

NATIONAL TRANSPORT DEVELOPMENT POLICY COMMITTEE

WORKING GROUP ON RAILWAYS

FINAL REPORT

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FOREWORD

I am pleased to submit the report of the Working Group on Railways for the National Transport Development Policy Committee (NTDPC). I take this opportunity to acknowledge the immense contribution made by the members of the 10-sub-groups ably led by the Chairpersons. I also take this opportunity to thank Dr.Rakesh Mohan, Chairman of the National Transport Development Policy Committee (NTDPC) for his guidance which helped the Working Group keep its focus on the big picture.

The report has attempted to make an in-depth analysis of the current state of Railways and the challenges before Railways. It outlines a roadmap for transforming IR into one of the best in the world by 2030. The plan proposed by the Working Group builds on Vision 2020 for Indian Railways and several other reports on Railways as well as some original work done by the Sub-groups. It encompasses every aspect of strategic planning and implementation with particular stress on environmental sustainability, capacity enhancement, modernization and customer-focussed service delivery. The recommendations are based on the long-term strategic vision for Railways and have far-reaching implications for the Government in terms of investment mobilization and regulatory and organizational aspects of the way Railways are being run at present. These are, however, the recommendations of the Working Group and do not reflect the views of the Government.

(Vinay Mittal)
Chairman, Railway Board
&
Chairman, Railway Working Group

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CHAPTER-1

Composition and TOR

The Working Group on Railways for the National Transport Development Policy Committee (NTDPC) was constituted by Planning Commission vide its letter No.,3/1/2010-Tpt dated 19-07-2010 under the chairmanship of Chairman, Railway Board (**copy of the letter containing the composition and the TOR is at Annexure-1**).

1.1 The Working Group was given a wide ranging ToR. Briefly stated, the Working Group was remitted to recommend on the role envisaged for Railways by 2020 and 2030 keeping in view the recommendations of various committees including National Transport Policy Committee, 1980 and the Expert Group on Railways, 2001 as also the need for environmental sustainability energy, security, safety, quality of life and reduction of logistics cost. The Working Group was asked to estimate the share of railways in freight and passenger transport, the capacity and investment required for the purpose, mechanisms for rational pricing of transport and development integrated logistics solutions. It was required to suggest a roadmap to realize the goals set including policy measures at the government level and internal measures to be implemented by railways themselves.

1.2 The Working Group held two meetings on 27-08-2010 and 12-10-2010. It was decided to constitute the following 10 Sub-Groups to address different elements of the ToR:-

Sub-Group	Task in Brief	Chairperson
Subgroup-1	External/Policy Environment Market Analysis and Demand assessment	Sh.S.K.N.Nair
Subgroup-2	Survey of International Experience & Railway Reforms	Sh.M.Ravindra
Subgroup-3	Capacity Planning and Resource Mobilization	Sh.S.B.Ghosh Dastidar
Subgroup-4	Strategic Planning, Organizational & HR Challenges	Sh.R.Gopalakrishnan
Subgroup-5	Technology and High Speed Rail	Sh.M.Ravindra
Subgroup-6	Information Technology	Sh.Saurabh Srivastava
Subgroup-7	Determination of full-costs, Accounting System and Tariff	Professor S.Sriraman
Subgroup-8	Multi-modal & Non-Bulk Traffic	Sh.R.N.Aga
Subgroup-9	International Rail Linkage	Sh.Raghu Dayal

Subgroup-10	Land Use Optimization	Sh.Sudhir Chandra
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1.3 The report is based on the work carried by the above Sub-Groups as well as inputs received from various stakeholders. For this purpose, a questionnaire was sent to the State Governments in February, 2011 seeking their inputs on several areas such as participation in railway projects and mechanism thereof, fast tracking of construction of rail over bridges (ROBs)/rail under bridges (RUBs), emergence of growth centres and shifts in traffic movement patterns, development/redevelopment of railway stations, development/upgradation of urban rail infrastructure and multi-modal logistics parks. Governments of Karnataka, Gujarat and Haryana responded on these issues. A Stakeholders' Workshop was held on 09-04-2011 with participation by State Governments, relevant Central Government Ministries, Chambers of Commerce and NTDPC members. The suggestions and inputs received in response to the questionnaire and in the course of the workshop have been considered and appropriately incorporated in the recommendations.

CHAPTER-2

Summary of the Report

2.0 The thrust of the TOR remitted to the Working Group is to recommend the role Railways should play in future and the policy/strategic choices to be made by the government and the Railways to fulfill that role. The Working Group has attempted to find answers to these issues around the following fundamental questions:

- Where are railways today?
- Where should railways be in 2030?
- How to reach these goals?
- What policy changes or government support would be required?
- What should railways themselves do to prepare them and meet the challenge?

2.1 Railways occupy a unique and crucial place in the country's transport infrastructure. Indian Railways (IR), managed directly by Ministry of Railways, Government of India is the third largest railway network in the world under a single management. At present, 82% of the network of 64015 kms is in Broad Gauge (BG) and the rest of the network barring hill/heritage railways is progressively getting converted to BG. The BG network accounts for 97.2% of the passenger and 99.6% of the freight traffic. It is the topmost rail passenger carrier (in terms of passenger kms) and the fourth largest rail freight carrier in the world.

To sustain the pace of economic growth, India needs an efficient and sustainable transport infrastructure. The quality, capacity and performance of Railways would be of crucial importance in this regard. IR has played a critical role in integrating markets and connecting communities throughout the length and breadth of the country and in transportation of passengers and freight. It is uniquely placed to serve the needs of the rapidly expanding and modernizing Indian economy and meet the aspirations of the country.

2.2 Optimal Share of Railways (Chapter-3)

Total Transport System Study by RITES and McKinsey's study on Building India: Transforming the nation's Logistics Infrastructure, 2010 have attempted to determine an optimal share of railways in the freight transport keeping in view the logistic costs as well as environmental and social benefits of rail transport. The losses on account of non-optimal and road dominant transport system have also been assessed. The current share of railway (36% of ton-kms) is neither optimal or sustainable in the long run. This contrasts starkly with experience of other large-sized countries like USA and China where share of rail transport in freight is close to 50%.

2.2.1 Studies by AITD and RITES had also assessed the environmental and social costs of various modes of transport. Asian Institute of Transport Development (AITD) in its study ‘Environmental and Social Sustainability of Transport- Comparative Study of Rail and Road (2000) had brought out the advantage of rail transport over road in respect of energy consumption, financial, environmental and social (including accident related and health damaged related) costs. It concluded that rail consumes 75-90% less energy for carrying freight traffic and 5-21% less energy for passenger traffic compared to road. Similarly, railway scores over road in respect of financial, environmental and social costs by a huge margin by virtue of its scale economies and being a safer and less polluting mode. Any shift of traffic from road to rail, especially in freight, would, therefore, result in substantial savings in energy consumption as well as reduced social costs. This has also been corroborated by the Total Transport System Study conducted by RITES for Planning Commission.

2.2.2 RITES’ TSS has carried out an optimization exercise by assigning the traffic flows to the most cost-efficient mode taking into account the total resource cost. This brings out that the rail share in inter-regional transport would go up to 88% from the present level of 36%. It is felt that this would represent a theoretical extreme. Given the real-world realities of cost, economics, customer convenience and the experience of large countries like USA and China, a share of 50% for railways in 2030 has been considered optimal.

2.2.3 RITES’ TSS has projected that size of the inter-regional freight transport would grow from around 1214 billion ton-kms in 2007-08 to 5345 billion ton-kms by 2025-26 (a growth rate of 8.58%). If this is extrapolated to 2030, the size of total transport inter-regional freight transport would come to 7430 billion ton-kms. The Working Group considers this to be conservative. If the country’s GDP continues to grow at 9% and the elasticity of freight traffic remains at a level of 1.25, transport demand would expand at 11.25%. At this rate, the total ton-kms would grow nearly 10-fold from the base-year figure for 1409 billion to 14090 by 2030. 65% of the total freight traffic is bulk in nature and 79% of the freight ton-kms moves over distances exceeding 400 kms. 50% share of the traffic for railway is, therefore, both desirable and feasible provided the challenge is approached the right way.

2.2.4 RITES’ TSS did not attempt a computation of the size of the total passenger transport market in the country nor its inter-modal distribution. Reliable information is available only in respect of rail and air transport and therefore, the size of the total passenger transport market is not known. However, it is a well known fact that railways has not been able to satisfy demand in full despite an annual growth of 5-6% in originating passengers and more than 8% growth in passenger kms in recent years. Therefore, a realistic goal for

railways in the next 20 years should be to remove supply constraints and satisfy the demand in full by setting for itself tangible targets for 8% growth in originating passengers and 10% growth in passenger kms to begin with. Raising of speed, shift of focus to long-distance and inter-city transport and suburban corridors involving dense passenger movements and improvement in quality of service should form part of the policy. Minimum levels of service and comfort at stations and in the trains need to be stipulated and complied with.

2.3 Major issues confronting Railways (Chapter-4)

The determination of optimal shares of railways is one thing but achieving these is quite another. Attainment of the optimal share would require action on multiple fronts. Major issues that confront railways would need to be identified and addressed. These include capacity constraints, investment planning, project execution, safety and reliability of operations, social and commercial objectives, financial issues (cost, tariff and accounting), productivity, HR, organizational structure and R&D.

2.3.1 Capacity constraints

A major reason why Indian Railways has suffered a steady decline in its share in freight and passenger transport is that its network is plagued by infrastructural and carrying-capacity constraints. Traffic flows on IR are highly uneven and imbalanced. 82% of its network on broad gauge carries almost the entire load of freight and passenger traffic. Further, the Golden Quadrilateral and the Diagonals connecting the four major metros, viz., Delhi, Kolkata, Chennai and Mumbai (along with the east-west diagonal extending to Guwahati) constitute less than 16% of the route, but account for more than 50% of the passenger and freight traffic. 189 sections out of the total 212 on these high density routes have already reached saturation (defined as 80% capacity utilization) in line capacity utilization. In fact, 141 sections have already crossed 100% utilization. Capacity bottlenecks that have already surfaced would need to be addressed. The planning framework needs to change to ensure creation of capacity ahead of demand.

2.3.2 Investment Planning:

Investment in Indian Railways has to be sharply focused and directed towards solution of the capacity constraint or improvement of operations. Quick pay-off projects that can ease the capacity constraint the fastest would need to be prioritized. IR needs to shift to a programme approach from the current project-oriented approach. Plan -head wise investment approach has to be dispensed with as it distorts investment priorities and promotes

departmentalism. Investment should be focused on total capacity creation including rolling stock, asset renewal, technology induction, Information Technology and identified investments in modernization etc. This should be quantifiable in terms of incremental tonne kms. Replacement and renewal of assets should be ensured. For this purpose, the ad hoc approach followed in respect of appropriation to Depreciation Reserve Fund needs to be changed to a rule-based approach that adequately takes care of this requirement.

2.3.3 Project Execution:

IR does not have good track record on funding and execution of projects. It requires complete revamping. At present, funds available are spread thin on numerous projects instead of concentrating adequate resources on a select few and getting these completed. All capacity enhancement projects need to be taken up after ensuring full funding before taking up the project execution for its time-bound commissioning. Project teams need to be held accountable for timely completion of the projects. Project managers would need to continue in their positions till project completion. Performance-linked incentive would need to be provided and also penalties for failure to be imposed.

2.3.4 Safety & Reliability of Operations:

Failure of equipment and disruption to traffic on account of accidents continues to be a problem and affects the reliability of operation on a saturated network.

2.3.5 Social and commercial objectives

For long-term sustainability, IR has to strike a balance between the commercial and the social parts of the business. At present, both the roles intermingle leading to uncertainty in creation of capacity and meeting the demand for rail transportation. Clarity is needed on the balance to be struck between the two in respect of investment planning and introduction of services. Commercial and social roles have to be kept distinct and separate and managed appropriately. This can be done by separation of funding of the projects and services on the social account. A part of the funding of such projects could come through stakeholder and beneficiary contribution. These would need to be funded in the same way as other social-sector programmes.

2.3.6 Financial issues (cost, tariff and accounting)

In the short run, most of the costs incurred by IR are fixed and therefore, the only option left is to expand volumes on a large scale. For instance, once laid, for all practical purposes, the track, stations, yards, repacking and goods sheds, locomotive and carriages/wagons maintenance facilities become fixed costs. Staff salaries also represent fixed costs. Thus increase in volume alone can bring about a reduction in the cost of carriage. This is best

achieved by increasing axle loads, running longer trains and increasing trailing load per train in the short run. It also requires that capacity constraints and service delivery issues are tackled on priority. Selective improvements and additions to facilities that remove bottlenecks can yield excellent returns with minimal investment.

Tariffs

Tariff –setting for passenger services has to be made rational and attuned to business growth requirement. Freight tariff needs to be based on differentiation linked to type and quality of service offered. Both freight and fare would also need to take into account competition from other modes, need for providing targeted subsidy and need to generate decent surpluses for reinvestment.

Accounting System

Accounting system also needs to be restructured and revamped to yield requisite information for managerial decision-making. The present system of accounting gives little information on how to control costs, as accounts are kept on “heads of account” rather than on the basis of activities . There is no satisfactory way to figure out, for example, which are the paying lines and which are not; which trains yield how much; what is the cost of a marshalling operation, or the cost of overhaul of locomotives at each depot.

2.3.7 Productivity

Not only the wage costs are high on Indian Railways but the productivity of employees measured in terms of transport output (million of passenger-kms and freight-ton-kms per employee) is relatively low compared to USA, Japan, Russia and China. Similarly, NTKMs per wagon per day as well as transport output per route kms is also low compared to Chinese Railways and Russian Railways. Productivity of employees and assets is a function of several factors such as state of the infrastructure, the level of technology, the skill of workforce and quality of management. However, the bottom line is that Indian Railways has a lot of catching up to do to reach the level of productivity achieved by several major railways.

2.3.8 Human Resource

HR functions in Indian Railways have traditionally evolved in the context of its being in the government. There is no mechanism for attuning recruitment and training to the job requirements through rewards and incentives. Improvement in HR practices to attract and retain talent would be a challenge. Multiplicity of departments and services would need to be reviewed. A few services may need to be merged or amalgamated while taking due care to ensure that the benefits of specialization and job-oriented skills are not lost. Recruitment of Group ‘D’ staff, especially staff on compassionate ground, would need to be critically

reviewed to ensure that the recruitment matches the skill level required for a technologically sophisticated and market focused railways in future.

2.3.9 Organization Structure:

Railway is organized in terms of several functional departments. The staffing pattern does not match the skills required to build a technologically sophisticated, responsive and customer-focused organization. The over-differentiated structure adversely affects development of a coherent vision on fundamental issues. IR needs to be restructured on business lines. IR also performs a wide range of activities from manufacturing of coaches/locomotives to running of schools/hospitals. Each one of these activities needs to be examined afresh from the perspective of either retention or hiving off based on operational need for integration, and “make or buy” decision. There is also a need to empower Zonal Railways headed by very senior functionaries (GMs) to a much higher degree than is the case at present and hold them accountable for both operational and financial results.

2.3.10 Research & Development

Research and Development can be a significant source of competitive advantage. However, Indian Railways has not been in the frontier of developing or innovating railway technologies. The gap between the state-of-the-art and technology adopted in construction, maintenance and operation on IR needs to be bridged. Efficient technological solutions such as high speed rail and heavy-haul operations would need to be adopted. RDSO would need to forge linkages with domestic industry and academia. A vibrant railway equipment industry would need to be created. An annual performance audit of RDSO for its performance over R&D would need to be carried out.

2.4 International Experience (Chapter-5)

Reform measures undertaken in a few major railway systems such as Japan National Railways, Russian Railways, Chinese Railways and British Railways have been studied to draw lessons appropriate for Indian Railways. The key drivers of reforms have been:

- (a) Competition, control of public subsidy and attracting private investment;
- (b) Financial crisis and over-indebtedness brought about by rapid expansion of network, operation of non-remunerative lines, inflexible organizational structure, exacerbated by powerful trade unions and erosion of market share;
- (c) Need for rapid expansion and improvement of operational performance; and
- (d) Ideological inclination of the government.

Broadly, the reforms have covered the following:

- (a) Separation between infrastructure and operation;
- (b) Institutional and regulatory reforms covering rationalization of tariff determination, investment decisions, freedom of operating companies and establishment of independent regulators; and
- (c) Labour reforms.

In case of Chinese Railways, a number of internal organizational reforms have been carried out to enable Chinese Railways to focus on and achieve one of the greatest rail construction programmes in the history of Railways. For the present and foreseeable future continuance of the integrated government-managed structure for IR with responsibility for both infrastructure and operation would best serve the interest of the country. However, major reforms would be required in the areas of accounting, investment planning, dispute resolution mechanism for private partnerships, reorganization along business lines, hiving-off corporatization of identified activities and redefinition of the role of Railway Board. A few changes in the Railways Act have been recommended.

2.5 High-speed rail (Chapter-6).

A brief survey of the development of high speed rail the world over has been carried out to analyze its relevance in the context of India. In the short and medium term, notwithstanding the undoubted advantages of high speed rail from environmental and developmental perspectives, due to high capital investment and slow pickup in demand, segregation of freight and passenger lines and raising of speed on the passenger lines to 160-200 kmph would yield the maximum benefit. Meanwhile, planning and technical standards could be finalized for construction of select high speed corridors. A separate authority would be needed to spearhead the effort and explore the option of bidding out and awarding a few projects on Public Private Partnership. If the global experience is any guide, such projects would entail substantial financial commitment on the part of the government, at least in the initial years .

2.6 International rail linkage (Chapter-7)

Improved connectivity with neighbouring countries required on diplomatic and political considerations should be fully funded by the exchequer and at the same time IR should exhibit greater urgency and expedition in their execution and operationalisation. Important cross border connections have been identified and listed.

2.7 Optimization of land use(Chapter-7)

Technological solutions like retaining walls, tunnels overhead alignments and optimization through critical re-look at Schedule of Dimensions (SoD) and removing

constraints coming in the way of full exploitation of Maximum Moving Dimensions (MMDs) would optimize the requirement of land. Admittedly, in most cases these may result in increasing the cost of the project that can improve and optimize the use of a scarce and critical resource like land. The recommendations include preservation and efficient use of available land as well as critical reassessment and minimization of fresh acquisition of land for projects.

2.8 Planning for 2030 (Chapter-9).

If India has to emerge as one of the largest economies of the world by 2030, Railways would need to greatly enhance its role in transportation and logistics. It has to set itself clear and challenging goals on market-share, network capacity and service delivery. IR must aim at 50% market share in inter-regional freight traffic by 2030. It must banish shortage of any kind in either freight or passenger service. There should be no capacity constraints on trunk routes. Freight and passenger corridors must be segregated and both services must match or exceed international benchmarks in trailing load, speed and service reliability. **Services must be market-focused and must veer away from the restrictive focus on train-load segment to embrace small-parcel-size segments through appropriate aggregation mechanisms.** It also must set clear goals to sharpen its edge in respect of energy efficiency, carbon footprint and efficient land use. IR also must embrace and fully discharge its strategic role in building and strengthening connectivity with neighbouring countries.

2.8.1 Strategic Plan:

A strategic planning process would need to be institutionalized and taking a forward view over the next 20 years. It shall comprise a multi-year investment plan fully supported by a credible funding plan:

- The plan must provide for the following:-
 - ✓ Construction of 5 Dedicated Freight Corridors.
 - ✓ Improved connectivity to 400 industry clusters and 200 ports (both major and non-major) involving nearly 750 last mile rail connectivity works (these have been identified by MCKinsey's study).
 - ✓ Development of 15 to 20 logistics parks as the main network hubs viz. Mumbai Bangalore, Cochin, Hyderabad, Kolkata, NCR Ahmedabad, Nagpur, Vishakhapatnam and Siliguri, etc.
 - ✓ Upgradation of rail wagons (higher axle load, better tare to pay- load by shifting away from carbon steel to stainless and high- strength steel, aluminum or

composite materials bodies to reduce the weight, increased payload of BCN through use of well wagons, better maintenance cycles, etc).

- ✓ Upgradation of wagons and track to 25 tonnes axle load.
- ✓ Improved infrastructure and rolling stock maintenance.
- ✓ Completion of identified inter-country connectivity projects and execution of bilateral agreements for smooth and seamless movement of intra-regional traffic among neighbouring countries.
- Projects taken up purely on social and strategic considerations must be funded separately through national/strategic projects or from state governments.
- The PPP projects should be identified and handed over to a dedicated organization to develop, execute and manage these projects. Regulatory hurdles coming in the way of implementation of PPP projects need to be removed.
- Generation of adequate internal surpluses through expansion of market share, cost reduction and correction in distortion of tariff must be planned and scrupulously monitored. A norm for internal generation as a percentage of gross revenue would need to be set and achieved by a combination of traffic growth, expenditure control and dynamic tariff setting. Attainment of this target should be monitored on an annual basis. Internal resources would be supplemented by prudent borrowing and backed by stepped up budgetary funding.
- Accounting system will need to be revamped to accurately reflect the cost of various activities and throw light on train-wise and route-wise profitability to aid managerial decision-making.
- Strategic plan also must include a marketing and business plan listing sequential steps on gaining market share in bulk and non-bulk cargo segments by providing mix of cost efficient services and premium value added service. Specifically, the freight, passenger and parcel strategies would cover:

(a) Freight:

During the last six years, freight traffic on IR has grown at a rate of 8% p.a. double the rate achieved by Indian Railways in the past. However, this performance is still an under-achievement as transport market is estimated to be expanding at the rate of 10% pa during this period.

In the face of severe capacity constraints, IR has focused on bulk cargo and did not feel the need for a strategy to attract any traffic other than bulk cargo or satisfy

the customers' logistics requirements. Even in the bulk cargo segment, its share is less than what it ought to be. It has not been able to offer scheduled services or assured supply of wagons on a specified date or guaranteed transit time. Freight service is also occasionally influenced by preference for certain cargos on public policy considerations to the detriment of long term customers. A number of commodities viz, automobiles, chemicals etc. which should be carried by Railways are transported by road.

A fast-growing Indian economy is expected to be accompanied by proportionately high demand for transportation services. This presents a huge opportunity for railways to increase their share. IR can also attempt to capture a significant share of the fast-growing fast-moving consumer goods (FMCG), consumer durables and IT (CDIT), containerized cargo and other segments like automobiles etc. where its presence is negligible or minimal.

The following specific actions would be required:

- i. Running of premium freight services with differential pricing and assured deliveries.
- ii. Supply of rakes on demand with differential pricing for different demand lead times.
- iii. Running of trains on schedule with guaranteed transit time.
- iv. Development of last mile connectivity on PPP in a time bound manner.
- v. Running of automobile, hazardous material trains, movement of bulk cement, etc by private train operators.
- vi. Reduction in cargo parcel size to 1000 tonnes and aggregation mechanism for even smaller parcel-sizes.

(b) Passenger:

IR caters to a wide range of passengers but is not able to meet the demand in full. For the year 2009-10, losses from passenger services are estimated to be around Rs.20377 crore on revenue of Rs.23488 crore (Indian Railway's Year Book, 2009-10) . These losses are due to a combination of factors including non-revision of tariff for the last 10 years, running of poorly patronized trains, operations of trains on uneconomic loss-making branch lines and running of slow, stopping passenger trains

for short distances. Ticketless travel also contributes to losses to some extent. However, train-wise disaggregated analysis is presently not available.

Passenger services offered by Indian railways are characterized by:

- Stand-alone service with little integration with other modes and absence of value-added services.
- Low speed (maximum 150 kmph). There is no high-speed rail (capable of over 250 kmph).
- Low to medium level of service and comfort.
- Poor facilities at stations.
- Below- cost tariff- setting
- Poor upkeep of stations/coaches.

Extensive use of information technology has made it easy for passengers to book tickets and obtain train information. However, much more remains to be done especially in respect of passenger guidance and signages in the stations.

Rapid urbanization, rising per capita income and the ongoing structural transformation of the Indian economy would give rise to increased demand for travel in general and high-speed, high-quality of rail travel in particular. This represents good opportunity which Indian Railways can seize by easing capacity constraints, upgradation of speeds, and improvement in quality of service and reengineering the business for sustained viability.

The following specific actions would be required:

- i. Augmentation of supply (more trains and longer trains) to ensure full satisfaction of demand.
- ii. Upgradation of speeds up to 200 Kmph on the identified corridors.
- iii. Redevelopment of stations for smooth flow and comfortable experience of passengers as also to ensure clean and hygienic environment.
- iv. Redesign of coaches to enhance travel comfort.
- v. Conversion of all stopping passenger trains to EMUs/DMUs or railcars; invitation to state governments to manage uneconomic and unpatronized services.
- vi. Development of select High Speed Corridors (Speed potential 350 Kmph).

(c) Parcels

While the country's parcel market is huge, railway's share is negligible at slightly more than 1% of the total. At present, parcel services are managed as a peripheral and associated service along with passenger trains. The service is backed by little marketing support and forward/backward linkages. Market-focused service and operation by a separate organization can bring about a sea change in the business. The parcels business will be separated from the passenger business and hived off to be managed through a newly created PSU. The company will develop parcel terminals, warehouses, develop linkage with the private partners and run scheduled, timetabled parcel trains from dedicated terminals.

2.9 Capacity enhancement, investment and resource mobilization (Chapter-10).

The requirement of capacity augmentation and modernization of Indian Railways has been summarized and tabulated. It is assessed that over the next 19 years, the total investment required in the Railway system to attain the targeted growth would be of the order of **Rs.51,00,000 crore**. Projections for resource mobilization indicate that Rs.18,40,000 crore – Rs.22,64,000 crore i.e. 37% to 43 % at the most (depending on whether the dividend payable by railways is reinvested in the development programme or not) could be mobilized by railways through internal generation. This projection is itself based and dependent on growth – enabling investments taking place in the initial year period before internal generation starts flowing. Internal generation would be slow to begin with and could pick pace only in the latter years with creation of sufficient capacity in the system and improvement in the level and quality of services. Therefore, role and availability of public funding including partnership with state governments would be crucial for development of a modern railway system at least in the initial years. Borrowing within prudent limits and earnest implementation of PPP projects would supplement the funding available through internal generation and budgetary sources.

2.10 Rational pricing (Chapter-11)

Chapter-11 describes the present accounting and tariff-setting practices of IR and suggests a framework for computation of cost and tariff-setting.

2.11 Research & Development and Energy Management (Chapter-12)

Chapter-12 describes the current state of R&D in Railways and presents a comparative picture of technology in use in various areas vis-à-vis the best of the technology globally. There is a gap between the technologies presently available on IR and the best of railway technology in use on other railway systems the world. This gap needs

to be bridged on top priority by technology upgradation and modernisation. This would, in turn, require a clear-sighted plan with timeframe, adequate funding and close monitoring of implementation. The chapter outlines a roadmap on how to catch up and achieve technology leadership. Key recommendations are:

- a. The up-gradation and modernisation of technology on IR can be realised by improvement of in-house R&D work and involvement of the manufacturers of railway products in R&D. Manufacturers of railway products need to be involved in R & D for both new technologies as well as for improvement of existing systems and products.
- b. Setting up of new units with participation of private-sector would also be useful in ensuring technological upgradation.
- c. RDSO needs to be completely revamped. Standard-setting and Inspection units need to be separated from actual R&D as these activities call for different expertise and managerial approaches. Recruitment and promotion policy must be reformulated to allow lateral induction of highly qualified PhDs at appropriate levels in adequate numbers. A challenging work environment and performance-linked career progression should be provided. The R&D unit may be reconstituted as a new organization after careful study of venerable R&D organizations like TTCI of USA or RTRI of Japan and C-DOT and DRDO in India.
- d. Result-oriented research teams should be set up to work on specified research projects. Such teams may include participants from outside IR, including from research/academic institutions and OEMs, contracted for the duration of the project. The research projects core team must not be disturbed till the end of the project and should have strong incentives (financial as well as others) to deliver.
- e. The work of vendor development in respect by RDSO needs to be transferred to the Zonal railways / Production Units so that RDSO is able to utilize its resources more effectively for Research & Development activities.
- f. RDSO may be granted greater autonomy in respect of financial matters pertaining to procurement of lab and testing equipment, trials and projects.

- g. An Integrated Energy Management System need to be set up under a separate directorate in the Railway Board. This needs to be assisted by a multi-disciplinary team at RDSO. Electrification on economic justification, induction of energy-efficient rolling-stock and monitoring of non-traction energy consumption should form part of energy management plan.

2.12 Information Technology(Chapter-13)

Chapter-13 analyses the current state of IT applications in Railways and suggests an institutional arrangement to attain and maintain a lead in use of IT in cutting-edge applications that would result in cost-efficiency and improved customers service. It recommends a centralized framework for need assessment, prioritization and project implementation. Business processes need to be reviewed and reengineered, wherever needed, before adoption of IT tools. Use of existing IT infrastructure needs to be optimized and adoption of relevant emerging technologies like cloud computing and crowd sourcing, systematically planned. It stresses the need for a comprehensive IT security system and recommends HR and change management practices to take advantages of the investment in IT. A panel of technology leaders could be involved in an advisory capacity to advise Railways on selection of IT platform and creation of homogenous framework.

2.13 Organizational Reforms(Chapter-14)

Chapter-14 deals with the reforms that IR would need to undertake to meet the challenges and attain the goals set. A rigid and rule-bound organization would be inadequate for the ambitious and challenging goals IR needs to set for itself and achieve. IR has to undertake a number of internal organizational reforms to speed up decision-making and bring about result-orientation even while retaining the departmental structure. This would include:

- Reorganization on business lines.
- Separation of policy making and operational responsibilities at the Railway Board level.
- Outsourcing of certain activities.
- Empowerment of Zonal Railways along with accountability.
- Reconfiguration of the organization and decision-making procedure for PPP.
- Investment planning.
- Project execution capability.

- Accounting Reform.
- Accounting separation on business lines.
- Business process re-engineering.
- Independent Tariff – setting and Dispute Resolution Mechanisms for PPPs through appropriate changes in Railway’s Act.
- Clear provision for enabling and regulation on non-government railways by appropriate changes in the Railway’s Act.
- Restructuring of the R&D organization.

2.14 HR:

Chapter-15 analyses the HR challenges that **IR** would need to address in order to succeed in future. Some of the key recommendations are:

- IR will have to undertake a programme to create an HR climate conducive to bringing out the best and the most creative performance from employees without fear of hindsight- based witch- hunting, by moving away from the present system of “fixing responsibilities.” There must be a time limit for the vigilance enquiries. The time limits need to be even more stringent, if the employee is due to retire, and he/ she will miss promotion in the event the enquiry is not completed on time.
- It would undertake compilation of an inventory of skills required to meet the objectives of technological upgradation and customer focused growth.
- IR would work with academic institutions to devise and impart specialized courses to create a large pool of skilled candidates for recruitment. Induction of unskilled staff would be reduced and gradually done away with.
- The recruitment process would be supplemented by well researched and meticulously developed induction and in service training to constantly upgrade the skills of employees.
- Rationalization and consolidation of the multiple services and cadres will be attempted without sacrificing the benefit of specialization and business oriented capabilities.

- Recruitment of highly qualified PhDs from IIMs/IITs and lateral recruitment from market would be considered for specialist functions with suitable compensation.
- A system of reward for collective performance and variable pay linked to incremental surplus generated by various units would be implemented.

CHAPTER-3

Demand Assessment and Optimal share of Railways

3.0 Transport in India is dominated by road. Share of road in freight transport (ton-kms) in India is around 57% against railway's share of 36%. This is in contrast to railway's share of close to 50% in comparable large-sized countries like USA and China (Building India: Transforming the nation's Logistics Infrastructure, 2010). RITES in their Total Transport System Study (TSS) carried out for Planning Commission estimated that over the years railway's share (in originating tonnage) has come down from 89% in 1951 to 65% in 1978-79, 53% in 1986-87 and 30% in 2007-08 and such non-optimal intermodal distribution of traffic flows could have cost Indian economy Rs.38,470 crore (16% of the total transport cost) in the year 2007. McKinsey in their report "Transforming the railway's logistics Infrastructure, 2010" have also estimated the cost of waste and loss due to poor logistics infrastructure at around 4.3% of the country's GDP. This is due in large measure to the inadequacies and inability of the railway to achieve a more balanced and less lopsided modal distribution. If the current trajectory of growth continues, railway's share in freight ton-kms may actually decline to 25% by 2020 and go further down by 2030. This would not only inflict a greater loss on the country's economy (5% of GDP by 2020 according to McKinsey's assessment) but may also put the continued growth of GDP at over 9% per annum at risk.

3.1 Road transport has also emerged as the predominant mode for passenger transport over the last few decades. Share of road in passenger transport (PKMs) has increased from 25.7% in 1951 to 86.7% in 2004-05 while that of Railways has declined from 74.3% to 12.9% during the period (TERI, 2009).

3.2 The current trend is not sustainable from the standpoint of both logistics and resource cost to the economy. As availability of energy is critical factor and going to be more so in future, energy efficiency must weigh high in transport planning. A number of studies carried out in the global context have established that Railways are more energy-efficient and eco-friendly than other rival modes of transport. In the context of India, the AITD's report on 'Environmental and Social Sustainability of Transport- Comparative Study of Rail and Road' (2000), came to the following conclusions:

- (a) **Energy consumption** – To transport one Net Ton Km (NTKM), Rail consumes 0.12 to 0.39 Mega-Joules compared to 1.13 to 1.58 Mega-Joules consumed by road. To

transport one passenger km, rail requires 0.16 to 0.2 Mega-Joules compared to 0.19 to 0.22 Mega-Joules required by road. Thus rail consumes 75% to 90% less energy for freight traffic and 5% to 21% less energy for passenger traffic compared to road.

- (b) **Financial Costs** – In the base year 2000, unit cost of rail transport was lower than road transport by Rs 2.09 per NTKM and Rs 1.62 per PKM.
- (c) **Environmental damage**- Railways cause less environmental damage compared to road; advantage is more marked in respect of freight traffic.
- (d) **Accident Costs**- Accident costs on road are significantly higher than those on rail. In the case of freight transport, road accident costs are 8 times that of rail and in case of passenger transport, they are 45 times higher.
- (e) **Health damage costs**- On an average, the health damage cost of rail freight traffic is lower than that of road by a factor of 7, while in case of passenger traffic it is lower by a factor of 5.
- (f) **Social Costs (all- inclusive costs)** – In terms of all-inclusive costs or social costs, railways have a huge advantage over road transport. The advantage is more pronounced in case of freight traffic. For urban areas, the cost advantage of rail in the base year 2000 is as much as Rs 2.81 per NTKM and Rs 1.72 per PKM, while for non – urban areas, the cost advantage is as much as Rs 2.47 per NTKM and Rs 1.68 per PKM.

3.3 According to International Union of Railways (UIC), rail transport emits 17 gram equivalent CO₂ equivalent per Passenger Kilometre (PKM) compared to 84 gram in case of road transport and 113 gram in case of airplanes. Similarly Mckinsey in their study “Transforming the railway’s logistics Infrastructure,2010” have indicated the emission per ton-km of freight as 64 gram CO₂ equivalent for road transport vis-à-vis 28 for rail,15 for water transport and more than 1000 for air.

3.4 An integrated approach and an enabling policy framework are required to correct the existing distortion in favour of road. Railways also have to be prepared to rise to the challenge. The demand assessment for the purpose of the policy has been made with the assumption that these actions would be forthcoming.

3.5 RITES in their Total Transport System Study estimated the modal shares of different transport modes in the inter-regional freight movement year 2007-08. The following table summarizes the finding of the study:

Table-1- Modal Shares in Freight Traffic (2007-08)

Mode	Modal shares in total originating traffic		Percentage shares in total transport out put	
	Tonnes(Million)	NTKMS(Billion)	Tonnes	NTKMs
Rail *@	768.72	508.10	30.08	36.06
Highways (Road) @	1558.87	706.16	61.01	50.12
Coastal Shipping	59.10	85.70	2.31	6.08
Airways	0.28	0.29	0.01	0.02
IWT	54.88	3.38	2.15	0.24
Pipelines	113.50	105.45	4.44	7.48
TOTAL	2555.35	1409.08	100	100
TOTAL FOR 4 MODES STUDIED	2386.97	1300.25		

*Includes IR & KRC ‘non-revenue’ inter-regional traffic as well as NTPC’s MGR traffic aggregating to 1.86 million tonnes and 26.1 million tonnes respectively.

@Excludes intra-regional traffic of 9666 MT.

