# 'Turnaround' of Indian Railways: Increasing the Axle Loading

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## Background

Axle loading had contributed significantly to the 'turnaround' of the Indian Railways (IR) in the two years 2004-6. As the Minister of Railways (MR) stated, "A one ton extra loading per wagon implied additional revenue of Rs 500 crore per annum for IR." The axle loading initiative was a significant step by IR, though sustainability was a concern. This paper focuses on the key driving events, process issues, impact and implications, and sustainability of the initiative of taking the load per wagon from its carrying capacity (CC) to CC+8.

As the Chairman, Railway Board (CRB), put it, "This one initiative had made a significant impact on the performance of IR over the past two years." This had been one of the key drivers of what had popularly come to be known as 'turnaround' of IR. Exhibit 1 gives the organization structure of the IR.

From a low net revenue (total earnings less total working expenses) of just over Rs 1000 crore in 2000-01, the actual for 2005-06 reached Rs 8005 crore (Exhibit 2). The jubilation was not only because of the rising trend of performance, but also because of the significant growth achieved in 2005-06 over 2004-05. Internal generation of cash surplus including provision for depreciation and the Special Railway Safety Fund (SRSF) reached a historical level of Rs 13,068 crore for 2005-06.

This had given IR a new-found confidence. Such funds would not only help improve the asset quality of IR, but also help in planning for large scale investments for growth.

Exhibit 3 describes the performance of the freight segment from 2001-02 to 2005-06. Goods earning in 2005-06 increased by Rs. 5509 crore over 2004-05 (17.9 increase on a base of Rs. 30,778 crore. The tonnage grew by 10.8 per cent and the net ton km (NTKM) by 8.3 per cent. This had a story to tell in terms of the impact of increase in axle loading (reflected as growth in tonnage) versus increase in freight rates (reflected along with tonnage as growth in earnings).

Another aspect was the impact of the overall growth in the economy on freight performance. While some observers of IR argued that the turnaround was just an outcome of the healthy GDP growth, others suggested that the increased demand because of economic growth could be responded to effectively only by increasing axle load.

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[1] Written by G. Raghuram and Niraja Shukla.

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## Earlier Initiatives on Axle Loading

The maximum axle load on IR had traditionally been 20.3 tons. However, the main line versions of steam locomotives had an axle load up to 22.9 tons. These tons were American 'short ton' of 2000 pounds, while the metric ton is about 2240 pounds. This makes the short ton 0.91 times the metric ton. Hence the effective axle load was 20.8 tons. Further, the wheel diameter was large, reducing stresses relative to today. However, in steam locomotives, a phenomenon called hammer blow occurred during every rotation of the wheel, which increased the impact loading on the track by about 25 per cent. This was accepted on the basis that a one off impact by a locomotive was acceptable every time a train passed, rather than the entire train causing stresses from such an axle load.

In the early 80s, IR had a dynamic Chairman in M.S. Gujral. He had pushed through far-reaching initiatives such as block rake movement (which eliminated the need for yard-based sorting and marshalling), segregating wagon stock with different speed and safety characteristics forming homogeneous rakes for enhanced performance, relaxing examination requirements of such rakes at each major yard enroute to just the origin, etc. He had proposed that IR should increase the axle load for better throughput and experimented with it. However, after his tenure, the initiative was not sustained on the grounds that it would affect safety adversely.

An increase in axle load from 20.3 tons to 22.9 tons allowed a four-axle wagon to increase its gross weight from 81.2 tons to 91.6 tons. CC for the wagon would be the loadable commodity weight, i.e. the permitted gross weight, less the tare weight. Since, even for a specific wagon type tare weight varied, CC also would vary. The increase in axle load would enable an additional loading of upto 10.4 tons, i.e. up to CC+8+2, two tons being the tolerance because of inaccuracies in loading and weighment.

Interestingly, the Railway Board (RB) had decided in early May 2004 to increase the chargeable CC to CC+2 for all commodities loaded in BOXN/BOXNHS wagons (Exhibit 4 gives a description of wagons in IR). According to Section 72 of the Indian Railways Act 1989, the maximum CC for wagons had to be fixed by the central government and hence the approval of MR was required. There was a change of government at the centre during that month. Mr Lalu Prasad became the new MR on May 23, 2004. This decision was approved by MR and was issued as Rates Circular No. 22 of 2004 dated July 29, 2004 (Exhibit 5), for implementation from September 1, 2004. This circular was one of a series that would be issued by the Traffic Commercial Directorate of RB, as part of RB's thrust on increasing the freight throughput on the IR by increasing the axle loading. According to this circular, extra loading of 2 tons for certain commodities had been approved even as early as July 1997 (for slack coal), March 1998 (for run-off mines coal), and July 1999 (finished iron and steel products).

In September 2004, RB advised the Research Designs and Standards Organization (RDSO) of IR to examine the possibility of increasing payload of open wagons (BOXN) by six tons. RDSO advised RB that by providing two additional springs in bogies, it was possible to increase the payload by six tons. (A brief description of the functions of RDSO is given in Exhibit 6.)

## Key Driving Events: September 2004 to February 2005

The start of the story for the vigorous thrust on increasing axle loading could be many. One of the events to which this was attributed was the visit of Mr Lalu Prasad to loading points and weighbridges at Muri (SER) and Andal (ER) in September-October 2004, when he

noticed overloading in wagons of iron ore and coal. Wagons, which were expected to carry from 58 to 60 tons had shown commodity weighments of up to 80 tons. MR wanted this leakage of revenue to be plugged, since it could bring in revenues to IR. He wanted a large number of weighbridges to be installed at originating points.

Recognizing this thought process in MR as an opportunity, the General Manager (GM) of a Zonal Railway (ZR) directed his Chief Operations Manager (COM) to send a letter to RB on October 10, 2004 with a proposal to increase the axle load to 22.9 tons on the iron ore loading circuit on its BOXN wagons. This was followed up by a letter from GM (an officer of the Mechanical Engineering Department) to RB on November 22, 2004:

> The ZR is having outstanding indents for over 7000 rakes and this excludes programmed traffic for coal and steel plants. Availability of BOXN rakes is further reduced during peak period as demands pick up at other loading points too. Shortage of rakes is combined with severe line capacity constraints, more so in the iron ore loading areas. Enough traffic is available and we are unable to meet the requirements. For increasing the throughput . . . Board may like to consider the scope of loading BOXN wagons with CC+10, effectively attaining the same axle load as of BOY and BOBS wagons. Incidentally, on the ZR, BOY and BOBS wagons ply on the iron ore circuit safely for long years. If the same axle load is permitted for BOXN wagons, only for iron ore and that too from mines to steel plants or to ports on ZR territory, the throughput can be enhanced substantially.
>
> It is suggested that for 4 months, from December 1, 2004 to March 31, 2005, purely as an experimental measure, ZR may be permitted to run BOXN wagons with CC+10 or upto the axle load of 22.9 tons, within our internal circuits. With this, the ZR can promise to load additional 3 mt over and above the Board's target of 71 mt.

In the meantime, with the clearance from MR, RB issued a Rates Circular No. 48 of 2004 dated November 4, 2004 (Exhibit 7) in which the chargeable capacity for all four axle broad gauge wagons was increased to CC+4. This circular qualified the extra loading as being applicable only to non-winter months. The circular recognized that BOY and BOBS wagons had a permitted axle load of 22.9 tons. It also recognized punitive charges for overloading at six times the highest class rates.

The then ME, although in favour of increasing the axle load in view of large scale renewal of track, sleeper material and density, fittings, ballast, and distressed bridges under the SRSF, took a cautious stand in view of the assessment of track and bridges based on existing premises of deterministic models which were risk averse. In terms of increasing throughput, increasing freight train speeds from the current 75 kmph was also considered as an option. Consequently, RB advised RDSO to work out the track structure required for improving infrastructure for operation of freight trains at 100 kmph in loaded and empty conditions. RDSO responded in December 2004 that for 22.1 ton BOXNHA wagons to run at 100 kmph, the track structure should be 60 kg 90 UTS rails on PSC sleepers with a density of 1660 per km and ballast cushion of 350 mm.

As Lalu Prasad himself put it, a one ton extra loading per wagon implied an additional revenue of Rs 500 crore every year. His of quoted remark summarized his perspective: "If you do not milk the cow fully, it falls sick." The logic was that each wagon could be loaded about 60 times a year (with the average wagon turnaround being a little over six days). Given that over 160,000 wagons could potentially benefit from this, the additional yearly loading could be up to 10 million tons (mt). At an average earnings of Rs 500 per ton, IR could earn an additional Rs 500 crore.

The GMs letter was discussed in RB. The discussion highlighted the different perspectives of various departments. This proposal moved around in RB until February 2005.

The main issue was whether, keeping in view the nature of movement of traffic across zones, a ZR could take a local initiative which violated the provision of a policy circular issued by RB. The discussion then went on to the view that, given the highly technical nature of the problem, it would be desirable that an in depth analysis be carried out by RDSO before an objective decision could be taken. A view was also emerging that, given the growing transportation demand thanks to enhanced economic growth, the need of the hour for IR would be to experiment with higher axle loads for increasing capacity.

- The Traffic Directorate referred to the policy circular of November 4, 2004(Exhibit 7), based on which it raised the question of whether ZRs can be permitted to take their own decisions based on local conditions and requirements.

- The Mechanical Engineering Directorate suggested that ZRs should operate within the provisions of the circular dated November 4, 2004, since such vital issues had safety implications and bearing on other railways.

- The Civil Engineering Directorate referred to the same circular and related instructions on maintenance of weigh bridges issued by the Commercial Directorate and the Civil Engineering Directorate on the grounds of implications beyond one zone and safety, and said that ZRs could not be permitted to take such decisions on their own.

- The Traffic Directorate highlighted that the ZR had been permitting loading of BOXN to CC+4 for many years and RB has issued instructions in this regard only recently. It may be required to examine as to what adverse impact on safety condition of wagons and tracks had taken place owing to loading. It questioned whether RDSO norms in this regard were too conservative and whether there was a need to relook at the basics.

- The Civil Engineering Directorate detailed safety implications such as suitability of the freight stock to withstand the extra loading, suitability of track structure, suitability of bridges, requirement of braking distance for the additional suggested loading, coupler forces, and haulage capacity of the locomotive. It further suggested that RDSO being the R&D wing of Indian Railways and having much more knowledge on technical issues RDSO should examine the whole issue and give its recommendations. It also proposed that the ZR may be asked to restrict the loading to the limit for which RDSO had issued safety certificate except for any overloading which had been allowed conditionally from the Board's office.

- The Traffic Directorate, indicated that, while it was a fact that RB had accepted the movement of BOXN wagons with CC+4 without any apparent technical input, ZR was following it since years. The temperature drop on all regions of India was not uniform. No analysis had been done prior to imposition of restriction on all sections during winter, including sections where the loads were already running with CC+4.

  It said that the present objections were too general in nature and neither based on technical analysis nor on a cost benefit study. Nearly 17,000 open wagons were loaded every day on IR. There was no dearth of traffic. If CC+10 in place of CC+4 was adopted, with a rough calculation, IR could carry 36.5 mt extra every year without much of an input in the system and generate Rs 1825 crore of additional earning with carrying of extra six tons per wagon.

Similarly, IR could think of carrying CC+10 in covered wagons. After some modification even more of bagged consignments could be loaded without incurring expenditure on additional line capacity.

The Directorate put forward the plea that the initiative of the ZR should looked into carefully and loading of CC+10 be permitted on experimental basis after taking safety precautions. In the meantime, a comprehensive study, including cost benefit aspects, may be done by RDSO or a committee of officers from RB in consultation with ZR, based on its experience. In addition, the feasibility of increasing axle load for all types of wagons commensurate with the axle load of locos should also be examined.

- The Directorate stated that Bogies of 'N' stock including BOXN could be upgraded to 22.9 ton axle load after providing extra springs in the suspension system. Bearings and wheels were already fit for 22.9 ton load. However, wagon body designs had to be looked at for 22.9 ton load. BOY and BOBS wagons in the design stage were designed for 22.9 ton load. Before IR ventured for 22.9 ton load on wagon stocks other than BOY and BOBS, structural design of the wagon body had to be studied and cleared. RDSO could be involved in this study.

- The Planning Directorate, looking at the future of IR, suggested that, with increasing pressure on IR to meet transportation demand because of enhanced economic growth and constraints of funds, substantially increased capacity could be provided by running heavy axle load trains. One of the deterring aspects was the perceived high investment needed for upgrading the track which was cleared for axle loading of 20.32 tons. The need for reassessment of the real capability of track became paramount, especially in view of three developments which had taken place:

  i. ME, during his address at the 24th meeting of the Governing Council of RDSO on November 5, 2004, had expressed the possibility of existing track being fit for 25 tons axle load since the value of track modulus and method of track calculation depended on old 1968 methods.

  ii. In a detailed calculation, Mr Don Gillstrom had indicated that the current rail structure appeared adequate for 30 tons axle load at 100 kmph. He had assumed a wheel diameter of 762 mm against the 915 mm diameter of IR which meant that he had taken higher stress into calculation and this provided higher degree of safety.

  iii. A study by CANAC, Canarail, had stated that the method followed by IR for calculating the stress capability of 60 kg 90 UTS rails was extremely conservative. It had indicated that a review of the track standards with respect to axle loading. Since North American tracks with 100 pounds per yard rail on wooden sleepers routinely and safely handled axle load of 29.83 tons.

Thus an in-depth review was necessary to find out the capabilities of the track to carry axle loads of 25 tons and above.

**Building Alignment: March 2005 to August 2005**

The first change among the members of RB, since Lalu Prasad took over as the minister, took place in March 2005 when the new ME and MS moved into their positions. RB now wanted RDSO to assess the capability of existing track for running heavy axle load trains. In March 2005, RDSO responded with the potential of different types of track structure for

operating heavy axle loads. For 22.9 ton axle load (CC+8+2), the minimum track structure was specified as 52 kg 90 UTS rails on PSC sleepers with a density of 1540 per km or more. In March 2005, RB advised RDSO to examine the proposal of ZRs on the possibility of loading up to 10 tons beyond CC.

A meeting was called by Railway minister on March 18, 2005, to examine the issue of increasing the axle load. After the meeting, a letter was circulated to RB and GMs under signature of the MR, with the following inputs:

i. The proposal of GM, ZR, to increase the axle load up to 22.9 tons along with various discussion points
ii. Report by CANAC, Canarail, CPCS Transcom, and LEA on Gujarat Double Stack Container Project
iii. Report of Don Gillstrom on "IR Track Design Analysis and IR Axle Loads"
iv. Note prepared on "Guidelines to Best Practices for Heavy Haul Railway Operations: Wheel and Rail Interface Issues"
v. Report by ED/FM on "Loss of Revenue Due to Difference Between Actual Tare Weight and Stenciled Tare Weight in BOXN and BCN Wagons"
vi. Report by GM, SECR on "Overloading in BCX/BCN/BCNA Wagons"

A summary of inputs (ii) to (vi) is provided in Exhibit 8. These were required to reinforce the revised assessment of track and bridge stresses based on probabilistic rather than deterministic models.

