Chapter 6

Gains from Higher HP/TL Ratio & Faster Freight Trains

In Chapter 5 we had seen relationship of HP/TL ratio on important running parameters like maximum speed, acceleration, time to achieve the maximum speed in more of a theoretical framework & established that HP/TL ratio has to be improved beyond 1.5 on IR. The actual impact of any such strategy will depend on host of other parameters in actual operating condition. This chapter further looks at overall impact of "High HP/TL Ratio & increasing speeds of freight trains" on desired parameters like line capacity, reliability & train operational as a whole. At the end this chapter presents a strategy for IR & analyzes it in terms of gains to line capacity & other parameters.

Impact of Higher Speeds & HP/TL Ratio on Line Capacity

A Multidisciplinary Team setup by Railway Board in 2005 did simulation trials on SEB-MGS section & constructed different scenario using high speed freight trains, high HP/TL ratio, tightening of passenger stops etc and observed the resultant increase in the line capacity. Their finding is summarized in the table 6.1. The interesting result presented in the above study is that as we increase the speed of the freight trains higher and brought them closer to mail express train the line capacity improved upto 33%.

Table 6.1 Gains in the Line Capacity under Different Scenarios

	Scenario	BOXN speeds KMPH	BTPN speeds KMPH	All Freight 80 KMPH	Pass. Halts = 1min	Pass Speed	High HP/TL 1.5 or better	Gain
1	All loaded freight Double headed 80 KMPH	80	80	80	Y		Y	19%
2	All Freight Loaded (2 WAG7)	90	90	-	Y		Y	21%
3	All Freight Loaded (2 WAG7)	100	100	-	Y		Y	33%
4	All Train 110 KMPH	110	110	110	-	110		8%

(Source : Throughput Enhancement Report of Multi Disciplinary Team)

However this result was possible only when HP/TL ratio was improved beyond 1.5. In the scenario no. 4 when HP/TL ratio was not increased and even when speed of all the trains was increased upto 110 KMPH the gain in line capacity was only 8%.

This result is very significant as is proves two important point that have been stressed earlier. First: reduced speed differentials by speeding up the slow freight trains increases line capacity & secondly increasing HP/TL ratio of freight trains is essential to obtain benefits of higher speeds & mere increase in the top speed will not benefit much unless acceleration is also increased along with.

The report also conclude a very important point, that is it is important to target the lowest running train in the section and try to bring freight train above

lowest running passenger train in terms of the speeds. This way we can dispatch freight trains ahead of the passenger trains in the same corridor.

Starting & Stopping: Energy & Line Capacity Consideration

Maximum energy is lost during acceleration & same is dissipated as heat during braking apart from wearing of brake blocks & wheel, though some part of it is reclaimed through regenerative braking wherever provided. Frequent stopping and starting of heavy freight trains waste lot of time and energy as well as section capacity, moreover there is extra wear & tear of the rolling stock whenever a train is started or stopped. So there are costs involved not only in terms of line capacity lost but also in operating & maintenance costs. There is a possibility that IR may be better off in not running some of the slow freight trains which finally gives 20 KMPH average speed and occupy scarce rail infrastructure for 20 hrs for a 400km run.

Gains from Running Freight Ahead of Passenger Trains

As explained earlier it makes sense to run freight trains without stops for a considerable stretch (numbers of block sections). In Indian condition it is only possible during non peak hours when there are few or no passenger trains in the section. The other option is to run faster freight trains ahead of the slow moving passenger trains.

The scenario has been plotted on the train sectional charts in both the cases: present & proposed (figure 6.1 & 6.2). The commercial speeds of the passenger trains could be in the range of 50 to 60 KMPH. Here real gains will

be achieved when freight speeds are above 50 KMPH of near to designated speed of 75 KMPH. In the second scenario the benefit of running freight train ahead of passenger is clearly visible & line capacity increases.