3.6 RITES in the above-cited study had also attempted to assess the social costs of various modes of transport taking into account the environmental and accident- related costs. The environmental cost per tonne kilometre (TKM) for various modes as brought in the study is as follows:

Table – 2: Environmental Cost

Mode	Cost (in Rs)
Road (Freight)	0.202
Rail (Diesel Traction)	0.051
Rail (Electric Traction)	0.015
Airways	0.0690
Coastal shipping	0.030

3.7 A comparison of accidents, deaths and injuries in both rail and road transport during the period 2004 – 2009 is presented in the table below:

Table – 3: Accident- related costs

Rail				Road			
Year	No. of accidents	No. of passengers killed	No. of passengers injured	Year	No. of accidents	No. of passengers killed	No. of passengers injured
2004-05	232	35	86	2004	4,29,910	92618	4,64,521
2005-06	233	168	483	2005	4,39,255	94968	4,65,282
2006-07	194	38	227	2006	4,60,920	1,05,749	4,96,481
2007-08	193	09	245	2007	4,79,216	1,14,444	5,13,340
2008-09	177	52	357	2008	4,84,704	1,19,860	5,23,193

Source: Ministry of Road Transport & Highways and Ministry of Railways

Road accident data are compiled for calendar years and rail data, for financial years. Even then, it can be clearly concluded that significantly lesser accident costs are associated with rail transport. RITES study summarized the accident cost relating to road and rail transport to be Rs.0.062/TKM and Rs.0.001/TKM respectively.

3.8 RITES had also estimated the total resource costs associated with different modes of transport on the basis of financial user costs as well as the social costs and based thereon had carried out an optimization exercise that would assign transport flows to different modes based on their total resource cost and break-even distances derived therefrom. The assessment of actual and optimal modal mix computed on the basis of this methodology in the study is summarized in the following table:

**TABLE 4: ACTUAL VS. OPTIMAL MODAL MIX*
(2007-08)**

Mode	Actual Modal Mix			Optimal Modal Mix		
	Flows	Cost	Throughput	Flows	Cost	Throughput
	Million Tons	Billion Rs.	Billion TKMs	Million Tons	Billion Rs.	Billion TKMs
Rail	736.2	497.3	498.6	1,704.18	1,423.4	1,168.7
Road	1,558.9	1,555.6	692.3	590.86	244.8	66.5
Coastal	59.7	34.0	90.0	59.72	34.0	90.0
Total	2,354.8	2,086.9	1,280.9	2,354.8	1,702.2	1,325.2

Source: RITES' Total Transport System Study

* Coastal flows not subjected to the optimal analysis.

The study also indicated that total throughput increased by 44.3 billion ton-kms (around 3%) while cost of transportation decreased by Rs. 38,470 Crore constituting about 16% of the total cost incurred on transportation during the year. The commodity-wise inter-modal switch between rail and road that would take place in the base year (2007-08) if the optimization exercise could in actual practice be undertaken was also assessed by RITES. This is summarized in the table below:

TABLE 5: SWITCH OF TRAFFIC BETWEEN RAIL AND ROAD IN COMPARATIVE SCENARIOS OF ACTUAL & OPTIMAL MODAL MIX

SN	COMMODITY NAME	TOTAL FLOWS (MT)	SHIFT FROM ROAD TO RAIL			SHIFT FROM RAIL TO ROAD		
			FLOW (MT)	O-D PAIRS (NOS)	TONNES (IN %)	FLOW (MT)	O-D PAIRS (NOS)	TONNES (IN %)
1	Coal	674.6	105.3	4,676	15.6	75.9	167	11.3
2	Other & Misc.	667.1	520.1	28,377	78.0	3.0	331	0.5
3	Pol	189.6	115.8	5,692	61.1	15.5	255	8.2
4	Foodgrain	187.7	86.4	10,182	46.1	2.4	243	1.3
5	Iron & Steel	169.1	103.3	10,091	61.1	4.0	141	2.4
6	Cement	154.8	55.1	5,029	35.6	5.2	159	3.4
7	Containers	77.5	15.8	689	20.4	1.0	84	1.3
8	Fruits & Vegetables	71.8	37.7	6,460	52.5	0.0	4	0.0
9	Fertilizers	54.6	10.4	1,668	19.0	1.9	169	3.4
10	Sugar	24.8	8.6	1,794	34.5	1.3	70	5.4
11	Livestock	8.2	4.8	810	58.8	0.003	2	0.0
Total		2279.8	1063.3	75,468	46.6	110.203	1625	4.8

Source: RITES Report

As would be seen from the above, while around 1063 million tonnes of traffic would shift from road to rail, about 110 million tonnes would also shift from rail to road. As a result, Railway would register a net gain of 953 million tonnes that would come from the whole spectrum of commodities but mostly from 'Other & Misc' commodities, coal, iron and steel, petroleum and foodgrain. This indicates the broad areas that railways need to work on to increase its share. However, the optimization model needs to be used with due caution. 88% share of rail indicated by the RITES' exercise (See the table-4 above) would represent an extreme theoretical case. Given the real-world realities of cost, economics and customer convenience, the present share of railways in India (36%) and the experience of large countries like USA and China which are considered to have an optimal inter-modal distribution, a share of 50% should be considered optimal for the year 2030.

3.9 RITES in their Total Transport System Study has attempted to make transport demand projections for three horizon years viz. short-term (2012-13), medium-term (2017-18) and long-term (2025-26). The methodology followed was to take eleven commodities (coal, rice, wheat, pulses, fertilizers, iron & steel, iron-ore, cement, petroleum products, limestones/dolomites and salts), project their transport growth and use the base-year proportionality of the eleven bulk commodities in the basket of 52 commodities selected by RITES for study (53%) to derive the total transport demand. The growth rates (CAGR) used by RITES for different time periods are:

Table-6: Transport growth rates used by RITES

Period	CAGR (%)
2007-08 to 2012-13	9.64
2012-13 to 2017-18	8.94
2017-18 to 2022-23	7.89
2022-23 to 2025-26	7.39
Overall (2007-08 to 2025-26)	8.58

Based on the above, RITES estimated that the total transport demand (52 commodities) will grow in the following manner:

Table-7: Projection of transport demand by RITES

Period	TKM in billions
2007-08	1214.3
2012-13	1923.6
2017-18	2952.3
2022-23	4316.0
2025-26	5345.4

Source: RITES Total Transport System Study.

3.10 If the projection made by RITES is extrapolated to 2030 at the overall growth rate of 8.58% the size of the inter-regional freight movement would come to 7430 billion TKMs. The Working Group considers the approach adopted by RITES to be conservative. A fast-

growing Indian economy is expected to be accompanied by proportionately high demand for transportation services. If the country's GDP continues to grow at 9% p.a. and the elasticity of freight traffic remains at a level of 1.25, transport demand would expand at 11.25% p.a. At this rate, the total freight tonne kilometers would grow nearly ten-fold from the base-year figure of 1409 billion (as estimated by RITES for 2007-08) to 14707 by 2030. According to the McKinsey's study, 65% of the total freight traffic is bulk in nature and 79% of the freight ton-kms moves over distances exceeding 400 kms. 50% share of the traffic is, therefore, not only desirable, but appears to be feasible provided the challenge is approached the right way.

The Working Group has not made any attempt to make detailed commodity-wise projections but the current trends and development plans of major freight generating sectors corroborate the conclusion that transport demand would continue to grow as indicated by broad macro-level projections. Major freight-generating sectors like power, steel and cement industries and consequently coal, both domestically mined and imported, are poised for a massive expansion. For instance, Ministry of Coal (coal that accounts for close to 45% of railway's freight movement) has projected that demand for/off-take of coal would rise from 696 million tonnes in 2011-12 (554 MT domestic and 142 MT imported) to 2343MT in 2031-32 (1400 MT domestic and a gap of 930 MT). A significant part of the coal movement would use non-rail alternatives like pit-head or port-based generation relying on merry-go-round or conveyor belt systems (416 MT) and road (484 MT compared to 126 MT in 2011-12). However, as projected by the Working Group on energy, coal transport by rail would continue to expand in volumes both from the mines and the ports. However, the proportion of domestic and imported coal may undergo a major shift and transportation out of ports may require attention.

3.11 The Working Group is under no illusion that attaining 50% of the freight transportation task of the country by 2030 would be easy or automatic. A number of actions need to be taken to halt and reverse the declining trend witnessed in the past. This is dealt with in the subsequent chapters.

3.12 Passenger traffic.

RITES' TSS did not attempt computation of the size of the total passenger transport market in the country and its inter-modal distribution among various modes. Reliable information is available only in respect of rail and air transport, two sectors which maintain and compile information on a continuous basis. Railway's passenger traffic has increased

over 5.6 or 13.5 times depending on whether one looks at number of passengers or PKMs during the period 1950-51 to 2009-10. Proportion of non-suburban passengers and that of upper class passengers within that category is increasing in the recent years. As a result the average lead of passengers overall has increased from 51.8 kms in 1950-51 to 124.7 kms in 2009-10. The increase in lead has taken place in both suburban (from 15.9 to 33.8) and non-suburban categories (from 66.3 to 229.2), the latter exhibiting a greater increase over the period (see tables 8, 9 & 10 below).

Table-8: GROWTH IN ORIGINATING PASSENGER TRAFFIC ON IR

(Figures in Millions)

YEAR	SUBURBAN		NON-SUBURBAN					SUBURBAN + NON -UBURBAN	
	TOTAL ALL CLASSES	% GROWTH	UPPER CLASS	MAIL/ EXPRESS	SECOND CLASS ORDINARY	TOTAL	% GROWTH	TOTAL	% GROWTH
1950-51	412		25	52	795	872		1,284	
1960-61	680	65.05	15	96	803	914	4.82	1,594	24.14
1970-71	1,219	79.26	16	155	1041	1212	32.60	2,431	52.51
1980-81	2,000	64.07	11	260	1342	1613	33.09	3,613	48.62
1990-91	2,259	12.95	19	357	1223	1599	-0.87	3,858	6.78
2000-01	2,861	26.65	40	472	1460	1972	23.33	4,833	25.27
2002-03	2,934	2.55	42	513	1482	2037	3.30	4,971	2.86
2003-04	2,986	1.77	42	571	1513	2126	4.37	5,112	2.84
2004-05	3,178	6.43	44	609	1547	2200	3.48	5,378	5.20
2005-06	3,329	4.75	50	668	1678	2396	8.91	5,725	6.45
2006-07	3,514	5.56	58	713	1934	2705	12.90	6,219	8.63
2007-08	3,689	4.98	66	776	1993	2835	4.81	6,524	4.90
2008-09	3,802	3.1	76	895	2147	3118	10.0	6,920	6.1
2009-10	3,876	1.9	86	983	2301	3370	8.1	7,246	4.7

Table-9: GROWTH IN PASSENGER KILOMETRES ON IR

(Figures in Millions)

YEAR	SUBURBAN		NON-SUBURBAN					SUBURBAN + NON -UBURBAN	
	TOTAL ALL CLASSES	% GROWTH	UPPER CLASS	MAIL/ EXPRESS	SECOND CLASS ORDINARY	TOTAL	% GROWTH	TOTAL	% GROWTH
1950-51	6551		3790	12537	43639	59966		66517	
1960-61	11770	79.7	3454	22251	40190	65895	9.9	77665	16.8
1970-71	22984	95.3	4394	37856	52886	95136	44.4	118120	52.1
1980-81	41086	78.8	5140	86712	75620	167472	76.0	208558	76.6
1990-91	59578	45.0	8712	138054	89300	236066	41.0	295644	41.8
2000-01	88872	49.2	26315	222568	119267	368150	56.0	457022	54.6
2002-03	90266	1.6	28970	254183	141625	424778	15.4	515044	12.7
2003-04	95981	6.3	28481	260639	156107	445227	4.8	541208	5.1
2004-05	103759	8.1	24877	273649	173417	47943	6.0	575702	6.4
2005-06	106419	2.6	27581	292501	189113	509195	7.9	615614	6.9
2006-07	111897	5.1	33913	333381	215573	582867	14.5	694764	12.9
2007-08	119842	7.1	40948	384785	224381	650114	11.5	769956	10.8
2008-09	124836	4.2	49468	419649	244079	713196	9.7	838032	8.8
2009-10	130917	4.9	55182	463321	254045	772548	8.3	903465	7.8

Table-10: PASSENGER LEADS ON IR

(Figures in KMs)

YEAR	SUBURBAN		NON-SUBURBAN					SUBURBAN + NON-UBURBAN	
	TOTAL ALL CLASSES	% GROWTH	UPPER CLASS	MAIL/ EXPRESS	SECOND CLASS ORDINARY	TOTAL	% GROWTH	TOTAL	% GROWTH
1950-51	15.9		151.6	241.1	54.9	66.3		51.8	
1960-61	17.3	8.8	203.3	232.4	50.0	69.5	4.8	48.7	-6.0
1970-71	18.9	9.2	274.6	244.2	50.8	75.1	9.2	48.6	-0.2
1980-81	20.5	8.5	484.0	333.3	56.4	101.3	33.5	57.7	18.7
1990-91	26.4	28.8	462.8	386.5	73.0	143.9	42.1	76.6	32.8
2000-01	31.1	17.8	659.3	471.3	81.7	176.9	22.9	94.6	23.5
2002-03	30.8	-1.0	689.7	495.3	95.6	198.4	12.2	103.6	9.5
2003-04	32.1	4.2	676.2	456.4	103.2	200.0	0.8	105.9	2.2
2004-05	32.7	1.9	570.3	449.2	112.1	207.3	3.7	107.0	1.0
2005-06	32.0	-2.1	558.9	437.9	112.7	205.3	-1.0	107.5	0.5
2006-07	31.8	-0.6	585.5	467.3	111.5	207.4	1.0	11.7	3.9
2007-08	32.5	2.2	624.7	495.5	112.6	229.3	10.6	118.0	5.6
2008-09	32.8	0.9	647.3	469.2	113.7	228.7	-0.3	121.1	2.6
2009-10	33.8	3.0	639.0	471.3	110.4	229.2	0.2	124.7	3.0

3.13 In the recent years, rate of air passenger growth in India has been one of the highest in the world. Number of passengers carried by air transport in India has grown from 30 million to 110 million in the year 2008-09. Although in terms of absolute numbers, air passenger traffic is still small, it is growing rapidly. Inter-metro traffic between the six large metros (Mumbai, Kolkata, Chennai, Hyderabad, Delhi and Bangalore) accounts for 46% of the domestic passengers. Travel from airports at these metro cities to others cities accounts for an additional 49% of the passengers. 64% of the passengers travel over distances of 400 to 1200 kms.

3.14 Data on the trends and the current shares of road transport in passenger movement are not available. However, TERI had estimated in 2009 that road transport accounted for as much as 87% of the total passenger transport in the country. While the accuracy of this figure could be open to challenge, the broad conclusion that road transport accounts for an overwhelming share of the total passenger transport is beyond dispute.

3.15 RITES' TSS has not carried out the optimization exercise in respect of passenger movement based on total resource cost as in the case of the freight transport. Therefore, there is no point of reference available for determination of an optimal share for railways. The Working Group is of the opinion that the optimality consideration may not be immediately relevant as railway's passenger transport has long been operating under manifest supply constraints. There is also an imbalance in the passenger mix in that a preponderant proportion of passengers carried by IR is of short-lead nature which perhaps could better be served by road. Over the next 20 years, railway's main aim ought to be besides improvement in quality of service, ensuring full satisfaction of demand in the medium and long distance segments and in some identified short-distance/suburban segments involving highly dense mass movement along with improvement.

3.16 Growth of population in general and urban population in particular (30% of India's population is urban in 2010; this is projected to grow to 40% by 2030 – India Urbanization Econometric Model, McKinsey Global Institute) along with increase in per capita GDP will result in greater travel propensity. Over the past 15 years, the historical and observed elasticity of growth of originating passengers and passenger kilometers vis-à-vis GDP growth has been 0.62 and 1.07 respectively. The passenger traffic growth can be computed using GDP growth projections (9 to 9.5% in the first decade and 8 to 9% in the second decade) and the observed elasticities. However, Past trends may not be an accurate guide for the future. Planning based on such elasticity may merely perpetuate the existing shortage syndrome and lead to continued diversion of traffic towards other modes. To deliver on the plan to satisfy demand in full, IR would need to plan for at least 10% annual growth in passenger kms and 8% in originating passengers. The current trends of progressively declining proportion of suburban passengers in the total (from 62% to 52% over the last 15 years) and increasing share of upper class and longer lead passengers would also need to be taken into account in planning. The table below shows the projection of passenger growth in railways on the basis of the above assumptions.

Table-11: Projections of passenger growth for IR

Year	Passengers Originating (in millions)			Passenger Kilometers (in billions)		
	Suburban (%)	Non-Suburban (%)	Total Passenger	Suburban (%)	Non-Suburban (%)	Total Passenger

2009-10	3860.85 (51.87)	3581.80 (48.13)	7442.63	120.4 (14.35)	718.8 (85.65)	839.2
2019-20	8034.04 (50)	8034.04 (50)	16068.08	239.4 (11)	1937.2 (89)	2176.6
2029-30	15610.4 (45)	19079.38 (55)	34689.78	451.7 (8)	5194.1 (92)	5645.8

3.17 Admittedly, attainment of the optimal shares as stated in the foregoing paragraphs would not be easy. It would require a paradigm shift in the way railways are managed today starting from planning and execution of railway projects to delivery of services. It would also require an honest appraisal the major issues confronting railways. This has been attempted in the next chapter.

Chapter-4

Major Issues confronting Railways

4.1 Capacity constraints

One of the major reasons why Indian Railways has suffered steady erosion in its share in the freight and passenger transport and has not been able to attain the optimal share is that its network is plagued by capacity constraints on stretches that matter the most. This has forced IR to focus on bulk cargo and forego the immense opportunity for growth in the non-bulk and non-train-load segment. In passenger traffic, this has meant that supply of seats/berths has always lagged demand.

4.1.1 Traffic flows on IR's network are highly uneven and imbalanced. As on March, 2009, 82.5% of its network of over 64000 route kms is broad gauge (BG), 13.2% is metre gauge (MG) and the rest 4.3% is narrow gauge (NG). The BG network accounts for almost 97.2% of the passenger and 99.6% of the freight traffic. In other words, almost the entire burden of traffic falls on the broad gauge network. Further, both passenger and freight trains share the same track capacity; passenger trains utilize nearly **65% of network capacity but contribute to less than 30% of the revenue**. While mixed traffic is beneficial from the point of view of efficient use of capital-intensive railway infrastructure, such operation in the face of saturation on the network imposes insuperable constraints on running of heavy-haul freight trains and high speed passenger trains, categories that can yield maximum efficiency in transport. Within the BG network, the traffic distribution is also highly skewed. The Golden Quadrilateral and the Diagonals connecting the four major metros, viz., Delhi, Kolkata, Chennai and Mumbai (along with the east-west diagonal extending to Guwahati) constitute less than 16% of the route, but account for more than 50% of the passenger and freight traffic. These routes have reached over- saturated levels of capacity utilization and at present are strained to the breaking point (see the table- 12 below).

Table-12: Capacity utilization on High Density Network (HDN)

Line Capacity Utilisation of sections in 2009-10							
S.No.	HDN Route	Less than 80%	80%-100%	100%-120%	120%-150%	More than 150%	Total
1	Delhi- Howrah	2	8	9	17	5	41
2	Mumbai - Howrah	2	7	19	13	1	42
3	Delhi - Mumbai	3	5	4	11	5	28
4	Delhi - Guwahati via Sitapur - Gorakhpur -	2	13	5	5	8	33

	Barauni - Katihar						
5	Delhi - Chennai via Jhansi, Nagpur-Ballarshah	3	2	5	13	2	25
6	Howrah - Chennai	1	4	7	5		17
7	Mumbai - Chennai	10	9	5	2		26
Total		23	48	54	66	21	212

As can be seen, of the total 212 sections, 141 sections have reached a level of line- capacity utilization exceeding 100%. Smooth operation of trains requires some slack in the line- capacity to absorb and recover from unforeseen disruptions. A line- capacity utilization of 80% is considered the optimum. If this is taken as the benchmark, 189 sections on the High Density network are saturated.

The unsatisfactory state of affairs extends to seven other secondary HDN corridors feeding to or distributing traffic from the primary HDNs (see the table 13 below) .

Table-13: Line Capacity Utilization on HDN Feeder Routes (2009-10)

S.No.	HDN Identity	HDN Feeder Routes	Sections having Line Capacity Utilization					Grand Total
			Less than 80%	80%- 100%	100%- 120%	120%- 150%	More than 150%	
1	HDN 1B	Ghaziabad-Hapur-Moradabad		4				4
2	HDN 1C	Delhi-Rohtak-Bhatinda-Suratgarh		2		2	1	5
3	HDN 1D	Andal-Pandabeshwar-Sainthia	2	2				4
4	HDN 2A	Bilaspur-Anuppur-Bina-Ruthiyai-Kota		2	1	3	1	7
5	HDN 2B	Surat-Jalgaon				4		4
6	HDN 3A	Delhi-Rewari-Ajmer-Chittorgarh	7		2	1	1	11
7	HDN 3B	Gandhidham-Bhildi-Palanpur and Bhildi-Samdhari	3					3
8	HDN 3C	Panvel-Jasai Road - JNPT	2					2
9	HDN 6A	Jharsuguda- Sambalpur-Titlagarh-Vizianagaram	2			2		4
10	HDN 7A	Guntakal-Bellary-Hospet-Hubli-Londa-Vasco	4	2	3	1		10
Total			20	12	6	13	3	54

As can be seen from the above, 34 of the 54 feeder sections are already saturated.

4.1.2 Table-12 and 13 illustrate capacity constraints that have already arisen and that need to be addressed. Capacity creation after the problem has surfaced has been the pattern

throughout. This will not do for the future if the goal is to attain the optimal share of the railway. The planning framework needs to change to ensure creation of capacity ahead of demand. In addition to removing bottlenecks that already exist, planning for future must be based on an in-depth analysis of the market trends and would need to take into account the aspects of service delivery strategy to be adopted, prioritization of projects, requirement and mobilization of the resources and last but not the least, strengthening the organizational capacity for project execution.

4.2 Investment Planning:

For an organization struggling with crippling capacity constraints over its most important routes, the purpose and direction of investment planning should be clear and obvious. More investment should be directed towards those projects and activities that would remove bottlenecks and generate the greatest returns. However, investment planning on IR is politically and departmentally directed rather than need-driven. Plan-heads are listed as distinct activities or projects tied to particular departments and activities (e.g new lines, gauge conversions, doubling, signaling and telecom works, electrification, other electrical works etc) rather than as capacity augmentation, bottleneck removal, safety, technological upgradation etc.

A complete revamping of investment planning is required. Capacity augmentation must be conceived in terms of immediately required projects (signalling improvement, traffic facilities etc), long-term capacity enhancement (like doubling) and socially desirable projects. Operationally urgent and quick pay-off projects that can ease capacity constraints the fastest (such as doubling) need to be prioritized for full funding and time-bound execution. In the rolling stock category, the procurement must be linked to the traffic requirements to avoid excessive procurement of rolling stock less in demand or under-procurement of rolling- stock actually required for meeting demand.

Replacement and renewal of assets should be fully ensured. For this purpose, the ad hoc approach presently followed in respect of appropriation to Depreciation Reserve Fund needs to be overhauled. A rule-based approach that fully and adequately meets the requirement needs to be put in place. Provisioning of DRF must be adequate to meet the requirement of replacement of fixed assets fully and at least 50% of the rolling stock replacement.

Prioritization of projects is very crucial especially since Railways are struggling with a large shelf of sanctioned projects in the face of limited resources and limited success in PPP. This, however, has not been easy to implement so far.

4.3 Project execution:

Project execution has to move in lockstep with rational planning and funding of projects. The record of railways in project execution has been poor in the recent years. The project approval process is loaded in favour of uneconomically unremunerative and socially desirable projects which neither remove bottlenecks nor ease congestion nor augment railway's capacity to carry traffic nor improve the productivity of operations. There is no system of prioritization in allocation of funds for projects required urgently for operational purposes. As a result, every project suffers from time and cost over-runs.

Railway's project organization is also organized on a zonal or a territorial basis rather than on a project basis, further reinforcing the ingrained practice and bias towards distribution rather than rational allocation of funds to projects to be completed on priority. Strong incentives for project teams and leaders to deliver on- time and within- budget execution of projects are also absent.

4.4 Social and commercial objectives:

For long-term sustainability, railways have to be run as a business on sound commercial principles. Simultaneously, large cross-sections of the population also view it as a public utility and expect IR to discharge a large number of social obligations ranging from sanction and construction of unremunerative lines to operation of uneconomic lines to running cheap and affordable passenger services. While IR has to fulfill both the roles, it is essential that the commercial and social roles are kept distinct and separate. The commercial part of the business has to be run with a clear set of objectives and judged by commonly accepted financial measures such as revenue, profit, return on capital and productivity of assets. The social part of the business would need to meet different goals and judged by parameters such as improvement in connectivity, service level, patronage and efficiency of delivery/provision of projects/services. Currently, these goals intermingle leading to uncertainty in creation of capacity and meeting the demand for rail transportation. There is lack of clarity regarding the balance to be struck between the two, both in respect of investment planning and introduction of services. Clarity on the goals of the organization is

required to reconcile commercial and social considerations as also for formulation and articulation of a coherent vision to bind the entire organization.

4.5 Financial issues: cost, tariff and accounting:

Table-16: Snapshot of IR's Financial Performance

Year	Gross traffic receipts (revenue)	Total working expenses (Exp)	Operating ratio % (Exp. /Revenue)
2004-05	47370	42,759	91
2005-06	54492	45574	83.2
2006-07	62732	49047	78.7
2007-08	71.720	54462	75.9
2008-09	79862	71839	90.5
2009-10 (RE)	88356	83440	94.7
2010-11(RE)	94764	87100	92.3

A combination of factors such as booming growth in the core sector and mineral industries, railway's decision to raise the axle load from 20.9 tons to 22.1 tons (increase in the carrying capacity by 15%) and run longer passenger trains, rationalization of the freight classifications, introduction of market-focused tariffs (e.g. lean season and empty flow discounts) contributed to improvement in the railway finances during the period 2005-06 – 2007-08. However, once these had run their course and the impact of award of the 6th Pay Commission had to be absorbed, the operating ratio (which is used as a rough gauge of the health of the railway finance) has climbed back into the 90s leaving the very little surplus for reinvestment. Sharp deceleration in the rate of increase in the revenue (caused by non-revision of passenger tariff for 10 years in a row, slow-down in the growth of the core sector, the primary contributor to the railway freight and capacity constraints which hamper the railway's effort to diversify into other segments) and rise in the expenditure due to higher wage and fuel bills have led to the financial distress.

4.6 Cost structure

Staff costs including pension account for close to 60% of the ordinary working expenses (i.e., expenditure excluding depreciation) and 50% of the gross traffic receipts. This is abnormally high even for a service industry like railways. Other major heads of

expenditure are fuel (20% of the ordinary working expenditure and 17% gross traffic receipts), lease charges (for IRFC debt servicing) and essential expenses for materials/components. Together, 95% of the cost (accounting for close to 90% of the revenue) is committed and invariable in the short run. Drastic restructuring or staff rationalization and wage freeze are not politically and administratively feasible. ***Viability in the short run, therefore, dictates that the volumes expand at viable tariff levels. As larger volumes bring down unit cost of operations, it could lead to a virtuous cycle of even larger volumes. This, however, presupposes that capacity is not a constraint and that the services offered create value for the customers.***

4.6.2 Tariff

IR used to have a large number of classes for freight tariff. These have been compressed and the range between the lowest-charged and the highest charged classes has narrowed considerably. Tariff-setting has also become flexible and adaptive to market. On the passenger side, however, the range is still wide (from 13 paise per PKM to 1.06 paise per PKM) and the average realization for PKM at 26 paise is one of the lowest in the world. Fare to freight ratio (fare per PKM: tariff per tonne km) that roughly captures the balance between passenger fares and the freight tariffs is also one of the lowest in the world for Indian Railways at 0.26 compared to France (1.3) and China (1.2). Not only the passenger fares are low, these are also riddled with myriad concessions.

4.6.3 Accounting System

The accounting system at present is organized to cater to government budget and control functions and not to shed light on the cost of various activities and services. As a result, computation of the losses on various activities and the contribution made by various services is difficult. There is virtually no support to management from the accounting side to enable the manager to achieve his/ her objectives. IR's accounting system must be revamped to accurately reflect the cost of various activities and service. Only with a credible accounting system, IR can manage the commercial and social parts of the business on a rational footing. The commercial part of the business must be managed to yield a surplus for reinvestment in the system.

4.6.4 Productivity

Not only the wage costs are high on Indian Railways, productivity of employees measured in terms of transport output (million of passenger kilometer and freight tonne kilometer) per employee(See the table-17 below) is relatively low (0.87) for the year 2006-07 compared to USA (15.13), Japan (20.09), Russia (2) and China (1.4). Similarly, the Net Tonne kilometer per wagon per day on Indian Railways is 6344 compared to Chinese Railways (10608) and Russian Railways (10104). Transport output per route km is also low in India (8.6) compared to Chinese Railways (45.6) and Russian Railways (26.9) (These comparisons are based on International Union of Railways (UIC) data.)

Table-17: Cost and Productivity of Staff

Year	No. of staff (in million)	Average wage cost/staff (nominal Rs)	Average output(NTKMs+PKMs) per staff(million)
1980-81	1.57	8435	0.23
1990-91	1.65	31864	0.33
2000-01	1.55	121281	0.50
2006-07	1.40	173799	0.87
2009-10	1.36	378781	1.1

The productivity of employees and assets is a function of several factors such as the state of the infrastructure, the level of technology, the skill of the work force and quality of the management. The degree of outsourcing also influences the productivity as measured by conventional parameters. Indian Railways has to do a lot of catching up to do to reach the levels of productivity achieved by several major railways of the world. Increase in axle load, better pay load to tare ratio, higher trailing load and improvement in headway are some of the measures that could improve productivity relatively quickly.

4.7 HR:

As on 31.03.2010, IR had 13,61, 519 employees on its roll with the following composition:

Table-18: Employees on IR

Category	Number in thousand	%
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Group 'A' & 'B'	16.8	1.2
Group 'C'	904.7	66.4
Group 'D'	440.0	32.4
Total	1361.5	100

In keeping with the continuous technological upgradation, the ratio of Group 'C' to 'D' has changed from 25:75 in 1951 to 67:33 in 2009-10 indicating a shift towards induction of larger number of skilled manpower, Workshop employees and artisans or transportation staff. However, a sizeable number of unskilled group 'D' staff is still being inducted into the railways. For instance, IR is recruiting 20000 staff annually through compassionate appointments. Such staff does not possess the skills required to discharge railway functions. In general, IR is not focusing on recruiting highly skilled personnel.

HR functions in the Indian Railways have traditionally evolved in the context of its being in the government. HR policies and practices on Indian Railways are for the most part attuned to policies of Government of India. There is no flexibility in terms of pay and rewards as these are determined by Pay Commission set up periodically by Government of India. The recruitment for superior jobs (Group A officers) is done through DOP&T and UPSC. The Ministry has, however, some latitude on the classification and sanction of subordinate posts as also in respect of recruitment for these jobs through Railway Recruitment Boards and other in-house agencies. Presently, the HR function is mostly confined to the traditional role of recruitment, training and establishment matters. There is no mechanism for attuning recruitment and training to job requirements in terms of skills, performance appraisal, rewards and incentives to achieve continuous improvement in HR practices to attract and retain talent. Of the multiple departments and services in IR, some manage these HR activities themselves without involving the Personnel department at Divisional/Zonal or Railway Board level. In an earlier era, Railways could attract talent by the mere fact that it was one of the few industries in the country and railway jobs offered the security and the prestige of government service. However, to attract, nurture and retain talent in large numbers for growth in future, IR has to take a close look at its HR policies and practices.

4.8 Organizational Issues:

Railway's organization structure is built around specialization. It is organized in terms of several functional departments like civil engineering, mechanical, electrical, signal

& telecom etc with divisional, zonal and Railway Board structures to bring unity and coherence to the task of transportation. Different departments are manned by different cadres. From recruitment to retirement, officers spend their time almost entirely in the department getting deeply steeped in departmental thinking. The result is an over-differentiated organization which prevents a coherent world-view on the basic role and purpose of the organization. Indian Railways is also vertically integrated. It does nearly everything that it needs including manufacturing its own coaches/locomotives, running schools and hospitals and maintaining its staff colonies distracting management attention from the core task of providing transportation with focus on the market.

The transportation task is overseen by 17 Zonal Railways headed GMs who are very senior functionaries in the railway hierarchy. But they do not enjoy commensurate autonomy and delegated authorities in their functioning. They also do not have accountability for meeting of annual financial targets.

4.9 Research & Development:

Research & Development can be a significant source of competitive advantage. However, Indian Railways has not been in the frontier of developing or innovating on railway technology. There is a gap of a few decades between the state of the art technology adopted in construction, maintenance and operation and as also different kinds of transportation solutions such as high-speed, heavy-haul operations in the developed railway systems and Indian Railways (This has been discussed in detail in Chapter 12). RDSO, the apex research organization of Indian Railways has not been in the forefront in developing technological solutions appropriate for India and it has limited linkage with the domestic industry or academia. In fact, railway equipment industry in India is very small compared to global giants based in other countries. R&D projects need to be identified based on operational needs and potential financial returns. These need to be supported through allocation of the adequate resources along with clear-cut accountability for their completion. An annual performance audit of RDSO and the R&D projects with regard to their impact on the functioning of IR needs to be instituted.

Chapter-5

International experience and lessons for IR

5.1 Experience of reforms carried out on some of the major railway systems such as Japan National Railways, Russian Railways, Chinese Railways, British Railways and German Railways has been summarized at **Annexure-2**. The factors and circumstances leading to reforms in different railway systems vary .However, generally speaking, key drivers for reforms were:

- (a) Financial crisis and over-indebtedness brought about by rapid expansion of network, operation of non-remunerative lines, inflexible organizational structure, exacerbated by powerful trade unions and erosion of market share;
- (b) Need for rapid expansion and improvement of operational performance;
- (c) Control of public subsidy;
- (d) Need to usher in competition and attract private investment; and
- (e) Ideological inclination of the government.

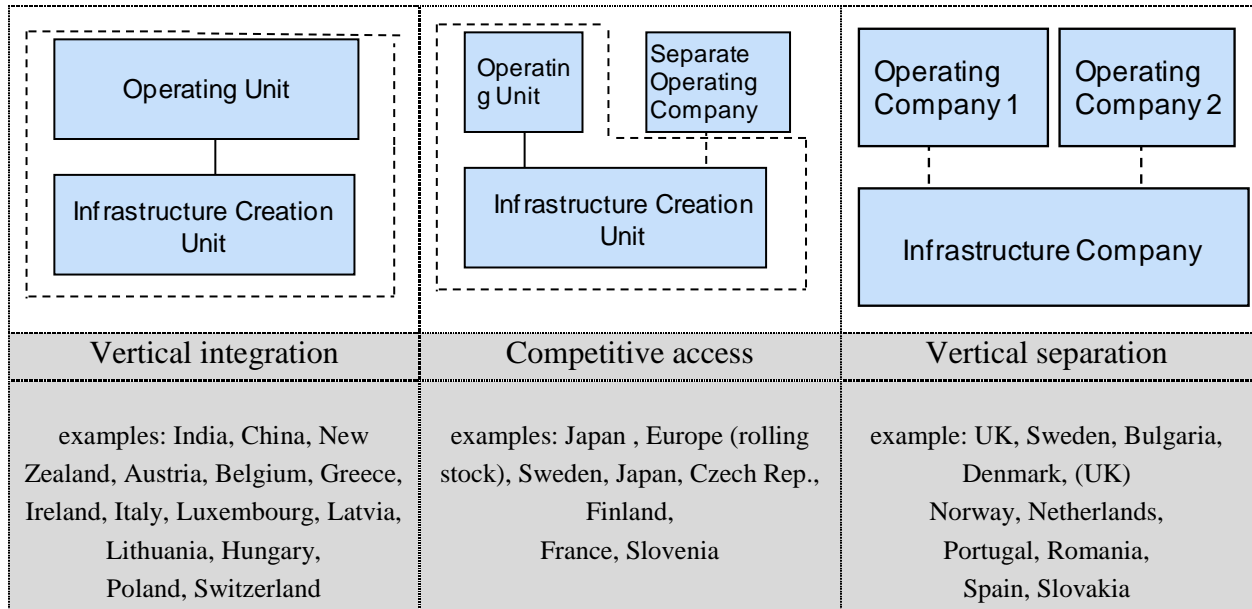
The reforms were carried out generally to address the above factors and to enhance the organizational efficiency and effectiveness of the railway systems.

5.2 Broadly, the reforms comprised one or more of the following elements:

- (a) Separation of infrastructure and operation;
- (b) Institutional and regulatory reforms covering rationalization of tariff determination, investment decisions, freedom of operating companies and establishment of independent regulators; and
- (c) Labour reforms.