The minister ended the letter: "The issues raised in this document may be examined with a view to increase the carrying capacity of BOXN, BCN, BTPN, BRN etc VPU and VPH and SLRs without compromising safety of trains. I may be appraised in the matter by 15.4.2005. This may be accorded top priority."

In early April, performance figures for 2004-05 were consolidated. IR had achieved a landmark in crossing 600 mt of loading for the year, an 8 per cent growth over the previous year and 20 mt over the budgeted expectations. This was partly attributed to the extra loading that was permitted since September 2004. There was a jubilant mood in RB, bringing forth a belief that 700 mt of loading could be achieved during 2005-06, if the increased axle loading could be put on fast track.

Further to the railway ministers letter of March 18, Sudhir Kumar, the Officer on Special Duty, circulated a report on April 13, 2004 containing the following:

i. Report by Allan M. Zarembski PE, President, Zeta-Tech Associates Inc, on "Heavy Axle Load Capital Needs Assessment"
ii. Report by John Bitzan and Denver Tolliver, Upper Great Plains Transportation Institute, on "Heavier Loading Rail Cars in North Dakota: Strategic Freight Analysis"
iii. Extracts from the book *Indian Railway Track* by M.M. Agarwal on track modulus and thumb rule concerning weight of rail and its relation to axle load
iv. Some clarifications from Don Gillstrom.

In response to RB's advice of March 2005, RDSO, stated in April 2005, that by providing two additional springs and using imported grease (for cartridge tapered roller bearings) suitable for higher axle load, it was possible to load ten more tons in BOXN wagons. RB wanted the comparative value of stress in rails to be worked out for different axle loads and different speeds. The detailed calculations were communicated to RB.

A new ML joined RB on May 1, 2005. On May 4, 2005, the Engineering Directorate brought out a comprehensive set of instructions to increase the axle load of freight wagons on iron ore routes to a maximum of 22.82 tons, i.e. CC+8+2. This was viewed as a pilot project to be in operation for one year (Exhibit 9). The instructions related to track and bridges, including testing and monitoring. Wheel impact load detectors (WILD) were to be installed in all railways. Instrumentation and evaluation of bridges would involve specialized external agencies and RDSO. This was required for validation of the presumptions made in adopting the probabilistic models.

In the case of 52 kg 90 UTS rails, speed of trains would be restricted to 60 kmph. In the case of lower standard rails (90 pound), speed would be restricted to 30 kmph. These stretches were few and the rails would be replaced on priority. RB also decided that a quarterly review should be done by a multidisciplinary core group consisting of PCE/CE (Coord), CME, and COM under the GM of respective ZRs and the report sent to RB. The loadability, routes, and commodities (ores, limestone and dolomite, gypsum, and stones) were specified in Rates Circular No 25 of 2005 (Exhibit 10).

Iron ore was selected as the commodity to focus on not only because one of the ZR's proposal suggested this, but also since, in spite of increased loading, the market share had been dropping until 2003-04. Iron ore exports (primarily to China) were growing yearly at over 25 per cent, while IR was struggling to provide capacity. Iron ore accounted for nearly 16 per cent of tonnage and over 11 per cent of earnings for IR during 2004-05. Road movement had increased significantly, though that was not the choice of exporters. Increased axle load would also release the much required wagon capacity from the programmed iron ore traffic to steel plants. Additional routes were added in June and August 2005 through notification by Rates Circulars.
In June 2005, RDSO developed a format for monitoring USFD testing, rail/weld fracture, and information on WILD and sent it to ZRs. A meeting was held at RB to discuss the technical inputs made available by RDSO for monitoring and review. RDSO undertook studies for updating track modulus and dynamic augment values in rail stress calculation. Based on literature survey and studies conducted at Ajgain station and field measurements, the values were updated. The suitability of existing PSC sleepers for heavier axle load was checked. It was observed that existing PSC sleepers could be used for heavier axle load up to 25 tons. It was suggested that future renewals should be done with newly designed sleepers, which would be fit for 30 tons axle load.

On July 8, 2005, the winter restriction for CC+4+2 was removed after a 'review' by RB through notification in Rates Circular No 41 of 2005. On August 1, 2005, RB had a new CRB and MT. To review the performance of running heavy axle load trains, a workshop was held in New Delhi on August 29, 2005 under the umbrella of the Institution of Permanent Way Engineers. The agenda and the summary of the workshop are given in Exhibit 11. The workshop provided an opportunity to share field level experiences and develop a renewed focus on monitoring and problem solving. RB reiterated its expectation of the first quarterly reports as soon as possible.

**CCRS Concerns**

The Engineering Directorate had marked a copy of its letter of May 4, 2005 to the Chief Commissioner of Railway Safety (CCRS), Lucknow. This was the first formal communication on increased axle loading that the Commission of Railway Safety had received. (Exhibit 6 gives a brief description of the functions of the Commission of Railway Safety.) CCRS responded on May 16, 2005, to ME expressing concern on RB's efforts at increasing the axle load and the Commission not being informed. The earlier issue of permitting two extra tons had been raised by the Commission in some of its accident inquiry reports. According to

RB's Policy Circular No 6 of 1999, a rolling stock for which the axle load was modified constituted a new rolling stock and the procedure for clearing the new stock for operations should be adopted. The current speed certificate by RDSO would not be valid. Further, according to Section 27 of IR Act, 1989, the Commission's approval should be taken for new stock. The Commission also expressed concern with respect to bridges: "While the axle load being permitted may be equal to BOY and BOBS wagons, the track loading density of BOXN with 22.9 ton axle load would certainly be higher than the above two wagons because of its reduced length."

It a letter dated August 1, 2005, the Engineering Directorate clarified that extra loading taking, into account the design parameters of the existing rolling stock, did not violate Section 27 of the IR Act, 1989. Just by increasing loading capacity, a rolling stock could not be designated as different or new. According to Policy Circular No 6, RB was the final authority and had delegated the responsibility of determining the maximum permissible speed to RDSO and ZRs. RB had also instructed that all the effects of increase in loading on bridges should be under close observation and the project would be reviewed quarterly by a multi-disciplinary core group which would submit quarterly reports to RB.

Given the differing perspectives between RB and CCRS, the Secretary of the Ministry of Civil Aviation wrote to CRB that reconciling this difference would require a joint meeting. CRB responded positively and a meeting was set up for October 7, 2005, at RB.

To make the meeting more meaningful, the CCRS sent a letter to the ME proposing an agenda: definition of a new rolling stock, status of RDSO's speed certificate, effect of hauling power of the locomotive due to extra tonnage, problems of stalling of trains and damage to track, impact on bridges and process for giving bridge certificates, installing monitoring devices, and extra workload of USFD testing of rails even when the normal workload was not attended to.

The meeting between RB and CCRS was held on October 7, 2005. After discussing various issues, it was agreed in the meeting that RDSO should issue a provisional speed certificate to run CC+8+2 trains, based on which ZRs would process the cases for RB/CRS sanction for running of these trains. Oscillation trials of the existing BOXN wagons with enhanced loading should be expedited. In case there was a change in wagon parameters like additional springs, oscillation trials should again be done and speed certificate should be processed. CRB concluded the meeting by saying that: "Growing traffic demands required introduction of higher train loads. But in no way safety would be allowed to be compromised."

Following up on the agreement with the Commission and the tests done by RDSO and ZRs, RB sought speed certificates from RDSO. By October 2005, provisional speed certificates for CC+4+2 loading in BOXN/BCN type wagons, provisional speed certificates for CC+8+2 and CC+6+2 loading up to February 2006, and final speed certificates for some cases were issued.

Based on some of the ZR quarterly reports, the Commission sent a letter to the Engineering Directorate in December 2005 mentioning no effect of its concerns raised in the meeting with RB on October 7, 2005. The letter specifically raised various concerns related to non-compliance of certain ZRs of RB instructions for running of higher axle loading, increased rail fracture/weld failures/rail withdrawals, non-installation of bridge instrumentation, non-procurement of WILD, etc.

As of December 2005, no ZR had yet come forward to obtain CRS sanction for the running of heavy axle trains, based on provisional speed certificates. On May 3, 2006, CR sent a

letter to CRS, Central Circle, Mumbai, initiating the process of obtaining CRS sanction. It was expected that sanction would soon be given and other ZRs would follow.

**Impact and Implications**

Given the understanding of the issues discussed in the August 2005 workshop and a general sense that increasing the axle load was a 'controllable' process, RB started expanding the scope of this initiative. RB had a further change on November 1, 2005 when the new MM joined, and on December 1, 2005, when the new FC joined.

On November 17, 2005, CC+6 was approved for coal on certain routes as part of the pilot project, to be valid from November 21, 2005, through Rates Circular No 67 of 2005. Coal accounted for over of 45 per cent of tonnage and 43 per cent of earnings, during 2004-05. After this, more Rates Circulars were issued, essentially increasing the routes over which CC+8 (in open wagons for iron ore, limestone and dolomite, gypsum and stones), CC+6 (in open wagons for coal), and CC+4 (in any four axled wagon for all loose and bulk commodities) would be valid.

On December 23, 2005, a notification was issued in which penalty charges for overloading were brought down (from six times the highest rated class) to twice the freight rates applicable to that commodity, if the aggregated payload in the rake did not exceed the permissible capacity of the rake. If it did, the penalty would be three times the freight rates. The penalties would be applicable for weights above the tolerance of 2 tons.

***Capacity***

As repeatedly emphasized by Sudhir Kumar in various forums, the axle load initiative had increased the carrying capacity of wagons by 7 to 12 per cent: "This had happened by the consistency of direction and implicit risk taking that Mr Lalu Prasad had provided. All the technical issues were being handled as required by RB and various other constituencies of the IR."

On February 24, 2006, during the budget speech in Parliament, Mr Lalu Prasad stated, "By starting 23 tons axle load BOXN freight trains on identified routes, we have made our presence amongst the few countries which run heavy axle load trains…. It has been decided to run 25 tons axle load trains on two routes, for the first time in the Indian sub-continent, in the coming year as a pilot project."

The 22.9 tons axle load trains were permitted to be run at a maximum speed of 60 kmph owing to track and bridge limitations. Speed also being a determinant of throughput, it would be important to understand the trade-off between permitted speed and the axle load, especially when the newer wagons had the inherent potential of 100 kmph speed, but the track and bridges did not. MT said, "most of the wagons still had a maximum speed limit of 75 kmph. Because of various operating constraints, the average freight train speed was only 23 kmph and thus the speed restriction would not really matter."

The railway minister, in his letter of March 27, 2006, urged GMs immediate identification of remaining sections on which traffic amenable to higher axle load of CC+6 tons with additional loading tolerance of 2 tons and sections on which traffic of CC+8 tons and additional loading tolerance of two tons should be permitted separately. He further advised them to ensure immediate processing of such cases and permitting running of higher axle load trains before the beginning of the next financial year.

After validation of assessment based on the probabilistic models, further increased axle loading was cleared. With this, the Rates Circular No 41 of 2006 dated May 10, 2006 was issued providing for the extension of the pilot project with increased scope (Exhibit 12) for one more year until June 30, 2007. Apart from this, the circular increased the scope of loading in certain additional wagon types and additional routes, and specified the chargeable weight in net tons to be loaded by the customer (rather than the earlier specified carrying capacity (CC) plus extra loading which made the loadability a function of the tare weight of the wagon).

### *Earnings*

As a consequence of increased axle loading (and other initiatives like reducing wagon turnaround), the freight tonnage went up by 8.1 per cent in 2004-05 and 10.8 per cent in 2005-06 (Exhibit 3). The impact on NTKM was 6.9 per cent and 8.3 per cent respectively. However, earnings increased by 11.4 per cent in 2004-05 and 17.8 per cent in 2005-06. This can also be seen at a micro level in one of the key loading points of SWR, Ranajitpura, where per box revenue went up by 65 per cent, while per box loading went up by 6.5 per cent (Exhibit 13).

This brings into focus that increase in freight rates also had a significant impact on the earnings. The public stance by the IR had been that freight rates were not increased. While it is true that the rate structure for the various freight classes had not changed, iron ore had been 'reclassified' into higher rate classes, especially during 2004-05 and 2005-06, based on market oriented pricing policies. Exhibit 14 summarizes various Rates Circulars that had an impact on iron ore movement beginning 2004-05. Exhibit 15 provides some statistics on iron ore exports and the sequence of reclassification of iron ore for exports by IR. The reclassification of iron ore for exports had increased the rates by 50 per cent. During the same time frame, the export price of iron ore had quadrupled. However, changes in other major commodities had been less significant and, in fact, implying a reduction for a commodity such as POL (Exhibit 16).

### *Customer*

While the extra capacity was welcomed in general, major customers such as CIL, CMA, NTPC, and SAIL complained about the ability to load coal to the extent of the chargeable capacity, since many grades of coal had a bulk density lower than what the chargeable capacity implied. In their assessment, they were loosing out about a couple of tons per wagon at the CC+6 level. This was worse with imported coal, which was washed, and coking coal. Exhibit 17 gives the sample weighbridge measurements for ten rakes in SWR. Four of these were coal rakes carrying imported coal from Mormugao port to the JSW steel plant at Toranagallu. According to the average loading per wagon, it did not appear that this coal was of a lesser weight than the chargeable capacity. On this route, coal was heaped on the wagons and had a tarpaulin cover.

Customers also expressed concerns regarding the difference between recognized (stenciled) tare weight of a wagon and the actual weight. If the actual weight was higher and the loading was based on their own weight assessments, penalties for overloading would accrue. If the actual weight was lower, they would be paying for unutilized capacity. On both counts, fault would not be theirs.

There was a concern about insufficient in-motion weigh bridges, especially at loading points, wherein, corrective measures could be attempted. (Many of the weighbridges were

sponsored by different customers). Customers were also concerned about the actual measurements that the weigh bridges indicated. A confidence on the reliability of measurements, especially with respect to speed characteristics of the train, had not yet set in. Exhibit 18 gives the measurements for a rake loaded at Ranajitpura, where there was mechanized loading, with the controlling weightometer set at 67 tons. Examining the summary of this rake presented as the first item, in Exhibit 17, the net weight per loaded wagon was 65.6 tons, the minimum being 56.20 and the maximum being 69.55. There was a possibility that the measurements were exceptions, since they reflected the loading in the first wagon and the last wagon respectively. Without these two, the minimum was 63.15 tons and the maximum was 68.15 tons.

