking at all possible means to increase the line capacity &

⁵ Sondhi, Jitendra. A Comparative Evaluation of Railways in India and China. *World Bank Consultant* (2009)

enhance throughput⁶. It is at the same time grappling with the problem of resource crunch as most of the resources are already stretched to the limits & with aging infrastructure there is mounting pressure on reliability. There are other concerns for example: safety, wear & tear which have been voiced in the wake of increasing wagon loading limits. There will also be huge requirement of resources to finance all the capacity enhancement programme and new lines.

In recent years there had been increasing focus on investments to augment capacity. The 11th Five Year Plan size at Rs. 2,51,000 Crores⁷ is nearly three times that of the actual plan expenditure for the 10th Plan & appears very ambitious. The problem here is that most of the above initiatives have long gestation period and will involve huge outlays, including DFC's whose progress till date is tardy. Resource mobilization to this extent would be a challenge for the Railways as there would be increasing reliance on internal generation and extra budgetary resources including private investment.

Line capacity & throughput enhancement on the existing network can provide the answer to all these questions. Deployment of higher horsepower locomotive to run freight trains at higher speeds could provide a cost effective solution to meet the present and future challenges.

⁶ Throughput: defined as the goods or passenger carried from one point to another in a given time

⁷ Railway Budget Document (2008)

Statement of the Problem

"You should increase your low speeds before you increase your high speeds"

The above was said for IR by Mr Nouvion, a SNCF expert in 1960 as recalled by Mr. A. K. Banerjee, retired General Manager IR⁸. This holds true even now, as IR gears up for even faster passenger trains. The present strategy of increasing passenger trains speeds, with freight trains languishing at the bottom of the speed chart, is not going to reap fruits.

Freight trains move at an average speed of just 25 KMPH⁹. The acceleration is low & has further been adversely affected by increase in the loading of the wagons recently. High speed differentials between different train types have further eroded the line capacity. Experts are of unanimous view that there is an urgent need to increase the speeds of the freight trains and to bridge the gap in speeds at which freight & passenger trains run.

Relationship between speed and throughput is direct. Throughput can be increased by increasing carrying capacity of the wagons, increasing speeds at which it moves or by Increasing no of lines (track)¹⁰. IR has already increased the carrying capacity of the wagons to nearly 11% in a recent move and seems to have exhausted this option for some time. The option of lying

⁸ Mathur, Vinoo. (2010). Challenges Ahead as IR Returns to High Growth. *Rail Business*, Focus India

⁹ Indian Railway Statistical Survey Data

¹⁰ Multidisciplinary Team (2005). Throughput Enhancement. *Railway Board Order ERB-I/2005/23/12 Dated 11/4/05*

additional track is exactly what the IR plan to achieve through DFC. Train speeds in India are still much lower compared to the other counterparts in rest of the World. Hence increasing the speeds is one area where large possibilities still exists. How IR can increase freight speeds and eventually increase line capacity/throughput & what are the impediments in its way are the issues being examined in this study.

Objective of the Study

This study highlights the factors affecting the “throughput” and “line capacity” on the IR Network? Whether higher speeds provide an alternative solution to increase the line capacity other than increasing the infrastructure involving huge costs? How & to what extent faster freight trains can help in achieving the same?

The study critically examines the current scenario in the IR in terms of the speeds of the freight trains & identifies the barrier that hampers the sectional speed over IR network? What are the limitations and inputs required in increasing train speeds and what should be the appropriate strategy for IR in short term and long term?

It also examines the role of locomotive power in train speeds & if policy of not deploying adequately powered locomotives & low “power to trail load ratio” (HP/TL)¹¹ is resulting in the loss of line capacity and being unproductive?

¹¹ HP/TL ratio: Ratio of Horse Power of Locomotive/s deployed to the total train load in tonnes

Study tries to provides answers to questions like: Whether higher horse power locomotives can provide a viable solution to increase speeds of freight trains leading to higher line capacity on IR or not?

The study also looks into the financial & infrastructural aspect of the policy, if locomotive power is to be augmented and suggests short term and long term solutions with tradeoffs.