5.3 Degree of separation between infrastructure and operation has varied across railway systems where reform has been carried out. Traditionally, railway systems have been vertically integrated (single entity controls both infrastructure and services and performs policy and regulatory roles). The objective of reform has been to bring about either a vertical separation (ownership of facilities being separate from entities controlling operations: accounting separation or through organizational unbundling) or a system to allow competitive access (a single entity may control infrastructure and operation but the usage of

infrastructure by other operators is allowed on payment of transparently determined access charges). Some examples of the countries following the three systems are shown in the figure below:



5.4 Once the railway systems moved away from vertical integration to either vertical separation or competitive access, the focus of further reforms has been to reorganize infrastructure and operation. The re-organization is generally based on the principles of:

(i) core and non-core business, (ii) geographical separation, (iii) line of business separation (freight, urban, long distance etc), (iv) functional separation (creation of profit centres and use of transfer pricing), and (v) traffic density (light density vs high density to identify to commercial services and social service obligations).

Administrative separation (separate administrative set-up) under an umbrella organization allows individual accounting, evaluation of units as separate profit or cost centres and charging of usage of assets by another unit on the principle of transfer pricing. Functional division also allows for bidding out of some of the core activities like maintenance of tracks and locomotives on a competitive basis. Alternatively, the reorganization may take the form of separate geographical organizations (e.g. Japan) or unbundling the current organization and privatization of several activities (e.g.U.K.). As summarized in the **Annexure-2**, extreme unbundling also led to coordination failure and cost of managing the same increased drastically.

5.5. Once the asset restructuring is completed, the operation of the railway can be governed through haulage agreement, exclusive or multiple access agreements, reciprocal

operating agreement, as the case may be. In the case of haulage agreement, track owner may allow any operator to use the track based on fixed haulage charges. American Presidents Line (APL), and CSX Corp are examples for these. In the case of access agreement with one or multiple operators, operator pays for the tonnage it carries e.g. Canadian National (CN) operating over CSX.

5.6 Labour reform has been another important dimension of reforms. Railways are traditionally one of the largest employers and therefore, the impact of any structural change on labour would need to be taken into account.

5.6.1 Japan grappled with labour issues through reactivation of railway management consultation system. This enabled direct discussion on issues such as work condition and organizational needs. Japan National Railway (JNR) also had to deal with issues of seniority versus skill-based wages, determination of retirement and social benefits.

5.6.2 In Sweden, high level of unionization existed among both blue-collar and white-collar employees and management was obliged to share strategic information with the employees and allow employee representation on the company board. Railway reorganization entailed negotiation with the unions on productivity issues through productivity incentivisation, multi-task assignment, and performance compensation. The restructuring had to work within the existing framework.

After restructuring, the labour cost as a percentage of revenue showed a substantial improvement in Japan and Sweden from 69.5% and 82.5% to 32.8% and 69.6% respectively.

5.7 The reforms in Chinese Railways have followed an entirely different course (see **Annexure-2**). Railway sector in China is supervised by Ministry of Railways (MOR), a body which is responsible for strategy, policy and regulatory functions as well as administration of operational entities that deliver the Chinese Railways network and rail transport services. MOR has overall control of policy, technical standards, planning, investment, finance and system-wide train and rolling stock control. Day-to-day management and delivery of railway infrastructure and rail transport services are managed and delivered by 18 Regional Railway Administrations (RRAs similar to Zonal Railways on IR). China's MOR also owns and supervises a number of specialized companies related to rail transport.

5.7.1 China's Ministry of Railways (MOR) has spearheaded and implemented one of the biggest and most unprecedented rail expansion programmes in the history of the world. In 1949, the rail network had only 22,000 kms of poorly-maintained and war-damaged railway lines (less than 1000 kms double-tracked without any electrification). Through successive Five Year Plans, this was rehabilitated and expanded substantially to reach a level of 58,000 route kms by 1990s. However, shortages were still endemic leaving a large volume of latent

demand that could not be satisfied. This got accentuated with liberalization and steady acceleration of the Chinese economy in the 1980s.

5.7.2 In the early 1980s, railway entities were granted autonomy in order to make them resemble state-owned corporations. A large number of management functions (wages, labour policies and store provisions etc) were decentralized from MoR to RRAs. RRAs retained the profits which could be used to fund investment and pay employee bonuses. In 1991, Railway Law was enacted. It created an enduring foundation for continued devolution of commercial responsibilities and accountability to railway enterprises while retaining strategic, regulatory and supervisory control with MOR in order to provide an integrated and coordinated national railway system branded as China Rail (CR). MOR controls the key lever of investment and another government body named, National Development and Reform Commission (NDRC) controls pricing. There is no intra-rail competition in the system; the objective is to concentrate and focus on maximization of throughput and satisfaction of demand rather than division of the market through competition. Many RRAs, however, have been granted autonomy in the matter of fare and freight fixation. A few railway companies have been formed as subsidiaries of RRAs and listed in the stock exchanges of Hong-Kong, New York and Shanghai (e.g. Guangsen Railway Corporation and Daqin Railway Company specializing in high speed passenger transportation and coal transportation respectively).

5.7.3 NDRC in a report dealing with key reforms in seven fields including railways in 2004 had identified the following key principles of reform:

- Separation of Government administration of the railways from enterprise management;
- Introduction of competition, wherever suitable; and
- Effective industry regulation.

The task, however, falls on MOR to identify specific actions and their timing. MOR's priority, however, has been to deliver the Mid and Long-range Network Plan (MLRNP) which aims at expansion of the railway network to 1,20,000 kms by 2020 along with a number of other goals such as dedicated passenger corridors and 12000 kms of high speed railway lines. The government, therefore had decided to allow MOR to keep its distinct identity and decided against merging it under the enlarged multi-modal Ministry of Transport (MOT)

5.7.4 In 1990s, MOR introduced an Economic Contract System (ECS) to increase productivity. Under the system, MOR entered into annual contracts with Government to meet national transportation targets (tonne-kms and passenger-kms). This was divided into subsidiary contracts between MOR and RRAs. Achievement of these targets forms the basis for incentive compensation system. ECS improved operating efficiency and generated

additional net revenue. This allowed Chinese Railways to accelerate investment. However, it was still a production-led approach with little consideration for financial profitability as pricing was not under the control of MOR or the RRAs. In 1999, the ECS was replaced by an Assets Operation Liability System (AOLS), more attuned to market. Under the AOLS, RRAs are responsible for managing and increasing the value of assets (networth) assigned to them rather than merely executing the plan developed by MOR. Bonuses for RRAs are set in relation to targets for increase in networth, profits as a percentage of gross operating assets and dividend to MOR as a percentage of MOR's capital investment. RRAs also have to commit to safe operation and a specified minimum increase in profits or reduction in losses. Each member of the RRA's management down to the rank- and -file employees make an incentive deposit which is forfeited if the targets are not met. The deposit is paid back with a bonus equal to twice the deposit if the targets are beaten.

5.7.5 While RRAs are integrated structures organized according to functional management of track and rolling stock etc. lines of business (e.g. passenger services and freight services) have been introduced under the RRAs.

5.7.6 Another key feature of reforms undertaken in Chinese Railways relates to divestment of non-core activities. In 1990s, Chinese Railways employed nearly 3.4 million staff in total of which 1.4 million were in non-transport organizations (construction, entities, rolling stock factories, schools, hospitals and universities). Over the years, engineering and rolling-stock manufacturing entities were reorganized as companies. Schools, colleges and universities other than railway technical and management institutes were transferred to local government or Ministry of Education. Similar action was taken in respect of hospitals. Chinese Railway Communication Company Limited and Chinese Railway Material and Supply Company Limited were also reorganized in similar way out of railway entities providing railway telecommunications and performing railway procurement tasks. Simultaneously, specialist train operating companies have been set up to handle containers, special freight and parcels to manage marketing and planning of such train.

5.7.7 That all these reforms have been successful is borne out by the results achieved by Chinese railways. Some of the key features of the success are:

- Effective response to competitive challenges of road and airline transport through successive speed-ups of the network, rollout of high speed passenger railways, upgradation of higher standards and improvement in track/rolling-stock technologies, development heavy-haul coal operations and double-stack container operations on electrified routes;
- Adoption of modern technology to enhance capacity, improve operational efficiency and service quality;
- Capacity building in R&D;

- Demonstration of project implementation capacity of a high order by adherence to the agreed medium and long term plan targets;
- Improvement in labour productivity and asset utilization;
- Extensive use of IT;
- Generation of substantial internal resources by creation of a Rail Construction Fund through freight surcharge, premium pricing of passenger transport and large-scale adoption of joint-venture railway model to attract funding from provincial and municipal governments.

5.7.8 The Chinese example illustrates that state-control and guidance need not necessarily be a handicap for rail reforms.

5.8 The context and the underlying causes that called for reforms in the railway system elsewhere do not wholly correspond with the Indian conditions. Indian Railways is not heavily indebted and is not dependent on government subsidy (except for capital support for investment). However, other factors such as erosion of market share, investment backlog resulting in inadequate capacity and technological gaps, sub-optimal levels of service, efficiency, excessive bureaucratization of decision-making processes and lack of clarity on the social role and compensation etc are commonalities that Indian Railways shares with other railway systems that went in for reforms.

5.9. Past studies and recommendation for railway reforms:

Prakash Tandon Committee (1994) had recommended the following:

- (a) Restructure the Railway Board with Members responsible for:
 - i. Bulk freight, passenger and inter-modal services;
 - ii. Infrastructure;
 - iii. Moving assets;
 - iv. Finance and Planning;
 - v. HR,R&D,Quality.
- (b) Railway Board to focus on policy, planning, performance evaluation, major projects and appointments and not day-to-day supervision/sanction/control.
- (c) Similar restructuring at Zonal Railways with six AGMs.
- (d) Minimum tenure of 3 years for Board Members and GMs.
- (e) Unified cadre for railways through cross-disciplinary rotation and selection for general management positions.
- (f) Recruitment of qualified finance professionals.
- (g) Shedding of off-line activities-corporatization of Production Units.
- (h) Induction of specialists as advisers.
- (i) JV with state governments and private entities.

- (j) Decision support system for investment planning.

5.9.1 The Expert Group on Indian Railways headed by Dr.Rakesh Mohan, in their report in 2001, had, inter alia, recommended:

- (a) Corporatization of Indian Railways into Indian Railway Corporation(IRC).
- (b) Re-organisation of Railway Board as Indian Railway Executive Board (IREB).
- (c) IRC to be governed by IREB.
- (d) Government to set policy directions.
- (e) Setting up of an Indian Rail Regulatory Authority to regulate IRC's monopoly. Provision of rail services, particularly, tariff-setting.
- (f) Compensation/subsidy for social obligations discharged.
- (g) IRC to focus on core activities and divest/hive off non-core activities.
- (h) Core activities to be managed as profit/cost centres on generally accepted accounting principles/reporting.

These recommendations have been accepted in parts and reforms have been attempted in a few areas such as accounting reform, hiving-off non-core activities, reduction of manpower, opening of some areas to private-sector (e.g. container movement by rail etc).

5.10 Organizational changes and reforms – lessons from the international experience

The reform experience of the railway systems studied shows that building a customer-centric and market-focused railway system does require appropriate reforms. However, there cannot be a standard and surefire recipe for such reforms. The reforms carried out in Japan, Europe and China vary greatly in both form and content. The Chinese example shows that government ownership and management by a Central Ministry does not come in the way of pragmatic and meaningful reforms. For practical reasons, Government of Peoples Republic of China has retained the central role of Ministry of Railways, while accelerating reforms on a host of areas. In the Indian context too, any profound change in the organizational structure may actually distract from the enormous task of the railways to build infrastructure and improve services. A number of reform measures which could help achieve these tasks are both necessary and possible. Some of the key elements of the reform would be accounting reform, reform in investment planning, regulatory structure, reorganization on business lines, hiving off of activities. These have been dealt with in detail in **Chapter-4**.

Chapter-6

High speed rail: International experience and relevance for India

High-speed rail (HSR) is defined as distinct category of passenger rail transport system that normally operates with separate track and rolling stock at speeds faster than 250 km/h. It uses a different level of rail technology and management principle that position it at an unbeatable advantage vis-a-vis other modes like cars and air-planes in the distance range of 500-1000 kilometers.

6.1 IR is unique and alone among major rail systems not to have gone in for HSR so far. For a discussion on its relevance for the country, it will be useful to consider the experience of other railway systems which have already done so. This has been attempted by the Working Group. A summary of the development of High Speed Rail in Japan, Europe, China, Taiwan and USA is at **Annexure-3**

6.2 Key benefits of High Speed Rail (HSR)

The High Speed Rail System has emerged as a fast and efficient transportation system for medium- distance travel of up to 1000 kms. Some of the main reasons for introduction of High Speed Rail in the countries surveyed are:

- (a) Need for generation of additional capacity on the conventional network;
- (b) Regaining share from airlines and road; and
- (c) Energy security and environmental concerns.

Some of the key benefits of HSR are briefly described below:

- **Increase in rail capacity:** Dedicated infrastructure for high-speed passenger lines frees up capacity on conventional lines, which can be used to accommodate additional freight and conventional passenger trains. In turn, this helps relieve congestion on the roads and drive down the related costs to society.
- **Lower energy consumption per passenger kilometer:** High-speed trains are environmentally more efficient than aircraft and road transport as trains

consume less energy and emit less carbon dioxide leading to reduced greenhouse emission responsible for global warming.

Lesser Land usage for a given capacity compared to motorways: A standard twin track high-speed railway line requires a corridor of only 25m land width to carry the same number of passengers for which a 6-lane highway is needed. The latter requires almost 6 times more space.

- **Safety-** HSR has an unblemished record in safety. 4 billion passengers have been carried in Japan on HSR since 1964 without any fatal accident. In Europe, billions of passengers have travelled in Europe with practically no accident attributable to high speed trains. Traffic control systems and infrastructure of HSR are simpler to control compared to aircrafts.
- **Significant saving in journey time:** Maximum operating speed of high-speed trains is lower than that of jet aircraft. However, travel by HSR saves time due to easier accessibility to city centres and better connectivity with other urban transport systems. On the other hand, the benefit of reduced journey time by air gets neutralized due to taxiing, check-ins, boarding, security check, luggage-retrievals, etc. HSR also scores over automobiles as it can move passengers at speeds far higher than those possible by road and HSR journeys are less stressful and more productive than road journeys.
- **Modal Shift in Transport:** Experience of Railways with HSR demonstrates that when the distances are between 300 to 600 km and the travel time by the high speed train is less than 2-2.5 hours, the market-share for HSR shorts up and stabilizes at around 75-80%. This plunges dramatically when the travel time of train increases to 4-5 hours and a round trip is not possible within a day.
- **Decongestion of Metro Cities:** Due to high average speeds of HSR, the commuting time is reduced significantly, making commuting feasible for distances of up to 500 km. As population in metros increases and cities reach a saturation point, reduced commuting time between adjoining cities

and suburbs helps decongest the metros. This has other attendant benefits such as increase in property values, high tax revenues and boost to growth in service industries and tourism.

6.3 Cost of construction and rolling stock per kilometre of HSR typically have ranged between USD 35 and USD 70 million depending on the complexity of civil engineering works, the degree of urbanization along the route and rolling stock required. Many projects have taken long periods to complete (over a decade is not unusual) creating a heavy capital and debt burden before any cash in-flows materialize. Any delay in passenger ramp-up period, or shortfall in ridership or yield, can, therefore, quickly create financial stress. Many HSR lines have run into trouble and had to have either restructure debt or seek additional funding from Government.

6.3.1 Operating and maintenance costs are generally low in comparison to the capital costs because high speed delivers better equipment utilization and train/crew turn-rounds. Most lines recover their operating and maintenance costs, but it is very difficult for most stand-alone high-speed railways (except for some of the densest- traffic corridors) to recover much of the capital costs from the passenger revenue stream alone.

6.3.2 In several countries (e.g. Japan and France), high speed trains have been able to wrest market share from rival modes by dint of their superior service and high frequency. Tellingly, airline services between Tokyo-Osaka and Paris-Lyon are negligible. In fact, some airlines tie up with the rail authorities to transport of passengers on these routes. At the same time, high speed rail has not been commercially successful in several other cases. Chinese Railway has embarked on the most ambitious construction of high-speed rail lines. In a few years, its network at more than 12000 kms will exceed the HSR network of the rest of the world put together. But it is too early to judge whether the HSR services would make a profit or break even.

6.3.3 Governments contemplating the benefits of a new high-speed railway, whether procured by public or private or public-private project structures need to consider the near-certainty of copious and continuing fiscal support for debt-servicing. It is estimated that an annual ridership of at least 20 million passengers are required just to cover the working

expenses and interest costs and probably double that number to have any possibility of recovering the capital cost.

6.4 HSR in Indian context:

Road-sector plays a dominant part in the passenger transport system in the country carrying almost 85% of the country's passenger traffic according to several estimates. The airline-sector is growing rapidly from a low base. It is estimated that the air passenger traffic will grow from 141 million in 2010-11 to around 482 million by 2020. Indian Railways carries over 20 million passengers a day and cannot carry more at present due to infrastructural bottlenecks and carrying capacity constraints. Most of the capacity that IR needs in future is yet to be built. Therefore, as a country, we are confronted with a choice whether to build more roads or airports or a few high speed rail system to carry the same passenger load at much less environmental and social cost. This is, therefore, an appropriate time to examine whether HSR could be one of the options for increasing capacity. Other reason to take a serious look at HSR are concerns over energy-security and growing dependence on imported energy and danger of higher pollution and green-house gas emission occasioned by a road or air-dominant transport system.

6.4.1 At present the maximum permissible speed for passenger trains on Indian railways is 150 kmph for a few trains and the average commercial speed is in the range of 70 kmph. With the construction and commissioning of dedicated freight corridors, freight trains would get substantially diverted to the new freight corridors. This would present an opportunity to increase the speed potential of the existing corridors to 160-200 kmph. A project to raise speed on these routes could be considered after a detailed survey to identify the engineering inputs required for speed-raising on these routes. Some of these inputs are:

- (i) Review of permanent speed restrictions (yards, due to curves & bridges etc.) and their removal or easing
- (ii) Improvement in signalling and telecommunication
- (iii) Sustained improvement in the track structure – especially ballast deficiency.
- (iv) Use of improved rolling stock; for example, 'tilting coaches' to help increase speeds through curves.

6.4.2 Speed-raising of this type would enable operation of overnight inter-city services in the distance range of 1000-1500 kms. This would also help connect cities within distance of 500-700 kms with high-speed day services. Till the time high-speed services come, these services would be able to satisfy the requirement of high speed travel in a large measure.

6.4.3 Work done so far

Ministry of Railways has identified the following six corridors for conducting pre-feasibility studies:

- (i) Delhi-Chandigarh-Amritsar (450 km approx.)
- (ii) Pune-Mumbai-Ahmedabad (650 km approx.)
- (iii) Hyderabad-Dornakal-Vijaywada-Chennai (664 km approx.)
- (iv) Chennai-Bangalore-Coimbatore-Ernakulam (649 km approx.)
- (v) Howrah-Haldia (135 km approx.)
- (vi) Delhi -Agra-Lucknow -Varanasi - Patna (991 km approx.)

6.4.4 The pre-feasibility study for Pune-Mumbai-Ahmedabad has been completed. The cost of construction of a high-speed double line rail corridor has been estimated at Rs.63,000 crore (excluding rolling stock) for 640 kms i.e. around Rs.80 crore per km. The pre-feasibility studies have been awarded for Delhi-Agra-Lucknow-Patna and Howrah-Haldia corridors. Consultancies are being finalized for other three corridors.

6.5 Major issues and options:

Some of the major issues that would need to be considered are: track gauge and implementation model to be followed for high speed corridors.

6.5.1 Track Gauge:

Indian Railway's network is predominantly on BG (1677 mm). Eventually, the entire network would be on this gauge. On the other hand, high-speed rail the world over has been developed on standard gauge (1435mm). Adoption of the standard gauge would have the advantage of the technology and rolling-stock being available off the shelf. A BG network would have the advantage of higher capacity and inter-operability especially for approach to major station terminals when new terminals are not feasible. However, some amount of technical work would need to be done for adapting HSR technology to BG. Supply chains for rolling-stock procurement would also need to be set up.

6.5.2 Implementation Model:

The second issue would be to consider whether HSR should be developed as a part of Indian Railways or as a separate organization through public private partnerships.

A separate organization could be set up to frame and finalize policy choices for high speed rail, set standards, plan and implement the projects selected. The new entity should operate on commercial principles and examine alternative options for implementation high-speed rail projects: setting of a company dedicated to construction and operation of high speed rail or construction, ownership and operation by a private concessionaire or construction and ownership by the newly constituted public authority and operation through a concession or vice versa.

6.6 Regardless of the option exercised, it is envisaged that substantial funding from government would be required to implement high-speed rail projects. Till the time the projects are found commercially justified or operationally required to cater to the country's growth and mobility needs, a programme for time-bound implementation of raising speed to 160-200 kmph on selected existing routes should be undertaken.

Chapter-7

International rail linkage

7.1 Integrated transport systems at the regional level are considered crucial to facilitate regional integration and sustain the pace of economic growth in the region. In the Indian context, rail connectivity to the neighbouring countries in the SAARC region and Myanmar is important both from the economic and strategic standpoints. India is the largest member of the SAARC with 51% of the surface area and 71% of population. It accounts for an even bigger share of the rail network. Rail connectivity with the neighbouring countries will foster increased economic cooperation among the countries and will yield not only economic but also social, political and diplomatic dividend by promoting good neighbourly relations among the countries. Of the eight SAARC countries, Maldives and Afghanistan have not been considered for direct rail connectivity with India at this stage due to geographical and political reasons.

7.2 Rail connectivity with neighbors- the present state:

Historically, the rail network of the region prior to independence and partition constituted an organic system. However, in the post- independence and post -partition period, rail systems of South Asia have developed in the national context with little consideration for cross-border connectivity and interoperability or compatibility/uniformity of standards in infrastructure and equipment. The current country-wise status is presented below.

7.2.1 Bangladesh: A number of connections existed between India and East Pakistan (now Bangladesh) at the time of independence. These include: Haldibari(India)-Chilahati(Bangladesh), Gitaldaha(India)-Mughalhat(Bangladesh), Agartala(India)-Akhaura(Bangladesh) and Shahbazpur(Bangladesh) -Mahishasan(India). Many of these, however, fell into disuse over the years. At present, railway systems of India and Bangladesh are linked to each other at five points. Of these,three BG links, namely, Gede (India) – Darshana (Bangladesh), Singhabad (India) - Rohanpur (Bangladesh) and Petrapole (India) – Benapole (Bangladesh) are currently open for freight trains. A bi-weekly passenger train ‘Maitree Express’ introduced on 14 April 2008 also runs between Kolkata and Dhaka Cantt. via Gede-Darsana route. The other two links, though in existence, lie dormant at present. These are:

1.	Radhikapur(IR)-Biorol (BR)	BG on Indian side, MG on Bangladesh side. Inoperative since 1 April 2005..
2.	Mahishasan(IR)-Shahbazpur (BR)	MG. Extensive damage by floods.

		Not functional since December 1996. Track on BR side needs strengthening.
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Over the years, the gap between BR and IR in regard to the loading capacities of rolling stock, length of passing loops, size of trains, braking systems, etc has widened. Difference in ground infrastructure and technology platforms has adversely affected interoperability. On the positive side, construction of a rail-cum-road bridge over the Ganga (Jamuna) with provision of dual -gauge rail tracks suitable for both MG and BG operation has connected the previously isolated east and west rail networks.

Akhaura, which was the rail-head for Agartala during the British colonial rule in undivided India, served as a major link between Chittagong port and the State of Tripura. IR have now extended the MG rail network up to Agartala and are extending it further south to Sabroom located on Tripura's border with Bangladesh. India has offered assistance to construct the MG Akhaura-Agartala rail link.

7.2.2 Pakistan: As with Bangladesh, there used to be several rail connections between India and Pakistan at the time of independence. Many of these connections fell into disuse over time. At present Attari-Wagha and Munabao-Khokhrapar links (both on BG) are operational. Attari- Wagha route is used to run both freight and passenger services while a weekly passenger service runs through Munabao- Khokhrapar. Other links which are no longer in use are: Sialkot (Pakistan)-Jammu(India), Dera Baba Nanak (India)- Jassar (Pakistan), Hindumalkote (India)- Mandi Sadiq Ganj Jn.(Pakistan), Fazilka (India)- Mandi Sadiq Ganj Jn. (Pakistan), Hussainiwala (India)-Ganda Singhwala(Pakistan) and Khemkaran(India)- Kasur Tehsil(Pakistan). Uneasy relations between the two countries have prevented any serious efforts to re-establish these connections.

7.2.3 Nepal: Nepal had a small narrow- gauge network. In 2004, an ICD which also serves as a rail terminal for bulk traffic was operationalised at Birgunj and connected to Raxaul on the Indian Railway network through a new 6-km long broad- gauge line. It deals with both inbound and outbound bilateral traffic from and to India and third country traffic through Kolkata and Haldia ports.Survey for five other rail connections between the two countries has been conducted:

Table- 20 :Rail Routes Surveyed for Nepal

Project	Length (km)	Estimated cost (Rs. Crore)	Rate of return:%
Jaynagar-Bijalpura-Bardibas	69	470	-5.7
Nepalganj Road-Nepalganj	12	149	Negative
Nautanwa-Bhairahawa	15	176	-4.14
Jogbani-Biratnagar	18.6	210	-3.6
New Jalpaiguri-Kakarbitta	70	341	-3.6

Of the above, Ministry of External Affairs has decided to fund the Jaynagar- Bardibas and the Biratnagar –Jogbani lines. These have been sanctioned and taken up by Indian Railways for execution. In addition, Ministry of Physical Planning and Works, Nepal got a techno-economic survey carried out in 2006 for a rail line to connect Birgunj with Kathmandu. The survey estimated the cost of the 160 km long BG electrified rail line along Kathmandu-Thingari-Kaveri-Hetuada-Pyramidi-Amlekgunj-Pathlauja-Birgunj alignment at NRs 2,965 crore.

7.2.4 Bhutan: Bhutan does not have a rail- head and is dependent on the stations on New Jalpaiguri-Guwahati Broad Gauge line in North East Frontier Railway for its rail transportation. Government of India commissioned studies for the following five connections to Bhutan:

Table- 21 :Rail Routes Surveyed in Bhutan

Project	Length (Km)	Est.Cost (Rs.crore)	Rate of Return:%
Banarhat -Samtse	23	205	-4.6
Hasimara- Phuentsholing	18	168	6
Kokrajhar- Gelephu	58	294	-9.7
Pathsala – Nanglam	51	669	4.7
Rangia – Sandrupjongkhar via Darranga	41	607	-8.2

Of the above, Hasimara- Phuentsholing line which will connect Bhutan to the Indian Railway Broad Gauge network has been proposed for construction.

7.2.5 Myanmar: Myanmar constitutes the crucial missing link or land-bridge between India and South-east Asia. Adequate connectivity with Myanmar would be an essential first step towards the integration of India’s North-east region with South-east Asian economies.

Rail linkages envisaged in the Trans Asian Railway project includes connections to Moreh in Myanmar from Jiribam in Manipur via Imphal. At present, work is progressing on the construction of a new line between Jiribam and Imphal.

In 2008, India signed the Indo-Myanmar cooperation agreement on the Kaladan multi-modal transport project . Although this project envisages use of riverine and road transport to connect Sittwe with Mizoram and Manipur, a railway line from Silchar longitudinally through Mizoram connecting Sittwe port will provide access to the land - locked regions of North Eastern India , in particular, states of Mizoram, Manipur, South Assam and Nagaland .

7.2.7 Sri Lanka: India and Sri Lanka are separated by sea and there is no physical connection between the two railway systems of Sri Lanka and India. In the past, railway line existed upto Dhanushkoti near Rameshwaram in Tamil Nadu from where there was a ferry service to Talaimannar in northern Sri Lanka. This link was destroyed in a cyclone in December, 1964. Since then railway link to Rameshwaram has been restored and upgraded to BG, but the link to Dhanushkoti remains disrupted. A ferry service remained operational between Rameshwaram rail-head to Talaimannar till 1984 when it was discontinued owing to the militancy plaguing North and East Sri Lanka in the subsequent years.

7.3 Regional and multi-lateral initiatives for cross border rail connectivity

Both SAARC and United Nations Economic and Social Commission for Asia and Pacific (UN-ESCAP) have attempted to draw a roadmap for regional and international rail connectivity in the context of SAARC and Asian region respectively.

7.3.1 A multi-modal transport study carried out at the instance of SAARC Secretariat suggested the following potential rail corridors:-

Table- 22 :SAARC Corridors

	Corridor	Countries served	Basis for selection
SRC 1.	Lahore (Pakistan)-Delhi/ Kolkata (India)- Dhaka (Bangladesh) - Mahishasan - Imphal (India)	Pakistan, India & Bangladesh	Potential growth of intraregional traffic. Reduced distance and shorter transit time.
SRC 2.	Karachi (Pakistan) - Hyderabad-Khokrapar - Munabao - Barmer -	Pakistan & India	Shorter route for intra-regional traffic. Access to Karachi port and potential third country traffic.

	Jodhpur (India).		
SRC 3.	Birgunj (Nepal) – Raxaul - Haldia/Kolkata (India)	Nepal & India	Access to the landlocked Nepal. Potential corridor for third country and bilateral traffic (Already functional).
SRC 4.	Birgunj (Nepal) - Raxaul-Katihar (India) – Rohanpur - Chittagong (Bangladesh) with links to Jogbani (Nepal) and Agartala (India)	Nepal, India & Bangladesh	Access to Chittagong port for Indian and Nepalese traffic. Shorter route for North Eastern States of India through Bangladesh
SRC 5.	Colombo (Sri Lanka) - Chennai (India)	Sri Lanka & India	Restoration of old rail ferry link to provide passenger and goods access from Sri Lanka to mainland South Asia

Corridor 1: The SAARC Rail Corridor 1 (2800 kms) is on BG from Lahore in Pakistan to Dhaka in Bangladesh and thereafter on MG on its eastern side. It is an almost continuous rail link and has the potential of moving intra-regional cargo via the shortest and the fastest mode. Lahore–Dhaka containerized cargo currently moving by a much longer rail-sea-road network (Lahore–Karachi–Chittagong–Dhaka) could move on this shorter and faster corridor, saving transportation cost and transit time significantly. This route would also facilitate traffic moving from destinations in India to its North-Eastern states, drastically reducing transportation costs and transit time (Kolkata–Badarpur via Guwahati is 1,356 km on the existing rail route against 682 km via Gede–Akhaura–Shahbazpur on this identified corridor).

The port at Karachi could provide a shorter route for international inward and outward cargo especially from North India, compared to the distance it has to travel to and from JNPT. **In fact, this corridor commands immense potential of carrying inter-continental containerised cargo, say, between Dhaka in the east and Europe in the west via a BG rail network through India and Pakistan onwards to Zahedan in Iran with only one transshipment at Zahedan to SG for further movement through Iran and Turkey on standard-gauge Network.**

Corridor 2: This 707 km rail corridor, re-commissioned on 15 February 2006, connects Karachi (Pakistan) and Jodhpur (India) and thus provides connectivity to the entire IR network. Currently, a passenger train “Thar Express”/”Link Express” operates between Mirpur Khas (Pakistan) and Munabao.

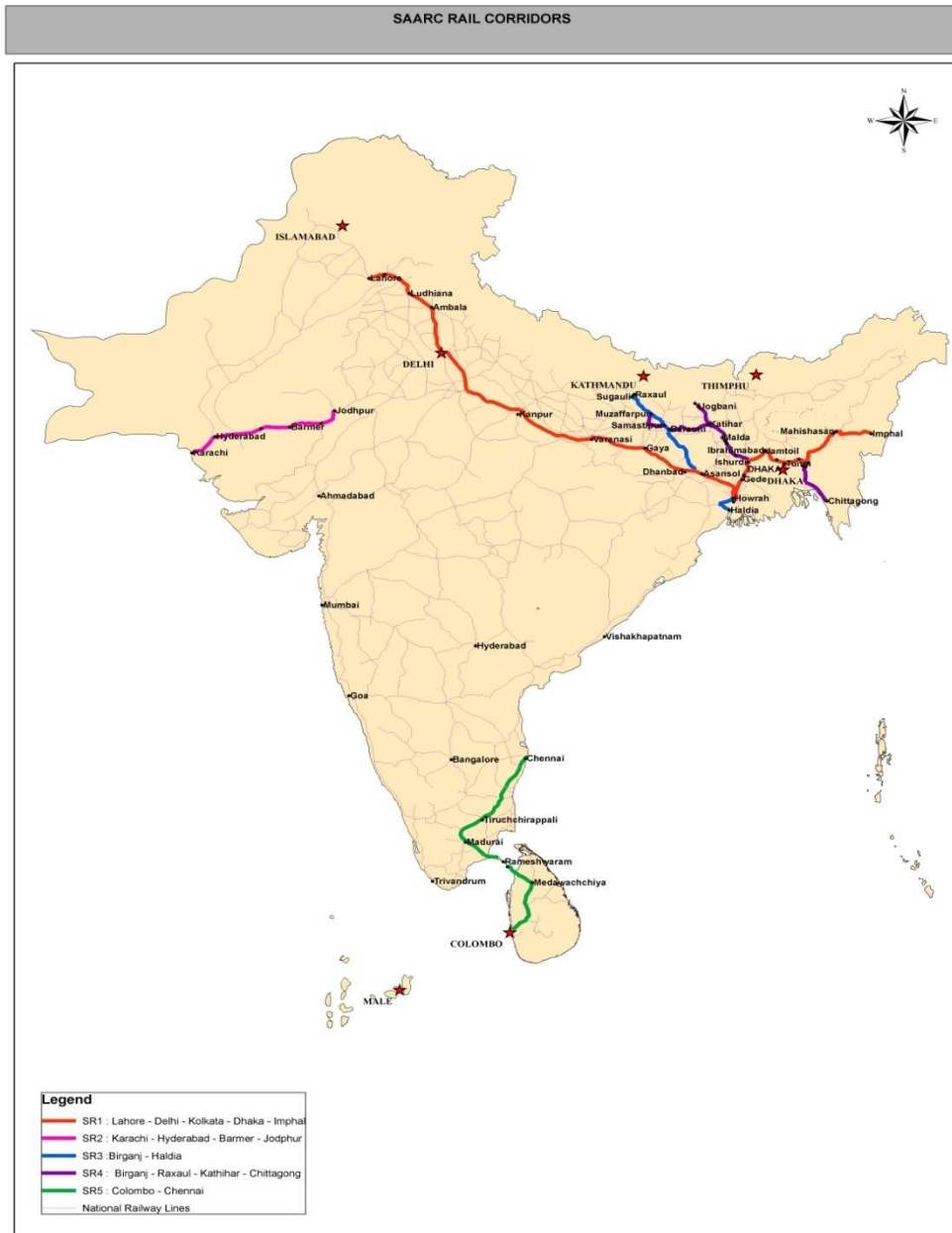
Corridor 3: This 700 km BG rail corridor provides the shortest and the fastest access for traffic to and from land-locked Nepal. The 704 km Birgunj-Kolkata port via Naihati and 832

km Birgunj-Haldia via Howrah corridor has been extended by a 30 km BG line link along Sugauli-Raxaul-Birgunj with a 6 km extension inside Nepal connected directly to ICD at Birgunj.

Corridor 4: The 1,146 km Birgunj-Katihar-Chittagong port corridor also starts at Birgunj in Nepal and connects the Indian rail network at Raxaul and runs South- east through Barauni-Katihar-Malda Town-Singhabad to the Bangladesh, border- crossing at Rohanpur. In Bangladesh the corridor then extends to the port of Chittagong via Rohanpur, Abdulpur, Ishurdi, Tungi and Akhaura. The existing rail link from Jogbani to Katihar has been identified as part of this corridor. Proposed connectivity to Biratnagar in Nepal with Jogbani (last station on IR) would provide a second rail route connecting Nepal with India and Bangladesh.

This corridor can potentially connect Akhaura in Bangladesh with Agartala in India and shorten the link between Kolkata and Agartala. Howrah-Agartala via Guwahati is 1,561 kms against 502 kms from Howrah to Agartala via Joydebpur and Akhaura.

Corridor 5: This 1,025 km Colombo-Chennai corridor has the potential of further connectivity with other SAARC member states through the IR network. It could also be utilised for the movement of containerised traffic with transshipment to sea vessels for movement across the channel connecting to the Indian mainland. The 35 km ferry link from Talaimannar Pier in Sri Lanka to Rameshwaram in India would provide connectivity with Chennai, 653 km away, through the IR network.