Keeping in view the variations in stenciled and actual tare weights (the potential loss from this is brought out in Exhibit 8), a significant departure was made in May 2006 (Exhibit 12) through Rates Circular No. 41, when the chargeable weight was redefined in terms of net weight rather than related to CC. For BOXN wagons, the chargeable weight for CC+8 was redefined as 67 tons and for CC+6 as 65 tons. The implication of this was that the risk of penalty/loss had been shifted from the customer to IR as extra axle load/under utilized capacity depending on whether the actual wagon weight was more than the tare weight or otherwise. Exhibit 17 gives the number of wagons that would be penalized and the number of wagons that would incur a loss owing to underutilization for the 10 sample rakes in the two scenarios. Based on this sample, the wagons on penalty have reduced, while underutilized wagons have increased (except in one case) owing to the change in definition of chargeable weight. Overall, there appeared to be scope in customers improving their loading parameters and IR improving the measurement reliability.

The major customers also expressed the view that significant changes in rates, loadability, penalties, etc. were made by IR unilaterally. They felt that a consultative process would be desirable.

### *Safety, Maintenance, and Operations*

Since safety and consequently maintenance and operations issues were involved, CCRS raised concern areas which needed to be monitored, measured, and acted upon: “Appropriate instruments need to be procured and installed. Whether the existing staff and systems would be able to absorb the increased measurement requirements is a concern.”

To ensure that rakes (and wagons) were in safe condition, there was a practice of examining and issuing a brake power certificate (BPC). As a separate initiative to reduce wagon turnaround, the maintenance examination requirements for BPC were relaxed from 6000 to 7500 km for closed circuit rakes on various routes. For non-closed circuit rakes, the concept of terminal based examination for ‘end to end’ BPC was being questioned, since the examination requirements were not distance based but trip based. It would be important to understand the link between increased axle load operations and the examination requirements for the brake power certificate.

For streamlined movement, it was important that a rake maintained its integrity right from the time of procurement or a major overhaul for the entire duration of operations. A senior officer from the traffic department in one of the ZRs observed: “For a variety of reasons, during examination, wagons are marked ‘sick’ [unfit for movement until repaired] and hence detached from a rake. During field inspection, we observed that a new rake of 58 wagons procured by one of the ZRs had 10 wagons that were not part of the original formation within 50 days of operations.” As a rake lost its integrity, the need for detaching wagons even for

overhaul maintenance went up during examinations. This directly affected wagon turnaround. As a consequence of this, instructions had been issued in certain closed circuit rake movement areas that wagons need not be detached if found unfit only on loadability, rather than safety. Exhibit 17 gives a sample of 10 closed circuit rake profiles, picked up randomly from three weigh bridge stations. One of the rakes loaded at Ranajitpura for exports had six of the 55 wagons going empty (Exhibit 18). While conceptually, an increased loadability of about 464 (8x58) tons could be achieved in a full rake of 58 wagons because of the increased axle loading, this rake was short of three wagons and had five wagons that could not be loaded. This reduction in capacity owing to operational issues was more than increased loadability. The senior officer however stated: “Drawing definitive conclusions from such data would be premature.”

An officer in another ZR remarked: “In terms of weight measurements, ensuring proper maintenance and operations of weighbridges is critical. The tare weight of wagons being an important input, it is essential that it is accurate and updated.” Whether tare weights can be measured before loading was an issue, given the practical problems of making available an electronic weighbridge at each and every loading point of the entire IR. At a more technological level, there could be scope to minimize the variance in tare weight by better wagon manufacturing quality.

From the safety perspective, the possibility of overloading over and above the extra loading was worrying CCRS: “With increased axle load, the slack for any such intended or unintended overloading has gone down, and hence could have safety implications, unless monitored and immediate corrective action taken as a matter of routine.”

The changes in loadability and rates were communicated to field level through rates circulars. The number of circulars had been going up in recent years. In 2003, 2004, and 2005, there were 36 (35 numbered), 56 (55 numbered) and 79 (76 numbered) rates circulars respectively. In 2006, 41 had been issued until May 10. Commercial staff at the field level remarked: “We receive rates circulars very often. Before we absorb the implication of one, another has been issued. It makes it difficult for us and for our customers. Some of the circulars are just corrections or clarifications which could have been thought about even in the first place.” A computer savvy staff said: “I watch the IR website for the latest circulars and download it for my use. The ‘official’ hard copy sometimes comes in after the implementation date, making it difficult for transactions since it could result in revised billing on the customer.”

### *Future*

IR faced several immediate future priorities: better instrumentation, and studies and to determine the impact of higher axle loading on bridges, track, and wagons.

The increased axle load had been viewed as a net revenue generator, with marginal revenues far exceeding marginal costs (Exhibit 19). However, a senior officer of the mechanical engineering department remarked: “A realistic assessment of the actual cost increases would be essential. Costs could be owing to increased fuel consumption, increased wagon and track maintenance, increased investments in wagons, tracks and bridges, instrumentation, monitoring and studies, and ill effects of increased breakdowns.”

Increasing loadability for a given axle load by improving the net to tare ratio from the current 2.7 (to possibly around 4) could be a possible technological solution. For a 92 ton gross weight, if the wagon weight could be brought down to 18 tons, the loadability would go up to 74 tons.

The concept of multiaxle vehicles which was popular on roads could also a possibility of on rail. While loadability would go up strength and safety of bridges would need to be examined afresh.

Long term possibilities were increasing the axle load to 25 tons and then 30 tons. These would require adoption of new technologies, apart from planning future rail construction and wagon procurement activity to meet the required parameters.

Better utilization of maximum moving dimensions would be another approach to increasing loadability. Apart from ores and high density coal, most of the other commodities including low density coal could not be loaded to their weight limits due to volume being constraining factor. Exhibit 20 analyses this by comparing the moving dimensions with the standard guage (used in Europe and North America). The Indian BG, even though wider, had smaller moving dimensions than the standard gauge.

Given the above possibilities, intellectual capacity building to develop and maintain such technologies vs outsourcing them would be an issue.

## Conclusions

### *Timeline*

The summary timeline of key events which increased the scope of axle loading both by weight and commodity is:

| | Slack Coal | ROM | Finished Iron & Steel | Iron Ore, Copper, Limestone & Dolomite | Coal | All Commodities |
|---|---|---|---|---|---|---|
| CC+2 | 30.07.1997 | 02.03.1998 | 12.07.1999 | | | 29.07.2004 (01.09.2004) |
| CC+4 | | | | 10.2004 | | 04.11.2004 07.11.2004 |
| CC+6+2 | | | | | 17.11.2005 (21.11.2005) | |
| CC+8+2 | | | | 10.05.2005 (15.05.2005) | | |
| 65 | | | | | 10.05.2006 | |
| 67 | | | | 10.05.2006 | | |

Exhibit 14 also gives a time-sequenced summary of Rates Circulars.

### *Minimum Additional Requirements*

The minimum additional requirements, both technically and systemically, that various actors need to be concerned about are:

| Items | RB | RDSO | CRS | Zonal Railways | POH Shops |
|---|---|---|---|---|---|
| **Technical Requirements:** | | | | | |
| Wheel Impact Load Detectors (WILD) | | X | | X | |
| Oscillation trials | | X | | X | |
| Instrumentation and evaluation of bridge | | X | | X | |
| USFD testing | | X | | X | |
| Provision of imported grease for cartridge tapered roller bearing | | | | X | X |
| Springs | | | | | X |
| Weigh bridges | | | | X | |
| **Systemic Requirements:** | | | | | |
| Provisional speed certificate | | X | | | |
| Final speed certificate | | | | X | |
| Quarterly reports to RB | X | | | X | |
| Quarterly reports to RDSO | | X | | X | |
| Brake power certificate | | | | | |
| Rail and Weld fracture report | | | | X | |
| CRS Certification | | | X | X | |
| Springs | | | | | X |

There have been concerns that some of these additional requirements are not being put in place at the pace in which it was expected. This could be dangerous. The CCRS has also remarked on this, from a safety perspective.

The RB's primary role is to monitor the 'negative' effects, so that appropriate corrective action can be taken well in time. While the explicit events in the paper describe some technical concerns, especially on the permanent way, impact on the traction line and wagons also need to be monitored.

### *Loadability vs Carrying Capacity*

Specifying the loadability in terms of carrying capacity has resulted in the following concerns:

- Specifying the loadibility in terms of carrying capacity will not highlight the tare weight. This has led to problems to customers like CIL, CMA, NTPC and SAIL who uniformly complained about the ability to load coal to the extent of the chargeable capacity, since many grades of coal had a bulk density lower than what the chargeable capacity implied.
- Customers also had concerns regarding the difference between recognized (stenciled) tare weight of a wagon and actual weight. If the actual weight was higher and the loading was based on their own weight assessments, penalties for overloading would accrue. If the actual weight was lower, they would be paying for unutilized capacity. On both counts, it would not be the consumers' fault.

Loadability in terms of tons will have the following pros and cons:

Pros

- Normally, even for a specific wagon type, tare weight varies. Specifying loadability in terms of tons will highlight the variations in tare weight.

- The limiting factor of the maximum moving dimension (MMD) will get noted and subsequently the payload to tare weight ratio.
- Customers are major beneficiaries of this type of loadability.

Cons

- Loading as per the standard payload capacity in terms of tons with existing type of wagons might lead to overloading in some wagons whose tare weight itself is high. This might lead to increase in trailing load and safety concerns.

***Future Possibilities of Increasing Loadability***

At 22.9 tons axle load, up to 67 tons can be loaded today in a wagon (in comparison to earlier loading of 56 tons, taking an average of 25 tons of tare weight). There are plans for increasing it further to 25t and 30t per axle loading in the proposed dedicated freight corridors. This would require certain infrastructural changes and safety issues to be addressed, even though some of the experts says that IR tracks are fit for 30 tons and 32.5 tons per axle loading with certain modifications like increasing ballast, replacing sleepers, etc. (Report of Don Gillstrom on "IR Track Design Analysis and IR Axle Loads," December 2004). Improved net to tare weight ratio, multiaxle vehicles, and utilizing maximum moving dimensions are the areas of research for increasing further loadability.

***Need for Expertise and Research***

MR, in various meetings of increased axle loading, has considered views of experts across the world on higher axle loading and their comments on IR's practice. Many reports have been circulated to GMs to have different views on this issue. A meaningful extension of this could be having a panel of experts who can provide consultancy to the IR and help them drive the initiative further. These experts can be a body keeping track of all the developments occurring in IR for increased axle loading and can advise IR from different perspectives, irrespective of the tenure of leaders. This could be a significant step by the current leaders to carry forward their initiatives and help sustain it further.

Research from the current experiments need to be properly documented and a knowledge base developed. Even the design of experiments may need modifications. Appropriate technologies need to be developed through fundamental research to sustain such initiatives. Either RDSO must be restructured to handle this or a new organization be set up. It is also important that such research is done in collaboration with academic institutions in India and abroad.

At a broader level, any quantum technological change in IR is possible today only by technology import. It is critical that capability be developed for technological advancements within India, including in the critical area of increasing axle loading. Such technological capability can also be marketed globally.

***Sub-institutional Perspectives***

Sub-institutional perspectives like those of the CRS and RDSO have played a role in this initiative. The concern is that their role was not proactively sought right in the beginning.

While some of the perspectives provide effective checks and balances, it is important to consider whether the motive behind the views is sufficiently corporate and holistic. These may need reflection and change/strengthening.

### *Organizational Restructuring*

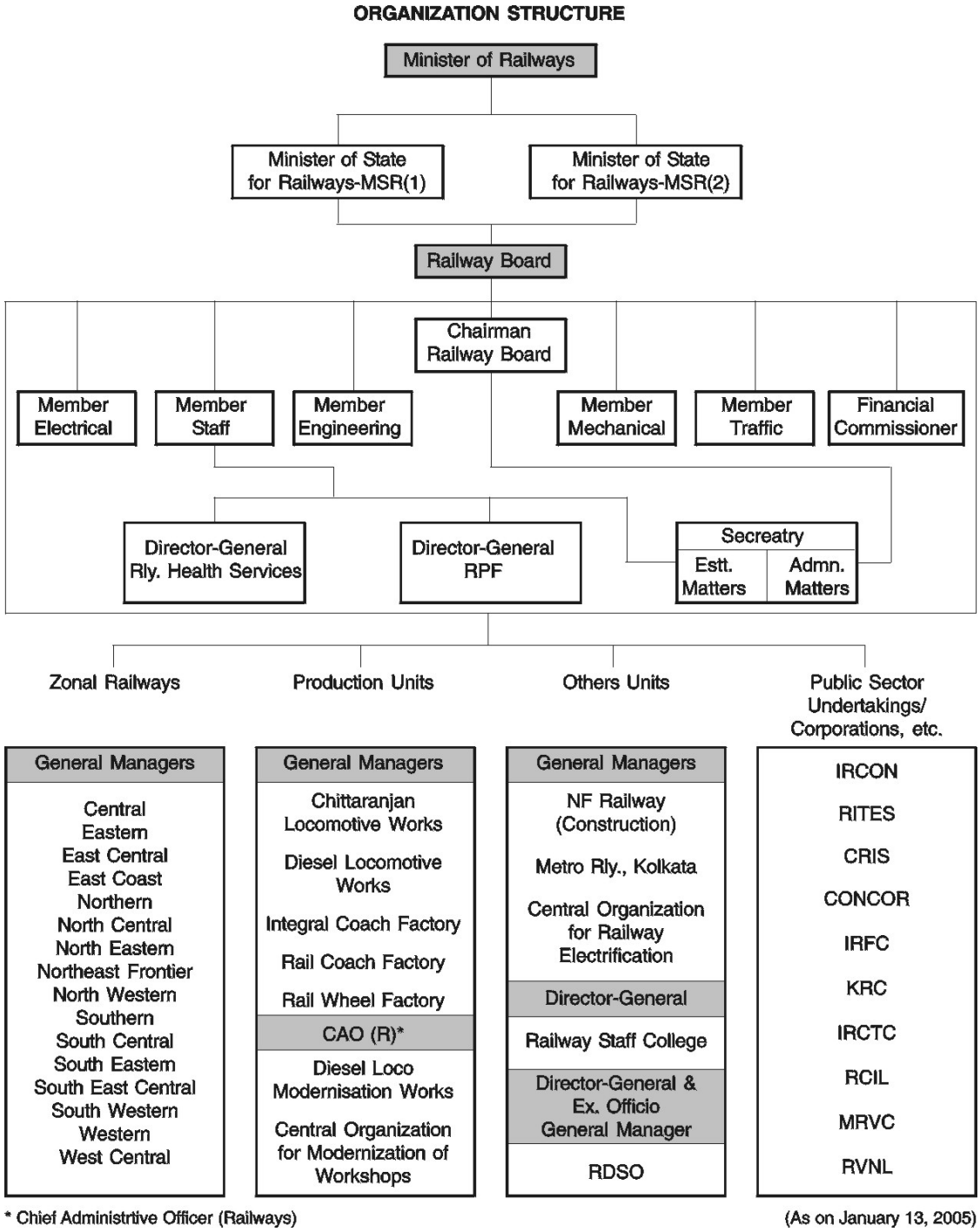
While IR is well set in terms of the human resources and a lot of systems, it does not have the structure for a corporate approach. The initiative of increasing the axle loading had to be triggered by the MR and his office, rather than emerge as an in house strategic decision. 'Departmentalism' is the major issue that comes in the way of the IR's ability to take strategic decisions from within. Further, top officials generally have short tenures. Given the relationship between political leadership and RB, short tenures hinder the consistency of initiatives. IR needs to redesign its organizational structure to bring a corporate perspective at higher levels. This would call for redefinition of the roles and responsibilities of the top management towards a business perspective rather than a functional perspective.