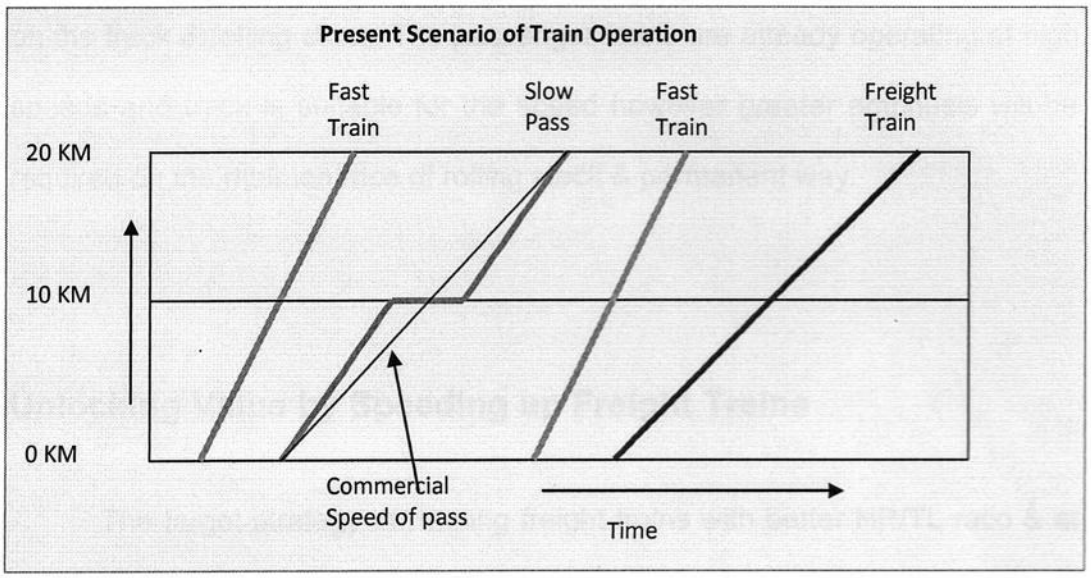

Figure 6.1 Illustrative Section Chart Depicting Present Scenario of Freight Trains running at lower Speeds behind Passenger trains

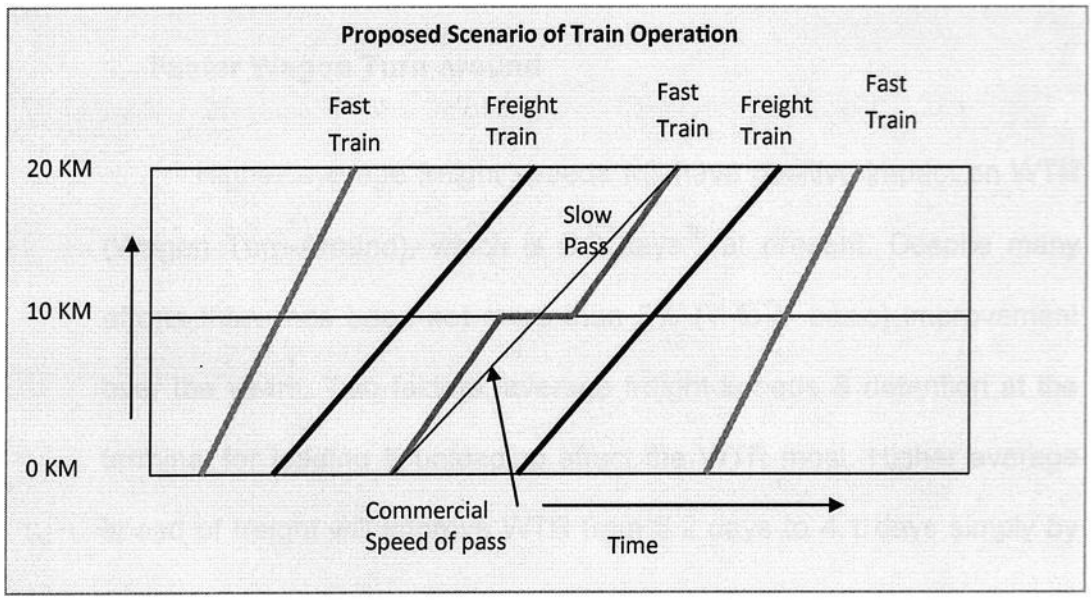

Figure 6.2 Illustrative Section Chart Depicting Proposed Scenario of Freight Trains running ahead of Passenger trains

Higher Speeds: Safety & Reliability Concerns

Higher speeds of heavy freight trains pose greater risk from safety point of view. They will have longer braking distances & will also cause more stress on the track & rolling stock. The passenger trains are already operating at high speeds and track is suitable for the speed however greater emphasis will be required on the maintenance of rolling stock & permanent way.

Unlocking Value by Speeding up Freight Trains

The target strategy of running freight trains with better HP/TL ratio & at average speed better than the commercial speed of the passenger trains will accrue a range of additional operational benefits other than higher line capacity, which are elaborated next.

1. Faster Wagon Turn-around

Higher average freight speeds will have positive impact on WTR (Wagon Turn-Around), which is 5.2 days[38] at present. Despite many efforts there has been not more than 5% (Y to Y basis) improvement over the years. Two factors; average freight speeds & detention at the terminal for loading & unloading affect the WTR most. Higher average speed of freight will improve WTR from 5.2 days to 4.1 days simply by

[38] White Paper on Indian Railways, 2009

accounting reduced transit time of the train, the detention on other account remaining the same.