7.3.2 Trans Asian Railway

UN-ESCAP under its Asian Land Transportation Infrastructure Development (ALTID) project identified three Trans-Asian Railway (TAR) routes. These are: (i) Northern Corridor which passes through Russian Federation, Kazakhstan, Mongolia, China and Korean Peninsula, (ii) TAR in the Indo-China and ASIAN sub- region starting from the Chinese border through Lao People’s Democratic Republic and Thailand up to Malaysia (with linkages connecting Myanmar, Cambodia and Vietnam) and (iii) The Southern Corridor comprising Turkey, Iran, Pakistan, India, Nepal, Sri Lanka and Bangladesh. Inter-governmental agreement on TAR has been negotiated under UN-ESCAP.

The Southern Corridor commences from Kunming in China and Bangkok in Thailand and ends in Kapikule in Bulgaria. The total length of this route between Bangkok and Kapikule is 11,460 kms and it provides Trans Continental rail connectivity to the countries of China, Thailand, Myanmar, Bangladesh, Pakistan, India, Iran and Turkey. The route, as proposed, would enter India at Tamu, bordering Myanmar, pass into Bangladesh at Mahisasan/Shabajpur and re-enter India from Bangladesh at Gede. On the West side, this route was proposed to enter Pakistan at Attari-Wagah. This route has a missing link of 180 kms between Jiribam and Tamu in India.

The Trans Asian Railway network is intended to provide connectivity between (i) capitals of member countries, (ii) main industrial and agricultural centers, (iii) major sea and river ports, (iv) major container terminals and depots, and (v) places of major tourist attractions.

7.4 The China Factor

Trans-continental rail connectivity as a strategic tool is being deployed to great effect by China. It has already developed transport links to the Korean peninsula, South-east Asia, Myanmar, Pakistan and Afghanistan. It is busy developing extensive multi-modal connectivity in India's neighbourhood which is perceived in strategic circles as an act of encirclement. It has established a presence in Pakistan with a new port at Gwadar and strategic linkages through Pakistan, Iran and Central Asia. China Metallurgical Group Corporation, involved in the development of the Aynak copper mines, has signed an MoU with Afghan government on 22 September 2010 to undertake a feasibility study for a 700 km rail -line connecting the Aynak copper mines in northern Afghanistan with Kabul and the two neighbouring countries, with connectivity to ports in Iran and Pakistan (estimated cost-\$5b). China is also actively working to incorporate the Gilgit-Baltistan tract into Xinjiang's logistics grid by widening the highway and laying a Pakistan-China rail link, through an MoU between Beijing and Islamabad for a trans-Karakoram rail line through the Gilgit-Baltistan region. Pakistan plans, with active Chinese involvement, a 900 km rail line from Gwadar port in Balochistan on Pakistan's south-west coast close to the Straits of Hormuz to join the Quetta-Zahedan line and via Dalbandin along Koh-i-Taftan (on Iranian border)-Spezand-Quetta-Chaman (on Afghan border) onwards through Khunjerab Pass in the

Karakoram to Kashgar (Kashi) connected to Xigaze in China. It has planned a railway and pipeline from Gwadar port to western China along the Karakoram Highway route.

China has also plans to build a new rail corridor to link it to the Mediterranean Sea through Central Asia, Afghanistan, Pakistan and Iran. It has proposed 580 km rail- line from Tehran through Hamadan, Malayer and Kermanshah to Khosravi on the border with Iraq, which will also provide a link between Arak and Malayer. The line will offer onward linkages via Iraq to the Mediterranean port of Latakia in Syria, thereby facilitating a southern route from China to Europe. Yet another transit route being considered is through Afghanistan and Pakistan along Askabad-Torghundi-Herat-Kandahar-Chaman-Quetta.

In the east, China has long -term plans to link up with the Bay of Bengal port of Sittwe (Akyab) through Mandalay and the Irrawady river . China is also planning to build a 232- km Lashio-Muse/Ruili rail line that would provide a strategic link through an extensive rail network across Myanmar. From Kunming in its Yunnan province, a network of road, rail and river links fork out to Sittwe in western Myanmar and Thilawa near Yangon on the Bay of Bengal. Myanmar would thus emerge as a possible land- bridge connecting South Asia and South-west China.

Besides the Irrawady corridor through Myanmar into the Bay of Bengal, China extends significant development assistance to Bangladesh by way of grant, credit, and interest-free or concessional loans for important bridge works, natural gas, etc. Plans are on the anvil, among other projects, for constructing the second Padma bridge and a 130 km rail line from Chittagong to Gundum on Myanmar-Bangladesh border. A Myanmar-Bangladesh rail link will help connect Kunming to Chittagong as well.

In the north, China is busy extending the world's highest 1,142 km Golmud-Lhasa rail line, that was opened in July 2006, to Xigaze, Tibet's second largest city, 253 km apart from its capital city, with plans to take it further towards Nepal, first to Nyalam, 400 km from Xigaze, on the China-Nepal border and finally a 120 km extension to Kathmandu.

In the south, a part of its "string of pearls" strategy of links with regional maritime nations, China is now Sri Lanka's biggest investor as well as aid donor. *The Economist* (10 July 2010) reported that China is financing nearly all of Sri Lanka's biggest infrastructure projects, e.g., a new sea port at Hambantota, an oil storage facility, a new airport, a thermal power plant, an expressway, besides a special economic zone at Mirigama near Colombo.

China is also rebuilding the main roads in the war-shattered north and east, and also a performance arts centre.

Chinese road and rail connectivity projects to speedily knit the South-east Asian land mass include the ambitious 5,380 km ASEAN flagship Kunming-Singapore rail line venture, a crucial corridor critical to the Trans Asian Railway project. China has been keen on connectivity of its rail network across those of the ASEAN region, even though there is no rail linkage between China and Myanmar, China and Laos, Myanmar and Thailand, Thailand and Cambodia, Cambodia and Vietnam, and Vietnam and Laos.

China's initiatives in expanding its rail connectivities beyond its own geographical borders has been dealt with in some detail because of its overarching strategic as well as political significance for our country. There are very important implications of Chinese advances in the neighbouring countries. In order to secure our strategic interests in the region, looking at rail linkages beyond the country's borders is not an option but a compulsion. Our long-term transport policy, therefore, has to take note of and provide for solutions to the challenges posed by the Chinese initiatives in the region.

7.5 Recommendations

7.5.1 TAR-Development of Missing Links and Transshipment Facilities

The Trans-Asian Railway network comprises railway lines which have been indicated by member countries to be part of such network. While continuity of network along all routes of the Trans-Asian Railway is ideal and desirable, discontinuity needs to be reckoned with and missing links need to be constructed. There is a missing link of 180 km in India between Jiribam and Tamu bordering Myanmar. Indian Railways have already sanctioned construction of 98 km new line between Jiribam-Tupul towards Tamu costing Rs.727 crores.) Similarly, break-of-gauge at various inter-change points of different railway systems also needs to be taken into account. (For example, India and Myanmar have different gauges and the same is true of some of the interchange points with Bangladesh.)

Break of gauge does not constitute an insurmountable problem to efficient services. A major part of the time-sensitive traffic is containerized cargo which, by nature, lends itself well to fast and efficient transshipment. With well-designed and well-organized facilities transshipment can take place within a few hours - a small fraction of the overall transit time over large distances.

The construction of missing links and development of transshipment facilities on the TAR network will have to be developed by parties to the Inter-governmental agreement within the framework of their own national programmes. Hence, no cost estimation for creation of such facilities at this stage will be possible or relevant.

While no tangible progress has taken place on the Southern Corridor which is of relevance to India, the Northern corridor has already taken off spearheaded by China to link its railway system to the network in Central Asia, most notably through Kazakhstan. China in association with other interests has operated full container trains from its eastern borders all the way to Europe.

India should play the leadership role in operationalising the southern corridor of the Trans Asian Railway (TAR) project. Connection from Jiribam in Manipur to Tamu in Myanmar via Imphal and Moreh should be expedited. The existing 201-km MG line from Lumding in Assam to Jiribam needs to be converted to Broad Gauge at the earliest. *(This is a sanctioned work at a cost of Rs. 4073.53 cr. Work on formation etc. is in progress and the work is likely to be completed in 2015)* The line from Imphal to Jiribam (97.9 km) sanctioned at a cost of Rs. 2492.53 cr needs to be completed in a fixed time schedule. Jiribam and Moreh need to be linked to Imphal. Connection from Imphal to Tamu (85 km) also needs to be taken up. Mahishasan (India) - Shahbazpur (Bangladesh) rail link needs to be rehabilitated and restored.

7.5.2 Rail linkage with neighbouring countries:

A summary of ongoing projects for establishment/restoration of links with neighbouring countries is at the Table below:

Table-23: Summary of on-going projects & current status

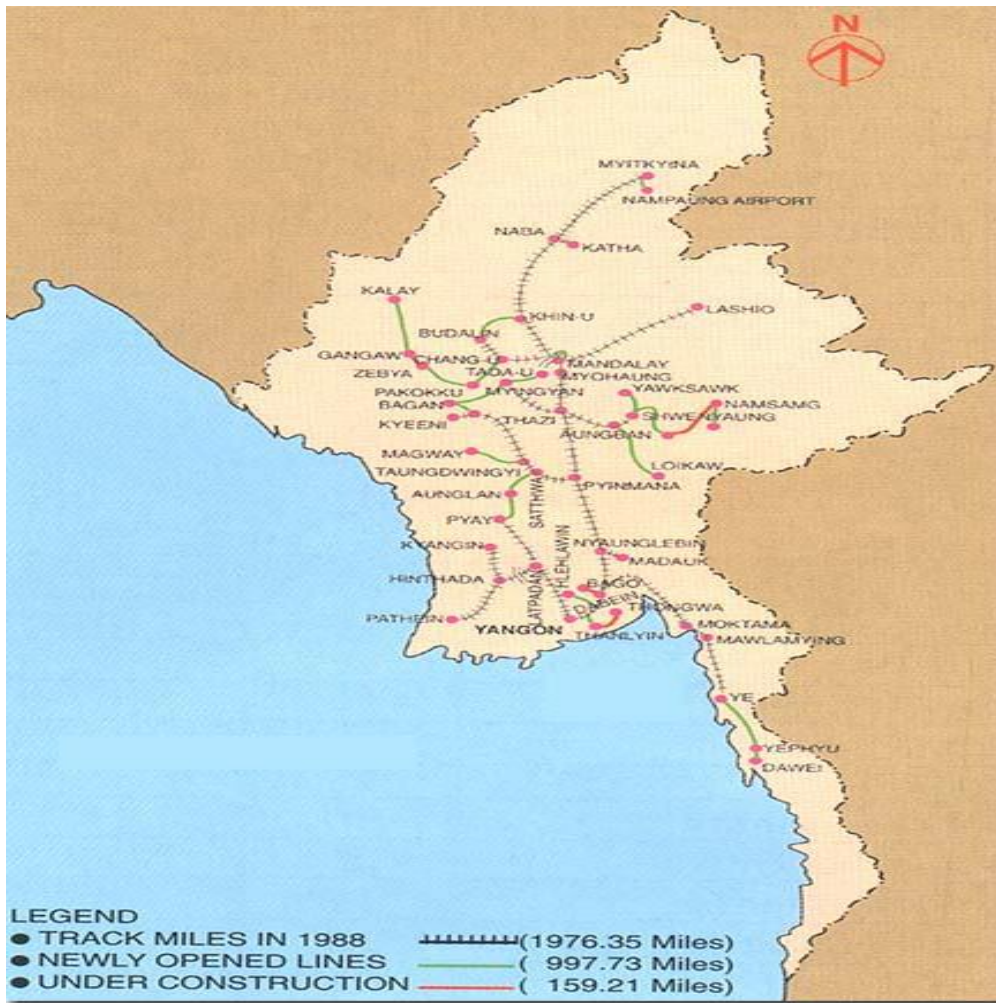
S.No.	Name of Project	Length (in km)	Cost (Rs in cr)	Present Status
	Trans Asian Railway			

1	Lumding-Jiribam (201 km) of Lumding-Silchar-Jiribam and linked fingers Gauge conversion	367	4073.53	Land acquisition, 599.78 lac cum earthwork, 313 minor bridges, 5473 m tunnel has been completed. Critical activity is tunnel no. 10 for which risk & cost tender was discharged and reinvited. Overall progress is 60%. TDC - Dec'2012. Land acquisition and other activities are in progress in balance sections.
2	Jiribam-Imphal (97.9)	97.9	2492.53	This has been declared as "National Project". 654 hect. land acquisition, 128 lac cum earthwork, 24 minor bridges and 2 RUB/ROB has been completed. Govt. has accorded 'In principle' approval for extension of line from Tupul to Imphal. Total cost of this project is likely to go upto Rs. 3123 cr. FLS in Tupul-Imphal section is in progress.
3	Imphal- Moreh	80		New line from Imphal to Moreh has not yet been taken up.
4	Shahabajpur (Bangladesh)- Mahishasan(India)			There has been no traffic on this section since 1996. The line is in disuse and will require rehabilitation. As yet, there is no proposal to rehabilitate the line.
Bangladesh				
1	Haldibari(India)- Chilahati(Bangladesh)			There has been no traffic on this section since 1965. The line is in disuse and will require rehabilitation. As yet, there is no proposal to rehabilitate the line.
2	Dhuburi(India)- Lalmonirhat(Bangladesh)			There has been no traffic on this section since 1956. The line is in disuse and will require rehabilitation. As yet, there is no proposal to rehabilitate the line.
3	Radhikapur- Birol(Bangladesh)			This link has been disrupted because of Gauge Conversion on the Indian side. No further work is required on the Indian side to restart this link. Bangladesh Railway has initiated the process of Gauge Conversion on their side.
4	Agartala- Akhaura	13.5	106	IRCON has identified the alignment for this line. Approval of Government of Bangladesh to the alignment is awaited. Funding issues within Government of India are yet to be settled
Bhutan				
1	Hasimara- Phuentsholing(Bhutan)	18	168	Draft report has been submitted by RITES to MEA. Problems of land acquisition have come up. These are to be resolved by the Railways and the State Government of West Bengal.

Nepal					
1	Jaynagar-Bijalpura GC and Bijalpura to Bardibas New line	69	470		New work included in Budget 2010-11. Funding is being tied up by MEA.
2	Jogbani-Biratnagar New Line	18.6	210		New work included in Budget 2010-11. Funding is being tied up by MEA.
3	Nepalganj Road (India) - Nepalganj (Nepal) New Line	12	149		Survey Report sent to Ministry of External Affairs.
4	Nautanwa-Bhairwaha (Nepal) New Line	15	176		Survey Report sent to Ministry of External Affairs.
5	Birganj-Kathmandu	160	1285		Survey conducted and completed by M/s PRCL and report submitted to Government of Nepal.
Sri Lanka					
1	Rameswaram-Dhanuskoti	17	54		Survey completed and report under examination by the Railways.
Pakistan					
1	Sialkot (Pakistan)- Jammu(India)				Physical infrastructure required for operationalising these links prima facie appears to be not very significant. However to make progress on these links, political will is required in both the countries. At present, there are no proposals for starting these links. No studies have been made so far to determine the feasibility, costs etc. of these linkages.
2	Dera Baba Nanak (India)- Jassar (Pakistan)				
3	Hindumalkote (India)- Mandi Sadiq Ganj Jn.(Pakistan)				
4	Fazilka (India)- Mandi Sadiq Ganj Jn. (Pakistan)				
5	Hussainiwala (India)- Ganda Singhwala(Pakistan)				
6	Khemkaran(India)- Kasur Tehsil(Pakistan)				

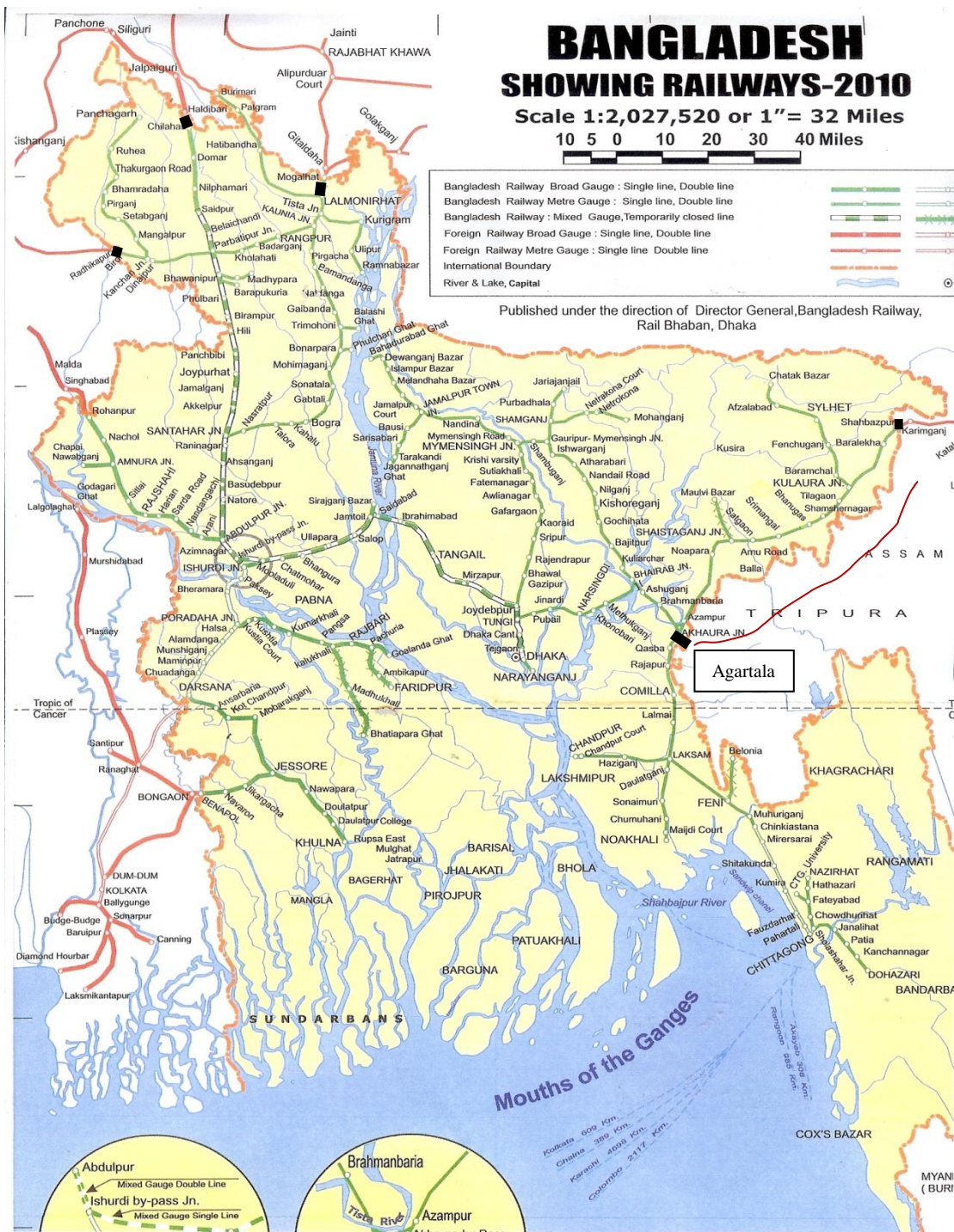
The work that remains to be done in respect of specific countries is described below:

(a) Myanmar



- i. A study should be commissioned to work out the costs and other details of the Kaladan project.
- ii. Jiribam-More and Seggi-Chaungh-Myohaunes lines should be constructed.
- iii. Yangone Mandalay rail-link needs to be upgraded.

(b) Bangladesh



- i. The old links between the two countries need to be restored for the sake of the development of India's North Eastern States as well as for the sake of better relations with our most populous neighbor. These would include:

Haldibari(India)- Chilahati(Bangladesh), Gitaldaha(India)- Mughalhat(Bangladesh), Agartala(India)- Akhaura(Bangladesh) and Shahbazpur(Bangladesh) -Mahishasan(India) .

- ii. Radhikapur(India)-Birol(Bangladesh) line needs to be reopened to facilitate transit trade between Bangladesh and Nepal through India.
- iii. Haldibari-Chilahati link needs to be restored for trade between Bangladesh and Bhutan through the Indian territory.
- iv. Agartala (India)- Akhaura (Bangladesh) connection needs to be re-established to provide the much-needed direct rail link to states like Tripura, Mizoram and Manipur to Chittagong port.

(c) Bhutan

REFERENCE :

	B.G.	M.G.	N.G.
1. EXISTING RAILWAY LINES	DOUBLE	SINGLE	---
2. LINE SURVYED	NL		
3. STATE LINE	---		



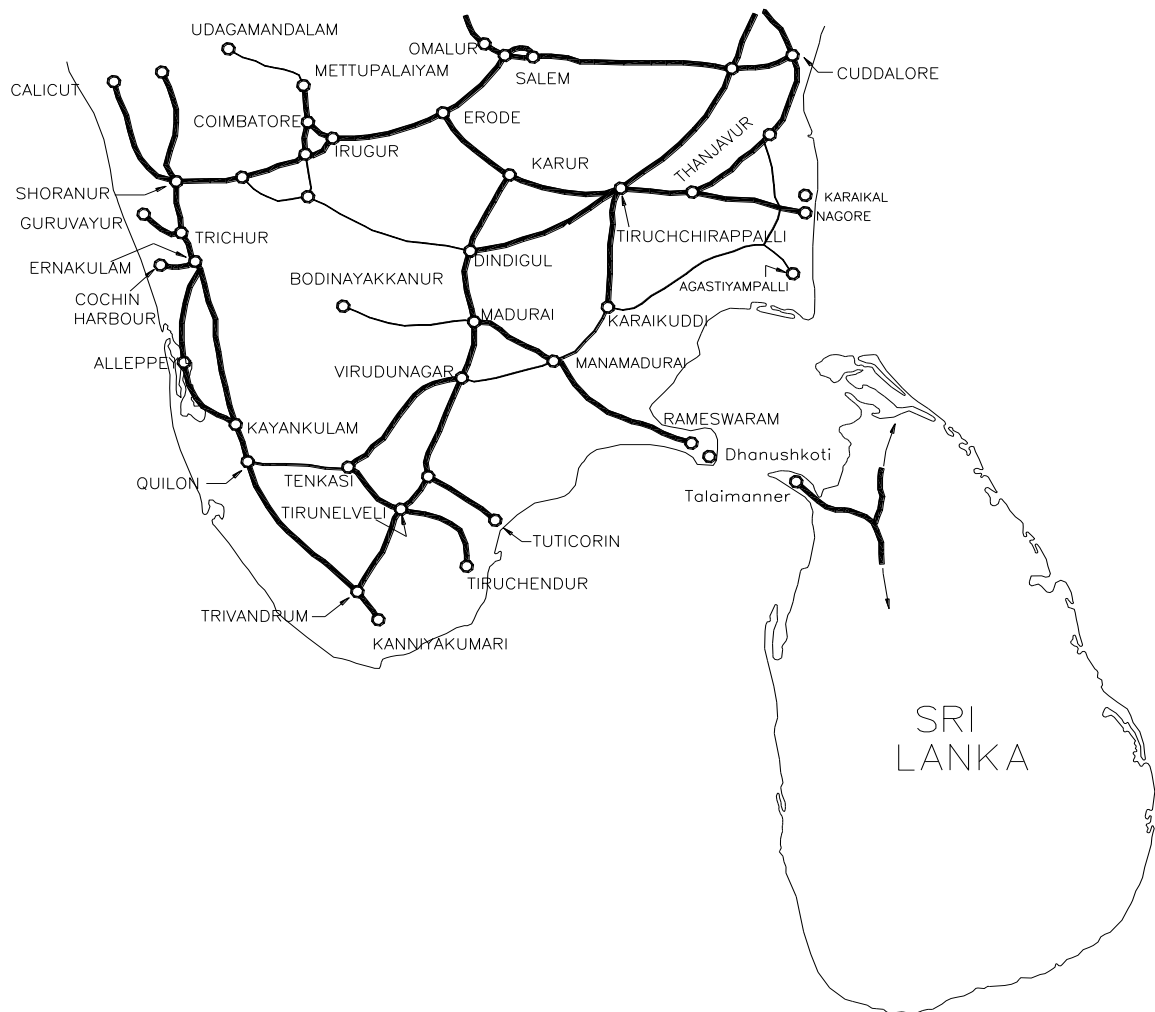
- i. The 17.5 km long Hasimara(India) - Phuentsholing(Bhutan) which has been identified for execution should be constructed. Issues relating to land acquisition need to be addressed by the State and the Union Government.

(d) Nepal



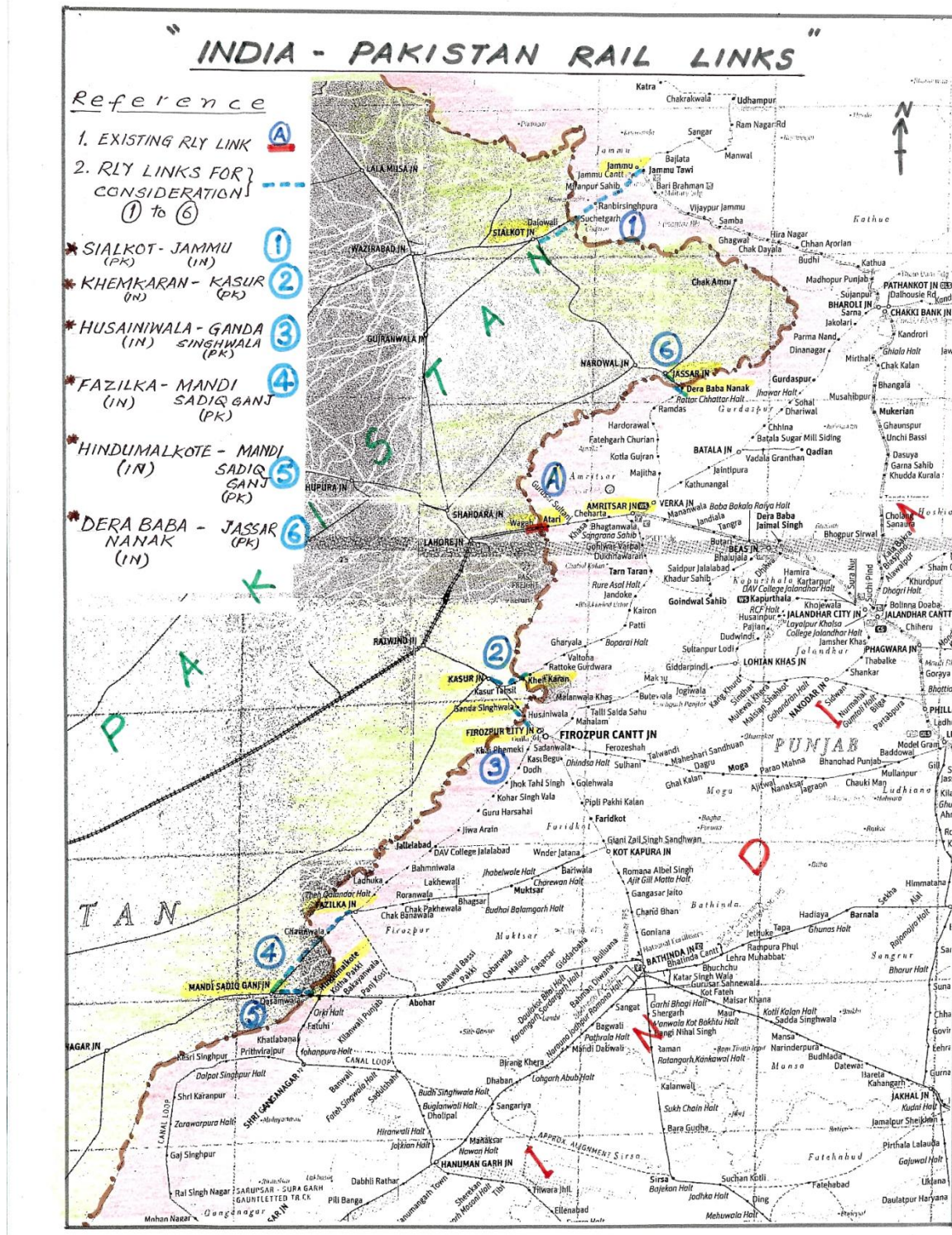
- i. Jaynagar – Bardibas (69.10 kms) and Jogbani-Biratnagar(18.60km) lines costing Rs. 470 cr and Rs. 210 cr. respectively and being entirely funded by the Government of India should be expedited.
- ii. Nepalganj Road-Nepalganj(12.11 km), Nautanwa - Bhairahwaha(15.30 km) and New Jalpaiguri -Kakrabitta(46.30 km), which have also been surveyed, should be taken up by the Government of India.
- iii. Rail connectivity with Nepal assumes special importance in view of the China factor discussed earlier. China is planning a rail line between Lhasa and Kathmandu. Strategically, it would be in India’s interest to construct the Birganj-Kathmandu line (160 km). The cost of this line as estimated by Pipavav Rail Corporation Ltd. (PRCL) is Rs. 1285 cr. (2006). This project admittedly will not be financially viable but it will be in India’s strategic interest to undertake the project at its cost if it has to preserve its preeminence in Nepal.

(e) Sri Lanka



- i. Rameshwaram-Dhanushkoti (17km) railway link and Dhanushkoti-Talaimanner ferry service should be revived for faster, easier and convenient communication between India and Sri Lanka.

(f) Pakistan



- i. The following links should be revived and rebuilt: Sialkot (Pakistan)-Jammu(India), Dera Baba Nanak (India)- Jassar (Pakistan), Hindumalkote (India)- Mandi Sadiq Ganj

Jn.(Pakistan), Fazilka (India)- Mandi Sadiq Ganj Jn. (Pakistan), Hussainiwala (India)- Ganda Singhwala(Pakistan) and Khemkaran(India)- Kasur Tehsil(Pakistan).

7.5.3 Customs and border- crossing - Facilitation Aspects:

- (a) In order to reap full benefits of the rail connectivity across countries, in addition to integration of physical infrastructure such as roads, railway lines, and agreed routes, etc., a mutually agreed regulatory framework for harmonization of documentation and customs procedures and the harmonized use of electronic data interchange (EDI) is also required .Electronic Data Exchange under a synchronized system needs to be evolved to enable expeditious clearance at the border.
- (b) Inter-country connectivity for trade, transit and trans-shipment should be able to seamlessly use more than one means of transportation: air, water (sea and/or river), rail or road. Simplified procedures like through-bill-of-lading or combined-transport-bill-of-lading can be introduced to facilitate this.
- (c) Inter-change of rail traffic between India Pakistan, Bangladesh, and Nepal is governed under the bilateral agreements. Bilateral agreements need to be reviewed for operationalising all such intra-regional corridors that would carry third country traffic and transit across another country on its rail network. The current bilateral agreements have to be revised to a trilateral or multilateral agreement for such through intra-regional rail movements.
- (d) Measures like visa -free travel between countries, single- point customs and immigration checks etc. are also required to usher in a regime that will facilitate seamless transportation across countries.

Chapter-8

Optimization of land use

Land is a critical and scarce resource and is getting scarcer as demands on the available land mounts due to the pressure of population and development. A proper policy framework is required to preserve the land already available with railways and to minimize the requirement of land in future. The Working Group has attempted to assess the additional requirement of land to cater to growth of railways and suggest measures for its smooth and speedy acquisition as well as appropriate technical solutions to reduce the requirement for land.

8.1 Roughly 10% of the total land under the possession of Indian Railways is vacant (estimated at approximately 4300 hectares). These are mostly alongside the track in longitudinal strips but there are some pockets around railway stations and railway colonies also. To keep a proper account of the land resources, an exercise for identification of the vacant land and systematization of records has been undertaken. Vacant land is primarily meant to meet developmental needs such as doubling, yard modeling, traffic facility works and manufacturing facilities (for various rolling stock and other components required by railways). If the land is not required for operational needs, it can be developed commercially by Railway Land Development Authority (RLDA) created specifically by an Act of Parliament, to generate additional non-tariff revenue for railways.

8.2 In future, Railway would need to use its existing vacant land scrupulously. It would also need to acquire land for various developmental projects such dedicated freight corridors, high speed passenger corridors, new lines and doubling projects as well as for major manufacturing units and multi-modal logistics hubs. In most cases, the requirement of land would be to connect places in a linear fashion and there would be little flexibility to vary the alignment due to technical constraints like radius of the curvature, gradients, soil characteristics, river- crossing etc. It may always not be possible to avoid agricultural land, forest land or tribal land. However, as construction of railway lines require only small strips of land, the hardship and physical dislocation to the land- losers can be minimized. Wherever possible, a detour could be taken or alignment changed and taken through tunnels. At some

places, retaining walls and breast walls can also minimize the land requirements. This would also help the environment as higher earthwork fillings and deeper cuttings not only use more land, but also disturb the environment through increased earthwork by borrowing or dumping.

8.3 Acquisition of the minimum land required for railway projects would be inevitable. In order to speed up the process, Ministry of Railways had enacted Railway (Amendment) Act, 2008 through an Act of Parliament. This Act provides for speedy acquisition of land for “special railway projects” by nominating a ‘Competent Authority’ by Railways without resorting to Land Acquisition Act under which acquisition is done through land acquisition officers of State Governments. Provisions of NRRP 2007 for rehabilitation and resettlement of affected persons in a fair and equitable manner have been embodied in the new Act. However, for speedier implementation of infrastructure projects the land acquisition process has to be based on fair compensation and consent of land-losers to the maximum extent. This, however, lies in the realm of amendment to the Land Acquisition Act for the country as a whole.

8.4 Infrastructure Corridors:

Several countries have followed the concept of infrastructure corridors to optimize use of land and avoid haphazard development along these corridors. In our country also, no development is permitted within 67 meters on either side of the national highways or 30 meters of the railway alignment. Similar restrictions exist for high-tension lines and petroleum pipelines also.

8.4.1 A master-plan for the country can be conceived and land for infrastructure corridors can be reserved: railway lines, expressways, power transmission lines and pipe lines can use the corridor and run alongside. A suitable legal and institutional framework can be developed to implement the concept.

8.5 Schedule of Dimension (SOD) and Maximum Moving Dimension (MMD):

Appropriate investments in track structure and SOD/MMD improvement (by systematically identifying constraining structures and standards and improving them) can potentially enhance the carrying capacity of existing lines and obviate the need for multiple lines and thereby conserve and economise the use of land. Adequate research and cost benefit analysis needs to be carried out on these aspects.

8.6 Leasing of railway land for certain specified purposes is permitted only if it is declared surplus to the long-term requirement. This has proved restrictive as vacant railway land in and around railway stations or railway yards can seldom be declared surplus if a time horizon of even 20-30 years is taken. However, transportation of passengers and goods, which is the core task of the railways, does require a number of ancillary activities and services. Several of these have been traditionally performed by railways departmentally, and now being increasingly outsourced or contracted out. Examples are: mechanized cleaning, linen and catering services on trains, parcel services etc. These cannot be run successfully unless the service providers are allowed space within the railway premises and permitted to create necessary infrastructure facilities such as water pipelines, electrical installations etc. Similarly, terminal-handling services for freight also require commodity-specific mechanization and other allied infrastructure such as platforms, warehouses and roads. As a policy, any service facility which is an extension of the railway operation or which helps to attract more traffic to railways should be permitted on the railway land. The private service provider may be given suitable license to use the land for the period of the contract limited to 5-10 years. The ownership of the fixed assets may always remain with the railways and that of mobile equipment plant and machinery etc with the service provider. A suitable institutional framework may be devised for this purpose.

8.6.1 Suburban stations provide an excellent opportunity for management of the precious land resources of Railways in urban areas. A standard template can be developed for redesign and redevelopment of the stations that maximizes the comfort for commuters and create space for premium retail in station premises.

Chapter-9

Planning for 2030

9.1 If the India has to emerge as one of the largest economies of the world by 2030, Railways must play its part in facilitating it. Indian Railways cannot afford to go on a business as usual trajectory. To be able to play its rightful role and attain the nationally optimal share in the freight and passenger transport, IR would need to critically assess the business environment it faces and the internal capabilities it has. It also has to envision the future and align its resources towards attainment of the goals. This would entail the following three fundamental questions:

- (a) Where are the Railways today?
- (b) Where should Railways be in 2030?
- (c) How to reach there?

9.1.1 The first question concerns the current state of Railways and can be discussed with reference to its presence and performance in major business segments, its strategic intent and record of execution along a number of dimensions such as capacity and investment planning, cost of service and productivity of assets and employees, finance and funding, HR and R&D capabilities etc. The second question entails setting strategic goals for Railways and the third question, the strategies and approaches to be used to realize these goals.