Even though IR has performed well in the past two years, there is need for organizational restructuring.

### *Sustainability of the 'Turnaround'*

Apart from a faster growing economy, consistency of leadership by the MR and a professionally responsive RB worked well in turning around IR. However, if the political leadership changes, how IR will respond is a big question. There is need for a system which focuses on continued innovation and not just on current strategic initiatives. Unfortunately, political leadership is not an outcome of a controlled process. Hence, the technocracy has to develop the capability for continuous innovation. There is also need for IR to become a commercially oriented organization with a corporate culture. Strategies and processes have to be customer centric and scientifically based.

**Exhibit 1: Organization Structure of IR**




Source: Ministry of Railways, 2006-b

Note: Reporting to the Members are Additional Members and Executive Directors (each typically incharge of a Directorate)

**Zone**

- General Manager
- Additional General Manager
- Principal Heads of Departments
- Senior Deputy General Manager
- Heads of Departments
- Deputy Heads of Departments

**Departments in a Zone**

| | |
|---|---|
| 1. Accounts (FA&CAO) | 2. Civil Engg (PCE) |
| 3. Commercial (CCM) | 4. Electrical Engg (CEE) |
| 5. Mechanical Engg (CME) | 6. Medical (CMD) |
| 7. Personnel (CPO) | 8. Operations (COM) |
| 9. Safety (CSO) | 10. Security (CSC) |
| 11. Signal & Telecom (CSTE) | 12. Stores (COS) |

**Division**

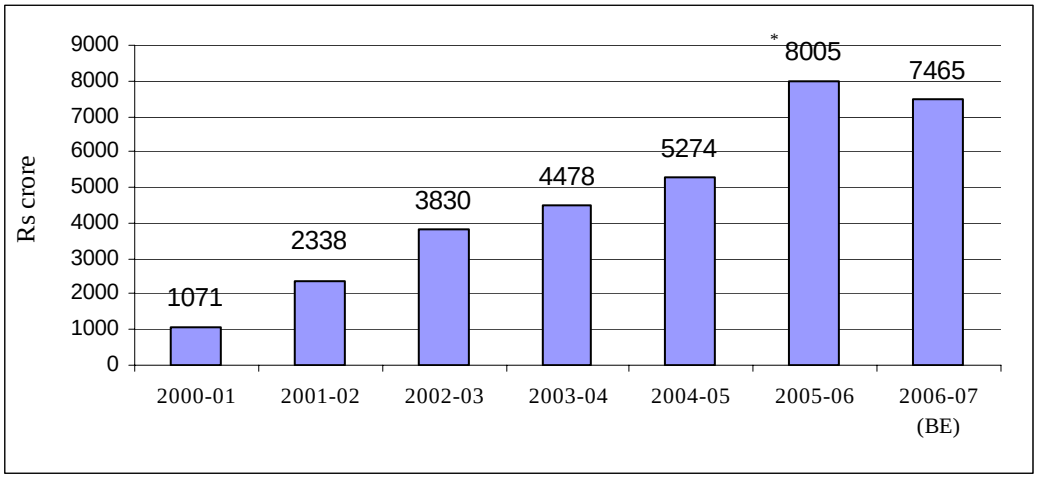
- Divisional Railway Manager
- Additional Divisional Railway Manager
- Branch Officers of the Various Branches
- Senior Scale/Junior Scale Officers
- Supervisors and Staff

**Branches in a Division**

| | |
|---|---|
| 1. Accounts (Sr DFM) | 2. Civil Engg (Sr DEN (Coordination) |
| 3. Commercial (Sr DCM) | 4. Electrical Engg Traction Distribtn Sr DEE (TRD) |
| 5. Electrical Engg Shed Sr DEE (TRS) | 6. Electrical Engg Train Operations Sr DEE (TRO) |
| 7. Mechanical Engg C&W (Sr DME) | 8. Mechanical Engg Loco (DME) |
| 9. Medical (CMS) | 10. Operations (Sr DOM) |
| 11. Personnel (Sr DPO) | 12. R P F (Sr DSC) |
| 13. Safety (Sr DSO) | 14. Signal & Telecom (Sr DSTE) |
| 15. Stores (DMM) | |

Source: Railway Staff College, Vadodara, 2006.

**Exhibit 2: Net Revenue Receipts**




Source: Ministry of Railways. * Railway Budget, 2006

**Exhibit 3: Performance of the Freight Segment**

| | 2001-2 | 2002-3 | 2003-4 | 2004-5 | 2005-6* | 2006-7 (BE) |
|---|---|---|---|---|---|---|
| Earnings[1] (Rs crore) | 24,845 | 26,505 | 27,618 | 30,778 | 36,287 | 40,110 |
| Growth (%) | 6.6 | 6.7 | 4.2 | 11.4 | 17.9 | 10.7 |
| Tons (m) | 493 | 519 | 557 | 602 | 667 | 726 |
| Growth (%) | 4.0 | 5.3 | 7.3 | 8.1 | 10.8 | 8.8 |
| NTKM (b) | 333 | 353 | 381 | 407 | 441 | 479 |
| Growth (%) | 6.7 | 6.0 | 7.9 | 6.8 | 8.4 | 8.7 |
| GDP Growth Current Prices (%)** | 8.7 | 7.5 | 12.8 | 11.8 | 12.9 | |
| GDP Growth Constant Prices (%)** | 5.8 | 3.8 | 8.5 | 7.5 | 8.4 | 7.9[2] |

Source: MOR, Various Years-a; *RB, 2006, Internal Correspondence; *CMIE, 2006

Note: [1]The earnings include the 'Miscellaneous Goods Earnings' due to wharfage, demurrage etc.
[2]CMIE Forecast

**Exhibit 4: Description of Wagons**

| Sr no | Type of Wagon | No of units | Tare wt (t) | Volume (m3) | Speed (kmph) | Commodity |
|---|---|---|---|---|---|---|
| 1 | BOX | 8885 | 25 | 56.3 | 75 | Center discharge wagons used for carrying coal and other bulk commodities |
| 2 | BOXN | 64,469 | 22.47 | 56.3 | 80 | Center discharge wagons for movement of bulk commodities like coal, iron ore, stone etc |
| 3 | BOXNHS | | 22.47 | 56.3 | 100 | Center discharge wagons for movement of bulk commodities like coal, iron ore, stone etc |
| 4 | BOBR | | 25.6 | 57.2 | 80 | Center discharge wagons used for carrying coal to thermal power plants, track ballast, stone etc. |
| 5 | BOBRN | | 25.6 | 57.2 | 100 | Center discharge wagons used for carrying coal to thermal power plants, track ballast, stone etc. |
| 6 | BOY (Vacuum brake) | 900 | 20.7 | | 50/65 | Iron ore |
| 7 | BOBS | 1542 | 30.4 | 34 | 100 | Ballast and ores |
| 8 | BOST | | 25 | | | Open discharge wagons used for carrying finished steel products and also for coal, stone etc |
| 9 | BCN | 42,957 | 25.9 | 104 | 75 | Water tight covered bogies for cement, foodgrains and fertilizers |
| 10 | BCNA | | 24.5 | 106.5 | 80 | Water tight covered bogies for cement, foodgrains and fertilizers |
| 11 | BCNAHS | | 24.5 | 106.5 | 100 | Modified BCNA wagons for carrying cement, foodgrains or fertilizers |
| 12 | BCX (vacuum brake) | 9208 | 27.2 | 104 | | Cement, foodgrains etc |

Source: MOR, Various Years-a; IRFCA, 2006

Note: In addition, IR has over 4000 container flats and over 7000 tank wagons.

**Exhibit 5: Rates Circular No 22 of 2004**

GOVERNMENT OF INDIA/BHARAT SARKAR
MINISTRY OF RAILWAYS/RAIL MANTRALAYA
(RAILWAY BOARD)

No.TCR/1394/2004/2 New Delhi, dated 29.07.2004

The General Managers (Comml)
All Indian Railways.

**Sub: Enhanced chargeable carrying capacity for loose/bulk commodities when loaded in BOXN/BOXNHS wagons.**

In terms of Board's message No. TCR/1304/96/20 dated 30.07.1997, the chargeable carrying capacity (permissible carrying capacity) of slack coal in BOXN wagons was fixed at CC+2 tons. Further, in terms of Board's letters No.TCR/1394/97/12 dated 02.03.1998 and 12.07.1999, the chargeable carrying capacity of run-off-mines (ROM) coal and finished iron and steel products in BOXN wagons was also fixed at CC+2 tons.

The Central Government have now decided that the permissible carrying capacity of all loose/bulk commodities presently charged at carrying capacity (CC) in BOXN/BOXNHS wagons, be enhanced from CC to CC+2 tonnes. Accordingly, all loose/bulk commodities presently charged at CC will now be charged at CC+2 tonnes when loaded in BOXN/BOXNHS wagons.

These instructions will come into force with effect from 01.09.2004.

This issues with the concurrence of Finance Directorate in the Ministry of Railways.

All concerned may be advised accordingly. Please acknowledge receipt of this letter.

**(L.Venkataraman)**
**Director, Traffic Comml (Rates)**
**Railway Board**

Source: IR, 2006

## Exhibit 6: RDSO and CRS

### Research Design and Standards Organization

The Central Standards Office (set up in 1930) and the Railway Testing and Research Centre (set up in 1952) were merged into a single unit named Research Design and Standards Organization (RDSO) in 1957, under Ministry of Railways in Lucknow. The purpose was to develop safe, modern, and cost effective railway technology complying with statutory and regulatory requirements, through excellence in research, designs and standards and continual improvements in quality management systems to cater to growing demand of passenger and freight traffic on the railways. The status of RDSO has been changed from an attached office to ZR from January 1, 2003.

RDSO is headed by a Director General, who is assisted by Additional Director General, Sr Executive Directors and Executive Directors, heading different directorates. These include Bridges & Structures, Carriage, Defence Research, Electrical Loco, EMU & Power Supply, Engine Development, Finance & Accounts, Geo-technical Engineering, Metallurgical & Chemical, Motive Power, Psycho-technical, Quality Assurance, Research, Signal, Telecommunication, Track, Testing, Track Machines & Monitoring, Traction Installation, Traffic and Wagon.

### Commission of Railway Safety (CRS)

The Commission of Railway Safety (CRS), working under the administrative control of the Ministry of Civil Aviation of the government of India, deals with matters pertaining to safety of rail travel and train operation and is charged with certain statutory functions as laid down in the Railways Act (1989), which are of an inspectorial, investigatory, and advisory nature. *The final authority, however, in respect of matters of safety, rests with the Ministry of Railways*.

The CRS was earlier called the Railway Inspectorate and was under RB. This was separated from the Ministry of Railways on May 12, 1941 and was placed under the Department of Communication making it independent of RB. The Railway Inspectorate was redesignated CRS on November 1, 1961.

The most important duty of the Commission is to ensure that any new railway line to be opened for passenger traffic should conform to the standards and specifications prescribed by the Ministry of Railways and the new line is safe in all respects for carrying of passenger traffic. This is also applicable to other works such as gauge conversion, doubling of lines, and electrification of existing lines. The Commission also conducts statutory inquiry into serious train accidents and makes recommendations for improving safety on the railways in India.

The Commission is headed by a Chief Commissioner of Railway Safety (CCRS), at Lucknow, who also acts as Principal Technical Advisor to the Central Government in all matters pertaining to railway safety. Working under the administrative control of CCRS are nine Commissioners of Railway Safety, each one exercising jurisdiction over one or more of the 16 ZRs. In addition, Metro Railway/Kolkata, DMRC/Delhi, MRTP/Chennai, and Konkan Railway also fall under their jurisdiction. There are five Deputy Commissioners of Railway Safety posted at the Headquarters in Lucknow for assisting CCRS as and when required. In addition, there are two field Deputy Commissioners, one each in Mumbai and Kolkata, to assist the Commissioners of Railway Safety in matters concerning signalling and telecommunication.

Source: RDSO, 2006; CRS, 2006

**Exhibit 7: Rates Circular No 48 of 2004**

GOVERNMENT OF INDIA (BHARAT SARKAR)
MINISTRY OF RAILWAYS (RAIL MANTRALAYA)
RAILWAY BOARD

No.TCR/1394/2004/2 New Delhi, dated 04.11.2004

The General Managers (Comml)
All Indian Railways

**Sub: Enhanced chargeable carrying capacity for 8-wheeled BG wagons for loading loose/bulk commodities**

1.0 In terms of Board's letter No.TCR/1394/2003/11 dated 16.09.2004 (Rates Circular No. 31 of 2004), the Permissible Carrying Capacity of different types of wagons was notified. Central Government has further decided to enhance the permissible carrying capacity of all types of 8 wheeled BG wagons by 2 tonnes for loading loose/ bulk commodities.

2.0 The above enhancement of 2 tonnes is not applicable for BOY, BOBS wagons where the axle load of 22.9 tons is presently permitted.

3.0 The enhancement in permissible carrying capacity by 2 tonnes shall be applicable during non–winter months throughout the country. The enhanced limit will also be applicable even during winter period in non-severe cold regions of the country. However, during the winter period, the earlier limit of permissible carrying capacity, as per letter dated 16.09.04, shall continue to be in force in the severe cold regions of the country.

4.0 For freight trains booked during the winter period in the region other than severe cold region and going to the severe cold region, the earlier limit of permissible carrying capacity, as per letter dated 16.09.04, shall continue to be in force.

5.0 The winter period for the purpose of booking as per this circular shall be from 30 November to 15 February. The non-severe cold regions where enhanced permissible carrying capacity shall be allowed throughout the year are: entire South Western Railway, entire Southern Railway, entire South Central Railway except Nanded Division, Waltair Division of East Coast Railway, Mumbai Division of Western Railway and entire Konkan Railway. The rest of the areas are severe winter regions where enhanced permissible carrying capacity shall be allowed in the non-winter period only.

6.0 The punitive charges will continue to be governed by Gazette Notification No. 909 dated 18.10.04.

7.0 These instructions will come into force with effect from 07.11.2004.

8.0 This is issued with the concurrence of the Traffic Transportation, Civil Engineering, Mechanical Engineering and Finance Dtes in the Ministry of Railways.

9.0 Please issue instructions to all concerned and acknowledge receipt of this letter.

**(N.K.Parsuramka)**
**Joint Director, Traffic Commercial(R)**
**Railway Board**

Source: IR, 2006.