Calculations (at appendix VII B) shows flat 21% reduction in the WTR for the trains at present run by single loco and 16% reduction on overall basis will result. This will release much needed rakes for further exploitation for future growth in freight traffic equivalent to adding about 32,000[39] new wagons to the system.

2. Gains from Reduced Heterogeneity

As seen in chapter 4, heterogeneity is one major factor which adversely affect the line capacity and globally train experts are looking at means to reduce the speed differentials, run similar types of trains, laying dedicated lines to make their life simpler. In Indian context heterogeneity will remain but its extent has to be reduced to draw gains in line capacity. Increasing freight train speeds, boosting HP/TL ratio and running freight trains ahead of the passenger trains are steps to reduce heterogeneity.

We may refer to the present speed & acceleration matrix of the trains in figure 4.1. The impact of the high HP/TL ratio will be to bring the spread closer as shown in the proposed scenario figure 6.3. The effort should be to bring all trains in quadrant 4 (high speed & high acceleration).

[39] 16% of total 210,000 wagons (2006 figure)

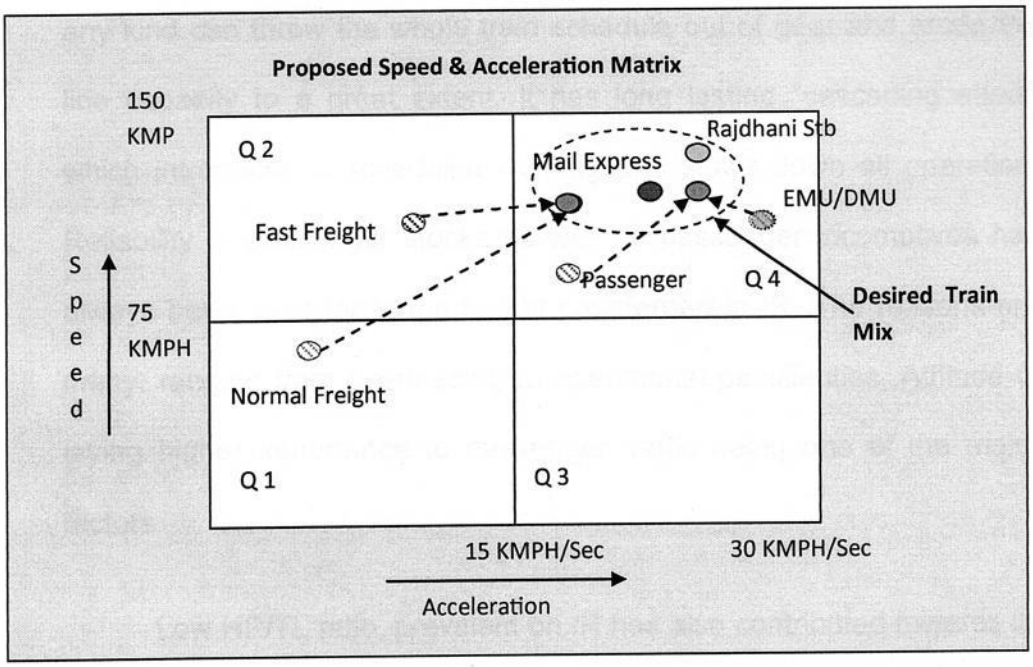

Figure 6.3 Proposed Speed & Acceleration Matrix of Different Trains

The proposed scenario assumes that slow passengers will be replaced by EMU's/DMU's. There is also an urgent need to increase the maximum speed of the EMUs to at least 100 KMPH to bring them at par to the fast Mail & Express trains. This is achievable within the available technology domain of IR, provided HP/TL ratios are increased as the freight rolling stock are capable of running upto 100 KMPH. The scenario depicted will offer considerable gains in the line capacity. The overall gains can be of the order of 30% or beyond as was shown by the simulation study discussed earlier.

3. Effect of High HP/TL Ratio on Reliability

Reliability of rolling stock is one parameter which cannot be neglected while considering train operation in any situation. A failure of

any kind can throw the whole train schedule out of gear and erode the line capacity to a great extent. It has long lasting "cascading effect" which introduces unscheduled working and slows down all operation. Reliability of passenger stocks as well as passenger locomotives has always been superior to the freight counterpart in IR. The reasons are many; ranging from overloading to operational peculiarities. Attitude of laying higher importance to passenger traffic being one of the major factors.