9.2 Freight Business:

Freight trains constitute approximately 35% of the total 18,000 trains run daily on Indian Railway's network, but yield more than 65% of the revenue. Freight services share the same track and infrastructure with passenger trains, but the latter understandably enjoy a higher priority in train scheduling and operation. There is also huge imbalance in the pattern of train operations: the trunk routes of the railways comprising merely 16% of the network (roughly connecting the four metro cities) carry close to 60% of the freight and more than 50% of the passenger traffic. These over-saturated routes are operating way beyond optimal levels of capacity utilization. Given that both freight and passenger trains use the same tracks, passenger trains enjoy priority over freight trains and the busiest trunk routes are saturated beyond capacity has implications for quality of service for freight trains. Speed of freight trains in Indian Railways has marginally improved from 25 kmph for a long time to 29 kmph and Railway's ability to meet demand and customer expectations for quality of service is severely restricted.

Given the above constraints, Indian Railways has focused on what it is best at – carrying bulk cargo in train-loads. Nine bulk commodities dominate the freight basket. Coal, steel, iron ore for export and domestic steel plants, other raw material for steel plants, cement, food-grains, fertilizers, petroleum products and container traffic account for over 90% of the railways of freight traffic (coal alone, around 45% of the total and coal and ores together more than 60% of the total). The infrastructural constraints have also prevented IR from aggressively seeking or attracting less than train-load traffic or offering value-added/premium services such as aggregation of cargo and guaranteed supply and transit. As a result, Railway's share in many traffic streams which could potentially be big contributors to Railway's freight such as the fast-growing Consumer Durables and Information Technology (CDIT), fast-moving consumer goods (FMCG), hazardous chemicals, bulk cement, fly-ash, automobiles, and containerized cargo, is low or negligible.

Even in the bulk cargo segment, which moves from siding to siding in rake-roads, IR's market-share is under threat. IR's share varies from as low as 16% in food grains and 21% in petro-products to 45% in cement and steel, and 66% in coal and iron-ore. Customers do not have an easy option to have sidings or last-mile connectivities built with little assistance in land acquisition and inadequate compensation or incentive for such investment. Exigencies of public policy in the face of capacity constraints also at times forces IR to assign priority to certain cargoes like fertilizer/sugar in preference to others. Capacity constraints have also forced IR to focus on managing these constraints and maximize asset efficiency rather than meet customers' needs.

The present rules governing construction and operation of sidings which are essential for railway traffic are one-sided and, overly protective of Railway's interests. These need to be made more user-friendly with a sound legal framework to incentivize users to build sidings and use the rail services instead of road.

Auto-carriage is a typical example of what railways are losing and why. Globally, automobiles are mostly carried by rail. IR's share in India's growing automobile production and transportation is a mere 2%. Railways do not have proper wagons to transport automobiles efficiently. The few make-shift wagons that have been designed are not capable of carrying optimum number of cars per wagon. The terminal infrastructure for handling is absent. Investment by automobile companies does not come forth as the facilities cannot be shared with competitors and single-user volumes may not justify stand-

alone investment. Automobile companies or third-party logistics providers can bring proven wagon designs from, say, USA or Europe, but the RDSO's approval process is tedious, protracted and uncertain. Policies to encourage private sector investment in auto-carriage rolling stock, infrastructure and marketing have been formulated but have not so far been successful.

Similar issues beset bulk cement, fly-ash and other potentially voluminous commodities not carried by rail in any sizable quantity.

9.2.1 Performance in freight:

During the recent years (2004-05 – 2009-10), average rate of growth in freight has been rather impressive at 8% per annum when compared to the period 1990-91 – 2003-04 when IR's growth averaged 4%. However, given the average GDP growth in the country during 2004-05 - 2009-10 (around 8%) and the transport elasticity to GDP of 1.25, IR's freight could have grown by 10% per annum. IR's performance below potential is explained by capacity constraints, service deficiencies and overdependence on a narrow basket of commodities.

9.2.2 Potential for growth in freight

A fast-growing Indian economy is expected to be accompanied by proportionately high demand for transportation services. According to the McKinsey's study, 65% of the total freight traffic is bulk in nature and 79% of the traffic in terms of ton-kms moves over distance slabs exceeding 400 kms. This presents a huge opportunity for railways to increase their share.

Taking a disaggregated view, power, steel and cement industries and consequently coal, both domestically mined and imported, are poised for a massive expansion. Although, part of the coal movement may shift to non-rail alternatives (e.g. pit-head or port- based power plants relying on merry-go-round or conveyor belt systems), concerns on pollution overload and energy security at state/regional level would lead to continued expansion of thermal generation capacity across the country. Both the volume and lead of coal transport would increase as a result. A large part of the movement would involve linkages to new mines or ports. Indian Railways can grow very fast in these segments and increase its share provided network and terminal capacity is built up expeditiously and its service offerings satisfy the increasingly cost-conscious customers who now operate in a fiercely competitive environment.

IR can also attempt to capture a significant share of the fast-growing FMCG, CDIT, containerized cargo and other segments like automobiles etc. where its presence is negligible or minimal.

9.2.3 Capabilities & weaknesses

Indian Railways are extremely competitive in high-volume commodities like coal and iron-ore that move from siding to siding. Coal and ores are particularly amenable to mechanized handling at both loading and unloading ends, further reinforcing the cost advantage. In such cases, rail transportation cost comes very close to total logistics cost. In commodities like cement, iron & steel, food grain etc, railways are competitive, but market characteristics (rake-size cargo may not always be required for all destinations), inadequate mechanization of terminals, unreliability of supply of covered-type rakes (which have multiple uses, at times get deployed for nationally urgent tasks like movement of fertilizer) and relatively inefficient turn-rounds of rolling stock compared to open-type rakes used for mineral cargos has held down railway's share compared to the high potential.

Indian Railways have also an excellent operating culture to monitor use and movement of freight rakes in real-time. All major freight terminals have computerized Terminal Management Systems. Entire freight and passenger operation and movement of rakes/trains are captured through computerized systems and MIS is generated.

However, freight management on Indian Railways also suffers from a number of weaknesses:

- Capacity constraints on most of the busiest routes on Indian Railways do not allow any opportunity for realization of the full market potential and promising and delivering a predictable level of service.
- Freight services are managed as a production function with excessive stress on productivity of assets rather than satisfaction of customers' needs. Productivity of assets is undeniably a worthwhile objective to pursue and improved rake utilization and turn-round over the years have enabled IR to meet requirements of bulk customers. However, there is a need to strike a balance between optimizing asset utilization and fulfilling the customer's requirements if the aim is to increase railway's share of cargo handled. Although, there is Freight Marketing Cell in the

Ministry of Railways, marketing function in the sense of understanding and responding to customers' needs is conspicuous by its absence.

- For the most part, IR does not perceive or define the freight business in terms of delivering transport solutions or logistics solutions. Transport and logistics are gravitating towards supply chain management and railways have to change to fit in with the rapidly changing landscape increasingly dominated by specialist logistics providers who put premium on reliability, efficiency, speed of transit and total cost of the supply chain. Railways' customers have negative perceptions on its handling of demurrage (detention of rolling stock at terminals) and disposal of claims. *(These issues can be handled through increased use of IT)*. Parcel size of cargo presently ranges between 2400 metric ton to 3800 metric ton. It does not suit the requirements of many customers in even in bulk cargo segment and hence puts a sizeable potential market beyond IR.
- Overdependence on a narrow basket of commodities has its risks.
- Railway does not take responsibility for last-mile connectivity from the nearest rail-head to customers' facilities nor does it incentivize customers to invest in such connectivities. It also does not incentivize customers to install rapid handling systems which can greatly improve the efficiencies of utilization of rolling stock.
- There is no institutional arrangement to attract and aggregate traffic of smaller parcel sizes (less than train- loads).
- IR does not operate truly heavy-haul freight trains that bring high level of cost-efficiency to freight operations. Compared to 20,000 tonnes -37,000 tonnes trains run in China, South Africa, Brazil and Australia, maximum gross load carried on trains in IR is 5400 tonnes. Both the carrying capacity of wagons and the length of trains would need to increase to bring in heavy-haul operations.

9.3 Passenger Business:

At present, Indian Railways caters to a wide range of passenger services (suburban and intercity with several types of trains such as Rajdhani, Shatabdi, non-stop Duranto, Mail/Express trains, passenger trains etc) but is not able to meet the demand in full.

Sub-urban and second class passengers comprise 55% and 44% of the total passengers respectively. The average distance travelled by passengers in Indian Railways is 124.7 kms (33.8 kms for suburban and 229.2 kms for non-suburban). Comparable figure for a similar

large-sized railway like Chinese Railways is more than 500 kms. Passenger services, which are priced below cost and cross-subsidized by freight services, constitute 65% of the total number of trains run on Indian Railways but contribute to 25% of the revenue.

Passenger services offered by Indian railways are characterized by:

- Stand-alone service with little integration with other modes and absence of value-added services.
- Low speed (maximum 140 kmph). There is no high-speed rail (capable of over 250 kmph).
- Low reliability.
- Low level of service and comfort.
- Inadequate facilities at stations and poor upkeep of stations/coaches.
- Below-cost tariff.

Extensive use of information technology for ticketing, reservation and enquiry functions in recent years has greatly improved the convenience of passengers in these areas. However, much more remains to be done especially in respect of removal of supply-side constraints, passenger guidance and signage in the stations.

9.3.1 Performance:

During the period 2004-05 – 2009-10, Railway's passenger traffic grew at 6.5% per annum on an average compared to 2% in the period 1990-91 – 2003-04. Despite this growth, the demand for passenger services has continued to exceed the supply at the aggregate level (not everybody who wants to travel by train is able to get a ticket or is able to travel in minimal comfort). In the year 2009-10, passenger services earned a total revenue of Rs.23,488 crore and incurred estimated losses of Rs.20,377 crore (Indian Railway's Year Book,2009-10).

9.3.2 Growth Potential:

Rapid urbanization, rising per capita income and the ongoing structural transformation of the Indian economy would give rise to increased demand for travel. Considering that Railways alone has the capacity to transport large numbers at affordable cost, it represents a good opportunity. However, removal of supply constraints, upgradation

of speeds and quality of service and re-engineering the business for sustained viability would be critical.

9.3.3 Capabilities and Weaknesses:

Railways have an excellent operating protocol in place to run around 12000 passenger trains a day. Train services are by and large reliable and popular. However, these do not compare well with best-in-class passenger railway systems the world over in terms of speed, reliability and comfort for a host of reasons such as infrastructural and capacity limitations, low level of technology, maintenance systems and procedures, poor upkeep of stations and coaches. While most of the developed countries have gone in for high-speed rail (dedicated tracks on which speeds upto 300-350 kms are attained) and rebuilt conventional tracks for speeds upto 200 kmph, maximum permissible speed on IR is only 150 kmph and the average achievable speed is actually in the range of 60-70 kmph. Infrastructure at stations and passenger terminals is inadequate. Cleanliness at both stations and trains is poor. Coaches generally do not have discharge-free toilets. On-board services like catering, bedrolls etc are unsatisfactory. Pre-embarkation and post disembarkation services like cloak-rooms, showers and toilet, retiring rooms and quality restaurants and other retail in the stations have scope for improvement.

To reposition rail travel as the first-choice option for passengers in preference to car in the medium distance segments and airlines in the long-distance segments, all these aspects would require close attention.

9.4 Parcel Business:

The size of the parcel business in the country is huge and expanding rapidly. However, IR's share in the business is low (5.6 million tonnes and Rs 1180 crore for the year 2009-10, estimated to be around 1%) and hence the potential to enlarge the share exists. Market-focused service provision and operation of dedicated parcel trains from dedicated terminals with specified time-table would be needed with focus on high-potential traffic streams like agri-produce, FMCG, processed food, electronic goods, textile, automotive parts and perishable.

9.4.1 Capabilities and Weaknesses:

At present, parcel services are treated as a peripheral activity and managed as an associated service along with passenger trains with little marketing support and backward/forward

services. While this may have an advantages from transportation point of view, it severely handicaps the scope of growth and in addition, causes considerable inconvenience to passengers who are forced to use over-crowded platforms cluttered with parcels.

Unless the business is hived off and managed professionally as a separate business unit, IR will not be able to take advantage of the growing market for parcel movement.

9.5 Other business:

Sundry earnings from sources like advertising and commercial utilization of surplus land currently contribute around Rs.3000 crore per annum. The vastness of the network and large masses of people who use railway stations and facilities, offer an attractive opportunity for advertising on freight and passenger trains, CCTVs at stations, on-board magazines for rail passengers and merchandizing opportunities on tickets, foodstuffs and other materials served on trains etc. Laying optic fibre along the railway tracks and leveraging the optic fibre network for broadband would be yet another avenue. Railways have not been able to fully exploit the potential from these sources as these activities are not managed professionally as separate profit-centres.

9.6 Goals for 2030: where should Railway be in 2030?

As brought out in the preceding paragraphs, IR has to set itself clear and challenging goals on market share, network capacity and service delivery:

- (a) **Market share-** If the GDP continues to grow at 9% and transport market expands at 11.25%, Railway's freight traffic has to grow at 13.3% to attain 50% of market share by 2030. Accelerating the growth from a level of 8% per annum achieved in the last six years to 13.3% in the face of severe capacity constraints may not be feasible. A more realistic goal would be to grow 10-11% till 2020 and accelerate the growth to 16-17% p.a. thereafter to reach 50% market share by 2030. Other alternative options are not simply available as growing at 10% p.a. while the transport market expands at 11.25% would mean that Railway's share would actually decline to 27.5% by 2030. Even to retain the existing share of 36%, Railway has to keep growing at 11.25% p.a. Simultaneously, IR also must attempt to satisfy the demand for passenger travel in full. Both these goals would mean that railway traffic has to grow at a rate much faster than that of the GDP.

- (b) **Network and Carrying capacity** – Attainment of the market share goals would depend crucially on how fast and efficiently Indian Railways augments its network and carrying capacity where it is needed. This would involve construction of dedicated freight corridors, segregation of freight and passenger corridors over trunk routes, upgradation of speeds over both the freight and passenger corridors to match or exceed international benchmarks, construction of high-speed networks, induction of modern and efficient rolling stock and use of modern track/signaling and information technology to optimize capacity utilization.
- (c) **Service delivery** – Indian Railways can use the capacity created and achieve the market share goals only if its services match the customers’ expectations and win their loyalty. For this, Indian Railways has to develop a deep understanding of the market, customers and devise solutions that anticipate and meet their needs in different segments. In the freight service, the bulk commodities and non-bulk commodities would demand different approaches. In passenger services, premium and non-premium passengers, suburban and intercity passengers would similarly demand different approaches.

9.7 How to realize the goals- need for a strategic plan.

Action on multiple fronts would be required to realize the ambitious goals and equally important would be sequencing of the action. First and foremost, IR has to institutionalize a strategic planning process taking a forward view over the next 20 years. The strategic plan will be prepared of involving Zonal Railways and key stakeholders and will clearly lay down the goals to be aimed at and attained and the path to be traversed. A multi-year investment plan fully supported by a credible funding plan will form the bedrock of the strategic plan.

While capacity planning has been dealt with separately at length in the **Chapter-10**, the salient features are described below.

9.8 Investment Planning:

An investment plan for the next 20 years needs to be prepared with the objective to quickly ease capacity constraints and create need based capacity ahead of demand. Instead of department and activity based plan- heads, the plan will be formulated in terms of capacity augmentation, bottleneck removal, technological upgradation or special categories of works such as high-speed rail and or heavy-haul freight. Projects that can pay back quickly either by creating capacity, removing bottlenecks or improving the reliability of infrastructure

equipment and operations should be identified and executed on a fast track. The plan would provide for the following:

- Constructions of 5 Dedicated Freight Corridors.
- Improved connectivity to 400 industry clusters, 200 ports (both major and non -major) involving nearly 750 last mile rail connectivity works. (These have been identified by the McKinsey's study)
- Development of 15 to 20 logistics parks as the main network hubs viz. Mumbai Bangalore, Cochin, Hyderabad, Kolkata, NCR Ahmedabad, Nagpur, Vishakhapatnam and Siliguri, etc
- Upgradation of rail wagons (higher axle load , better tare to pay- load by shifting away from carbon steel to stainless steel and aluminum/ other light- weight bodies, increased payload of covered wagons (BCN) through use of well wagons, better maintenance cycles, etc).
- Upgradation of track to 25 tonnes axle load.
- Improved infrastructure and rolling stock maintenance.

9.8.1 Capacity augmentation projects must be taken up on route-wise consideration. The projects undertaken for the operational purposes must be justified on the basis of either operational necessity or economic return and prioritized according to the urgency. Funding for these projects should be ensured through increased allocation towards investment in DFCs, rolling stock and others like new lines, doubling and gauge conversions that add to carrying capacity.

All capacity-enhancement projects need to be taken up after ensuring full funding to facilitate awarding of contracts having financial liabilities spanning over two to three years and ensure time-bound completion. Project teams need to be held accountable for timely completion of the projects. Emphasis should be on project completion (and hence the generation of revenue) rather than starting new projects. Project managers would need to continue in their positions till project completion. Performance- linked incentive would need to be provided and penalties for failure.

9.8.2 The projects taken up on social considerations must be the categorized separately and their funding must come separately either through national /strategic projects or from state governments. The two categories of projects must not be mixed up and must be handled by

different project organizations with different project leaders. Further, projects that could be best delivered by private-sector through PPP must be identified and handed over to a dedicated organization to structure, bid out and manage such projects.

9.8.3 Funding Plan:

The investment plan must be backed by a credible funding plan. The funding plan must be prepared on the basis of a mix of internal generation, borrowing/PPP and budgetary support from government. Internal generation would be maximized by focusing on capacity creation, improved service delivery, rational pricing, cost-efficiency and by capturing an ever larger share of the freight and passenger market. A norm will be fixed for the internal generation as a proportion of gross revenue. This will be achieved by a combination of expenditure control, rational tariff fixation and traffic growth. This would be supplemented by prudent borrowing and private participation in identified areas. Funding of social projects will be done through a combination of social funding plan on the pattern of social programmes of the central government and contribution by the beneficiary state governments. Government would ensure budgetary allocation in terms of an agreed long-term plan. The budgetary funding will be frontloaded as capacity enhancing works would have to be taken up immediately to generate capacity. This may be gradually brought down as the capacity of IR to fund investment plan through internal and extra budgetary resources picks up.

9.8.4 Generation of internal surplus for reinvestment

As the room for maneuver on the cost side is limited in the short run, the foremost task for the organization will be to capture a larger share of the transportation and correct the distortion in tariffs by gradually and steadily revising the passenger fares to bring these in line with the true cost of provision. Eventually the process for tariff setting must be freed from adhoc decision-making. A formula-based approach could be institutionalized whereby certain percentage of the cost escalation must be periodically neutralized through tariff revision and the other part is absorbed through efficiency improvement. Over a period of time, the fare to freight ratio should be rationalized to the best of the international benchmark. The subsidy for cheap travel for needy sections and uneconomic lines must be targeted, accurately computed and transparently compensated by the government.

The issues connected with rational pricing of rail transport have been dealt with in detail in **Chapter-11**.

9.9 Marketing and business strategy

Before the investments bear fruit and adequate capacity is created, IR would consolidate its presence in the bulk cargo segments by providing or facilitating last-mile connectivities, ensuring adequate rolling stock and incentivizing its mechanized handling. As the capacity bottlenecks get removed, it would expand its presence into non-bulk and less-than-train-load cargo by offering premium value-added services, scheduled services and guaranteed supply of rolling stock and delivery at destination on a just-in-time basis. It would expand partnership with private sector to facilitate private freight terminals, operation of container, automobile and special freight trains and third-party leasing of wagons. It would also work closely with state and city authorities to set up rail-based multi-modal logistics parks to attract increasing volumes of miscellaneous cargo to rail.

9.9.1 Freight: The strategy for freight business would specifically cover:

- Running of Premium freight services with differential pricing.
- Supply of rakes on demand.
- Running of trains on schedule with guaranteed transit time.
- Development of a few selected corridors for heavy-haul operations.
- Development of last mile connectivity on PPP in a time bound manner
- Running of automobile, hazardous material trains, movement of bulk cement, etc by private train operators.
- Reduction in cargo parcel size to 1000 tonnes.

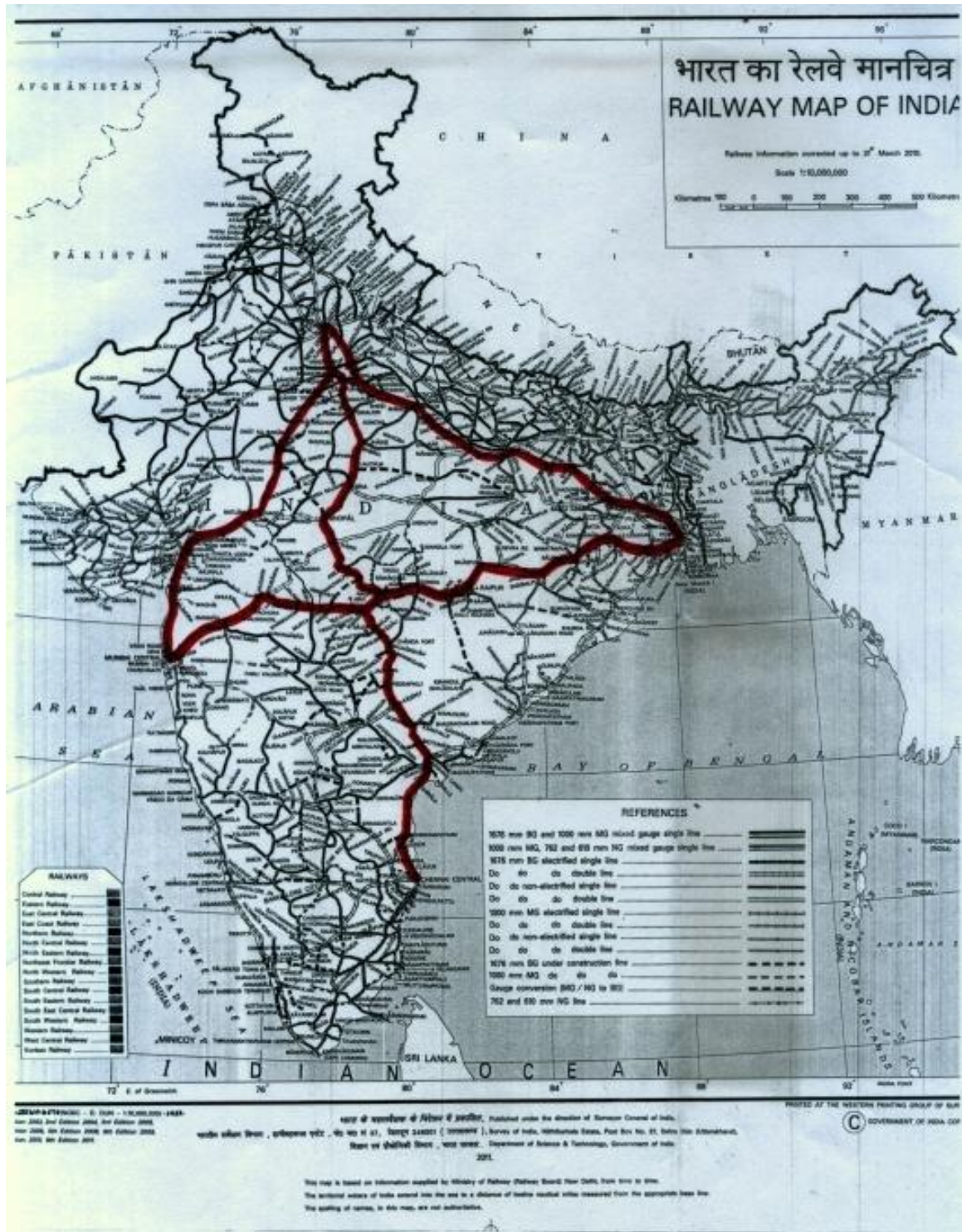
9.9.2 Passenger:

As projected in Chapter-3 (table 12) , passenger traffic is expected to grow at 8% per annum (PKM) to reach a level of 5646 billion from the present level of 839 billion. However, a major shift will take place in the pattern of passenger traffic. As per capita income grows, demand for upper- class and higher -speed intercity services will grow much faster than the demand for second-class travel. Further, as a conscious strategy, Indian Railways would position its services to compete effectively with both airlines and hotels by providing high -speed comfortable services in the train and a host of facilities (such as budget hotels, lounges, shower and cloak room etc) at stations. Commuter services would be hived off to SPVs to be

formed in partnership with the State Governments. Proportion of suburban traffic in the overall traffic would also come down. The strategy for passenger business will include:

- Augmentation of supply to ensure full satisfaction of demand.
- Upgradation of speed to 200 Kmph on selected corridors.(See the map below)
- Redevelopment of stations for smooth flow and comfortable experience of passengers as also to ensure clean and hygienic environment.
- Redesign of coaches to enhance travel comfort.
- Conversion of all stopping passenger trains to EMUs/DMUs or railcars; invitation to state governments to manage uneconomic and unpatronized services.
- Development of select High Speed Corridor (Speed of 350 Kmph).

Routes Suggested for Increasing Maximum Permissible Speed to 160-200 Kmph



9.9.3 Parcel:

Parcel business will be separated from the passenger business and hived off to be managed through a newly created company. The company will develop parcel terminals, warehouses, develop linkage with the private partners and run scheduled, timetabled parcel trains from dedicated terminals.

9.10 Attainment of the goals envisaged in the strategic plan would call for a review of a number of areas such as Research and Development, use of Information Technology as well as carefully thought out interventions in organizational and HR areas. These aspects have been detailed in the **chapters-12-15**.

Chapter-10

Capacity Enhancement, Investment and Resource Mobilization

10.1 As noted in earlier chapters, the potential to grow in both freight and passenger traffic segments is immense but without adequate capacity any amount of effort to court and capture traffic would come to naught. Therefore, capacity creation is the single biggest challenge confronting Railways in the next few years. Plans for capacity creation must encompass both infrastructure and rolling stock and cater to projections for both the existing traffic streams (an analysis done by Long Range Decision Support Systems (LRDSS) of Ministry of Railways indicates that most of the traffic growth would come along the existing Golden Quadrilateral and Diagonals) and capacity needed to cater to new traffic streams. Need for network expansion to connect unconnected regions through new lines must be addressed as also the special requirements of urban transport and terminals which are crucial for rail transport. Further, investments needed to modernize the railway system and ensure a zero-accident and fully reliable system needs to be provided.

10.2 As indicated in Chapter-9 (para 9.8), an investment plan for 20 years articulating clear goals and fully backed by a funding plan is needed. For the purpose of this chapter, a time-horizon of 2012-13 to 2031-32 spanning four-five-year plans (12th to 15th plan) has been considered.

10.2.1 Any serious effort at capacity augmentation must first and foremost be focussed on decongestion of congested routes and segregation of freight and passenger traffic on the most heavily trafficked routes. This can be achieved by a combination of construction of Dedicated Freight Corridors (DFCs) on the busy high density network such as Delhi-Mumbai, Delhi-Kolkata, Delhi-Chennai, Kolkata-Mumbai and Kolkata-Chennai routes with specifications that enable high traffic and heavy-haul freight operations and construction of 3rd & 4th lines on other saturated routes. Some of these specifications that would have to be incorporated in construction of DFCs are:

- Track fit for 25t axle load and upgradable to 32.5t axle load;
- 1 in 200 gradient with a maximum 2° curve;
- Fit for 100 kmph speeds;
- Long loops to permit long haul running (equivalent to 2 normal trains); and
- Automatic Signalling.

10.3 Six DFCs totaling 9538 kms that would be needed are:

- (a) Western DFC (Delhi-Mumbai) 1534 kms;
- (b) Eastern DFC (Ludhiana-Kolkata) 1839 kms;
- (c) East West DFC (Howrah-Mumbai) 1976 kms;
- (d) East-Coast DFC (Kharagpur-Vijaywada) 1097 kms;
- (e) South DFC (Chennai –Goa) 902kms; and
- (f) North South DFC (Delhi-Chennai) 2190 kms.

Of these the first two are already under construction and for other prefeasibility studies have been carried out.

10.4 In addition to the DFCs, a number of other saturated stretches approximately 14500 kms of the route would also need third and fourth lines. Lines approaching major metropolises would also require additional 5th and 6th lines to effectively segregate commuter lines from non-commuter lines.

Around 24000 kms of single lines facing congestion would similarly need to be doubled. In other words, roughly 48500 kms of the network (which should exceed 90,000 kms by 2030) would need to be either double or quadruple lines. Gauge conversion (the remaining part of the network, roughly 11000 kms) would need to be completed. Freight bypasses and traffic facility works such as splitting of block sections, construction of additional loops etc would also need to be taken care of in full.

In addition to the capacity augmentation, network expansion by way of new lines to provide connectivity to both traffic generation centres and populations not yet connected to railways would need to be planned on a much bigger scale than has been done so far. Since independence the pace of new lines construction has been roughly 200 kms per annum. This needs to be accelerated to a level of at least 2000 kms per annum over the next 20 years. It is envisaged that the total length of new lines to be constructed would be around 30,000 kms (including national projects and projects required for strategic regions and international corridors). Of this, projects for 14,104 kms have already been sanctioned. This would cost around Rs.3,00,000 crore at present-day costs. Some of the last-mile connectivity to traffic generation centres and ports would be taken up with participation of the customers; however, most of these lines would be constructed for socio-economic reasons and therefore a system of separately earmarked public funding with support of beneficiary states, to the extent feasible, would need to be put in place.

In addition to these investments, a major effort is also required for upgradation of speeds on segregated passenger corridors to 200 kmph – this would imply deployment of advanced signaling technology (ATP/Cab signalling/CTC), elimination of level crossings,

fencing of tracks and removal of permanent speed restrictions etc. The investment on this account would be of the order of Rs.1,00,000 crore. Other safety works (signalling, removal of level- crossings, renewal/modernization works for track/signalling etc) will entail investment to the tune of Rs2,50,000 crore.

In addition to the above, 4000 kms high-speed corridors costing Rs.4,00,000 crore could be planned.

10.5 A summary of capacity augmentation needed by 2030 is as under:

S.No.	Category	Kms	Cost Rs. in crore
1.	DFCs	9538 @Rs 25 crore	2,38,450
2.	Quadrupling (Non-DFC lines)	14500@Rs 20 crore	2,90,000
3.	5 th & 6 th lines	300@Rs 10 crore	3000
4.	Doubling	24000@Rs 10 crore	2,40,000
5.	Gauge conversion	8000@Rs 6 crore	48,000
6.	New lines including international corridors and port connectivity works.	30000@Rs 10 crore	3,00,000
7.	Speed raising	10000@Rs 10crore	1,00,000
8.	Bye-passes (40 bye-passes)	120 kms@Rs 10 crore	1200
9.	Traffic facility works.	N.A	70,000
10.	High-speed corridors	2000@Rs 100 crore	4,00,000
11.	Other Safety Works		2,50,000
12.	Electrification	20,000@1.25 crore	25,000
	Grand total		19,65,650

10.6 Urban Transport:

Indian Railway's network running through the country's fast-growing urban agglomerations including major state capitals already carry significant volumes of commuter traffic. In some cities like Mumbai and Kolkata and to some extent in Chennai, IR's commuter network constitutes the lifeline of sub-urban transport. IR's role will continue to be relevant despite the advent of metro rail networks that have started altering the urban

transport landscape in several cities. From the railway's standpoint, the foremost concern stems from operational losses suffered on these services and capacity constraints. Railway networks in urban areas were primarily built for long-distance intercity transport. Only with segregation of suburban and long distance passenger/freight traffic, efficient provision of commuter service is possible. MRVC in Mumbai and MMTS in Hyderabad are two successful models for financial participation and cooperation with State Governments. Other states need to be engaged for similar initiatives. Viable cost sharing arrangements for both infrastructure and rolling stock investment and management of commuter operations need to be configured. It is envisaged that over the next 20 years IR's share of expenditure (@ 50%) in augmentation of urban networks would amount to Rs.3000 crore per annum or roughly Rs.60,000 crore. In addition, two elevated rail corridors using the existing right of way of railways in both Western and Central Railways in Mumbai (Churchgate-Virar and Mumbai VT to Karzat) costing approximately Rs.40,000 crore could be implemented through PPP along with Viability Gap Funding. Similar other projects in Mumbai and other cities will come up in future. It is estimated that an investment of the order of 2,00,000 crore would be required on this account.

10.7 Terminals:

Railway operation, by its very nature, would require efficient terminals to even start marking any impact in the transport market. At present, most of the freight transport is carried out in customer-owned private sidings. These are basically meant for exclusive use of major customers. There are also roughly 1300 goodsheds owned and managed by railways. Of these, around 500 handle more than 10 rakes per month. Not only the railway goodsheds with potential need to be augmented to handle at least one rake per day (with planned investment in lighting, circulating area, approach road and facilities for customers), private sector would need to be encouraged come forward to build new efficient terminals equipped with related logistics services like warehousing and inter-modal transfers etc. Similarly, in the passenger area, major stations catering to more than one lakh passengers a day must be upgraded to global standards. This would entail segregation of incoming and outgoing passengers, seamless connectivity with the surrounding city, ample parking space, comfortable concourse areas and platforms etc. Modern coaching maintenance terminals capable of ensuring quick maintenance and washing of train-rakes care for with utmost safety and cleanliness will be needed. While investment for redevelopment of stations (roughly, Rs.2,00,000 crore) and development of freight terminals (roughly Rs.1,00,000 crore) could

be mobilized through private participation, investment in coaching terminals (around Rs.1,00,000 crore) would have to be publicly funded.

10.8 Rolling Stock:

On the basis of growth projections (7361 billion ton kms and 5646 billion passenger kms by 2030; by this time railway's freight share would reach 50% and thereafter growth rates may slow somewhat to match growth rates in GDP), the rolling stock requirement has been worked out taking into account, 100% improvement in utilization of freight wagons, 50% improvement in efficiency utilization of freight locomotives, 20% improvement in utilization of passenger locomotives and the replacement requirements. These improvements may appear too high, but would need to be aimed at and realized given the scale of investment in track capacity, zero-accident/failure and high-horse power locomotives envisaged.

In addition to the above, upgradation of Production Units and Workshops for maintenance of the rolling stock would also require investment to the tune of Rs.3,00,000 crore.

	Current holding	Incremental requirement including replacement	Estimated cost (Rs. in crore)
Freight wagons	2,20,000	11,00,000@ Rs.30 lakh each	3,30,000
Electric locomotives	3849	28000 @ Rs.20 crore each	5,60,000
Diesel locomotives	5000	15000 @Rs.15 crore each	2,25,000
EMUs/MEMUs	6694	30000 @Rs.2 crore each	60,000
Coaches	50000	2,10,000 @Rs.1.5 crore each	3,15,000
Upgradation of PUs/Workshops	Nil	Nil	3,00,000
Total	-	-	17,90,000

10.9 Technological upgradation and Safety:

In order to match the best of the railways in terms of technology and safety standards, investment would also be required in upgradation of assets (track for better loading standards and moving dimensions, bridges, signal and telecom etc), Information Technology and Research & Development. Given the prevailing security environment in India, investment also would be needed in beefing up security at stations, in trains and other railway installations. It is estimated that all these works may add upto about Rs.8,00,000 crore over the next 20 years.

10.10 A summary of the investment required by 2032 is as under:

S.No.	Broad category	Investment required (Rs. in crores)
1.	Capacity augmentation (Ref: Para 10.5)	19,65,650
2.	Urban Transport (Ref: Para 10.6)	2,00,000
3.	Terminals (Ref: Para 10.7)	
	(a) Redevelopment of railway stations	2,00,000
	(b) Development of coaching maintenance terminals	1,00,000
	(c) Freight terminals	1,00,000
4.	Rolling stock (including upgradation of production units and workshops) (Ref: Para 10.8)	17,90,000
5.	Technological upgradation and modernization (track, bridges, Signal & Telecom, Information Technology, Research & Development and other miscellaneous works. (Ref: Para 10.9)	8,00,000
	Total	Rs. 51,55,650

10.11 Physical phasing of important works/investment

The investment is proposed to be spaced out in the following manner:

S.No.	Category	2012-13 – 2016-17 (XII Plan)	2017-18 2021-22	2022-23- 2026--27	2027-28— 2031-32	Total
1	DFC (Kms)	3,400	2,500	2500	1138	9538
2	Quadrupling/5 th & 6 th lines/Doubling (Kms)	7,700	15,000	15,000	1100	38,800

3	Gauge conversion (Kms)	3900	4100	-	-	8000
4	New lines(Kms)	2500	10,000	10,000	7,500	3,00,000
7	Electrification (Kms)	6,500	10,000	8,500	-	25000
8	Freight wagons (numbers)	1,60,000	4,00,000	3,00,000	2,40,000	11,00,000
9	Electric locomotives (numbers)	2000	10,000	10,000	6,000	28,000
10	Diesel locomotives (numbers)	2000	5,000	5,000	3,000	15,000
11	Coaches including EMUs/MEMUs (numbers)	24000	70,000	76,000	70,000	2,40,000
12	High-speed rail (Kms)	500	1000	1000	1500	4000

Phasing of funding

It is envisaged that bulk of the funding and project execution will take place between 2017 and 2027. By that time most of the network capacity and modernization works would have been completed. The spending would, therefore, be slightly wound down in the next and final five years. (See the table below)

S.No.	Period	Investment	% of Total
1	2012-13 –2016-17	7,36,000	14.3
2	2017-18 2021-22	13,59,478	26.4
3	2022-23-2026--27	17,59,478	34.1
4	2027-28—2031-32	13,00,094	25.2
	Total	51,55,050	100

It is apparent that the task being attempted is huge (see the table below for a comparison with the actual achievement in the Tenth and Eleventh Five Year Plans).