**Exhibit 8: Summary of Inputs on Axle Loading**

A. Summary of report by CANAC, Canarail, CPCS Transcom, and LEA on "Gujarat Double Stack Container Project" - November 2004

- IR allows a substantially lower maximum axle load on track which appears to be of similar quality to that found elsewhere in the world. Like, North American track with a rail section of 100 pounds per yard (approx 50 kg/m) on wooden sleepers routinely and safely handles axle loads of 29.83 tons per axle. Thus IR allows only 68% of North American loading.
- It recommends a detailed comparative analysis of track design standards, including rail, sleepers, sleeper spacing, fastenings, ballast and formation to be undertaken to assess whether the existing axle load maximum is relevant, and to determine what actions would be required to increase the axle load to maximum.
- RB should ensure that any new construction of main line track, or conversion of MG to BG, adheres to a standard that will accept expected future axle requirements. As an interim step, until additional research can be completed, considerations should be given to a minimum of at least 25 tons.

B. Report of Don Gillstrom on "IR Track Design Analysis and IR Axle Loads" – December 2004

- IR track structure is close to adequate. There may be additional cost for improved components such as sleepers and rail, however, in the case of rail, the railways appear to be already paying for the stronger rail, but perhaps not getting what they pay for. He says the design is sufficiently robust for extra loading up to 30 tons and 32.5 tons on IR tracks except for an additional 50 mm of sub-ballast. He mentions that with this the areas of risk can be:
  1. Whether the existing sleepers are adequate to support the high bending stresses.
  2. Whether the rail will accommodate the contact stresses from the wheels.

C. Note prepared on "Guidelines to Best Practices for Heavy Haul Railway Operations – Wheel and Rail Interface Issues." - May 2001

- It defines heavy haul as 25 ton or greater axle loads with 20 MGT annual traffic on line or operation of trains in excess of 5000 gross tons.
- It mentions the parameters of track structure and wheel profiles for an axle load up to 29 tons and traffic density up to 49 MGT with terrain having a radius of less than 875 meters
- It states that for introduction of heavy haul on Indian Railways for axle load up to 29 tons and traffic density up to 49 MGT, most of the above parameters have been satisfied except
  - Crossings are 1:12.5 instead of 1:20 for which suitable speed restrictions can be imposed.
  - Limit for hollow wear of the wheels will have to be restricted to 3 mm instead of 5 mm
  - Rail should undergo periodic grind to remove corrugation and surface damages. Lubrication at curves to be imposed reducing friction
  - Bridges etc. to be tested for the increased axle loads.

D. Summary of report by ED/FM on "Loss of Revenue Due to Difference Between Actual Tare Weight and Stenciled Tare Weight in BOXN and BCN Wagons"

- Based on a sample of three BOXN and two BCN empty rakes in NR, the average difference between actual and tare weight in BOXN wagons was 1.48 tons, while that in BCN wagons was 1.53 tons.
- Based on the average daily wagon loading (14790 BOXN and 6720 BCN), total loss of originating loading amounted to 7.99 mt for BOXN and 3.75 mt per year.
- At Rs 51 crore per mt, the total loss of revenue amounted to Rs 599 crores.

E. Summary of report by GM, SECR on overloading in "Overloading in BCX/BCN/BCNA Wagons" – March 2006

- SECR did an experiment by loading more cement bags than the permissible number, and with reference to IRCM, Vol II, found that an excess of 150 to 200 bags loading was possible in BCX and BCN/BCNA wagons.

Source: MOR, 2006, Internal Correspondence

**Exhibit 9: Letter from Engineering Dte Regarding Pilot Project**

GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS
(RAILWAY BOARD)

No. 2003/CE-II/TS/5 Vol.1 New Delhi, dated: 04-05-2005.

The General Manager,
ECOR, SECR, SER, SCR, SWR, SR.

**Sub: Increase in axle load of freight wagons on iron ore routes.**
**Ref: This Office letter of even number dated 02.05.05.**

In partial modification to the instructions issued by the Board vide letter referred above, following instructions are issued.

1.0 BOY & BOBS wagons which have an axle load of 22.86 MT and 22.9 MT respectively, are already cleared for running on iron ore routes. Board have decided to permit running of BOXN wagons, loaded up to CC+8+2; on identified iron ore routes, as a pilot project, where CC is the designed carrying capacity of BOXN with a view that axle load in loaded condition does not exceed 20.32 MT, permitted over load is 8 MT per wagon and loading tolerance is 2 MT per wagon i.e. maximum axle load of 22.82 MT. This pilot project will be in operation for a period of one year to start with.

The iron ore routes, identified for this pilot project, are as under :

(a) Gua-Barajamda-Rajkharasawan-Sini-Chandil Gardhrubeswar-Joychandipahar-Damodar-Burnpur-Asansol.
(b) Bondamunda-Sini-Adityapur
(c) Bolanikhadan-Barajamda
(d) Bondamunda-Barsuan
(e) Bimalgarh-Kriburu
(f) Bhilai-Dhalli Rajhara
(g) Damodar-Kalipahari
(h) Padapahar-Banspani
(i) Bondamunda-Nawagoan-Purnapani
(j) Bhilai-Ahiwara
(k) Waltair-Kirandul Section (Commonly know as KK Line)
(l) Vasco-Hospet-Guntakal-Reningunta-Chennai.
(m) Nawagoan -Hatia-Muri-Bokaro
(n) Purulia-Kotshila
(o) Daitari-Jakhapura-Paradeep
(p) Sambalpur-Titlagarh-Rayagada-Vijayanagaram-Vishakhapattanam

1.1 The extent directions in respect of weighment, circulated vide Boards letter no. TCI/2004/109/4 dated 04.11.2004, which was issued while permitting CC+4+2 in general, shall continue to be applicable for this pilot project.

2.0 The haulage of 58 BOXN wagons with (CC+8+2) load, would require adequate powering and higher tractive/braking forces. It will also have higher trailing loads. It is therefore essential to:-

a) Record the loading spectrum actually passing over the track and bridges during the period. For this purpose, adequate number of Wheel Impact Load Detector should be installed on each Railway. Some Engineer (SE/JE), specifically nominated by PCE/CE, should take the recording. The installation and maintenance should be ensured by Engineering department.

b) Analysing and monitoring of effects.

Therefore, Engineering Deptt. shall keep the Track and Bridges on these routes under observation, with review being done at least every quarter. Specific items for this monitoring are as under:

## 2.1 Track

**2.1.1 Track structure related speed restrictions** - The maximum permitted speed for these freight trains, will be 60 Kmph. In case of 90 R rails, the maximum speed permitted shall not exceed 30 Kmph. It will be further subject to other restrictions in force. The railways shall take action to replace 90R rails, if any, on priority.

**2.1.2 USFD testing-** With increased loading, especially with respect to 90 UTS rails, the phenomenon of rolling contact fatigue (RCF), is likely to take place. The USFD technique to detect RCF, is already available. This may be especially kept in view while doing USFD examination of rails as per existing instructions.

Based on the experience, in the initial period of operations, USFD testing at appropriate frequency, to detect RCF defects, should be under taken in due course.

## 2.2 Bridges

**2.2.1** Bridges on sections are mostly of BGML standard. Each bridge needs to be evaluated as an individual entity regarding safety vis-à-vis its physical condition.

a) Thorough physical inspection as per proforma in Bridge Inspection register, shall be done for each bridge, at the start of pilot project.

b) The bridges found distressed, shall be sanctioned for rehabilitation immediately and taken up.
c) Bridges shall be analysed for the expected loading and where required rehabilitation/strengthening sanctioned and taken up.
d) The speed restrictions as are required from safety considerations, shall be imposed.

**2.2.2** Sample bridges (representing type and span of those available on the routes) and vulnerable bridges, shall be selected for instrumentation, for monitoring the effects of increased longitudinal loads and higher axle loads on the bridge components i.e. foundations, piers and abutments, bearings and super structure.

Instrumentation shall be with respect to measurement of settlement of foundations, tilting of piers/abutments, loads on bearings, deflections and stresses at critical points. Change in dynamic parameters may be monitored for quick evaluation. NDT tests may be carried out periodically.

**2.2.3** Instrumentation and evaluation of bridges needs to be assigned to specialized agencies. Some of the suggested agencies are:-

(a) SERC, Chennai
(b) BBR, Bangalore
(c) Span Consultants, Delhi
(d) Lea Associates (LASA).

Railways shall finalise the agencies at the earliest so that monitoring starts along with the pilot project.

The recording of data and analysis thereof would be required to be done for longer period so as to provide realistic data for future for allowing higher axle loads. This be done at least for 3 years with report every 4 months.

3.0 RDSO shall also associate in these studies and monitoring exercises so as to evaluate the effect of running all these freight stocks in pilot sections.

4.0 This is being issued with a view that required monitoring mechanism is put in place by Engineering Deptt. immediately.

5.0 The formal directions for loading BOXN wagons up to CC+8+2, on these identified iron ore routes, shall be issued separately by Traffic Commercial Dte. of Board.

6.0 Since we are going to operate at a very high traffic density level, it is of paramount importance that strict discipline is observed by all concerned and severe punitive measures are taken for any overloading that may come to light. With this in view and for ensuring strict compliance in observance of rules as laid down, Board have also decided that quarterly review shall also be done by

a multi-disciplinary core group comprising of concerned PHODs namely PCE/CE(Coord.), CME and COM under GM of respective Zonal Railways, and a report sent to Board.

Pradeep Kumar 04.05.05

**(Pradeep Kumar)**
**Executive Director Civil Engg(Planning),**
**(Railway Board)**

**Copy for information and necessary action to:**

Principal Chief Engineer/Chief Engineer (Coordination),
ECOR, SECR, SER, SCR, SWR, SR.

DG/RDSO/Lucknow,

ED/Track/RDSO. ED/B&S/RDSO. ED/GE/RDSO, ED/TM/RDSO,
ED/QA/Civil/RDSO, Lucknow

AM/TT, AM/Mech, AM/Commercial/Railway Board,
EDCE/B&S, EDTC(R), EDTT(M), EDME(Fr.)/Railway Board.
Sr. PPS/ME, MT & MM for kind information of Board Members.

**Copy for information to:**

Director/IRICEN/Pune,

CCRS/Lucknow.

Source: MOR, 2006, Internal Correspondence

**Exhibit 10: Rates Circular No 25 of 2005**

GOVERNMENT OF INDIA (BHARAT SARKAR)
MINISTRY OF RAILWAYS (RAIL MANTRALAYA)
RAILWAY BOARD

No.TCR/1394/2004/2 New Delhi, dated 10.05.2005

The General Managers (Comml)
ECOR, SECR, SER, SCR, SWR, SR

**Sub: Increase in permissible carrying capacity of BOXN wagons on iron ore routes.**

1.0 The matter regarding increase in axle load of freight wagons has been under the consideration of the Board. It has since been decided by the Board to permit running of BOXN wagons, loaded up to CC+8 tonnes with an additional 2 tonnes loading tolerance, on identified iron ore routes, as a pilot project for one year, subject to fulfillment of various conditions stipulated in Board's letter No.2003/CE-II/TS/5 Vol.1 dated 04.05.2005 issued and circulated separately by Civil Engineering Dte of RB. In terms of para 5.0 of aforesaid letter, sanction of the Central Government is hereby accorded to enhance the chargeable carrying capacity of BOXN wagons to CC+8 tonnes on the specified iron ore routes mentioned below, under this pilot project for certain specified main commodities heads. The enhanced chargeable carrying capacity of CC+8 tonnes with additional 2 tonnes loading tolerance shall be applicable to Ores, Limestone & Dolomite, Gypsum and Stones.

2.0 The routes, identified for this pilot project, are as under :
…16 listed routes…

3.0 This instruction will come into force w.e.f. 15.05.2005.

4.0 This issue with the approval of Civil Engineering, Mechanical Engineering, Traffic Transportation and Finance Dtes of RB.

5.0 Issue necessary instructions to all concerned. Since the pilot project of enhanced CC is on a few specified routes, the implementation of the same should be monitored closely.

6.0 This instruction is also available on Indian Railways' official website www.indianrailways.gov.in.

7.0 Receipt of this letter may please be acknowledged.

**(N.K. Parsuramka)**
**Joint Director, Traffic Comml. (Rates)**
**Railway Board**

Source: IR, 2006.

**Exhibit 11: Workshop on Running of Heavy Axle Load Trains on Indian Railways, New Delhi, August 29, 2005**

## Agenda

1. Indian Railways are under pressure to meet the transportation demand due to enhanced economic growth in the country. Constraint of funds for augmentation of line capacity and long gestation period in the implementation of such works will worsen the situation. We have already surpassed originating loading of 600 mt and the target for the current year is 700 mt.

   This has led to demands for increasing the throughput by better utilization of existing assets and by introducing higher axle load wagons on the Indian Railways.

   At present, the normal axle loads on the Indian Railways is 20.3 tons except for certain sections where it is 22.9 tons (BOBS/BOY circuits). The existing casnub bogie design is fit for axle load up to 23.5 tons.

2. This led to an examination of practices on the world railways. It is seen that Australia, Brazil, Canada, USA, South-Africa and China have successfully implemented movement of heavy haul trains. In Australia the permitted axle load is 37.5 tons.

3. During the Governing Council meeting of RDSO on 5th November 2004, ME indicated that the existing track may be fit for 25 ton axle load since the value of track modulus and method of track stress calculation is still being done as settled down in 1968 whereas there has been substantial change in the track structure with improved rails, sleepers and mechanized maintenance. This matter was further examined and the Board have already issued instructions increasing the axle load of freight wagons on iron ore routes by permitting loading of CC+8+2 in BOXN wagons on specified iron ore routes as a pilot project.

4. The time has now come to share the experiences of these higher axle load operations and to evolve a consensus on the matters which will have a bearing on introduction of higher axle load wagons and heavy haul operations to get the resultant economic advantages.

   Sixty-six per cent of the total traffic handled by Indian Railways is amenable for heavy haul operations. However, there are a number of issues involved in this connection which need to be sorted out before heavy haul is fully implemented on the Indian Railways.

5. Some of these issues are

*(i) Mechanical*

   a. Coupling of locomotives and failures
   b. Availability and failure of powers
   c. Increased braking distance and its impact on operations of trains
   d. Improved designs of wagons and their colour (provision of additional springs on wagons, etc)
   e. Bankers' requirements
   f. Design of 25 ton/30 ton axle load wagons within the existing standard moving dimensions
   g. Re-examination of the restriction on the axle load of BOXN HA wagons which through designed for 23.5 tons are restricted to 20.32 tons due to the restriction
   h. Modification of design of existing wagons on order to make them fit for 25 ton /30 ton operations

*(ii) Engineering - Track and Bridges*

   a. Stallings, wheel burns, instances on exit from yards, graded sections
   b. Standard of maintenance required
   c. Rail stresses and reduced fatigue life, quality of grooved rubber pads. Impact on PRC sleepers, track fittings, formation and need for formation strengthening by blanketing, frequency of incidences of rail/weld fractures

d. Planning for track renewals for long and continuous stretches free of speed restrictions.
e. USFD testing to detect rolling contact fatigue and gauge comer fatigue defects.
f. Behaviour of LWR, need of distressing twice - before winter and summer seasons.
g. Rail profile measurements, rail grinding
h. While the track structure for 25 ton axle load has been specified as 70 kg 90 UTS rail of PSC sleepers 1660 per kilometre, no track standard has yet been laid down for 30 ton axle load. Work on this needs to be taken up by RDSO.
i. Bridge capability by using non-destructive techniques for assessing capability of bridges taking into account the design features and to identify individual bridges which may need strengthening or which could be used with speed restriction for the high axle load till they are strengthened.
j. The need for review of the standard of construction of all new line bridges/gauge conversion projects now in progress where track work has not yet been done to identify sections where the required upgrading for higher axle load can be done now itself by the process of material modification to the sanctioned estimates.
k. There would appear to be a need to review the existing codes for design of bridges utilizing the services of IITs and eminent consultants to study the world practices and update our codes.
l. To start with, monitoring of the effect of the haulage of 58 BOXN wagon trains with CC+8+2 loading needs to be done with wheel impact load detectors and inspection and checking of the effect on individual sample bridges.