Low HP/TL ratio, prevalent on IR has also contributed towards its share of reliabilities issues also. For example adequate HP/TL ratio can prevent incidents like failure of locomotive due to overloading, wheel skidding leading to rail burning & stalling cases on gradients. There had been 785 stalling cases in three months (Apr-June 08)[40] on IR which could have been avoided by deploying adequate HP locomotives. One stalling case blocks section for at least 100 Minutes eating into the running path of at least 5-6 trains directly and many more due to the cascading by bunching of the trains. There may be additional gains due to reduced asset failure (Locomotive Equipment Failure) due to reduced overloading/continuous running of equipment. All this put together which can improve line capacity by 10% at a rough estimate.

[40] Data taken from Elect. Directorate Railway Board

4. Reduced Requirement of Locomotive Driving Units & Crew

Faster turnaround will also reduce the overall requirement of locomotive driving unit (DUs[41]) as lesser no of trains will be on the circuit for the same NTKM loading. Reduced DUs will also demand lesser crew and supervisory staff. The detailed analysis is carried out in next chapter. Better average speeds of goods trains will thus reduce the net crew requirement per GTKM[42] of goods transported over IR.

5. Other Benefits

Many other fringe benefits may also accrue due to the higher speeds & HP/TL ratio some of them are detailed below:

a. Reduced requirement of Banker Locomotives

The practice of stationing banker locomotive in the "*ghat*" sections (sections having high gradient) will be greatly reduced with higher HP/TL locomotives, thus saving on the idle locomotive and crew. The time lost in the banking operation will also be net addition to the line capacity.

b. Saving on Crew Fatigue

Unpredictable running & long stops of goods trains waiting for path at way side stations tends to overstretch crew hours beyond recommended. This results in crew getting "under rest" causing

[41] DU: Driving unit may consist of 1, 2 or 3 locomotive running together.

[42] GTKM: Gross Tonne KM

reduction in efficiency & causing delays in arranging for relief crew. Higher speeds thus will also reduce crew fatigue and save crew related delays.

Combined "Synergy Effect" on Operations

At present on Indian Railways, fast run-through freight trains are run only during identified clear paths called "interlinking path", normally available during night after mail/express trains are through. Their numbers are limited & other freight trains run in small patches of few block sections, stopped frequently to allow a passenger train to pass. Average speed of such goods trains is in the order of 20 KMPH and is dropping due to introduction of new passenger trains. Higher speeds, better acceleration, improved reliability are going to bring in much needed confidence in the freight operations to the train controller. It will make him dispatch a freight train ahead of mail & express trains which he is unable to do so at present. The combined effect of this will be better synergies in the freight & passenger operation leading to optimum asset utilization. This will help in bringing in a much needed change in the mindset of the officers and policy makers towards higher freight orientation, granting due importance to the freight movement, it deserves.

Appropriate Strategy

To meet its passenger and freight traffic demands Indian railways has to optimally utilize its resources and improve line capacity. For that, lower end of speed and acceleration spectrum has to be shifted higher. Speeds of freight trains & slower passenger trains have to be brought closer to faster passenger

trains. Running of freight train, matching commercial speeds of passengers trains came out as the most appropriate strategy in terms of reducing speed differentials & heterogeneity in train mix. From the analysis it becomes clear that if IR plan to run its freight trains at the prescribed speed of 75 KMPH it will have to improve HP/TL ratio to beyond 1.5. Vision 2020 has envisaged raising freight speeds to 100 KMPH, for that even higher power locomotives will have to be deployed.

Higher HP/TL ratio was also found to give host of other operational benefits which will further boost efficiency and improve line capacity. From above analysis it becomes clear that to take advantages of higher speeds of goods train following strategies needs to be adopted by IR.

- **Run all the freight trains at speeds of 75 KMPH in first step which should be raised to 100 KMPH in due course.**
- **Operate HP/TL ratio of at least 1.5 and preferably stepping it up to 2 by deploying horsepower locomotives.**
- **Replace all slow passengers by EMU/DMU's which also needs to be run at 100 KMPH with reduced stoppages duration.**

The combined strategy is likely to give benefit in line capacity in following ways:

- **line capacity gains due to Higher Speeds & HP/TL ratio upto 30%**
- **line capacity gains due to reduced incidents/failures & operational synergy upto 10%**

Even on the conservative estimate we can assume that all these measure will at least yield a 20% improvement in the line capacity. These gains can further be improved by systematic improvement like high speed turnout and terminal efficiency.

Summary

Faster freight trains with higher HP/TL ratio will benefit IR in the following ways: Improving average speed of the freight trains to bring them closer to the commercial speed of the mail & fast passenger trains coupled with faster acceleration & braking. The gains in the line capacity, WTR will be through overall increased average speeds of the trains and through reduced heterogeneity. Natural fallout of this strategy will be by ways of increased reliability of freight operations, reduced uncertainties leading to smoother operation. It will give much needed increase in the line capacity upto 30% & may provide a solution to the growing stress on the Railway resources, paving way for future expansion.