Actual achievement in last two plans

S.No.	Category	Xth Plan	XIth Plan
1	New lines (kms)	920	2555
2	Gauge conversion (kms)	4289	5482
3	Doubling (kms)	1300	2873
4	Electrification (kms)	1810	4501
7	Freight wagons (nos)	36222	62964

8	Coaches (nos)	12,202	17,274
9	Diesel locomotives (nos)	622	1287
10	Electric locomotives (nos)	524	1225

10.12 The bottom up assessment depicted in the preceding table has been crosschecked from a macroeconomic prospective. In the year 2001, investment in Chinese Railways by the Government of Republic of China represented 0.8% of the GDP. In the year 2009, this figure stands at approximately 1.7% of GDP. In 2009-10, investment in Indian Railways is of the order of 0.6% of GDP. It is considered essential that the investment in railway infrastructure is ramped up to reach at least a level of 1.3% of GDP by the year 2030 and stay at that level till 2032. Following this approach would imply that a total of approximately Rs.58,31,000 crore would need to be invested in the Railways during the period 2012-13 - 2031-32 i.e. Rs.2,91,537 crore per annum on an average over the next 20 years. (This is based on the assessment of GDP growth@9% made by the NTDPC secretariat). The gap is explained by the fact that the Working Group has been conservative on certain investment-intensive projects like high-speed rail. Further, the Working Group feels that once growth-inducing investments are made, enhanced efficiencies could bring down the need for more investment purely from the view-point of satisfying demand for freight and passenger traffic at the improved service level. The Working Group has, therefore, worked out the projections for resource mobilization on the basis of investment requirement of Rs. 51,55,650 crore assessed in para 10.10.

10.13 Resource mobilization:

The projection for mobilization of internal resources for investment has been worked out on the basis of the following assumptions:

- (a) Freight traffic would grow at slightly more than 10% in the first nine years and at close to 17% in the next 10 years to reach a targeted level of 7361 Billion NTKMs by 2030. Thereafter, rate of growth could slow down and match the rate of GDP growth. This would represent roughly 50% of the country's freight transport task in that year compared to 606 billion NTKMs in 2010-11.
- (b) Passenger traffic (PKM) will grow at 10% p.a. to reach a level of 5646 billion passenger kms in 2030 compared to 1007 billion passenger kms in the year 2010-11. The same growth rate will continue till 2032.
- (c) Revenue per NTKM (i.e. the freight tariff) will remain unchanged in real terms but revenue per PKM (passenger tariff) will grow by 4% p.a. in real terms to reach a level

of 54.7 paise in 2030 compared to 26 paise at present. If this is done, the fare to freight ratio which is roughly 4 at present will be corrected to 2. The ratio will still not be equal or close to unity as in case of countries like France and China.

- (d) Other coaching earnings and sundry earnings will increase 5% p.a.
- (e) Operating ratio will start at 98% in 2010-11 and will improve by 1% p.a. till 2016-17 and 2% p.a. thereafter for the next per years to reach 84% in the year 2020-21 where it will get stabilized.
- (f) Net dividend to exchequer will grow by 10% p.a. and appropriation to Depreciation Reserve Fund will also grow 10% p.a. from the level of Rs. 7000 crore budgeted for 2011-12.

10.14 With these assumptions, the total internal generation is estimated to be around Rs. 18,39,000 crore over the next 20 years. There is a strong case for plough back/redevelopment of dividend paid to exchequer into the railway development programme. If this is done, Rs. 4,24,000 crore would be available in addition over the next 20 years. However, internal resource mobilization would exhibit an uneven trend. It will slow to begin with; total mobilization during the next five years from 2012-13 to 2016-17 would be around Rs.1,04,000 crore (or Rs 1,24,000 crore if the entire dividend payable is ploughed back) followed by Rs.2,23,000 crore (or Rs 3,00,000 crore if the entire dividend payable is ploughed back) in the next five years, about Rs. 5,19,000 crore (or Rs.6,37,000 crore) in the next five years and Rs.10,40,000 (or Rs 12,85,000 crore if the entire dividend payable is ploughed back) in the final five years. The projections show that if capacity is built up and market-share goals are achieved with rationalization of tariff, by 2027-32, IR would be able to finance its investments mostly through internal generation with little need for reinvestment of dividends payable. The need for budgetary support would also sharply come down.

10.15 However, public investment would have to play a significant role in creating the necessary capacity for growth in the initial 10 years supplemented by the borrowing within prudent limits and implementation of suitable identified projects such as high speed rail corridors, segments of dedicated freight corridors, elevated rail corridor in Mumbai, last-mile connectivities, rolling stock and other service provision etc. in PPP.PPP and partnership with state governments in implementation of new line and suburban projects would also play a significant role.

10.16 A thorough review of the experience and relative lack of success in respect of PPP projects so far need to be undertaken. Organizational and institutional deficiencies inhibiting PPP need to be identified and addressed. Clear-cut empowerment and accountability for PPP projects need to be established. Decision-making for PPP projects need to be streamlined. Capacity building for officers handling PPP projects both at the Ministry and the field level need to be taken up with help of professional bodies. Standardized documents balancing risks and reverts of private partners must be prepared in advance to avoid delay in decision-making in the course of the bidding/award process. The PPP programme may start with a few identified projects where quick wins are scored and then scaled up further. This has been elaborated in Chapter-14. In fact, for the XIIth Five Year Plan currently under finalization, a very ambitious target for PPP is being attempted. Going forward, IR should aim at mobilizing over Rs 7,00,000 crore of investment through PPP in the next ten years. The table below shows the financing pattern of the last two five-year plans and the funding envisaged for the XIIth five-year plan.

Sources of funding for Xth, XI th and XIIth Five Year Plans (Rs crore)

S.No.	Source	Xth FYP	%	XIth FYP	%	Projected-XIIth FYP (2012-13 – 2016-17)	%
1	Gross Budgetary Support	37,516	44.6	77,021	37.9	3,18,000	43.2
2	Internal resources	29,568	35.2	71,832	35.3	2,00,000	27.2
3	EBR	16,980	20.2	54,458	26.8	2,18,00	29.6
	(PPP Component)	-	-	(8,000)		1,26,000	
	Total	84,064	100	2,03,311	100	7,36,000	100

10.17 Funding: Although, it is difficult to determine the precise mix of funding sources over the next 20 years, the funding plan would rely heavily on budgetary resources in the initial period. Internal generation would pick up and contribute an overwhelmingly large share in later periods (see the table below).

Financing the investment

Source	Projected investment (Figures in Rs crore at 2011-12 prices)				
	12 th Plan	13 th Plan	14 th Plan	15 th Plan (2027-	Total for the

	(2012-17)	(2017-22)	(2022-27)	32)	period
GBS	3,18,000 (43.2%)	6,00,000 (44.1%)	7,00,000 (39.8%)	1,56,094 (12.0%)	17,74,094 (34.4%)
IEBR	2,92,000 (39.7%)	4,59,478 (33.8%)	8,59,478 (48.8%)	10,40,000 (80.0%)	26,50,956 (51.4%)
Private sector	1,26,000 (17.1%)	3,00,000 (22.1%)	2,00,000 (11.4%)	1,04,000 (8.0 %)	7,30,000 (14.2%)
Total	7,36,000	13,59,478	17,59,478	13,00,094	51,55,050

10.18 Needless to say, attainment of the ambitious growth would be predicated upon necessary investment in capacity augmentation and enhancement and modernization of railways. Ability of Railways to implement this programme would be a critical determinant in achieving these projections.

Chapter-11

Determination of Full Costs, Accounting System and Tariff

Rail transport is associated with a wide range of externalities (positive and negative) arising out of the railways reach out to the community. The positive ones could be in the form of greater industrialization, trade and commercialization activities, higher social mobility, property price appreciation (which could form the basis for some subsidization of tariffs), greater potential for tourism, etc. The negative ones could be the environmental degradation resulting from railway operations (air, water and noise effects), accident related damage, barrier effect (communities severed by rail), etc. The sub-group has focussed on the negative externalities arising out of railway operations.

11.1 Negative externalities impose costs on the community. But eliminating them altogether could also impose significant costs. The socially optimal level of an externality will rarely be zero due to the costs of abatement action. A socially optimal level lies somewhere in between, with some amount of ‘bad’ tolerated in exchange for the benefits of economic activity. In other words, the social benefits of reducing an externality must outweigh the social costs of doing so, if the community is to benefit overall. Accordingly policy aimed at reducing external cost should target the cause of the externality and encourage opportunities for achieving minimum cost abatement.

11.1.1 Transport modes generate a range of significant ‘external effects’ – such as accidents, air pollution, noise, intrusion effects, green house gas illusion and congestion. These vary greatly between different locations (for example urban & rural) and at different times. A somewhat detailed review of the literature in the area indicates the following:

- Road transport generates much higher external cost than rail particularly in urban areas
- However for both modes external cost are relatively low on the rural interstate corridor where road and rail compete

11.1.2 In the recent decade, many studies have sought to evaluate the external costs of transport. The evaluations differ considerably in their scope, the transport modes considered, the kinds of impacts evaluated, the hypotheses used and, correspondingly, the quantitative results obtained. Some consistent conclusions that were drawn as follows:

- External costs in absolute terms represent a substantial problem.
- The highest contributors to these costs are air-pollution, climatic change and accidents. Congestion is less significant overall, but especially relevant within urban areas.
- Road transport with its larger share in both passenger and freight volumes is also the largest contributor to total external costs.
- More environment-friendly railway mode with low external cost is generally under- represented in terms of the market share.

11.1.3 According to a study undertaken in the EU context (INFRAS, 2000), external costs of transport are large in the European Union - estimated at about 8% of the GDP. Road transport, which dominates overall mobility volumes, is responsible for more than 90% of the costs with rail accounting for about 2% of the costs. Definitive studies of this type in the Indian context have been hard to find though attempts are still being made to identify these in order to provide at least a macro perspective. It is obvious that external costs are to be evaluated if they are going to be used as a basis for calibrating transport taxes and charges. However, it is widely recognized that there is no unique, commonly accepted methodology for evaluating external costs. A quick review of the literature in the area suggests that though methodological aspects of the incorporation have been firmed up, the implementation is still to materialize in any significant sense since it requires that adoption of these practices be taken up in other modes too with a view to achieve neutrality across modes. In the European Union, only Sweden has included accident costs and environment costs as part of the variable charges while Finland has attempted to include accident costs. Of the eighteen systems considered, seven (Denmark, France, Germany, Austria, Italy, Switzerland and the UK) provided for an element of congestion and scarcity charges.

11.1.4 There have been attempts in recent years to identify (and possibly recover) costs associated with externalities resulting from railway operations and incorporate these into the pricing scheme. These include social costs of emissions, noise pollution, accidents. An ideal objective would be to assess the significance of each of these especially the negative ones with a view to zeroing in on the major components which need to be looked at closely from the point of view of incorporation into overall costs and thereby into pricing. **But where action is taken, it is important to ensure that externalities in all the modes of transport**

(including public transport) are addressed. Otherwise, patterns of production and consumption will be distorted, and there could be a net welfare loss. Moreover, according to a recent report (Commonwealth of Australia, 2006), while the non-inclusion of externalities in transport pricing can be expected to favour road relative to rail overall, the competitive neutrality implications are limited given limited substitutability and much complementarity between them.

11.1.5 A modal operation that involves external costs can be required to ‘internalize’ this cost by paying a tax or charge to reflect the additional costs to society from the externality. The imposition of such ‘Pigouvian’ taxes is expected to result in a socially optimal level of pollution. In the case of Railways, certain externalities are systematically internalized. For instance, accidents are already incorporated into the cost profile of the railways and to that extent these are integrated into the tariff as well. Accordingly, there is need to focus on the other external costs components related to railway operations with a view to internalizing them.

11.1.6 In recent years some attempts have been made in India to evaluate the external costs the different transport modes. AITD (2006) carried out an empirical study exploring economics of environmental and social costs for the two modes of rail and road transport and monetized them in a manner relevant to Indian conditions. The objective was to examine the issue of an optimal modal mix in the Indian context so as to further examine moves to induce the transport user to move towards such optimal modes. This valuation was examined in the context of ecological, social and institutional perceptions and relevance. The study analyzed only those factors which are of greater damage value in a developing country like India such as air pollution, congestion and accidents. In terms of social costs, railways have a huge cost advantage over road transport. The advantage is greater in freight traffic (range of social costs on rail is between Rs.0.4 and 0.8 per tonne km. as against the range in road being between Rs.2.4 and 2.8) than in passenger traffic (range in rail being between Rs.1.2 and Rs.1.8 and that in road being between Rs.1.2 and 2.8 per pass.km.). Some fine tuning of these figures to remove accident costs and to update them may be necessary to incorporate these into railway costing and pricing. This can be done without much difficulty. **However, it must be emphasized that it is essential to adopt this principle of incorporating external costs at the level of the different modes so that it reflects the comparative advantage of each of these from the social and economic perspective.**

11.2 Costs of Rail Transport

The twin determinants of price in a “relatively” free market are supply and demand. Supply bears a one-to-one relation to costs under conditions of perfect competition. Under less than perfectly competitive circumstances, the amount supplied at alternative prices will depend on the level and elasticity of demand. Thus conditions on the demand side will also influence the optimal profit output. Costs and prices are normally related. If total traffic on the railways, for example, depends on the freight rate (at all or any level of aggregation) and if per unit cost depends on volume, then per unit cost depends on the freight rate. This will not happen only when the costs are constant.

11.2.1 Three types of costs which are normally estimated for point-to-point traffic are:

- ***Short Run Marginal Costs.*** These are the addition to total costs within the short-term (e.g. within 12 months) resulting from the addition of small increments such as one more tonne of freight to total output. These include cost elements which only vary in the short run and do not include capital investments. Elements of short run marginal cost are the cost of train crews, fuel, locomotive and rolling stock maintenance and incremental track maintenance needed to carry an extra tonne of freight or an additional passenger.
- ***Long Run Marginal Costs.*** These are marginal costs vary over the long term (generally during periods of longer than 12 months). These would include short run marginal costs and incremental capital investments needed to support additions to output. One example of such a capital cost increment would be the purchase of new wagons to carry additional freight tonnage or investment in infrastructure such as additional loop-lines, sidings, signaling, or telecommunications equipment etc.
- ***Fully Distributed or Fully Allocated Costs.*** These result from the addition of overhead or indirect cost (i.e. costs which cannot be directly associated with and do not vary in proportion to output). The distribution of these costs to specific services and traffics is often in proportion to direct costs or to some physical measure of relative usage such as gross tonne-kilometres.

A particular form of indirect cost frequently encountered in railway operation is joint cost or common cost. This is the cost of providing two or more services, the production of which cannot be physically separated. That is, the provision of a facility for one service will automatically make that facility available (up to the limit of its capacity) for all other services. The signaling system costs and the costs of railway administration provide classic examples of joint costs.

11.2.2 Traditionally, railway systems across the world had adopted the principle of “what the traffic could bear” having regard to both to competition and the segment’s characteristics i.e. as much as could be got without reference to the cost of performing the service. In fact, at that time, it was found impracticable to accurately determine the cost of conveying any particular kind of goods between two stations. Since then, with better accounting practices and availability of data, it has been possible to establish costing principles and methods that provide a more rigorous basis for charging practices. Two system costing procedures called *particular* and *generalized* costing procedures began to be adopted since then. In both these procedures, attempts are made to estimate costs under seven or eight heads such as shunting at terminals, provision of terminal facilities, terminal haulage, provision and maintenance of wagons, documentation, marshalling, trunk haulage, etc. under the broad category of direct costs and some cost allocation under the category of indirect costs. Under particular costing, an attempt is made to work out the particular costs of a particular traffic – in terms of a standing cost and cost per distance moved to which is added a percentage to cover the risk of damage or loss. All this would stand as a minimum basis for charging. To this would be added some amount to take care of track, signaling and administration which would not be costed separately. This could mean working out in great detail costs of point to point movements up to certain level beyond which some amount of judgement is applied. Under generalized costing, costs are worked out under the same heads; system wide averages are used with some level of disaggregation to reflect some commodity characteristics, loadability, etc. The averaging process is normally based on surveys conducted from time to time which reflect system- wide average figures. The averaging leads to traffics having very different costs being, in practice, costed at the same rate.

Indian Railways have been following the generalized costing procedure (under the overall principle of Fully Distributed or Allocated Cost with some modifications) with its attendant implications.

11.2.3 Costing of Freight Services

Broadly speaking, the costs are divided into:

- (a) **Direct Costs** comprising cost of documentation, other terminal cost, marshalling cost, line haul cost of traction, other transportation cost, provision and maintenance of wagons.
- (b) **Indirect Costs** – Overhead charges and Central office charges.

The two sets of costs broadly provide the estimates for expenses incurred in the movement of the different commodity groups on the Indian Railways. The apportionment of indirect costs is done by using a certain percentage of the direct costs. A surplus generated in each of the major commodity groups that collectively account for nearly 99% of the Net Tonne Kilometres carried on the Indian Railways. At this level of apportionment, the proportion of direct to indirect costs in the total is presently 80:20. With better availability of data, IR's Statistics and Economic cell has been able to make firmer estimates at an average level. The accounting reform process currently under way would enable cost estimation at a far more disaggregate level. While this would sharpen the estimation of direct costs, the role of approximation and judgement is expected to continue in case of indirect costs.

11.3 RITES' Study – 2009

The costing exercise undertaken by this study had as its central objective – calculation of fixed and variable cost for each category of service, i.e. Goods and Passenger for Broad Gauge Railway lines comprising 82% of the total rail network.

11.3.1 The RITES study uses the statistical approach to assign costs to different services. The basic approach is to use linear regression tools to estimate and link expenditure to output. The first step involved the estimation of unit operations and maintenance costs and capital based on 2006-07 expenses and performance data. The second steps involved the extrapolation of unit costs to 2007-08 levels and use these as the basis for sectional costs and financial costs of some commodity groups.

11.3.2 The study compares the derived unit costs with the unit costs of the Indian Railways under six groups. Of these, costs of five differ from railway's estimates by less than 10%. For Signal & Telecom, the difference was wide. This is ascribed to the lack of relevant data. From the analysis presented in the study, it appears that only the direct costs elements have been considered in the study leaving open the appropriation of indirect costs in an appropriate way. The potential of the statistical approach adopted by RITES needs to be studied in detail to come to a conclusion on its usefulness and applicability.

11.4 Cost Recovery in Passenger Services : Railway Passenger Services in India can be typically classified as the following:

- Suburban Services
- Regional Services
- Conventional Long Distance Services
- High Speed Services
- Freight Services

Each of these services has typical characteristics which need to be taken into account for costing and pricing.

11.4.1 Historically, passenger services have been incurring losses at the aggregate level made good by cross -subsidy from freight services. In 1997-1998, an overall loss of Rs. 4329 crores was incurred. Upper Classes (except for First Class M & E) generated some surplus and the leading losers were second Class (Ordinary) followed by Sleeper Class (M & E). Overall, Sleeper and second Class (M & E and Ordinary) contributed to nearly 91.00 percent of the total losses on the Non Suburban Services. In 2009-2010, a slightly different picture emerges: except for 3 AC Class, all the other classes show losses. Once again ,second Class (Ordinary) tops the loss-making list with Rs. 5524 Crores with Sleeper Class (M & E) closely behind with the loss of Rs.5197 cores, and second Class (M & E) loss of Rs.2981 . These contribute to 98.47 of the total loss of Non- Suburban category.

11.5 Implications of Current Costing Practices

Current costing practices are still being determined by a top-down approach using total cost at an aggregate level, not by an activity-level costing .Yet, disaggregated information is necessary for pricing. The fact that costs on railway networks are largely common (or joint) to different services and that the overwhelming part of the cost are fixed and economies of scale can be only be fully exploited with large traffic volumes render certain degree of cross

subsidization between services and or between segments of the network unavoidable. This has matched well with the conventional theory of price discrimination which provided the basis for differential pricing (differing price elasticities) and hence cross-subsidization.

11.5.1 The cross subsidization that exists is seen at various levels (AITD, 2001):

- Between freight and passengers services: here it must be understood that passenger service is a direct consumption item while freight service is an intermediate item. Cross subsidization here has involved imputing a lower weightage to surplus generation by producers vis-à-vis consumers surplus generated from a lower passengers tariff.
- Cross subsidy between different classes of passengers traffic – part of the problem is that the willingness to pay by common people is often deliberately underestimated. It should be easily possible to segment the market for the passenger services by appropriately differentiating the product and accordingly attempting to recover the cost of services. This would help delimit size of the market requiring effective subsidy.
- Cross subsidization across the zones: This is partly because of the composition of traffic. The passenger's component substantial in many of the zones with result that revenue is low and losses cannot be compensated by profit from the freight segment.

11.5.2 Cross subsidization does, however, lead to high tariffs for freight and diversion of traffic to non-rail modes involving higher use of scarce resources of the society. In other words, the market response to the cross-subsidy may also lead to sub-optimal allocation of resources. The extent of effective cross- subsidy needs to be measured to determine an optimal level of cross-subsidization.

11.6 Pricing

Efficient prices or non-distortionary prices are typically the outcome of a highly competitive market or an effective regulator. When prices are non-distortionary across the transport sector the market will automatically lead the consumer to choose an optimal mix of modes. How can the pricing on the Railways provide the correct market signals? In a perfectly competitive environment, the market forces ensure efficient pricing. Railways does operate in a highly competitive environment in several freight and passenger segments, but in a few others, it faces little or no competition. Further, the externality effects are not reflected in the prices. In the absence of competition, a regulator is often instituted to set prices based on true costs

revealed by the monopolist or near monopolist. Truthful cost revelation is a major problem for the regulator and there is a large literature on how to provide the right incentives to the firm to reveal their costs. In the current scenario, the Ministry of Railways is expected to play the dual role of the firm and the regulator

11.6.1 Freight Pricing

The freight rates are commodity specific and yet costs are not available at commodity level. The logic for pricing based on the ability of the commodity to bear is an age-old principle in the Railway industry. In recent times, however, most Railways worldwide have moved away from a commodity based pricing mechanism to either a haulage costs based rating or individual contractual agreements based on the shipper's requirements. With the separation of the infrastructure owner and the service provider, a new market for access to paths and pricing of paths, has developed. Thus at this stage Indian Railways has to make a choice; whether to continue to rely on a regime of commodity based pricing or to move to newer methods of pricing.

Commodity based pricing has undergone a lot of rationalization over the last decade or so. The commodity classification has now been reduced to much more manageable number. The commodity class 100 represents the breakeven price, and the highest class (200) represents a 100% mark up on this breakeven price. The chargeable capacity of wagons has been standardized with suitable changes in commodity classification to handle the lighter, less dense commodities. In recent years, in the case of iron ore for export, the Railways were able to informally peg the price to the export price and thus align itself to the market. However, for other commodities there are no such readily available proxies to which the Railways can use to gauge the market. Thus the first aspect of commodity based pricing is the ability to correctly discern what the commodity can bear. In the absence of clear market signals this has been a problem area. It would probably not be unfair to state that the Railways priced themselves out in the case of POL products when pipelines were being considered as an alternative. The second key aspect to commodity based pricing is for the organization to know the cost of transportation. As pointed out above, costs tend to be aggregated and averaged in a manner that does not clearly indicate the commodity specifics. Greater emphasis on disaggregated costing methodologies is important in a commodity based pricing regime. The bulk commodities that are the mainstay of Railway freight movement is an area where the current pricing methodology despite its limitations, is by and large serving

the market. The ability to capture a greater share in this area is not dependent on price as much as other factors such as supply constraints. Thus, the current pricing regime does not require any major change.

The Railways also moves a significant share of commodities like cement, fertilizer, and iron and steel. While the market conditions in each of these sectors is somewhat different, from the Railways perspective the key point to note is that this sector is harder to cater given the emphasis on rake load movements. There is a tendency for these commodities to move in smaller consignments (less than rake load) and to shorter distances. Since the eighties, Railways have actively discouraged such traffic. Lately attempts to recapture lost ground have not made much headway. Are the Railways likely to get a larger share of the market in these sectors through better pricing? Competitive pricing would help, non-price factors are also important.

Traditionally with commodity based pricing, Railways deal directly with the industry shipping the commodity. In recent times, the relationship between the shipper and Railways has changed in the case of certain commodities that are containerizable. Container transport moves on rails either as CONCOR rakes or more recently as rakes of private operators. From these operators, the concern is to recover haulage charges and the commodity being carried is no longer of any importance to the Railways as the transporter. Again for calculating haulage charges, accurate estimation of costs is a critical element. There is need for a more rigorous methodology to determine the haulage charges that should be levied.

Recommendations:

- i. For loose bulk commodities, the current regime of pricing is a good approximation and provides the right incentives. Non-price factors are critical for obtaining a better share and in the case of certain commodities the Railways should consider long-term contracts to bring about greater efficiency in investments.
- ii. For bagged bulk commodities and non bulk commodities, the current regime is too centralized and therefore slow to respond to market changes. Service-based pricing to attract traffic in these industries would help.
- iii. For the growing sector of containerized goods, greater research on the method of calculation of efficient haulage charges is required.

11.6.2 Passenger Pricing

There is a common feeling that the pricing of passenger services is a highly political issue and not dictated entirely by efficiency considerations. A market size of 20 million passengers daily is a huge number and a big responsibility for any service provider. Under these circumstances, it is but natural to be sensitive to the needs of the passenger and try to provide services that are accessible to the needy. Mobility is an important element in the ability of the poor to access better economic opportunities.

However, in the context of limited resources available to the Railways, sustainability of the existing subsidy regime needs to be seriously considered. Further, the opportunity cost of various services is another key consideration. For example, the mix of speeds and service types (a Superfast Rajdhani train and a slow all-station stopping passenger or commuter trains results in several freight train paths being lost) leads to severe curtailment and under-utilization of existing capacity . The issue germane to pricing is that these services are heavily under- priced even though their economic costs are high. Further, shift in the relative price of passenger rail travel vis-à-vis other modes of travel does affect the modal choice of many a passenger. It thus inflates demand and constant pressure to add more services that is difficult to meet.

11.7 Efficiency and Competition Issues

Efficiency has two aspects:

- a. **Productive efficiency:** Productive efficiency occurs when an economy cannot produce more of one goods or service without producing less of another. This generally occurs when firms produce at minimum average total cost (full capacity utilization); and
- b. **Allocative efficiency:** Allocative efficiency occurs when the economy cannot raise one consumer's satisfaction without lowering another's. This occurs when price signals to consumers are based on marginal cost. From a transportation perspective, both modal competition and modal complementarities contribute to allocative efficiency.

Productive efficiency of Railways pertains to full capacity utilization. In other words, it is concerned with the question of what would enable railways to provide service at the minimum technologically feasible average cost.

11.7.1 The economic definition of full capacity utilization on rail or efficient utilization of rail capacity is the volume of traffic beyond which unit costs begin to rise more or less rapidly. However, since railway operation, like many others, consists of an inter-related series

of steps or processes to produce the 'final' product (marshalling, line-haul movement, repairs, etc.) and since each of these processes normally have a different capacity, increased traffic can be expected to create rising unit costs in some processes before others. For example, terminal congestion may occur long before line-haul congestion (or vice-versa) and thus unit terminal costs may begin to rise well before unit-line-haul cost. It is therefore possible to have excess capacity in some processes and no excess capacity (or inadequate) in others. Thus the capacity of a railway network (even for that matter a rail line) is not readily amenable to generalization in terms of the efficiency of usage.

Further, in network-based operations like the railways, the link between cost and efficient operations is not straightforward. Elements of fixed and variable costs of operations of an industry provide benchmarks for pricing. But this benchmarking is itself linked to certain norms of operations or efficiency. In the context of Railways, one approach would be to compare efficiency (performance) indicators of IR with other comparable systems of the world. This provides a relative standing, but it must be remembered that characteristics of networks could be different. Another approach could be to fix the targets for the future keeping in mind the past performance improvement that should take place in respect of various efficiency indices. In the case of freight movements, these are:

- a. Net tonne Kilometres per wagon day.(‘most important unit for watching the movement and loading of a wagon)
- b. Percentage of loaded to total wagon movement (kilometers).-
- c. Wagon kilometers per wagon day.
- d. Net tonne kilometers per tonne of wagon capacity
- e. Turn -round time of a wagon. (the gap between two successive loadings)

A study of the performance indicators over a long period of time reveals consistent improvement in performance on the freight front. However, an analysis of efficiency of operations can be taken no further than to distinguish between the actual cost of rail services provided and what the cost might have been if operations were more efficient. A methodology for calculation of this cost differential, if it exists would need to be evolved.

11.7.2 Competition Issues

As a general rule, the rail mode has a competitive advantage over road transport in carrying large quantities of goods which have a low value per unit weight- these are the so called bulk goods such as grains, coal, oil, etc. For general freight, the rail network competes directly with the highway network. General freight transported by rail usually needs a road at

one or both ends to achieve door to door delivery. The fact is that rail needs roads but the relationship is not normally reciprocal.

It is often pointed out that the issue of competition from the road mode in the case of conventional bulk items moving over long distance is not as relevant as the sheer inability of the railways to carry on account of capacity constraints forced a shift to the roads (except for POL which began to move to pipelines). A focused strategy on capacity creation could create a winning situation for the railways. However, if the inherent flexibility and reliability related to truck movements and the fact that road hauliers have been fiercely competing for custom in the market are factored into the calculations, the importance of a market-focussed tariff policy would become apparent.

11.7.2 Institutional Arrangements for Pricing

The power to fix rates for the carriage of passengers and goods traffic has been vested in the Central Government vide Section 30 of the Railways Act, 1939. Rates and fares are fixed based on the unit costs of operations involved in different services and other factors such as the type of the good/ service in question, the nature of competition, relative size of transport cost as a proportion of the final product price, etc. In effect, the government has been the producer and the regulator of these services. In the case of other public services like power, telecom, etc. where the concerned regulator looks at these issues very carefully and decides on the extent of increase or change in rates. The need for a Rail Regulator has often been stressed in this context. The question that has been raised is: whether a government department like the railways can be brought under an independent regulatory framework. It has been argued that a rail regulator could depoliticize the process of passenger fare revision and arbitrate disputes and grievances of freight customers and PPP concessionaires.

Presently, Railway Rates Tribunal (RRT) and Railway Claims Tribunal are the two dispute settlement bodies on IR. Their mandates and powers are limited to complaints against Railways relating to discrimination and excess charging, etc. by the freight customers and disputes arising out of claims settlement respectively. The role of the RRT could be enlarged and fixation of rates and fares could be brought under its mandate. In addition, the Rates Directorate of the Railway Board which has an important institutional role in fare/rate fixation needs to be strengthened. An institutional mechanism to gather, analyze and use cost data and market intelligence needs to be established. With computerization of freight and passenger transactions, Railways now have a huge database. This needs to be used to gain

insights on the behavior and preferences of passengers and freight customers. This would need expertise and such expertise is not possible to recruit and retain within the Railway Board on a sustained basis. This can be perhaps done through a CRIS project to design and install a decision support system for the Rates directorate.

Chapter-12

Technology, Research & Development and Energy Management

12. Technology on IR – the present status

12.1 A comparison of the technologies employed on Indian Railways for locomotives, passenger coaches, freight wagons, operational management, Information Technology, signalling, communications, track etc. with the best of the technology available or in use on other railway systems is tabulated in **Annexure-4**. Although Indian Railways has over the years assimilated modern technologies in several facets of infrastructure, maintenance, construction and operation in general, it has lagged behind its peers the world over in adoption of the best of the railway technologies available. If IR has to successfully face the challenges of capacity augmentation and improvement in operational efficiency and service quality, it would need to consistently keep abreast of the best technology available in the world and emerge as a leader in rail technology. It has to take a serious look at the state of the technology in use and re-engineer the organizational systems and processes to achieve this goal.

12.2 The technology gap can be bridged by a systematic plan for upgradation and modernization. This can take place through two inter-related routes. The first is by way of procurement of systems, equipments and products through technology transfer from manufacturers, suppliers or railway systems who already possess and use such technologies. The second is adequate in-house capabilities not only to absorb adapt and improve upon the received technologies but also to develop new ones. Adequate in-house capability is, therefore, the starting-point.

12.3 In-house Research & Development (R&D) on IR

Research, Development and Standards Organization (RDSO), Lucknow is the sole R&D organization of Indian Railways. It functions as the technical advisor to the Railway Board, Zonal Railways and the Production Units. It is entrusted with:

- Development of new and improved designs.
- Development and adoption of new technologies for use on Indian Railways.
- Development of standards for materials and products specifically needed by Indian Railways.

- Technical investigation, statutory clearance, testing and provision of consulting services.
- Inspection of critical and safety items for rolling stock, locomotives, signals, telecommunications equipment, and track

12.3.1 Infrastructure with RDSO

RDSO has a number of laboratories, equipped with research and testing facilities, for development, testing and design evaluation of various railway related equipments and materials. Examples are Air Brake Laboratory, Brake Dynamometer Laboratory, B&S Laboratory, Diesel Engine Development, Fatigue Testing Laboratory, Geo-technical Engineering Laboratory, Metallurgical & Chemical Laboratory, Psycho-Technical Laboratory, Signal Testing Laboratory, an environmental testing section, Signaling Equipment Development Centre, Track Laboratory, Mobile Test Facilities, Network of Testing and Recording Apparatus (NETRA) car, Vehicle Characterization Laboratory. The Centre for Advanced Maintenance Technology at Gwalior also functions under RDSO.

Although these laboratories have achieved their limited purpose, these are not state -of -the art. Facilities for development of model/prototype research work and workshops equipped to support such research work do not exist at RDSO.

12.3.2 Collaboration with Research and Academic Institutions

RDSO has also forged links with premier technical institutions and organizations, such as the Indian Institutes of Technology (IIT) at Kanpur, Roorkee, New Delhi and Chennai, the Defence Research and Development Organization (DRDO), New Delhi, and the Central Scientific Research Organization (CSIR). A Memorandum of Understanding (MoU) has also been signed with Indian Institute of Technology (IIT), Kharagpur to set up a Centre for Railway Research at Kharagpur for developing next generation railway technology for Indian Railways.

12.4 An Assessment of the existing system

12.4.1 Although Research, Development and Standardization are the primary tasks assigned to RDSO, it has not been able to fully achieve these objectives. Indian Railways is mostly dependent on imported technology. RDSO's role has largely remained restricted to

facilitating adoption of imported technology by Indian Railways and standardization of design specifications and development of indigenous sources for import substitution.

12.4.2 Staffing Pattern at RDSO

The current staffing pattern of RDSO is given in the table below:

Staff	Sanctioned Strength	Actual on roll	Mode of Recruitment
Group 'A'	212	192	By deputation of officers from Zonal Railways/promotion from Group 'B'
Group 'B'	166	140	By promotion from Group 'C'
Group 'C'	2101 (Tech-1553, Non-Tech.548)	1612 (Tech.1141, Non-Tech.471)	RRB/Compassionate Ground
Group 'D'	870	505	RRC/NER & Compassionate Ground

As can be seen from the above-table, the top-echelon of RDSO is manned by officers on deputation from Zonal Railways. Most of the staff of RDSO are recruited at relatively low-level.

12.4.3 Some of the main factors that have impeded RDSO's emergence as the R&D spearhead of IR are:

- (a) Bright and talented technical personnel with exposure to global technological trends are required for research. Such technical expertise is not available with RDSO. RDSO is mainly manned by railway officers and their knowledge is limited to railway operation as it exists. Railway officers are undoubtedly required to bring relevant domain knowledge and clearly define research areas, but beyond that their skills are of limited use for research, development or innovation.
- (b) RDSO postings are not considered very attractive by many railway officers. Even the railway officers who are sent on deputation to RDSO stay there for short tenures. The limited expertise or exposure gained by them is also lost and no institutional capacity gets built.
- (c) RDSO lacks research labs with state-of-the-art equipment. It is also hamstrung by the government procedure in procurement of research and testing equipment.

(d) Workload on account of vendor development has increased manifold in the recent past. As a result, registration and approval of vendor consumes a considerable part of the time and resources at the disposal of RDSO, adversely effecting serious R&D work.