*(iii) Traffic*

a. Stalling of freight trains in the sections (level and graded).
b. Monitoring of overloading of wagons (CC+8+2) and weighment conditions.
c. Trailing load and powering of trains.
d. Requirement of bankers on graded sections
e. Operational problems of running heavier freight trains.
f. Running of coupled locomotives.

*(iv) Electrical*

a. Coupling of Electrical Locomotives, failures of powers due to increased load, calculation of increased braking distance and its impact on operation of trains.
b. Movement of TE and PF with coupled loco operations.

*(v) S and T*

a. Increased braking distances and its impact on inter-signal distances. There would be a need to examine the impact of the heavier axle load trains on the braking distance and location of signals to see if any modifications are required.

*(vi) RDSO*

a. Reports of wheel impact load detectors.
b. Study on rail stresses based on increased track modulus calculated.
c. Report of stresses on sleepers at various points.
d. Report of bridge load monitoring system.
e. Report of vibration signature technique to measure dynamic recording and to monitor characteristic and changes thereto to monitor health of bridges.
f. TRC/Oscillation trials of sections carrying heavy axle load.

**Rapporteur's Summary**

## A Brief

1. Treasurer/IPWE and ED/Track (Machine), RB, welcomed the participants and AM/Traffic gave introduction to the subject. The keynote address was delivered by CRB. Thereafter, presentations were made by speakers from ZRs who are running the higher axle load trains as a pilot project.
2. Following the presentations, an Open House session was held during which various participants, including some retired Board Members and other senior officers, put forward their views. The session concluded with addresses by ML, MT and finally by ME (President/IPWE).
3. The workshop drew an excellent response and was attended by more than 100 delegates including top brass of the Indian Railways, retired Board members and other officers. A large number of delegates present were from outside Delhi.

## B An Introduction to the Subject

1. In May 2005, permissible carrying capacity was enhanced to CC+8+2 tons for BOXN wagons on 22 identified iron ore routes covering about 3725 route kms (5610 track kms).
2. AM/Traffic while introducing the subject brought out that while on overall basis, railway freight is increasing at about 7%, the growth in case of iron ore traffic is expected to be 15-16%. It is not possible to meet the increasing demand of iron ore traffic unless higher axle load is permitted. Allowing CC+8+2 tons has helped the railway in moving higher volumes, increasing throughput and reducing the per unit cost of transportation.
3. The workshop was organized to know the views of ZRs based on their experience of running higher axle load trains during past three months.

## C Keynote Address by CRB

- Indian Railways' main competitor is road. Freight vehicles of higher axle load have already been put in service on road and their number is multiplying fast. IR needs to wake up to meet the challenge offered by road to survive in the business of transportation.
- Traffic at ports is increasing at a fast pace.
- Golden quadrilaterals are already saturated.
- GDP is growing at 7%.
- Aspirations and demand of public compel IR to introduce more passenger trains making the task more difficult.
- Dedicated freight corridors are being considered. However, any plan which is made now will not mature before next 5-7 years.
- Allowing CC+8+2 tons on iron ore routes as a pilot project has greatly facilitated IR's task.
- Indian Railway needs to extend this to more routes to have greater experience.

## D Summarized Views/Experiences of EDs/RB and ZRs

Views/experiences presented by various EDs of RB and ZRs in the workshop are summarized as under:

*EDCE (P)/RB*

- Additional stresses created by higher axle load were presumed to be taken care by controlled static load and controlled dynamic load factor.
- RB specified conditions for CC+8+2 tons. The main being:
  Provision of weighbridge.
  Cross-check of loading.
  Joint inspection of weighbridges at divisional level.
  USFD examination for gauge corner defects.
  Track recording at least once in four months.
  Replacement of 90R, 52 Kg MM rails on priority.
  Provision of WILD equipment.
- RDSO was assigned work of measuring track modulus and calculating rail stresses.
- Railways were asked to submit quarterly reports but these are still awaited.

- In some special reports, which have been received, no common pattern is emerging. ECoR, SER and SECR have reported overloading
- CCRS has interpreted that increase in axle load of a wagon should be treated as new wagon but RB has not agreed with CCRS. However, RDSO has been asked to do more oscillation trails and issue revised speed certificates.
- RB has received proposals for running CC+8+2 tons on some more routes.
- Railway is planning is to go for 25 ton axle load for existing routes and 30 ton axle load for dedicated freight corridors

*EDCE (B&S)/RB*

- Presented statistics of bridges on the Indian Railways and on identified routes.
- On the identified routes, there are 23 distressed bridges out of which 13 are in SER.
- On the identified routes, RB has prescribed inspection and testing of bridges which include repairs/strengthening, instrumentation on sample bridges, monitoring health of bridges by NDT/vibration testing, installing bridge load monitoring system to monitor load spectrum etc.
- Agencies for carrying out studies have been identified and ZRs informed

*Eastern Railway*

- Total trains run were 117 and most of them terminated at Durgapur Steel Plant. The stretch (Asansol-Durgapur) is mostly level except grade of 1 in 150 rising (ruling gradient) for 1.68 Km length.
- No problem of train parting, breakage of coupling, etc. was observed.
- No problem of stalling and wheel burns was reported.
- No increase in IMR defects or any adverse impact on LWR behaviour was noticed.
- There was no problem of power failure.
- No problem related to signalling as EBD increased from 814 meters to 896 meters only (ie less than 1000 meters).
- No adverse affect observed on bridges. However eight bridges identified for instrumentation and close monitoring.
- No adverse impact noticed during safe to run examination.
- Additional springs being provided in wagons.
- Wagons used for CC+8+2 tons should form a close circuit for proper monitoring of wagon behaviour.
- Possibility of overloading still exists. Weighment should be made compulsory at loading point and RR made should be based on weighment.

*East Coast Railway*

- Increased incidences of stalling and wheel slipping.
- Rising trend of failures of certain important equipment in electric locos has been observed.
- Increase in sick detachment.
- Rail/weld fracture increased from 12 to 17 (+41.71 %).
- No adverse affect noticed on bridges.
- Ten bridges identified for instrumentation and further evaluation

*South Eastern Railway*

- Total trains run were 444 (electric-388, diesel- 56).
- Modification to spring nest in progress.
- Increase in enroute detachment due to wagon body bulging.
- Body defects are likely to increase.
- Increased incidences of stalling and wheel burns.
- Design checks on bridges reveal
  - o Existing substructure of 40' and 60' spans are more vulnerable.
  - o Marginal safety in specific members in some girders.
  - o Holding down bolts of bearing inadequate.

*Southern Railway*
- SERC, Chennai was involved in preliminary instrumentation of bridges.
- Dispersion of longitudinal forces established through field experiments.
- No sign of distress noticed in any bridge.
- PSC sleepers do not show any damage at rail seats. No adverse impact on elastic rail clips. However, rubber pads get crushed at faster rate.
- No adverse impact observed on rail/weld failures.
- Increase in overall sick marking.
- Increase in spring failures and brake beam defects.

*South Central Railway*
- Increased incidences of breakage/chipping of CMS crossing nose; 36 cases reported against 8 during same period last year.
- There were five case of stalling of CC+8+2 rakes as compared to 1 of other than CC+8+2 rakes.
- Scabbing of the rails has been noticed at few locations.
- USFD defects in rails/welds have increased after introduction of CC+8+2.
- Body repairs have increased from 12 to 30 per month and door repairs have increased from nil to 6 per month.
- Wagons are being modified for higher axle load operation.

*South Western Railway*
- Additional line capacity generated - one train per day. Throughput increased by 8%.
- No direct correlation between CC+8+2 and stalling/parting.
- Emergency braking distance trials need to be done for CC+8+2 to prevent overshooting of signals/accidents
- Five cases of wagons body bulging have been reported.
- Increased incidences of spring breakages. Cases of centre pivot and side bearer housing have also shown an increasing trend.
- Improved maintenance facilities required for better examination and repair.
- 100% replacement of CBC and draft gear, side bearer and housing during POH is recommended.
- No specific problem in track maintenance was observed. No abnormal behaviour of LWR was noticed.
- Six bridges found overstressed in theoretical calculations and kept under close watch.
- Five bridges identified for instrumentation

*RDSO*
- Track prepared at Ajgain in Lucknow-Kanpur section for investigating track modulus.
- Vibration signature technique is one of the effective ND techniques for bridge health monitoring. RDSO has used this technique on 20 bridges.
- Dispersion of braking force permitted for checking adequacy of existing bridges.
- Wheel Impact Load Detector (WILD) has been developed indigenously. ZRs have been asked by RB to identify locations for provision of WILD.
- Second distant signal would be required if EBD is more than 1.0 Km

**E Views Expressed by Board Members and other Participants**

*Member Traffic*
- The decision to allow CC+8+2 tons will improve railway's competitiveness and finances.
- There is no option but to increase net to tare ratio.
- EBD requires rechecking with the introduction of air braking stock.
- Cases of stalling can be reduced by improving enginemanship of the drivers.
- Each and every case of stalling should be investigated.

*Member Electrical*
- Complimented the speakers for presenting their views transparently.
- Cases of stalling can be reduced by good enginemanship.
- Some stretches of gradients need to be passed under run-through condition.
- EBD should not be a problem. Double distant signal may not be required

*By other Participants*

- HH rails, swing nose crossing, fully mechanized gangs should be adopted.
- Glued joints should be strengthened.
- It is economic necessity for the railways to change.
- Electronic weighbridges should be provided at all loading points.
- Caution need to be observed that some railway staff do not get mixed up with loaders.
- Mechanical maintenance with clean ballast cushion is required.
- WILD should be provided all along the selected routes to keep the routes under check.

*Concluding Address by Member Engineering/(President, IPWE)*

- He complemented the ZRs who have accepted the challenge to run CC+8+2T freight trains.
- As a measure of abundant caution, routes selected for pilot project were predominantly freight routes where passenger services were few.
- Another factor considered was that all negative factors do not happen together.
- Track modulus adopted hitherto was old reflecting the scenario of 1970s.
- It is satisfying to note that no adverse affect on bridges has been reported.
- It is encouraging to note that barring providing few additional springs, no other modification is required in wagons as presented by speakers from the mechanical branch.
- The pilot project should now logically be extended to additional routes.

Source: IPWE, 2005.

**Exhibit 12: Rates Circular No 41 of 2006**

GOVERNMENT OF INDIA (BHARAT SARKAR)
MINISTRY OF RAILWAYS (RAIL MANTRALAYA)
RAILWAY BOARD

No.TCR/1394/2004/2 New Delhi, dated 10. 05.2006

The Chief Commercial Managers
All Indian Railways

**Sub: Increase in permissible carrying capacity of wagons on CC+8 and CC+6 routes.**

**Ref: Rates Circular Nos. Rates Circular Nos. 25, 29, 42, 45, 67, 73 and 76 of 2005 and 10, 11, 15 and 27 of 2006**

1.0 In terms of Rates Circulars referred above, running of BOXN wagons loaded with CC+8 tonnes and running of BOXN/BOXNHS/BOBR/BOBRN wagons loaded upto CC+6 tonnes with an additional loading tolerance of 2 tonnes, was permitted on selected routes as a pilot project. Loading upto CC+8 tonne in BOXN wagon was applicable for loading of Ore, gypsum, limestone and dolomite, stones and clinker and loading upto CC+6 tonne in BOXN/BOXNHS/BOBR/BOBRN wagons was applicable for E, F, inferior grade coal and washery middlings.

2.0 The matter has been reviewed. It has been decided to extend the validity of the above instructions for one more year, subject to following revised terms and conditions. These instructions will come into effect from 15.5.2006 and shall remain valid upto 30.6.2007.

3.0 It has also been decided to permit running of BCN, BCNA, BCN AHS and BOST wagons with CC+6 tonnes.

4.0 The following CC+8 routes have been identified for running of BOXN/BOXNHS wagons
…27 listed routes…

5.0 The following CC+6 routes have been identified for running of BOXN/BOXNHS/BOBR/BOBRN/ BCN/BCNA/BCNAHS/BOST wagons
…23 listed routes including 11 sets of Intra-railway routes…

6.0 The chargeable weight for ores, gypsum, limestone and dolomite, stones, clinker, E, F, inferior grade coal, washery middlings and all types of washed coal (superior as well as inferior grade) when loaded in BOXN/BOXNHS/BOBR/BOBRN/BCN/ BCNA/ BCNAHS/BOST wagons, on CC+8 and CC+6 routes, will be as per table given below.

| Wagons | Chargeable weight on CC+8 routes | Chargeable weight on CC+6 routes |
|---|---|---|
| BOXN | 67* | 65 |
| BOXNHS | 67* | 65 |
| BOBR | 61 | 61 |
| BOBRN | 62 | 62 |
| BCN | 60 | 60 |
| BCNA/BCNAHS | 63 | 63 |
| BOST | 62 | 62 |

* Chargeable weight for all other commodities including E, F, inferior grade coal, washery middlings, all types of washed coal (superior as well as inferior grade) in BOXN/BOXNHS wagons shall be 65 tonnes.

7.0 The permissible carrying capacity (chargeable weight) as mentioned in para 6.0 above, is not inclusive of loading tolerance of 2 tonnes.

8.0 The aforementioned pilot projects are applicable for traffic from any station to any station falling on these identified routes only. Any sidings, which are falling in the identified routes are also included in this pilot project subject to the existing terms and conditions. Branches, if any, taking off from specified routes are not included in the pilot project.

9.0 This issues with the approval of Civil Engineering, Mechanical Engineering, Traffic Transportation and Finance Dtes of RB.