The aim of the study is to present a comprehensive & practical framework for policy decision to the planners and decision makers. Give a clear picture on what options are available to them in terms of increasing freight throughput by increasing train speeds. What are the inputs required and suggest the short term & long term strategies. The study in the end also tries to raise long term policy & infrastructural issues which may induce further research in the related subject.

Research Questions Being Answered

Specific research questions that are to be answered at the end:

1. What are the factors contributing towards low freight train speeds and high speed differentials between the trains in IR?

2. How & to what extent the low speed of freight train is affecting the line capacity of IR network and to what extent increase in sectional speeds of freight trains can increase line capacity?
3. How the low HP/TL ratio (locomotive power to trailing load ratio) is affecting the freight train speeds? How adequate horse power of locomotive to the train load (HP/TL) ratio can provide the desired speed & result in increased throughput/line capacity?
4. What will be the impact of providing higher powered locomotive on the other parameters like wagon turn-around, rolling stock reliability etc and how it will benefit the operations?
5. How the higher HP/TL Ratio & adequate powering of locomotive can be implemented on the IR and what infrastructural inputs will be required to implement right powering on IR?
6. What will be the financial implication of the providing higher HP/TL ratio? What can be the role and form of PPP in this strategy?

Delimitations & Limitations of the Study

There are many initiatives Railways have taken to improve operational efficiency in freight movements, for example: fast wagon turnaround, improvement in terminal operation etc. Similarly use of improved permanent

way technology such as high speed turnouts, better signaling can also improve the line capacity and throughput. However this study focuses on the finding solution for improving line capacity with the present infrastructure limitations, by increasing the speed of freight trains through increasing horse power of the locomotives and its fallouts. The study limits its scope of study to Indian Railways and tries to present solution within the realm of the locomotive & wagon technology available in India at present or within reach. Study also examines the resources required to increase locomotives power by either increasing HP of locomotives or increasing numbers of units. The study, in concluding chapters evolves and presents a framework for meeting the future growth strategy for the freight and passenger operations over IR through this approach.

Research Methodology

The dissertation is based on primary & secondary data sources, discussions with various stakeholders and literature review. It aims at critically reviewing the big challenge which is to improve the line capacity and throughput on IR network in sustainable way.

The study heavily relies on the internal reports, technical circulars, trial reports of RDSO, work study reports and other papers of IR on the relevant subject. The statistics and historical information is taken out from Year Books, Budget Reports and White Papers etc. or compiled from data available with

statistical organizations of IR. There was also be discussion with various senior railway officers & ground officials dealing with this subject and information provided by them & their views are in analysis and in finding the answers to the research questions. The author is a senior Indian Railway employee and had over 20 years of experience in railway operations in various capacities hence many observations made during these years are also utilized in the analysis.

The study bases the findings on the available research work or technical studies available in the domain. Carrying out simulation and practical study of any particular section requires huge data, specialized software and analysis, which is well beyond the time & resources available for this study. There are simulations data available for IR & foreign railways where findings and trends are imperial in nature and are utilized to develop argument & analysis.

Summary

To summarize, the study is an effort towards finding a viable, economic and practical solution to the challenges of the high growth of freight traffic envisaged by IR by ways of increasing speeds of the freight trains on IR network which at present is much lower than the passenger trains. It highlight the bottlenecks & constraints at present in doing so. The study examines whether increasing the power of the locomotive can present an efficient & practical means to achieve it, and if so what are the implications in terms of

requirement of additional locomotives and related infrastructure. Finally future strategies and sustainability of the solution presented have also been examined in the study.

Review of Literature

Historical Overview of Research Literature

Most of the available literature on railway infrastructure capacity and capacity expansion considers conditions of technological advances and increases in demand is not concentrating on the subject of increasing speeds. The topic of research is very narrow and available literature on the subject is limited. Most of the literature available is either very general or does not address specific problem.

A large section of the literature available is on mathematical optimization techniques for freight management and freight load, which is beyond the scope of this study. The literature available on the IR mainly deals with the historical development of various railway technologies, gauge conversion, electrification and other historical issues. There are however many contemporary studies on IR mainly dealing with financial issues, restructuring of IR also covers the issues of safety, staff utilization and of low average speeds on IR.