12.5 Manufacture of major Rail Equipment in the Country

Currently IR manufacture almost all the locomotives and coaches it requires except for a limited number of electric locomotives procured from BHEL and conventional /EMU coaches from BEML. Similarly, all the wheels and axles are manufactured by IR. On the other hand, all the freight wagons are procured from the market. The **Table-** below gives a summary of in-house manufacturing facilities and further plans to expand capacity. **Table-** describes the external sources from which rolling-stock and rails are procured.

Table - :IR's Production Units

Unit	Current Installed Capacity (per Annum)	Capacity being expanded to	Further Plans
CLW, Chittaranjan (Electric Locos)	220	275 (by 2016-17)	Migration plan from present mix of 60% single phase and 40% 3-phase to 100% 3-phase locos by 2019-20. A new Electric Locomotive Factory is being envisaged at Madhepura with annual capacity of 100 locomotives. This is being planned on assured off-take to a private-sector supplier.
DLW, Varanasi (Diesel Locos)	200	300 (by 2015-16)	DLW is working to raise capacity to 300 high horse-power locomotives. In addition, Diesel Modernization Works at Patiala would also manufacture about 100 locomotives per annum by 2015-16. A new Diesel Locomotive Factory is being planned at Marhowra with annual capacity of 100 locomotives. This is being planned on assured off-take to a private-sector supplier.

Unit	Current Installed Capacity (per Annum)	Capacity being expanded to	Further Plans
ICF, Perambur (Conventional, EMU, DMU & Metro coaches)	1500	1700 (by 2015-16)	A new Rail Coach Factory is being set up at Rai Bareilly as a Production Unit with capacity of 1000 mainline coaches. This may come on stream by 2015-16. New coach factories are also envisaged at Kancharapara with annual capacity for 500 EMU/MEMU/Metro coaches and at Haldia with annual capacity of 400 DEMU coaches.
RCF, Kapurthala (Conventional, MEMU & LHB coaches)	1500	1500	
RWF, Bangalore (Wheels & Axles)	1,40,000 Wheels	2,00,000	A Rail Wheel Factory is being planned at Chapra with annual capacity of 1,00,000 wheels and new axle factory is being planned at New Jalpaiguri with capacity of 25000 (this is being set up by Rashtriya Ispat Nigam Limited under an agreement with IR)
	52,000 Axles	52,000	

Table- :IR's Procurement from external sources

Unit	Current Installed Capacity (per Annum)	Capacity being expanded to	Further Plans
BHEL (Electric locos)	50	100 (by 2012-13)	Presently manufacturing single phase locos and is expected to migrate to production of some 3-phase locos from 2013-14 onwards and reach a level of 70% 3-phase locos by 2019-20.
BEML & Others (Conventional & EMU coaches)	450	600	
Wagon Production	14500	29500	Apart from capacity expansion of existing units, 5 new wagon manufacturing units with total capacity of 6000 wagons per annum will be set up.
Rail Production At SAIL	1 Million tonnes	2.2 Million tonnes	A new Universal Rail Mill at Bhilai Steel Plant, with

			production capacity of 1.2 Million tonnes, is targeted to be commissioned by March 2013
Rail Production At JSPL	0.2 – 0.5 Million MT		JSPL's rail rolling mill at Raigarh is claimed to have a capacity of 2–5 Million tonnes

12.5.1 IR's Production Units use technologies that were procured through technology transfer contracts when the units were set up. In some cases, the technology was upgraded after a few decades, but by and large, the technologies once procured remain in use for decades . Moreover, these manufacturing units do not face any competitive pressure and hence, have no incentive or motivation to carry out R & D to improve their products.

12.5.2 Role of Manufacturers for R&D on Indian Railways

It is not expected that IR would carry out fundamental or basic research at the cutting-edge of modern technology. However, as a large scale user of railway technology, IR would benefit immensely by adopting new or improved technologies. This can be achieved through the involvement of manufacturers of railway products in R & D. Manufacturers of railway Equipment can play a very important role in this type of research as they will have a stake in marketing their product. Procedures for selecting technology, ordering trials and placement of orders would need to be streamlined and speeded up to bring this about. Corporatization of existing production units and their partial disinvestment subsequently along with setting up of new production units with participation of private sector are also methods that have been tried in several Railways.

12.6 Induction of New Technologies

Major manufacturers of railway products all over the world invest considerable resources in developing more productive, cost-effective products and systems. Over a period of time as these products are put to use on major railways, significant data and information become available to judge the efficacy of such products. It is imperative that RDSO obtains a thorough understanding of such products/systems and the technologies supporting these products. For products that have potential for application on IR, RDSO should carry out trials

on an appropriate scale in association with the Original Equipment Manufacturers (OEMs) to evaluate the performance and reliability under Indian conditions. Once found suitable, these can be adopted on IR. Signaling systems, high power electric and diesel locomotives using latest technologies, diagnostic safety devices to monitor track and rolling stock condition on a real time basis and technologies employed for heavy haul, technologies for high -speed trains are some of the areas that require such study. Similarly, research projects could be taken up for raising train speed to 160 km/h on existing corridors, improving energy efficiency of electric and diesel traction, reduction in rail and wheel wear, reduction in unit cost of track maintenance, reduction in signal failures on main rail corridors, etc.

12.6.1 R&D projects needs to be identified based on operational needs and potential investment returns. These need to be supported through allocation of adequate resources. Clear-cut accountability for outcome and timely completion would need to be established and monitored through annual performance audit.

12.7 *Dedicated research teams*

Result -oriented research teams are set up to work on specified research projects. Such teams may include participants from outside IR, including from research/academic institutions and OEMs, contracted for the duration of the project. The research projects core team must not be disturbed till the end of the project and should have strong incentives (financial as well as others) to deliver within the time frame prescribed.

12.8. Intellectual Property Rights (IPR) Issues

As long as IR obtains railway products from manufacturers outside IR, the supplier shall own the IP rights. This will have its pitfalls and can only be obviated if IR, through its own R&D efforts, makes a substantial improvement in the product. For example, Chinese Railway (CR) procured the technology for EMUs for a maximum speed of 250 km/h. CR then set about the task of developing EMU train- sets having a maximum speed of 350 km/h or more. After an effort of over two years 350 km/h train sets were developed locally and tested. CR was able to claim that it owns the IPR for these EMUs.

It would be inappropriate for IR to make minor changes in the design of the products supplied by other manufacturers and then claim IPR over such products. A more practical approach would be to procure, as part of transfer of technology contract, rights of manufacturing the products locally for use on IR and export to specified countries or regions.

12.9 Energy Management: Notwithstanding railway's inherent and undoubted superiority in respect of energy consumption and energy efficiency, concerns over depletion of non-

renewable fossil fuels, energy security and global warming would mean that energy management would merit serious attention at the highest level. The current planning of Railway's for electrification needs to be taken to its logical and economically optimal limit. Deployment of new-generation, energy-efficient locomotives, multiple-unit train-sets and freight wagons (greater pay-load to tare ratio, self-steering bogies etc) must be consciously planned. Non-traction energy consumption (in buildings and production units, for example) would need to be monitored and economized. The Production Units and Workshops must chalk out plans to reduce diesel consumption and gradually swith-over to renewable energy. Energy consumption for unit of production/output should be reported An Integrated Energy Management system needs to be set up under the separate directorate in the Ministry of Railways assisted by a multi-disciplinary team at RDSO.

12.10 Recommendations

- (a) There is a gap between the technologies presently available on IR and the best of railway technology in use on other railway systems the world. This gap needs to be bridged on top priority by technology upgradation and modernisation. This would, in turn, require a clear-sighted plan with timeframe, adequate funding and close monitoring of implementation.
- (b) The up- gradation and modernisation of technology on IR can be realised by improvement of in-house R&D work and involvement of the manufacturers of railway products in R&D. Manufacturers of railway products need to be involved in R & D for both new technologies as well as for improvement of existing systems and products.
- (c) Setting up of new units with participation of private-sector would also be useful in ensuring technological upgradation.
- (d) RDSO needs to be completely revamped. Standard-setting and Inspection units need to be separated from actual R&D as these activities call for different expertise and managerial approaches. Recruitment and promotion policy must be reformulated to allow lateral induction of highly qualified PhDs at appropriate levels in adequate numbers. A challenging work environment and performance-linked career progression should be provided. The R&D unit may be reconstituted as a new organisation after careful study of venerable R&D organizations like TTCI of USA or RTRI of Japan and C-DOT and DRDO in India.
- (e) Result-oriented research teams should be set up to work on specified research projects. Such teams may include participants from outside IR, including from

research/academic institutions and OEMs, contracted for the duration of the project. The research projects core team must not be disturbed till the end of the project and should have strong incentives (financial as well as others) to deliver.

- (f) The work of vendor development in respect by RDSO needs to be transferred to the Zonal railways / Production Units so that RDSO is able to utilize its resources more effectively for Research & Development activities.
- (g) RDSO may be granted greater autonomy in respect of financial matters pertaining to procurement of lab and testing equipment, trials and projects.
- (h) An Integrated Energy Management System need to be set up under a separate directorate in the Railway Board. This needs to be assisted by a multi-disciplinary team at RDSO. Electrification on economic justification, induction of energy-efficient rolling-stock and monitoring of non-traction energy consumption should form part of energy management plan.

Chapter-13

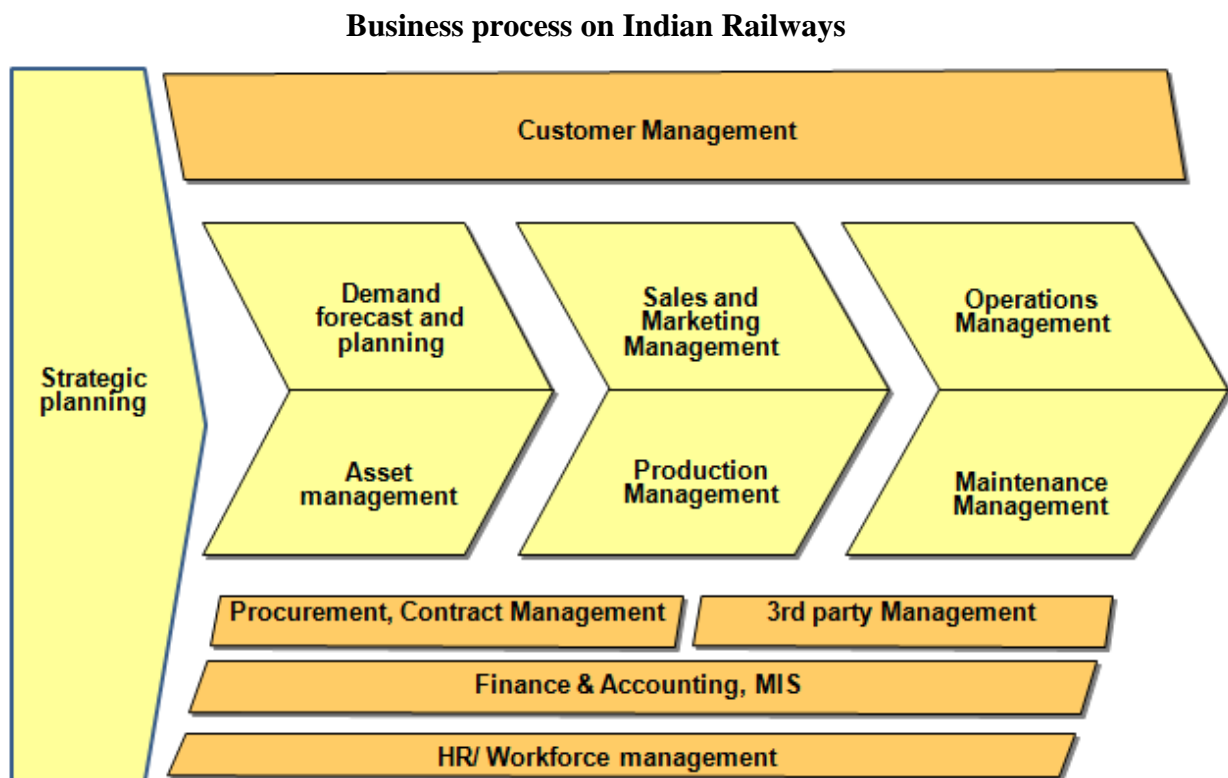
Information Technology

Use of Information Technology (IT) would play an increasingly important role in managing IR's huge network, infrastructure and assets on Indian Railways. It can not only help improve efficiency and customer services and thereby contribute towards the goal of enhancing rail's share in the total transport, but also can play a transformative role in railways.

Indian Railways is one of the country's earliest pioneers in leveraging the power of information technology. Passenger Reservation System (PRS) is a highly successful example of use of information technology. Over the years, information technology also has been used for other passenger and customer related services such as Unreserved Ticketing System (UTS) and Freight Operations and Information System (FOIS). However, system-wide use of IT has remained partial and incomplete.

13.1 Business process on Indian Railways:

The business process on Indian Railways can be depicted diagrammatically as follows:



13.2 Relative assessment of the IT adoption and maturity across key business areas

The relative level of IT application and its maturity is depicted in respect of these areas in the following diagram.



Current IT Enablement across Business Units

Legend

Green Box – The IT enablement has been good and has yielded positive outcomes

Yellow Box – The IT enablement has been done but has not yielded the desired outcomes

Red Box – The IT enablement has either not been done or requires a great deal of process re-engineering

13.3 A description of the IT environment in respect of the major areas is given below:-

13.3.1 Passenger reservations and Ticketing:

The Passenger Reservation System is a fully networked system, enabling “anywhere-to-anywhere” reservation along with the facility of E-Ticketing through internet. The Unreserved Ticketing System (UTS) provides the concept of “cluster-to-anywhere” booking, up to 3 days in advance for non-suburban and suburban tickets in the unreserved segment, which accounts for over 90% of the tickets and 55% of the passenger revenue. Automatic Ticket Vending Machines have been installed in various cities and these machines are connected to Unreserved Ticketing System.

While there has been significant improvement and advancement in the passenger booking and ticketing functions, full potential of the PRS data warehouse as a valuable platform for decision support to the Passenger Marketing directorate in Railway Board needs to be leveraged. Systematic assessment of passenger demand and capacity can help Indian Railways to identify gaps and opportunities help informed decision-making with regard to pricing and increase or decrease in scheduled services. Work on the following areas can increase operational efficiency and revenues:

- Analysis of passenger flows to view potential capacity problems.
- Sizing coach and route capacity based on passenger profiles.
- Generation of trends on frequent passengers and their profiles.
- Dynamic pricing based on parameters like demand for service, time to departure and capacity flexibility on the route; utilize simulation and modeling tools to help create robust and reliable forecasts.

13.3.2 Freight Management System:

Freight Operations Information System (FOIS) was conceived in the early 1980s. This system, in its current state, comprises two modules, namely, "Rake Management System (RMS)" and "Terminal Management System (TMS)". For large freight customers, a pilot electronic payment gateway has been introduced in 2008. FOIS implementation and operation is managed by a FOIS organization under CAO/FOIS based in Delhi. FOIS has facilitated issuance of Railway Receipts (RRs) from enabled terminals, but actual booking still needs to be done from the loading stations; anywhere to anywhere booking needs to be enabled to obviate the physical presence of customers or their representatives for several functions. Further work needs to be done in respect of the following areas:

- Computation of freight transport cost for optimal pricing, optimization of indent/supply lead-times, parcel tracking load and stack design to reduce product breakage and loss.
- Dynamic pricing based on parameters like route capacity, seasonal trends for goods/ services, demand for service, time to departure and capacity flexibility on the route.
- Transport follow-up: Invoicing and booking documents, sending of transport alerts (delay, accident, non-forecast stops).
- System to constantly monitor and enable intelligent business decision- making based upon the reporting of key Logistics KPIs On Time Pick Up or Delivery Performance relative to request; Cost Per tonne- km; etc

13.3.3 Multi-channel Management:

Efforts are on to implement multi-channel ticketing using General Ticketing System, ATVM, touch screen kiosks and Mobile Tracking besides the existing PRS system and I-Ticketing and e-Ticketing implementation has been quite successful. These need to be scaled up with user feedback to enhance appeal and encourage adoption. IT tools can also be harnessed to achieve inter-modal collaboration with other service providers like airlines, road transport and hospitality industry to provide a seamless end -to -end experience to users.

13.3.4 Customer Service:

Real- time enquiry related to passenger trains schedule, tracking of goods transported through IR and management of customer complaints are some of the areas that currently make some use of IT. There are readily available IT solutions with inbuilt rules for logging, escalation, resolution and redressal communication to the origin. Such proven systems can be tailored and adopted on IR.

13.3.5 Demand Forecasting

This area includes Demand Forecasting, Operations Planning and overall Corporate Strategy Development. Apart from Operations Planning, the other two have a low level of IT enablement, particularly for Freight. Given that freight accounts for two-thirds of railway's revenue and almost the entire surplus, more robust demand / supply forecasting and planning tools are required for freight. A system-wide forecasting and dynamic capacity management system fully integrated with other operational systems such as dynamic pricing and revenue management should be adopted to improve capacity utilization, revenue generation and transparency across the system.

13.3.6 Demand and Marketing Management

IT-enabled processes and systems need to be adopted for managing the demand and operational planning aspects for the freight and passenger businesses. It is important to have

processes where all different functions are fully integrated and everybody has the same view and understanding of requirements and the resources required to meet the demand forecasts. This will enable cross-functional alignment to achieve the targets. Focussed marketing efforts aided by sharp IT tools like loyalty programmes and Customer Relationship Management are required to maintain the edge over competition and regain the lost share of freight business.

13.3.7 Operations Management

This area includes Train Operations, Crew Planning and Scheduling, Terminal Operations and Freight Tracking, Signaling and Safety and DSS. While some systems such as crew scheduling, terminal operations and parcel tracking have been partially implemented, there is need for further enhancing the functionality of these systems, and also implementing optimization / integrated operations tools.

The crew scheduling system implemented by Railways currently covers about 1 lakh employees, consisting of mainly locomotive drivers, guards and the on-board staff. However other categories such as TTEs, line staff, on-ground staff etc. are not covered. Expanding the system to include other categories will help significantly in crew planning and control. The system also needs to focus on crew optimization and productivity improvement.

RFID tracking of wagons as well as parcel bar-coding were implemented on a pilot basis and there are plans to expand these system-wide. In case of phased implementation, best results can be achieved by covering a particular type of wagon on the entire network rather than localizing the scope in a geographical region. The improvement seen in wagon turnaround times and wagon utilization over the last few years can be further enhanced through complete implementation of the RFID system for coaches, wagons and locomotives. It will also improve management of congested terminals. Other railways such as Canadian National Railway and South African Railways have achieved benefits of cost reduction, efficiency improvement as well as improved customer satisfaction from RFID implementation.

13.3.8 Asset/ Equipment Tracking and Management:

Work is in progress in the areas of Integrated Coach Management System and Rolling Stock Maintenance. Some initiatives are also already planned or underway in the area of fixed asset management – land, track, bridges, signaling and telecom, etc. These need to be taken further to the next level to achieve an integrated asset tracking and management view. GIS system is planned for the land management system, which could ultimately become a universal system.

13.3.9 Capital Investments:

The ongoing Works Programme Management System is expected to help automate the processes leading to quicker and more visible system to monitor new and on-going capital expenditure.

13.3.10 Material Management:

Presently Zonal Railways and Production Units have their own Material Management Systems, following common processes, but hosted in their own servers. This will change with the introduction of the centralized Material Management Information System, which is in the initial stages of development at present. Scope of the procurement function should be ideally extended to the management of the assets from acquisition to disposal with systemically enabled request and approval process, life cycle management, redeployment and disposal management. The same would help railways to:

- realize opportunities for savings through process improvement and support for strategic decision making;
- reduce risk through standardization, proper documentation, loss detection;
- increase accountability to ensure compliance;
- display a dashboard based on a KPI- driven framework to get a real-time and lifecycle view on all assets and gain effective control of all inventory
- Enhance performance of assets.
-

13.3.11 Procurement and Contract Management

E-tendering system has been implemented successfully for purchase and works tenders, e-auctions of scrap material, reverse auctions. A Works Programme Management System is already being developed for management major contracts that form part of implementation of annual Works Programme. Further improvement in the procurement process can be brought about by adopting IT solutions for the following areas:

- Management of PPP- based initiatives.
- Procurement of allied services like catering and other on-board services.

IT-based solutions should cover the following aspects:

- Approval Process and Escalation Management
- Key Date & Completion Tracking
- User Interface and critical reporting
- Email Notifications and alerts for SLA violations
- Invoice & Payment Tracking and blacklisting controls
- Contract Lifecycle Management
- Negotiation Workflow
- User Access Control

13.3.12 Production Management:

Currently Production Planning Systems are operational in some of the Production Units such as Rail Wheel Factory (Bengaluru), Integral Coach Factory (Chennai) and Rail Coach Factory (Kapurthala). There is plan for introducing ERP systems after the pilot system being implemented in ICF, Chennai is completed successfully. An ERP-based system for Workshops is also being developed as a centralized system hosted in CRIS. Most of the production units and maintenance Workshops are already certified for ISO: 9000. Automation of the processes for quality management is being attempted as a part of the implementation of the information system.

13.3.13 Maintenance Management:

A pilot ERP- based system for maintenance of rolling stock is being implemented. After completion of the pilot project, this will be hosted as centralized application in CRIS.

13.3.13 Maintenance of Permanent Way & Reporting

Maintenance of permanent way and reporting is the aspect of railway maintenance which is designed to ensure that the railway remains clear, safe, and navigable. There are a number of components to maintenance of way and a big part involves maintaining the tracks themselves. Tracks must be regularly checked for signs of problems which can include missing or damaged ties, damage to the rails, and obstructions such as fallen trees or disabled trains. Maintenance includes routine checking, clearing, repairing the tracks and reporting.

Currently there are manual intensive systems in place which do not provide real time information. There is no single system for track maintenance and updates and there is limited IT enablement in this sub-area. Though additional projects have been outlined for Vision 2020 what is required is an advanced unified system for track maintenance and reporting.

13.3.14 Maintenance Scheduling & Reporting

All aspects of maintenance related to coach depot, freight, locomotive & shed and workshops in covered in this sub-area which is essential for the day to day running and scheduling of the trains & locos.

Our current assessment shows that there are multiple systems in place for maintenance works in coach depot, freight, locomotive & shed and workshops; however, there are limited insights into real time tracking of each asset with respect to maintenance and

timelines. Majority of these systems are under pilot stage with future plans of full coverage and there is a lack of an integrated system that tracks end to end of schedule maintenance and reporting. We recommend an integrated system that links the multiple systems to provide an end to end view and enable better and faster decision making.

13.3.15 Facilities Maintenance

Maintenance and care of all facilities maintained by the railways is in scope in this sub-area. It covers multiple disciplines to ensure functionality of the built environment by integrating people, place, processes and technology.

The team did not get insights into facilities maintenance systems or tools, either at a zonal / regional or central level. From our limited understanding there is a current gap in that there is no IT enabled system or tool in place which makes it difficult to plan, schedule and monitor activities. What is required is a real time monitoring of all facilities with respect to maintenance, scheduling and reporting.

13.3.16 Work Order Cycle

Work management process is critical to handle maintenance requests and tracks completed work orders. It allows for a well managed manner to plan and initiate maintenance tasks, manage assets and report the results effortlessly. There is a need to have BPR to establish the end to end of the work cycle for different works and then establish a tool to schedule, track and report all types of work order cycle.

13.3.17 Financial Accounting systems and MIS

Payroll system has been computerized; however, there is no single Financial ERP system across all the zonal railways. Many of the zonal railways have implemented their own ERP systems, making several customizations for their needs. This has resulted in disparate processes and systems. There is a need to consolidate the disparate ERP systems across zones, by first undertaking a business process standardization exercise and then implementing a unified financial ERP system.

Similarly while Railways has implemented several IT systems across a number of areas, there is a lack of an integrated MIS and integrated Decision Support System (DSS) which aggregates all the information required for making planning and operational decision making in a central system. Tools providing scenario analysis and use of optimization algorithms across zones would allow Railways in better managing demand-supply including directional requirements, and help enhance revenues. This would also provide greater transparency across the system and more dynamic management of resources. There is a need to review the large number of MIS reports in the light of MIS needs across the Railways and implement a single MIS system which incorporates business intelligence and analytics.

There is also a lack of a centrally driven, standard framework to compare, evaluate and prioritize among the competing IT priorities, which often results in project delays and suboptimal utilization of the IT staff. This needs to be addressed.

13.3.18 Workforce Management

IT solutions can help in better management of the recruitment, training, compensation and HR functions. A comprehensive system covering everything from vacancy management to recruitment, training, seniority, promotions and post -retirement information is required.

13.4 Key Findings and Suggested Approach

There are three broad areas in which IR has to work to fully leverage the power of IT:

13.4.1 Structural/ Organizational

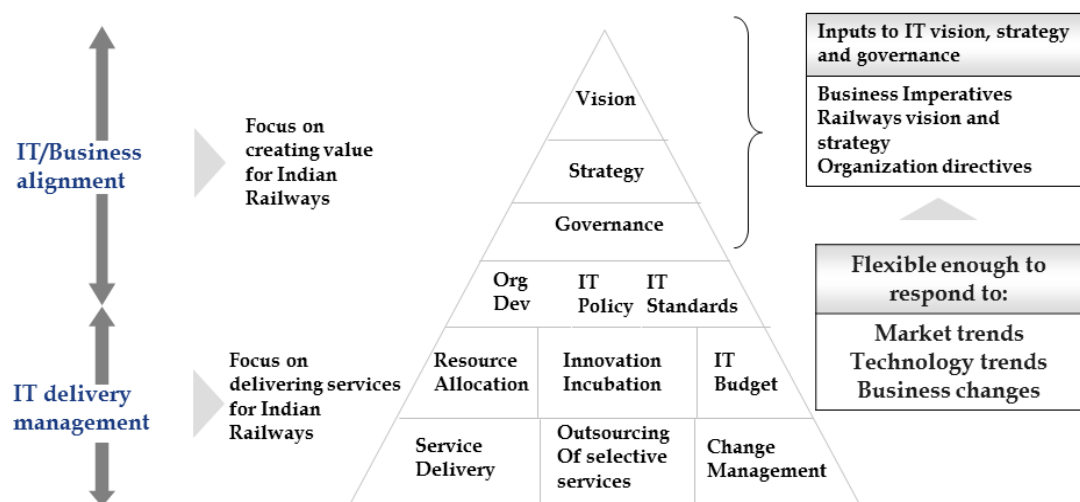
There is no single department within Railways which has the complete responsibility of conceptualizing and driving all IT needs. Currently C&IS is playing the role of a CIO within Railways while FOIS and CCMs are taking care of IT implementations for Freight and Consumer segments respectively. The role of CRIS is also not clearly defined and often a number of IT applications are developed by entities other than CRIS. There is a process of deputation from IR to bodies like CRIS for bringing domain expertise into the IT project implementation. However, the deputations are often short term and the rules for deputation are not conducive for sustaining the domain expertise within CRIS and other such entities. Due to these problems, CRIS has not been able to attract the best available talent both from internal sources as well as externally.

There is therefore a need for a central IT body (it could be C&IS directorate duly strengthened) for conceptualizing and driving all IT needs. The central body needs to have a tiered structural hierarchy for meeting all divisional/zonal needs. FOIS and CCM could be empowered for implementation and to ensure adequate skills. The tenure of government officials in FOIS and CCM should be fixed and for longer durations. Similarly, the deputations to CRIS can also be long term. CRIS should continue to play a pivotal role in new application development and remain a key body providing oversight on the Indian Railways IT application landscape. CRIS should be strengthened accordingly. The internal profile/perception of the existing IT bodies (such as CRIS, C&IS Directorate, EDP Centers in the Zonal Railways/PU/RDSO/RB etc.) of Railways should be raised and they should be transformed into ‘premium IT organizations’ such that they become a sought- after career option

There is also room for improving the way the IT projects are conceived, prioritized and the execution done. As with other conventional projects most of the IT projects are driven by the respective departments. This is necessarily a fragmentary process without a single, strategic, and overarching roadmap driven by business objectives using IT as an enabler. Ideally, business strategy should be the starting-point to identify the value drivers, imperatives and focus areas which would further be enabled by IT. This approach would ensure that there is built-in synchronization and cohesions among different respective project teams which function with a clearly defined purpose. This is depicted graphically below:

IT structure proposed for Indian Railways

Pyramid shows the span of control which the IT leadership of Indian Railways should have . . .



Business Process Review: Implementing IT/ERP systems frequently requires organizations to change their existing business practices to fit the new system prior to the implementation. Especially in large organizations that are operating with different models and technology platforms and tools, BPR may be urgently needed. Even if technical performance is adequate, other improvements may be needed – such as training, organizational change, leadership development etc. Understanding the business process workflow, job description, performance measurement and adoption of information technology are some of the basic pre-requisites. Normally BPR attempts to:

- a. View business as a set of customer (both internal and external) oriented processes rather than a set of departmental functions.
- b. Identify clear -cut ownership for key processes.
- c. Eliminate non value adding activities within a process.
- d. Gather information at the point of origin.

A successful BPR implementation has the potential to bring significant improvement to productivity, customer service and bottom-line while implementing any technology / IT solution.

13.4.2 Technology

While majority of the Railways IT projects are now implemented by CRIS led by executives from the Indian Railways who bring in much-needed business perspective, there is a lack of a parallel set of technology leaders and IT experts in CRIS. This often leads to a lot of time being spent on in assessing and comparing various technologies for each project and the choice of technology/platform being generally left open during the tender process.

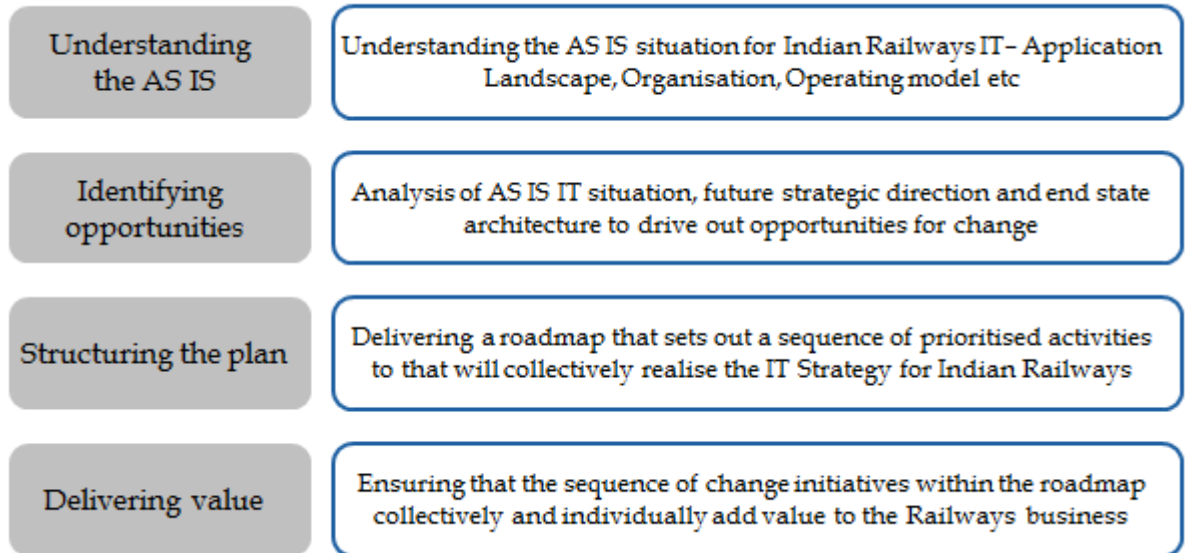
Given that the vendor selection is based on L1 criteria or a combination on techno-commercial assessment, over time this leads to a proliferation of different technologies across different projects, in some cases even for similar applications.

IR has an opportunity to develop an integrated and holistic IT framework for application management. A committee/ group in Indian Railways needs to be made responsible for keeping the railways portfolio of applications abreast by effectively managing the value of all the existing as well as proposed applications. The group can initially focus on the applications and facilitate the following decisions:

- a. Evaluating the application's effectiveness against the desired and evolving objectives.

- b. Periodically reviewing the applications to assess the need for replacement, retirement, upgrade, maintenance.

Over time the scope of this group can be extended to monitor and optimize the broader IT ecosystem. Some broad tasks can be depicted as



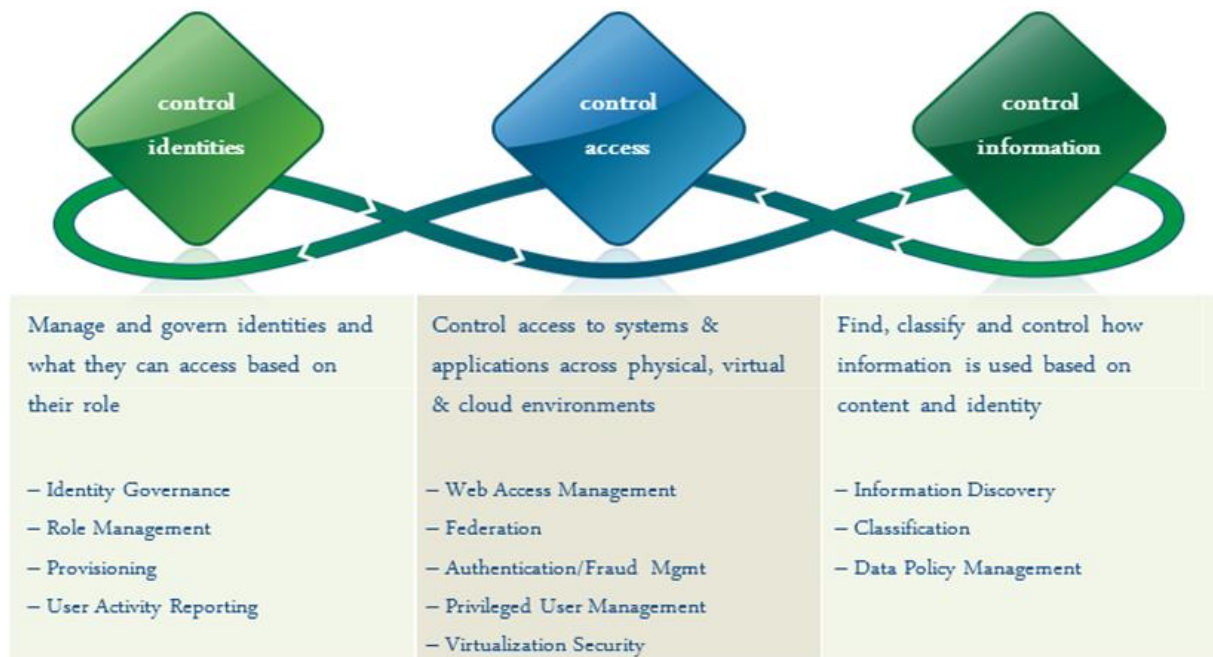
Security:

There is a strong need for a comprehensive IT security framework to safeguard critical information and avoid unauthorized manipulation / damage to the data as well as denial of service to authorized users. There are various external Applications like Passenger Reservations, Indian Railways Portal, Freight Operations involving numerous financial transactions from external users which require high levels of security. Similarly, internal applications like MIS, financial applications, Workshop Designs containing sensitive / confidential internal data stand a risk of unauthorized access, data leakage etc. which are required to be secured.

Presently, security is primarily managed through policies and periodic reviews (mostly manual). The security policy is inadequate and left to interpretation of the each division/project owner. Employee transfers happen on a regular basis and in most cases user access /accounts are not deleted/remain active post the transfer/new assignment, thereby posing a grave security risk. Increase in number of employees, technical / non technical staff also leads to known / unknown risk of leak of sensitive data / project reports / financial reports

Considering the above challenges from external as well as internal users, there is indeed a great need for Indian Railways to have a comprehensively secure framework for IT

network / applications / infrastructure that should at the minimum provide control for identities, access and information.



In this respect, the IT Security Framework must provide the following capabilities:

(a) Host Based Access Control for Protecting Critical Servers:

Any datacenter of IR hosting critical data in various servers will need to protect the data from unauthorized access / actions. This capability is essential especially when there are multiple stakeholders involved and multiple people have access to the same data. It is important to restrict access rights to various resources (like files, directories, applications, registries etc.) for even administrators / super users. Lot of accidental / targeted incidents may compromise the data availability and security. Hence it is essential to control the rights of people accessing data from the OS level including rights for Super-users / administrators and provide them fine grained access.

(b) Another key requirement is to have an audit trail where un-tampered logs of every incident that has happened would need to be preserved. This would also enable a security base-lining for various heterogeneous OS platforms within the datacenter from a central location so that access to critical data is completely governed and audited. Unfortunately, native server operating system (Windows/Unix/Linux) security does not provide sufficient control over who can access what resources, nor does it provide the granular auditing needed to meet IR's security information management and compliance requirements. Organizations need Server Access Control that provides an independent, security-specific layer of server protection to reduce security risks, including risks from internal unauthorized administrative access, and helps fulfill compliance requirements through high integrity auditing.