10.0 Issue necessary instructions to all concerned.

11.0 Receipt of this letter may please be acknowledged.

**(N.K.Parsuramka)**
**Director, Traffic Commercial(R)**
**Railway Board**

Copy to: The General Managers, All Indian Railways for information and necessary action for ensuring compliance of instructions issued by CE Dte vide letter No.2005/CE-II/TS/7 dt 01.05.2006 and No.2005/CE-II/TS/7 pt dt. 09.05.2006

Source: IR, 2006

**Exhibit 13: Loadings and Earnings at Ranajitpura, SWR**

| Sr No | Items | 2004-5 | 2005-6 | Increase over previous year |
|---|---|---|---|---|
| (i) | Total No of Rakes | 2026 | 2488 | 22.5% |
| (ii) | Total No of Boxes | 115,479 | 140,124 | 21.3% |
| (iii) | Total Weight (t) | 7,033,398 | 9.091,409 | 29.3% |
| (iv) | Freight Earnings (Rs m ) | 2139 | 4298 | 100.0% |
| (v) | Per box loading (t) – (iii)/(ii) | 60.9 | 64.8 | 6.5% |
| (vi) | Per box revenue (Rs) – (iv)/(ii) | 18,525 | 30,678 | 65.6% |
| (vii) | Per ton revenue (Rs) – (iv)/(iii) | 304.1 | 472.8 | 55.5% |

Source: SWR, 2006, Internal Correspondence

## Exhibit 14: Rates Circulars for Iron Ore Movement

| Sr no | Date of Circular | Circular No | Details | Date from when applicable |
|---|---|---|---|---|
| 1 | 29/7/2004 | 22 of 2004 | • Board's message No. TCR/1304/96/20 dated 30.07.1997 - slack coal in BOXN wagons was fixed at CC+2 tons<br>• Board's letters No.TCR/1394/97/12 dated 02.03.1998 and 12.07.1999 - run-off-mines (ROM) coal and finished iron and steel products in BOXN wagons was also fixed at CC+2 tons.<br>• With reference to the above two changes, permissible carrying capacity of all loose/bulk commodities be enhanced from CC to CC+2 tons | 1/9/2004 |
| 2 | 16/9/2004 | 31 of 2004 | • Permissible carrying capacity of different types of wagons notified. | -- |
| 3 | 27/10/2004 | 45 of 2004 | • Class 120 to Class 130 (train load)<br>• Class 125 to Class 135 (wagon load) | 29/10/2004 |
| 4 | 4/11/2004 | 48 of 2004 (TCR/1394 /2004/2) | • The permissible carrying capacity of all types of 8 wheeled BG wagons enhanced by 2 tons for loading loose/bulk commodities. This enhancement doesn't apply to BOY and BOBS wagons. The enhancement shall be applicable during non-winter months throughout the country. It shall also be applicable during winter period (30th Nov – 15th Feb) in non-severe cold regions. | 7/11/2004 |
| 5 | 24/11/2004 | 51 of 2004 | • Class 130 to Class 140 (train load)<br>• Class 135 to Class 145 (wagon load) | 27/11/2004 |
| 6 | 6/1/2005 | 1 of 2005 | • 'High Density Iron Ore Aggregates' included in 'Iron Ore' group. Classification, thus, revised from Class 100 to Class 140 for trainload movement and from Class 105 to Class 145 for wagonload movement. | 1/2/2005 |
| 7 | 17/3/2005 | 15 of 2005 | • 'Premium Registration Scheme' for quick supply of wagons for non-programmed traffic. The consignor has to pay freight charge at two classes higher than the class prescribed for that commodity. | 1/4/05 -upto 1 year |
| 8 | 23/3/2005 | 17 of 2005 | • Highest class has been reduced from Class 250 to Class 240.<br>• The classes in 'fives' have been abolished.<br>• The classification has been revised from Class 140 to Class 160. However, the classification for 'programmed' iron ore for steel plant sidings shall continue to be charged at class 140. | 1/4/2005 |
| 9 | 10/5/2005 | 25 of 2005 | • Regarding the matter of increase in axle loading, the permissibe carrying capacity of BOXN wagons was enhanced to CC+8 with 2 tons loading tolerance on 16 identified iron ore routes as a pilot project for one year. The commodities to be carried were Ores, Limestone and Dolomite, Gypsum and Stones. | 15/5/2006 |
| 10 | 11/5/2005 | 26 of 2005 | • Words 'programmed for steel plant sidings' to be deleted from the earlier Rate Circular 17 of 2005.<br>• Iron ores other than programmed traffic for steel plant sidings shall be charged at Class 160. | 15/5/2005 |

| Sr no | Date of Circular | Circular No | Details | Date from when applicable |
|---|---|---|---|---|
| 11 | 8/7/2005 | 41 of 2005 | • Restriction imposed in severe cold regions of the country, during winter period, for the purpose of enhanced permissible carrying capacity, was withdrawn. Thus the enhanced permissible carrying capacity will be applicable throughout IR, round the year. | Immediate effect |
| 12 | 29/11/05 | 69 of 2005 | • Iron ore booked to ports gets shifted from Class 160 to Class 180. | 1/12/2005 |
| 13 | 1/12/2005 | 69 of 2005 (Corrigendum) | • The term 'Iron ore booked to ports' was clarified as 'iron ore booked to stations/sidings serving ports' and was instructed to be read accordingly. | -- |
| 14 | 1/2/2006 | 11 of 2006 | • BOXN/BOBR/BOBRN wagons permitted to run with CC+6 loading with 2 tons tolerance on specified additional routes for loading of 'E', 'F', inferior grade coal and washery middlings.<br>• The routes earlier cleared for running BOXN wagons with CC+6 loading on Central Railway will also be applicable for BOBR/BOBRN wagons. | 6/2/2006 |
| 15 | 28/3/2006 | 25 of 2006 | • Freight Incentive Scheme: Policy Guidelines | 1/4/2006 |
| 16 | 29/3/2006 | 26 of 2006 | • Busy season pricing and busy route surcharge floated for the period of 1st April, 06 to 30th June'06.<br>• Busy season pricing:<br>  • Commodities in class 160 and below except coal and coke - 5% surcharge<br>  • Commodities in classes above 160- no surcharge.<br>• Busy route surcharge:<br>  • All traffic of iron ore booked to goods sheds and siding serving ports - 10% surcharge. | -- |
| 17 | 29/3/2006 | 27 of 2006 | • With reference to the Board's Rates Circular No 67 of 2005, sanction was made to run wagons loaded with CC+6 tons with an additional 2 tons loading tolerance on certain specified routes, as a pilot project, for loading various commodities. These instructions were valid upto 31.3.2006. the validity of these instructions are extended beyond 31.3.2006 to upto 31.5.2006. | -- |
| 18 | 25/4/06 | 32 of 2006 | • Inflation in distance on Hassan Mangalore BG section by 100%. | 26/4/2006 |
| 19 | 10/5/06 | 41 of 2006 | • The pilot project of CC+8+2 tons loading extended to one more year from 15/5/06 to 30/6/07<br>• BCN, BCNA, BCNAHS and BOST wagons permitted to run with CC+6 tons routes.<br>• Chargeable weight for BOXN on CC+8 routes is 67 tons and on CC+6 tons is 65 tons. | 15/5/2006 |

Source: IR, 2006]

Note: In addition, many Rates Circulars like No 29, 45, 76 of 2005 and No 15, 27 of 2006 were issued related to additional routes for increased axle load trains of iron ore.

**Exhibit 15: Iron Ore Export Statistics**

| Year | Turnover[1] (US$ m) | Quantity[2] (mt) | Price ($/t) | Carried by IR (mt) | Freight Class |
|---|---|---|---|---|---|
| 2001-02 | 428 | 42 | 10 | 16 | 120 |
| 2002-03 | 870 | 48 | 18 | 17 | 120 |
| 2003-04 | 1130 | 63 | 18 | 27 | 120 |
| 2004-05 | 2630 | 78 | 34 | 36 | 120, 130 (29/10-26/11), 140 (27/11-31/03) |
| 2005-06 | | | 42 | | 160 (01/04-30/11), 180 (01/12-till date) |

Source: MOR, Various Years-b; [1]Business Line, July 26, 2005; [2]FIMI, 2006

Rail Freight

Rs per ton

| Distance (km) | Class 120 | Class 180 |
|---|---|---|
| 200 | 166.1 | 249.1 |
| 400 | 298.1 | 447.1 |
| 600 | 430.1 | 645.1 |
| 800 | 562.1 | 843.1 |

Source: MOR, 2006-c

**Exhibit 16: Freight Classes for Major Commodities**

| Commodity | Coal | Cement | POL | Iron and Steel | Fertilizers | Food-grains |
|---|---|---|---|---|---|---|
| 2001-2 | 130A | 145A | 270-290 | 200A | 85-115 | 95M |
| 2002-3 | 130 | 140 | 280[1] | 190 | 95 | |
| 2003-4 | 130 | 135 | 250[1] | 180 | | |
| 2004-5 | 140 | 140 | 220-250 | 180 | 90-115 | 90 |
| 2005-6 | 140 | 140 | 240 | 180 | 100 | 120 |
| 2006-7 | 140 | 140 | 220 | 180 | 110 | 110 |

Source: Ministry of Railways, [1] *Business Line,* November 26, 2003.

## Exhibit 17: Sample Weighbridge Measurements in SWR

| Sr No | Station | Train No | Material | No of Wagons | No of Empty Wagons | Speed (kmph) | Time | Total Gross Wt (t) | Total Net Wt (t) | Net Wt per Wagon (t) | Wagon Tare Wt (t) (As stenciled) | | Wagon Gross Wt (t) | | Wagon Net Wt (t) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Min | Max | Min | Max | Min | Max |
| 1 | Bellary | RNBD10 | IOF | 55 | 6 | 7.5 | 7:19 AM | 4479.1 | 3213.6 | 65.6 | 20.6 | 28.9 | 85.1 | 92.7 | 56.2 | 69.6 |
| 2 | Bellary | RNRC06 | IOF | 57 | - | 8.2 | 9:38 AM | 4738.3 | 3454.9 | 60.6 | 21.2 | 25.8 | 71.3 | 95.0 | 49.2 | 72.2 |
| 3 | TB-Dam | YT8 | IOF | 58 | - | 8.6 | 8:01 PM | 5220.5 | 3903.5 | 67.3 | 21.6 | 23.8 | 80.2 | 101.6 | 56.2 | 78.7 |
| 4 | TB-Dam | VS06 | IOF | 54 | - | 9.6 | 3:48 PM | 4728.5 | 3514.5 | 65.1 | 21.1 | 25.7 | 82.1 | 93.9 | 58.6 | 70.9 |
| 5 | TB-Dam | YTO | IOF | 58 | 1 | 9.6 | 7:05 PM | 5227.9 | 3921.5 | 68.8 | 20.4 | 23.2 | 83.0 | 98.8 | 60.0 | 77.2 |
| 6 | TB-Dam | VH01 | IOF | 58 | 3 | 10.2 | 3:36 AM | 5012.3 | 3691.2 | 67.1 | 21.5 | 25.5 | 83.3 | 107.9 | 60.3 | 82.4 |
| 7 | Dharawad | J100L6 | Coal | 54 | 1 | 8.1 | 9:08 PM | 4633.7 | 3400.4 | 64.2 | 21.3 | 26.1 | 81.8 | 92.6 | 58.2 | 69.8 |
| 8 | Dharawad | HJ3L6 | Coal | 53 | - | 7.2 | 4:16 PM | 4558.8 | 3343.4 | 63.1 | 21.1 | 25.6 | 83.2 | 90.0 | 60.0 | 66.8 |
| 9 | Dharawad | HJ98L6 | Coal | 54 | - | 7.1 | 12:14 PM | 4786.4 | 3532.3 | 65.4 | 23.0 | 24.2 | 83. 5 | 96.6 | 61.1 | 72.4 |
| 10 | Dharawad | HJ97U6 | | 57 | 1 | 6.7 | 12:00 AM | 4935.2 | 3633.2 | 64.9 | 20.9 | 25.6 | 77.8 | 93.1 | 57.3 | 71.1 |

| Sr No | Station | Train No | Material | No of Wagons | No of Empty Wagons | No of Wagons on Penalty | | No of Wagons Underutilized | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Gross Wt > tare+CC+8+2 (91.2 t) | Net Wt >69 t | Gross Wt < tare+CC+8 (89.2 t) | Net Wt <67 t |
| 1 | Bellary | RNBD10 | IOF | 55 | 6 | 1 | 1 | 35 | 39 |
| 2 | Bellary | RNRC06 | IOF | 57 | - | 2 | 2 | 50 | 53 |
| 3 | TB-Dam | YT8 | IOF | 58 | - | 21 | 17 | 25 | 29 |
| 4 | TB-Dam | VS06 | IOF | 54 | - | 3 | 2 | 36 | 38 |
| 5 | TB-Dam | YTO | IOF | 58 | 1 | 28 | 27 | 19 | 19 |
| 6 | TB-Dam | VH01 | IOF | 58 | 3 | 15 | 11 | 25 | 29 |
| | | | | | | **> tare+CC+6+2 (89.2 t)** | **>67 t** | **< tare+CC+6 (87.2 t)** | **<65 t** |
| 7 | Dharawad | J100L6 | Coal | 54 | 1 | 9 | 6 | 29 | 30 |
| 8 | Dharawad | HJ3L6 | Coal | 53 | - | 1 | 1 | 39 | 46 |
| 9 | Dharawad | HJ98L6 | Coal | 54 | - | 23 | 15 | 18 | 24 |
| 10 | Dharawad | HJ97U6 | Coal | 57 | 1 | 21 | 14 | 20 | 25 |

Source: SWR, 2006, Internal Correspondence

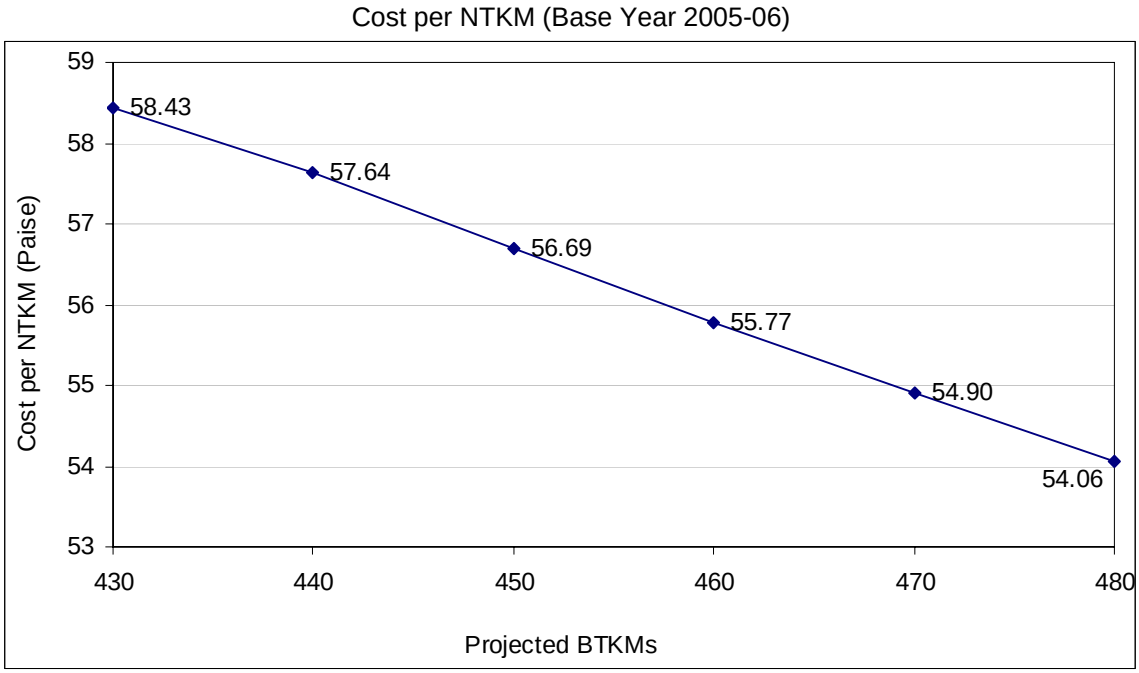
## Exhibit 18: Weighbridge Measurements of Wagons of a Rake

**Weighbridge at Bellary** **Loaded at Ranajitpura**
Train no: RNBD10 Average speed:7.5
Material Name: IOF Time: 3:36:18 AM
Rake no: GALAXY-3-LOCO-13236-14968

| Sl No | Wagon No | Tare Wt (t) | Gross Wt (t) | Net Wt (t) |
|---|---|---|---|---|
| 1 | WR 980506 | 28.90 | 85.10 | 56.20 |
| 2 | CR 107661 | 23.00 | 88.85 | 65.85 |
| 3 | CR 1950320 | 25.10 | 88.25 | 63.15 |
| 4 | ER 56258 | 23.00 | 88.00 | 65.00 |
| 5 | SC 72044 | 23.00 | 88.05 | 65.05 |
| 6 | ER 65084 | 23.00 | 89.10 | 66.10 |
| 7 | CR 106203 | 23.00 | 88.55 | 65.55 |
| 8 | CR 1910068 | 23.00 | 86.65 | 63.65 |
| 9 | WR 87407 | 22.60 | 22.00 | -0.60 |
| 10 | ER 57046 | 23.00 | 90.45 | 67.45 |
| 11 | ER 43056 | 23.10 | 87.70 | 64.60 |
| 12 | ER 45600 | 22.60 | 87.85 | 65.25 |
| 13 | CR 112045 | 23.80 | 88.25 | 64.45 |
| 14 | ER 46637 | 23.00 | 87.30 | 64.30 |
| 15 | SE 100307 | 23.00 | 22.35 | -0.65 |
| 16 | SE 89015 | 23.00 | 90.55 | 67.55 |
| 17 | SE 101883 | 23.00 | 89.70 | 66.70 |
| 18 | SC 72371 | 23.00 | 88.70 | 65.70 |
| 19 | SC 76489 | 22.70 | 87.45 | 64.75 |
| 20 | CR 108832 | 23.00 | 89.10 | 66.10 |
| 21 | SE 175175 | 23.30 | 89.00 | 65.70 |
| 22 | SC 39847 | 23.00 | 89.45 | 66.45 |
| 23 | SC 71177 | 23.00 | 87.85 | 64.85 |
| 24 | SC 92519 | 23.00 | 88.65 | 65.65 |
| 25 | ER 110279 | 23.00 | 87.15 | 64.15 |
| 26 | WR 980680 | 21.50 | 23.45 | 1.95 |
| 27 | SE 197398 | 23.00 | 91.20 | 68.20 |
| 28 | NR 89125 | 22.50 | 87.00 | 64.50 |
| 29 | SC 76478 | 22.70 | 21.05 | -1.65 |
| 30 | SE 115540 | 23.00 | 90.00 | 67.00 |
| 31 | ER 40662 | 20.80 | 87.85 | 67.05 |
| 32 | SE 120811 | 23.00 | 88.65 | 65.65 |
| 33 | SE 120773 | 20.60 | 88.75 | 68.15 |
| 34 | EC 72051 | 23.10 | 87.90 | 64.80 |
| 35 | SC 119022 | 23.00 | 89.60 | 66.60 |
| 36 | SE 124331 | 22.80 | 89.75 | 66.95 |
| 37 | SE 124968 | 23.00 | 89.95 | 66.95 |
| 38 | ER 47059 | 23.00 | 89.20 | 66.20 |
| 39 | NR 97961 | 23.00 | 88.15 | 65.15 |
| 40 | SC 108165 | 23.00 | 89.90 | 66.90 |
| 41 | CR 111146 | 23.00 | 88.25 | 65.25 |
| 42 | SC 89975 | 23.00 | 87.60 | 64.60 |
| 43 | WR 900147 | 23.00 | 89.05 | 66.05 |
| 44 | ER 42331 | 22.30 | 88.45 | 66.15 |
| 45 | ER 66402 | 23.00 | 87.85 | 64.85 |
| 46 | SR 31468 | 23.00 | 88.30 | 65.30 |
| 47 | NR 93323 | 23.00 | 88.60 | 65.60 |
| 48 | SE 104927 | 23.00 | 89.90 | 66.90 |
| 49 | SE 121419 | 22.30 | 87.20 | 64.90 |
| 50 | ER 45501 | 23.00 | 21.85 | -1.15 |
| 51 | SC 960477 | 23.60 | 89.75 | 66.15 |
| 52 | SR 36396 | 23.10 | 22.05 | -1.05 |
| 53 | WR 900225 | 23.10 | 90.40 | 67.30 |
| 54 | SE 102967 | 23.00 | 88.85 | 65.85 |
| 55 | CR 107713 | 23.00 | 92.55 | 69.55 |

Source: SWR, 2006, Internal Correspondence

**Exhibit 19: Marginal Net Revenue Analysis for Freight**




| | 2000-01 (Actual) | 2005-06 (Projected) |
|---|---|---|
| Realization per NTKM (paise) | 74 | 77 |
| Cost per NTKM (paise) | 61 | 56 |
| Margin per NTKM (paise) | 13 | 21 |
| Total BTKM | 310 | 460 |
| Net Surplus (Rs crore) | 4030 | 9660 |

| | |
|---|---|
| Marginal revenue for incremental million ton | Rs. 53 crore |
| Marginal cost for incremental million ton | Rs. 13 crore |
| Marginal net revenue for incremental million ton | Rs. 40 crore |

Source: Sudhir Kumar, 2005

**Exhibit 20: Heavy Axle Wagon**

IR has adopted rather restrictive maximum moving dimension. We have not taken full advantage of our wide gauge of 1676 mm. Other railroad systems with narrower gauges pack in a lot more cubic content and weight of the consignment in their freight wagons. Comparative schedule of moving dimensions on the IR and the US Railroads laid to 1435 mm standard gauge are placed alongside (Figure A). This leads to a high cost of bulk freight transportation which is as much as 5 to 7 times of that in the US railroads on the purchasing power parity basis. A large wheel diameter of 1000 mm and a coupling height of 1105 mm have also not helped matters.

Adoption of liberalized moving dimensions along with reducing wheel diameter and coupling height to 840 mm and 850 mm respectively would permit substantial increase in cubic content and carrying capacity of wagons. A suggested profile of moving dimensions is shown in the attached sketch (Figure B). Given our BG it was possible to provide larger width of wagons but in order to ensure interoperability with the existing network, the width of the stock has been limited to that which is already available on the BOBRN Wagon.

Taking advantage of the higher volume of consignments that would be possible to accommodate in the freight car designed to liberalized moving dimensions (Figure C), the axle loads could be increased from the prevailing 20 tons to 30 tons or thereabouts. These features would enable ushering in designs of high productivity freight stock on the Indian Railways with improved payload to tare ratio of 4.2 (23 tons tare plus 97 tons payload). This would constitute an effective way forward in not only expanding system capacity but bringing down the cost of transportation approaching those prevailing in other heavy haul railroad systems.

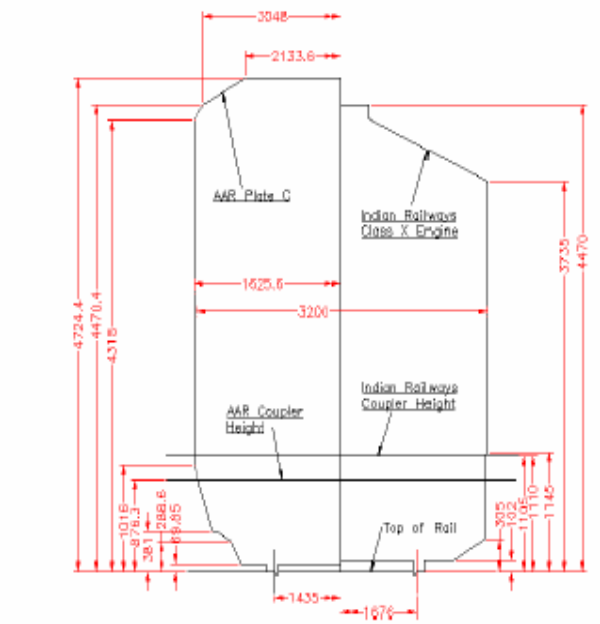



**Figure A**

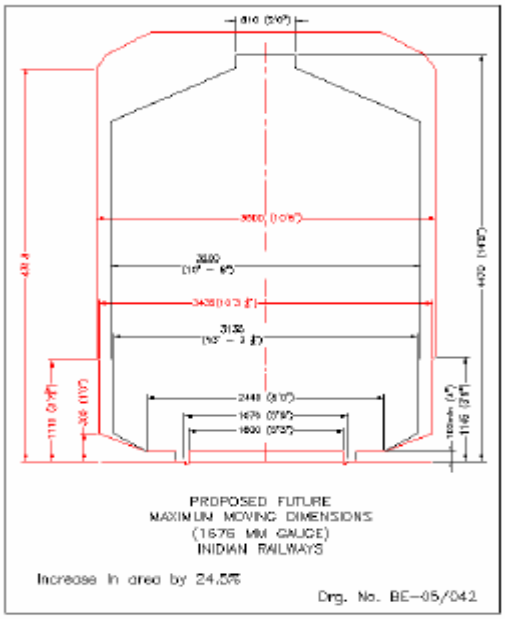



**Figure B**

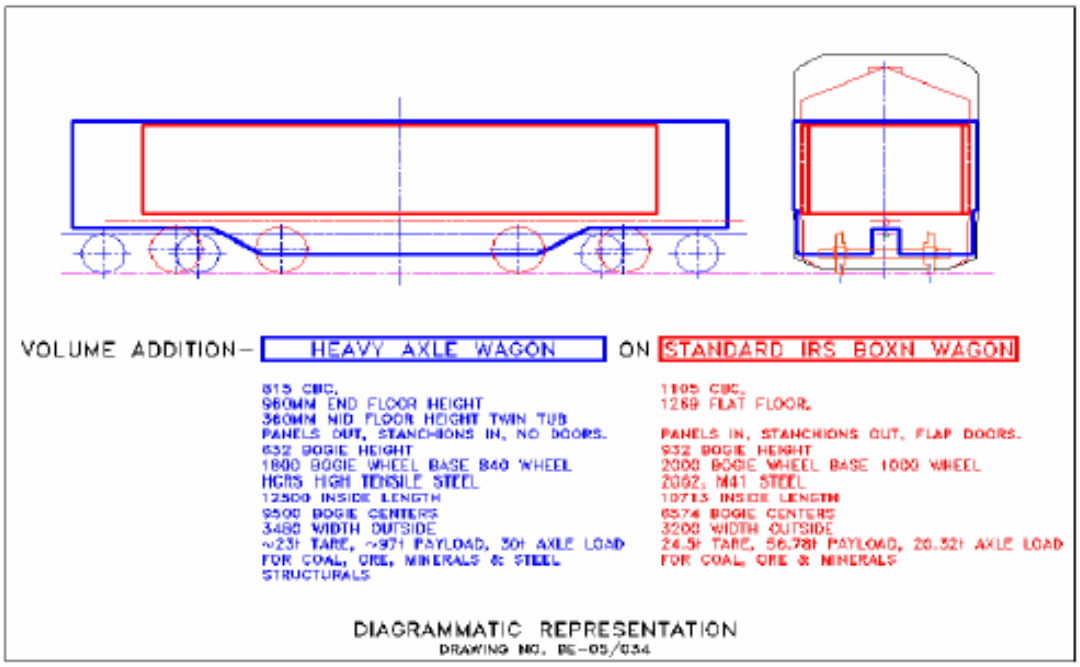



**Figure C**

Source: Banerji, 2005.

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## Glossary

### Designations

| | |
|---|---|
| AM(C) | Additional Member (Commercial) |
| AM(CE) | Additional Member (Civil Engineering) |
| AM(T) | Additional Member (Traffic) |
| AM(P) | Additional Member (Planning) |
| CCRS | Chief Commissioner of Railway Safety |
| CE (Coord) | Chief Engineer (Co-ordination) |
| CME | Chief Mechanical Engineer |
| COM | Chief Operations Manager |
| CRB | Chairman Railway Board |
| CRS | Commissioner of Railway Safety |
| DG | Director General |
| EDCE (B&S) | Executive Director, Civil Engineering (Bridges and Structures) |
| EDCE(P) | Executive Director, Civil Engineering (Planning) |
| EDME(FR) | Executive Director, Mechanical (Freight) |
| EDTC(R) | Executive Director, Traffic Commercial (Rates) |
| EDTT(M) | Executive Director, Traffic Transportation (Movement) |
| EDTT(S) | Executive Director, Traffic Transportation (Steel) |
| FC | Financial Commissioner |
| GM | General Manager |
| JDTC(R) | Joint Director Traffic Commercial (Rates) |
| ME | Member Engineering |
| ML | Member Electrical |
| MM | Member Mechanical |
| MR | Minister of Railways |
| MS | Member Staff |
| MT | Member Traffic |
| OSD | Officer on Special Duty |
| PCE | Principal Chief Engineer |
| PHOD | Principal Head of Department |

**Organizations**

| | |
|---|---|
| CIL | Coal India Ltd |
| CMA | Cement Manufacturers Association |
| CR | Central Railway |
| Dte | Directorate |
| ER | Eastern Railway |
| NTPC | National Thermal Power Corporation |
| RB | Railway Board |
| RDSO | Research Designs and Standards Organization |
| SAIL | Steel Authority of India Ltd |
| SECR | South East Central Railway |
| SER | South Eastern Railway |
| SWR | South Western Railway |
| TTCI | Transport Technology Center Incorporated |
| ZR | Zonal Railway |

**Others**

| | |
|---|---|
| BG | Broad Guage |
| BPC | Brake Power Certificate |
| NDT | Non Destructive Testing |
| PSC | Pre Stressed Concrete |
| USFD | Ultra Sonic Field Detection Testing |
| WILD | Wheel Impact Load Detector |
| UTS | Ultimate Tensile Stress |

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1. CIL: Mr K Ranganath, ED (Marketing), and Team CIL
2. CMA: Mr E N Murthy, Secretary General
3. CONCOR: Mr Rakesh Mehrotra, MD
4. JSW Steel Ltd: Team JSW Steel Ltd
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