Key Benefits that Server Access Control Solution will provide:

- > Server Access Control regulation on:
 - Who can access information
 - What info can be accessed
 - When this be done
 - Where the logical location is
 - How using what program
- > Data Protection and Secure Auditing
 - Protects **critical data** against hacks and thefts
 - Delivers **granular access** control for all files
 - Addresses **regulatory requirements** by enabling secure audit logs to be locally generated and centrally collected
 - Provides **self-protected audit records**, which prove that security measures have been taken
 - Offers a **full identity trail for accountability**, which provides strong forensic evidence of security violations and can expedite an investigation process

(c) **Identity Management**

Identity Management will help in reducing administrative costs through automation and strengthen security and compliance. Identity Management automates the creation, modification and deletion of user identities for growing numbers of internal and external users, and provides audit capabilities across the full range of enterprise systems, from mainframes to web applications.

The benefits of integrated and automated identity management include:

- *Reduced costs:* Fewer IT trained administrators are required, self-service can reduce the total number of administrators relative to users, workflow and delegation can simplify business process. Automation eliminates manual steps and reduces the overall number of steps required to complete provisioning or de-provisioning, automation links organizations together and workflow supports more streamlined business process.
- *Improved security and enhanced compliance reporting:* Who can access user data and change that data, who can create and who can delete user accounts is tightly controlled and auditable. All changes to the user records are auditable, user accounts can be created, passwords can be synchronized and users can be accurately and quickly de-provisioned from all systems.
- *Increased productivity:* New applications utilize existing administrative structures with existing user stores or even new user stores, thereby, eliminating the creation

of new administrative positions and process for each new application deployed. Employees and contractors employed to manage any aspect of the applications or business transactions support for the new system, product or service delivery are quickly defined and added into the required applications.

- *Increased user satisfaction:* Users of all types can access easy to use self-service systems reducing support call frustration and offering 24 hour service. In addition, Forgotten Password Service allows end users to reset their own passwords, thereby avoiding frustrating help desk calls. New employees and contractors can quickly get to work avoiding the frustration of “waiting to get access to email and applications.” They can also get quick access to applications and data as teams are formed and roles are changed making all employees and contractors more efficient and satisfied.

(d) Web Access Management and Single Sign-on (SSO)

Web Access management will enable Indian railways to meet the challenge of deploying resources via the Web while maintaining high performance and high availability. It will allow controlling who is able to access which applications and under what conditions, improve users’ online experience and simplify security administration. By enforcing policies and monitoring and reporting online activities and user privileges, it will also ease regulatory compliance. Web Access Management Solution provides a broad range of benefits including:

- *Ensure the Right Users have the Right Access:* With Web Access Management, the secure management of identities across diverse web systems means the system controls access by leveraging the user’s context to the business and their rights to each application. Web Access Management enables users to connect to the information and applications that they need to perform their jobs.
- *Increase Security to Mitigate Risks:* Web Access Management reduces the risk of unauthorized access to critical resources and sensitive information, protecting the content of an entire web portal or set of applications. Centralized security enforcement and FIPS certified cryptographic algorithms means that there are no holes left open in the secured web environment.
- *Provide Users with a Positive Online Experience:* Web Access Management lets a user sign on once to access web applications, engaging them in a unified, personalized online experience rather than frustrating them with multiple logins.
- *Increase Business Opportunities:* Web Access Management will allow IR to securely deploy web applications to multiple different user communities spread across widely sparsed geographies, enabling increased business opportunities that can enhance passenger/freight revenue. By extending Web Access Management

- with identity federation, IR can further improve collaboration with its partner agencies to enhance relationships, increase revenue, manage cost and mitigate risk
- *Manage Costs:* Web Access Management mitigates IT administration costs. It also reduces the security burden on users and thus the burden on the help desk caused by lost or forgotten credentials. It also reduces redundant security-related application development and maintenance costs.
 - *Ease Regulatory Compliance:* Central policy management, enforcement, reporting and auditing can support IR's ability to comply with IT impacting regulations.

(e) Data Loss Prevention

Indian railway needs to secure its IT infrastructure and the various forms of sensitive data that it contains. To reach this goal, IR will have to define how critical data is used throughout its environment and where it is stored. To complicate matters further, there are an ever increasing number of exposure points for the wide range of data types that require unique levels of protection. Consistent, accurate, and effective protection and control of information across the entire system is critical to IR.

Data Loss Prevention Technology provides a common management platform with modular enforcements points that support data at rest, data in motion, and data in use. This technology can provide various benefits including:

- Reducing the intentional or inadvertent misuse of information across the enterprise
- Educating end-users about proper information use
- Improving compliant behavior for communications and the use of sensitive data

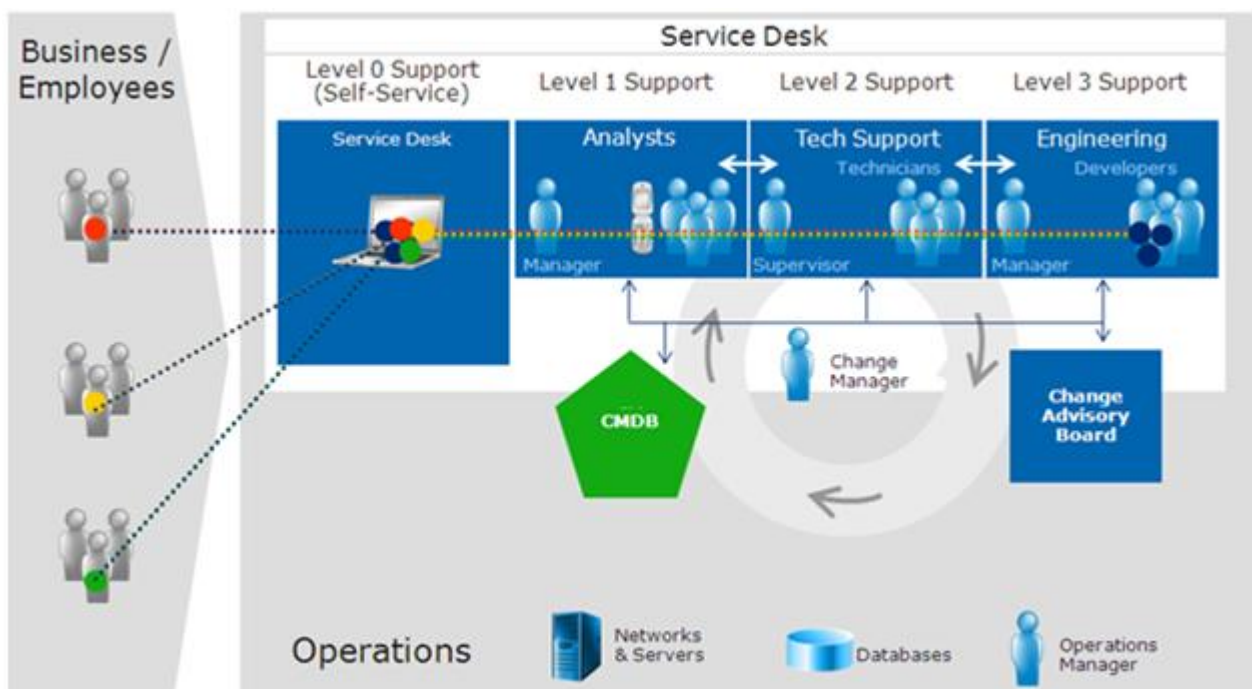
13.4.3 Central Helpdesk:

Currently there is no central IT helpdesk available within the Indian Railways which can cater to IT related problems of complete railway network. Although the Railways network is widely spread across the country and cross departmental communications/changes/projects take place on a day to day basis for IT / non IT related queries/ concerns/ project updates etc., however, there is no “single point of contact” mechanism for all employees across various departments/ Zones / Sub offices to report their IT queries/issues/problems and get quick resolutions. There is also a lack of an automated troubleshooting whereby system where system failures can be automatically posed to a central IT helpdesk and can be addressed without any manual intervention.

With the increasing adoption of best practices, a centralized help desk will become the cornerstone for automating IT processes and providing audit trails for regulatory compliance.

The Help Desk will automate various administrative processes to consolidate, log, track, manage and escalate incidents and problems. It will help to accelerate detection and problem resolution, maintain accurate configuration details, and minimize the risk caused by any change in the IT infrastructure.

A centralized service desk (help desk) will help IR administrators to log helpdesk incidents in the event of any failure or open change orders for implementing any changes to me made. Help Desk will seamlessly integrate with the network management solution (NMS) in order to automatically raise an alarms, send and generate a ticket when certain users attempt to modify the configuration of a device. The Help Desk operator will be able to view the change in any configuration. Once the ticket is approved the user is automatically notified and is able to proceed with the change.



Helpdesk System would act a single point of contact for various users in the organization. This will facilitate the restoration of normal operational service with minimal disruption within agreed service levels and business priorities. A Help Desk System will yield the following benefits:

- A single point of contact via a centralized service desk
- Standardized business processes
- Incident detection and recording
- Classification and initial support
- Investigation and diagnosis
- Resolution and recovery

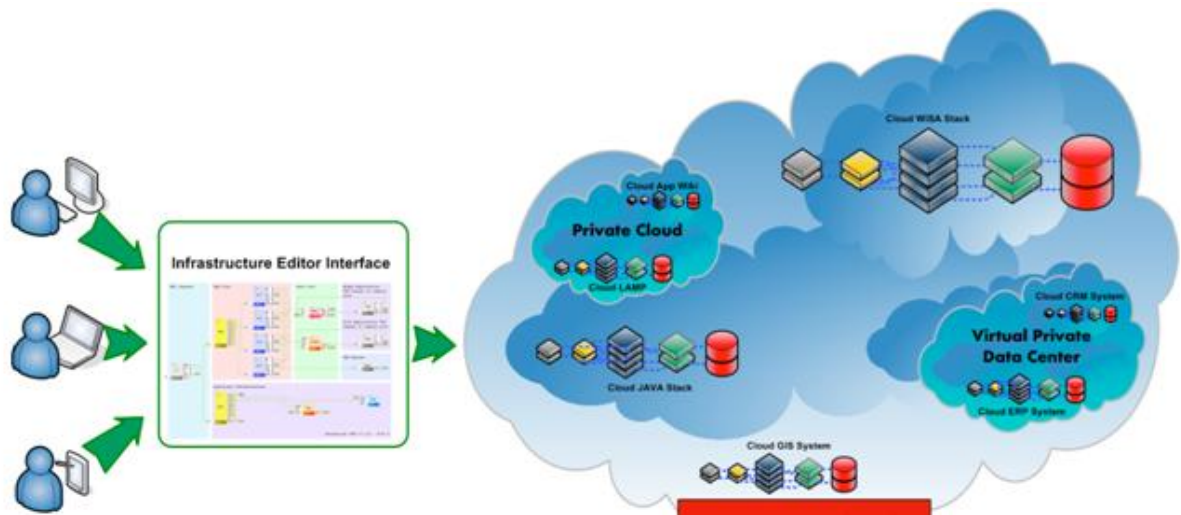
- Incident and Request closure
- Ownership, monitoring, tracking and communication

13.4.4 Cloud computing:

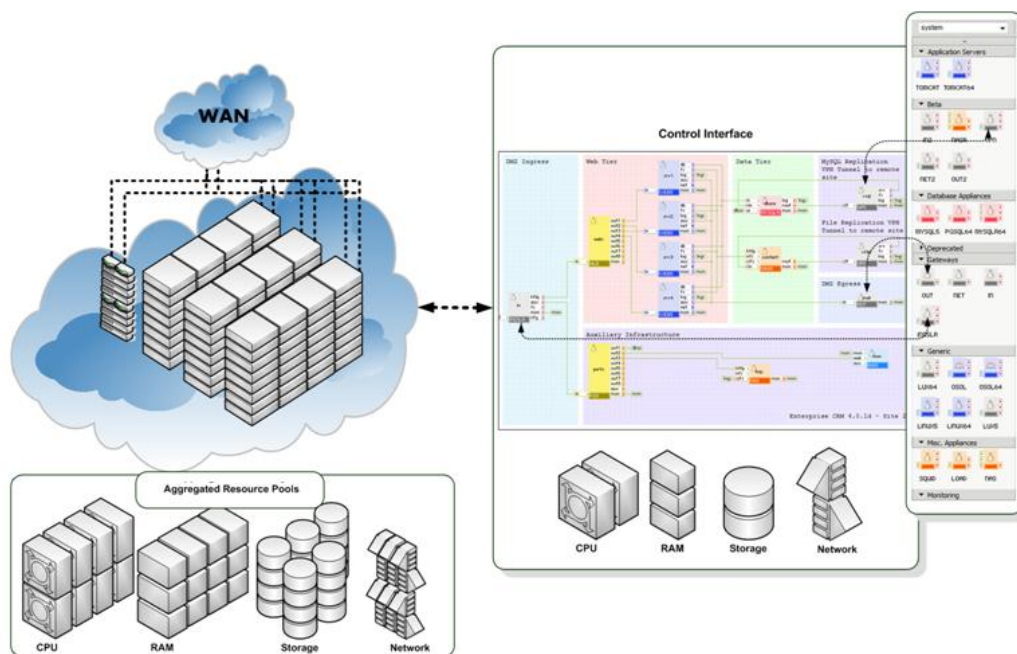
With the increasing number of applications and users / employees over the widespread network there is a need for a continuous effort to keep abreast and ahead of fast-changing IT trends. This can be done in optimally utilizing the existing infrastructure to save the cost of new procurements and time spent on implementation and the long government procurement cycles. IT requirements of various departments/divisions of Indian Railways should also be centrally met by sharing the available infrastructure across multiple departments/divisions while each department / division is having complete ownership/control over its data and applications.

Further, Indian Railways need to leverage new technologies like cloud computing in order to increase the quality of service while simultaneously reducing cost and the go-live time for the new solutions. With the cloud infrastructure and the service creation and deployment capabilities, the enhanced environment will uniquely provide integrated networking, high availability, virtual SAN, metering operations, monitoring and management capabilities etc. to help Railways rapidly achieve their business goals. The cloud infrastructure will drastically reduce the time to create new passenger/freight services from months to minutes and will make managing, moving and scaling them fast and easy. This will provide the flexibility to make the right sourcing decisions and respond to new demands quickly, while increasing the efficiency of IR's operations.

In the cloud platform, a cloud is configured from server, storage, and networking components in a manner opaque to the end user. A cloud controller takes care of provisioning and managing all networking and hardware infrastructure on behalf of cloud applications. The end user (such as different divisions of IR) will therefore need not know the specifics of the underlying cloud hardware and networking infrastructure to define, deploy, and redeploy their applications.



The cloud platform can seamlessly pool existing resources and provide true cloud offerings in the form of applications, software stacks, and infrastructure such as firewalls, load balancers in a simple graphical interface.



The platform will not only model cloud applications and their networking infrastructure, but also greatly simplify network management, application and execution. It will automatically detect and compensate for system changes (such as wiring changes) and network failures and issue alarms to the cloud console. It would also perform automated recovery from such failures. The platform should manage all network path optimizations, ensuring maximum bandwidth availability for application network-infrastructure components.

13.4.5. Management/ Execution

As already noted, business processes must be reviewed and re-engineered before IT adoption. There is also a need of an organization- wide change management process to ensure better IT adoption. In today's environment where an IT implementation can dramatically shift and change the ongoing current process and the way employees work and interact, both internally and externally, it is imperative to manage change in an effective and timely manner. Currently, the change management is managed as part of any initiative individually by the team implementing it and is on a standalone basis. There is no structured approach in place that makes it a mandatory pre-requisite and is repeatable and replicable every time a IT initiative is put in place.

There are certain elements that are common to all successful change initiatives, wherein we move from the current state, through the transition, to the improved state. It is essential that this be formulated centrally and then it becomes mandatory to adopt for all IT projects wherein the actual implementation is fine tuned to the specific task at hand while ensuring the overarching central policy.

13.4.5. 1 Project and Portfolio Management (PPM):

Indian Railways has various Zones / departments / offices which are spread across the country in remote locations. However, there is a lack of an integrated project management solution which can be accessed from anywhere over Railways Intranet/Network in a secured manner. Every year, a number of new projects are launched whose progress in terms of time, resources, assets etc. are required to be monitored from the very beginning. Similarly, the existing projects such as Passenger reservation system (UTS , PRS), Freight operations Information System, Workshop Information System, Coach Management, Locomotive Maintenance, HRMS, Track management etc. also **need** to be and monitored. An efficient **web-based** Project and Portfolio Management (PPM) System can provide multiple dashboards and reports on the progress of various projects spread across multiple geographic locations and can help **relevant** authorities **take** timely decisions on project execution. PPM can be accessed by Project managers, Project coordinators, team members and Senior Officials of IR from anywhere. PPM will provide portal based access control on a "Need to know, Need to have" basis.

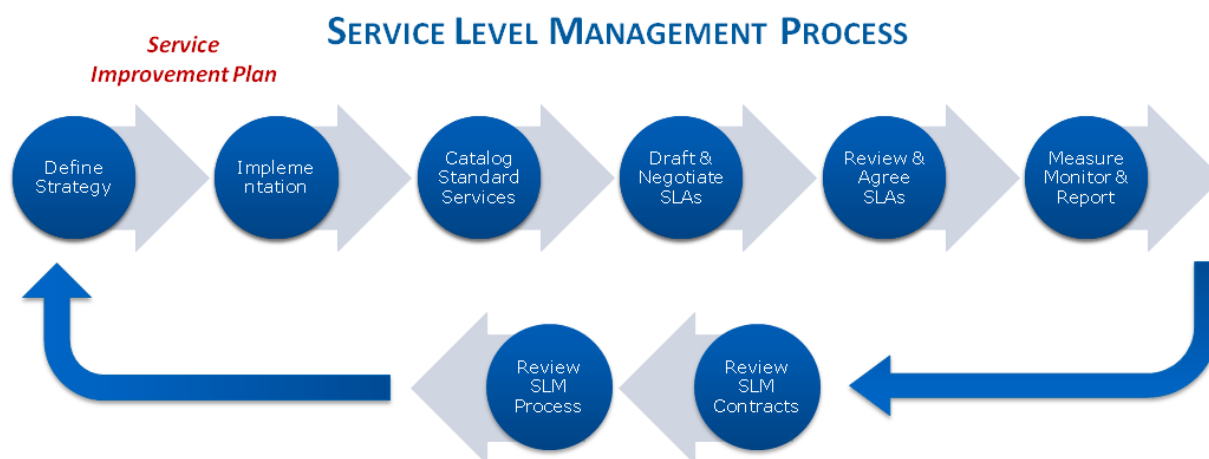
Project Portfolio Management



13.4.5. 2 Service Efficiency Improvement:

Increasingly many big projects are being awarded to private firms on long-term contract by various departments like Electrical, Civil, Signaling & Telecom, Tourism & Caring etc. However, presently no model exists to manage and monitor service delivery. As the portfolio of PPP projects expands, management of service-level agreement (SLAs) and other key performance Indicators (KPIs) would emerge as a challenge.

Therefore, a Service Level Management (SLM) / Contract Management Systems needs to be designed for management, monitoring, and reporting of service level agreements (SLAs) and service delivery for IR by service providers. Such a SLM/Contract Management System should cover well-defined service metrics monitorable contractual obligations and performance targets and facilitate real-time action based thereon.



13.5 Summary of Recommendations

i. Structural /Organizational

- There is a need for a central IT body (this can possibly be played be C&IS directorate) for conceptualizing and driving all IT needs. The central body needs to have a tiered structural hierarchy for meeting all divisional/zonal needs.
- FOIS and CCM should be empowered for implementation. Tenures should be fixed for longer durations and deputations to CRIS should be long-term.
- CRIS should continue to play a pivotal role in new application development and remain a key body providing oversight on the Indian Railway’s IT applications. CRIS should be strengthened.
- The internal profile/perception of the existing IT bodies (such as CRIS, C&IS Directorate, EDP Centers in the Zonal Railways/PU/RDSO/RB etc.) of Railways should be elevated. These should be transformed into ‘premier IT organizations’ such that they become a sought-after career options.
- A centralized framework for assessing the IT needs, evaluating their feasibility, determining priorities among them and authorizing ‘go ahead’ for projects should be developed.
- A common MIS and an integrated Decision Support System (DSS) should be utilized to support strategic as well as operational decision-making within railways.
- The focus/ control on implementation/ execution needs to include Business Process Re-engineering so that the processes are operationally optimal before they are taken up for IT enablement
- There is a need to benchmark the IT spend of Indian Railways vis-a-vis global railways and the large logistics organizations. Globally, the large logistics organizations spend 1-2% of their revenues on IT as against less than 0.5% in IR.

- IR should partner with local/global IT organizations, in the form of consulting/advisory roles. Representatives from industry, academic institutions, CRIS and IR that can together bring in strategic thinking best practices and suggest optimal solutions for Indian Railways.

ii. Technology

- A Consultative Committee for IT needs to be institutionalized with representatives from the Department of IT, Industry, Planning Commission, Academic Institutions and Railways.
- Internal expertise should be developed within CRIS across technologies like RFID, Business Warehouse, Analytics, ERP etc.
- An integrated IT framework for applications, commissioning, maintenance and replacement needs to be developed which can over time address other aspects of the IT ecosystem for Indian Railways.
- A comprehensive IT Security Framework to safeguard critical information, avoid unauthorized access / manipulation and denial of service is immediately required.
- A central IT helpdesk and an automated Trouble-shooting system needs to be developed.
- The existing infrastructure of IR should be optimized by using newer technologies like Cloud Computing to reduce cost as well as the time to go-live for new projects.

iii. Project Management/ Execution

- An Integrated Project Management System should be established in order to better manage all projects across all Zones / departments / offices in order to make intelligent decision making.
- A model to automate, activate and accelerate the management, monitoring and reporting of service level agreements (SLAs) for PPP (Turn-Key / BOO / BOOT) kind of projects should be developed.
- A comprehensive HR management system should be developed to better manage HR processes and costs as well as to allow proper tracking of skills and to gain improved efficiencies by assigning the right people to the right jobs.
- An organization wide Change Management Process to ensure better IT adoption needs to be adopted.

Chapter-14

Organizational reforms

14.1 As brought out in the earlier chapters, in order to sustain the pace of GDP growth being attempted and play its rightful role in meeting the expanding transport requirement of the country, Railways have to reinvent itself. It has to rapidly expand its network and augment capacity, modernize and improve services so as to carry 50% of the freight transport by 2030 and meet the passenger demand in full. Briefly, by 2030, Railways would need to:

- (a) carry close to 7000 billion tonnes kms compared to 606 billion tonne kms in 2010-11;
- (b) meet passenger demand in full – i.e. cater to a passenger growth at 10% per annum or more; vis-à-vis 6-7% per annum at present.
- (c) improve the speed of passenger services to 160-200 kmph from the present day maximum speeds of 130-140 kmph along with selective high speed corridors (speeds in excess of 250 kmph);
- (d) upgrade service delivery to an extent that Railway services represent the best value proposition against competition;
- (e) build a modern network and achieve the goal of zero accidents and zero equipment failure;
- (f) carry out major capacity augmentation – close to 10000 kms of DFCs, 40000 kms of doubling/quadrupling/multiple lines, 30000 kms of new lines; and
- (g) develop coaching and freight terminals, procure adequate rolling stock and undertake other works required to meet expected level of quality and satisfaction for customers and meet the projected growth.

It is clear that the task being attempted is stupendous by any measure, especially judged against the pace of capacity augmentation and growth achieved in the past. Just to take two examples, new line construction and doubling/multiple lines being attempted (at the rate of 2000 kms per annum each) is four times as large as the best that has been achieved by Railways in the Five Year Plans in the past.

14.1.1 All these tasks are inter-related; without adequate capacity to raise and mobilize resources, utilize resources efficiently and execute projects, attainment of the targets envisaged would not be possible. Railways, as organized now, will be totally inadequate for the task. Before examining the individual issues and possible solutions, there is a need to

examine the present organizational setup in terms of ownership and legal framework. As may be recalled from earlier chapters, some of the problems afflicting the IR's organizations at present are:

- Duality of role – commercial as well social without any clear demarcation.
- Centralization of decision making on many operational issues at the level of members of Railway Board. It leaves little time for strategic thinking and interferes with policy making role of the Board.
- Overly differentiated and departmental organization structure and lack of a coherent vision to guide the organization.

- Production-centric approach to business and lack of commercial and customer-orientation..
- Bureaucratic decision- making processes and procedures.
- Inadequate empowerment at Zonal Railway level coupled with absence or diffusion of accountability.
- Short tenure at the top.
- Politicization of tariff- setting and investment planning.
- Poor project management and inadequacies in project delivery system resulting in enormous time and cost overrun.
- Lack of capacity and policy for attracting private investment.
- Accounting system inconsistent with business accounting, which does not help as a decision –making tool for management.
- Absence of a system to track trends in technological developments, induct new technology and develop indigenous technology.

14.2 It is apparent that the present organization would need to be restructured to address all the above lacunae. However, any organizational restructuring without proper forethought and planning is fraught with the risk of unsettling disruption. Therefore, it is necessary to weigh the pros and cons of all available options. Organizational restructuring should be used as a means to achieving the goals set for the organization and not as an end itself. The options available are:

- (a) Retention of the government structure with appropriate changes to bring in accountability at various levels.
- (b) Corporatization of the railways.

(c) Privatization of the railways.

14.2.1 Recognizing the unique and strategic role played by Railways in the transportation space, rail transport has been one of the three areas reserved for public sector in successive industrial policies of the country (the others being atomic energy and defense). Railways are considered critical not only from the standpoint of connecting remote regions and providing affordable transportation services (especially passenger services) but also from the perspective of defense movements, (which cannot be passed on to the private sector) and meeting the transportation requirement in the wake of national emergencies and natural catastrophes. Railways in India is used as a tool for development, equity and integration of all parts to the mainstream. Privatization of the railways has not been considered feasible in any public discourse on the subject by Government. The Working Group has also not considered privatization as an alternative.

14.2.2 Corporatization is also not recommended as it is not a solution by itself. Railway are already having enough financial independence by way of separate budget and decision-making. Recognizing the business nature of Railways, Acworth Committee had recommended separation of Railway Budget in 1924, so that its performance can be evaluated independent of financial results of the government. Further, International examples (e.g. Canadian National Railways or Japan National Railways) testify to the fact that company structures by themselves are not synonymous with sound performance. In these cases, the respective governments had to subsequently resort to privatization. In contrast, Indian Railways has performed reasonably well under a government structure and the recent success of Chinese Railways proves that government ownership by itself may not be a bane. Keeping in view the tenuous law and order situation in many regions of the country and exposure of the railway assets to vandalism/target of attacks, there is increasing need of the authority of the government to run it in a safe and efficient manner.

14.3 Organizational reforms that achieve the results without distracting the organization and its energy from the pressing tasks would best serve the country at the stage. The following reforms are suggested:

14.3.1 Separation of policy making and operational responsibilities at the Railway Board level - Railway Board would concern itself with strategic planning, policy making and

the usual functions of a government Ministry and not with day- to- day operations. It should function as much like a board of a company as is possible with clear focus on business, bottom-line and other clearly defined objectives. Day- to- day operations monitoring and decision making could be delegated to a separate executive body with power of oversight over the Zonal Railways and project organizations. The Railway Board would, however, continue to monitor periodically the performance to ensure that the strategic plans and the policies are implemented. Besides, regular weekly meetings, it will hold special quarterly meetings where fixed number of nominated external experts having expertise in technical, managerial and financial and economic fields would be invited as special invitees. This would help Railway Board in getting fresh thinking on strategic issues.

14.3.2 Organisation for PPP: In the Railway Board, an empowered PPP Cell would be set up with officers drawn from all relevant disciplines (including Finance) and necessary support staff to formulate, process and award PPP projects. Public Private Partnership-Appraisal Committee (PPP-AC) architecture would be replicated for internal processing and approvals within MoR; in other words, PPP Directorate will circulate proposals for consideration of a Empowered Committee of Board. A Railway PPP approval committee will be created comprising CRB, FC, Member (Engg) and concerned Member to consider and clear PPP projects/proposals. PPP projects would be taken up through standardized documents and processes. Appraisal and approval would conform to Cabinet approved PPPAC/CCI procedure. There will be similar PPP units at regional/zonal level on a need-based manner.

14.3.3 Non-transportation tasks – The entire range of activities falling outside the core transportation operations such as management of major stations and staff colonies etc, could be critically reviewed from the perspective of either retention or out sourcing on the basis of organic integration with operational need and the logic of “make or buy”. These activities can be classified into two categories: one group consisting of activities that are required for transportation service but can be done by another agency more efficiently (e.g. cleaning of coaches, provision of linen in trains etc.) and at lesser cost; and the other consisting of major activities that are related to transport but not strictly a part of transport activities (e.g. manufacturing facilities for locomotives, coaches, and wagons). Outsourcing would be a solution for the former: public private partnerships for new units and induction of competition could be a solution for the latter. There are also activities which are amenable and eminently suited to commercialization and yet suffer from loss of focus being confined to

a small part of the railway's operations at present. In the past, Railways have benefited from corporatization of such activities as project/technical consultancy, construction, container transportation, telecom services etc. Going forward, parcel service management would be an ideal candidate for corporatization. Other activities of similar nature could also be considered. In several railways, for instance Chinese Railways and Japanese Railways, transportation of special cargo (container, special freight and parcel), construction of railway infrastructure and management of stations has been successfully implemented to facilitate quick upgradation of technology, independent R&D and sharpen focus on upgradation of passenger facilities and revenue generation.

Railways have been experimenting with outsourcing of a number of activities. Examples are: onboard cleaning, supply of linen in trains, station cleaning etc. The results have not always been salutary or satisfactory. In fact, some of the outsourcing activities have given rise to a large number of complaints from customers. This, however, does not make a case against outsourcing. On the other hand, it demonstrates the need for seeking professional help and guidance in designing outsourcing modules and monitoring performance post-outsourcing.

14.3.4 Reorganization on business lines – As elaborated in Chapter-4, Railways is presently organized in terms of several functional departments like Civil Engineering, Mechanical Engineering, Electrical Engineering, Signal and Telecom etc. While in theory, such a structure would promote functional specialization, each department being manned by separate cadres has led to lack of unity and strategic coherence. From recruitment to retirement, officers spend their service years almost entirely in the department getting deeply steeped in departmental thinking. A great deal of organizational energy is expended in inter-departmental competition for resources and a zero-sum game of one-upmanship and departmental aggrandizement. Several railways have addressed this issue by reorganizing their operations in terms of business lines. Infrastructure management, freight transportation, passenger transportation, parcel and miscellaneous activities should similarly be organized as separate profit-centres by IR. These businesses could be further sub-divided in terms of different activities. For instance, freight transportation could be reorganized in terms of bulk transport, non-bulk transport, container transport and passenger transport in terms of high-speed, intercity, sub-urban and regional services. IR should concentrate on providing cost-efficient solutions in each activity by doing its part efficiently and taking the assistance of private partners or special created SPVs for other activities such as development and

management of terminals, marketing, road bridging etc. In the suburban passenger transport, the attempt should be to achieve physical separation of the long-distance network for the suburban network. Modern accounting practices would ensure that infrastructure and rolling-stock resources used by these lines of business can be properly costed and charged for. Railway Board at top level will also reflect this re-organization.

14.3.5 Empowerment of Zonal Railways - GMs of Zonal Railways could be empowered to take decisions that could enhance the revenue, reduce costs or build platforms for higher growth in future. For example, if a freight bye- pass or traffic facility work or a signaling change can increase capacity or remove a bottleneck, GMs could have the power to take such decisions without reference to Railway Board within a framework of rules and investment limits. The present system of seeking sanction for investment to be included in the Works and Rolling Stock Programmes irrespective of the size of investment should give way to a more decentralized decision- making at the zonal level. Simultaneously, the Zonal Railways would be made accountable for return on capital, transport output, profitability and safety. An enabling framework can be created to stimulate internal competition among Zonal Railways with incentives and bonuses for high performers.

14.3.6 Accounting Reform-

Railways would follow accrual based account system in parallel to government accounting. It should meet the norms prescribed by Governments Accounting Standard Advisory Board (GASAB) and at the same time provide activity- based revenue cost data meeting generally accepted accounting standards. The Accounting Reform should facilitate assessment of profitability of different operations, routes and sections and accounting separation of various lines of business and services within the lines of business. The principles for identification and allocation of joint costs and methodology for computation of operation and maintenance cost should be possible. Codification of these principles and development of an IT-based system to provide timely compilation of accounting and budget statements would be attempted.

This would facilitate determination of of cost of infrastructure services and the operational activities with an acceptable degree of exactitude and help decisions on rational pricing on the basis of train-wise, route-wise profitability analysis. This would also provide an

important input for determination of tariff, recovery of O&M cost from SPV/PPP projects, where applicable and financial computation of the social service obligations and subsidies.

The need for Accounting Reform has been recognized and accepted in Railway Board. An Accounting Reform project was initiated and sanctioned in the year 2004-05. Funded as a part of ADB's Railway Improvement Projects, the consultants were appointed in February, 2006. The consultants have submitted the draft final report on formulation of a new accounting architecture on the basis of lines of business and profit-centres and activity-based costing and pricing. However, the work has made a very tardy progress and the final results are yet far off. There is a need to hasten and complete the process.

14.3.7 Regulatory Structure – Under the provision of Railway Act, 1989, fixation of freight and fares is the prerogative of Ministry of Railways. Railway Rates Tribunal (RRT) can be approached for relief in respect of freight tariff only. The scope of Railway Rates Tribunal can be expanded to cover passenger fares and parcel tariff also. RRT at present has only one bench at Chennai. Regional benches of RRT need to be set up.

At present, Sections 30-32 of the Railway Act empower the Central Government to fix the tariff and Sections 33-48 of Railway Act deal with Railway Rates Tribunal, an Appellate Authority for disputes relating to tariff. Passenger fares are outside the jurisdiction of tribunal. With entry of multiple players through the PPP route, dispute resolution would assume urgency. The role of Ministry of Railways as licensor, regulator and a key player may not be conducive for attracting sizeable private investment into railways. An independent regulatory authority to fix tariff and deal with matters relating to tariff affecting PPP players would be needed. A Dispute Settlement Tribunal for PPP contracts of MoR would also greatly help in imparting credibility and predictability to the process. Appropriate changes in the Railway Act would need to be enacted to bring this about. This in turn would help in expansion of the PPP programme of Railways.

At present, Sections 11-20 of Railway Act deal largely with issues relating to construction of a railway line from the standpoint of a Government Railway. Appropriate changes need to be made in these Sections of Railway Act to enable construction and operation of non-government railways and its supervision/regulation by Ministry of Railways. Section 70 prohibits undue or unreasonable preference as a public carrier to any person or any particular description of traffic. Preference for certain high-paying traffic or just-in-time kind of service under certain conditions and circumstances should be legally permissible to bring in commercial orientation in carriage of freight traffic. This needs to be clarified.

14.3.8 With accounting reform and setting up of regulatory structure, the regulator should determine the costs of operating uneconomic railway lines built on social consideration and loss on passenger services on account subsidized tariff-setting. Government will have the option of closing operation of such lines or services or raising tariff. Alternatively, Government could decide to provide subsidy as determined by the regulator.

14.3.7 Business process re-engineering - The decision-making process will be streamlined to speed up decision-making and bring about accountability, result-orientation and responsiveness at all levels. IT tools will be harnessed towards this end.

14.3.8 Restructuring R&D: As brought out in Chapter- 12 , RDSO would be radically restructured. Standard-setting and Research activities would be separated. Recruitment and set up a research institutes as centre of excellence and management of top talent for both the activities and R&D in particular would be the keystone of the approach. A new research unit will be set up as a centre of excellence.

14.3.9. Investment Planning: As brought out in Chapter-9, Projects will be divided into two groups. Capacity creation, modernization and safety- related projects will be implemented through a system of financial closure within the system of annual budgetary allocations. Special funds will be created for each of them. These projects will be implemented in programme mode. Project heads will be given tenure posting till project completion.

14.3.10 HR reform: HR reform should proceed hand in hand with organizational reform. This aspect has been dealt with in the next chapter. In sum, the stress would be on building skills and promoting and incentivizing excellence at all levels. As a part of the process, multiple services and cadres of Railways would be rationalized and coalesced into fewer services. Government would appoint a Consultant to prepare a roadmap for Organizational Reform and move towards it in a time-bound manner

14.3.11 - Possible reorganization of Railway

A possible road-map for reorganization of Railways is described below:

- a) The Railway Board would need to be reorganized to enable it to face the challenges of the future. Chairman, Railway Board will act as the Chief Executive Officer and other Members would formally report to him. It will mimic the structure of the board of companies and will be designed to bring business and profit-orientation to the Railway organization. It will also improve accountability of the management.

- b) Chairman and other Members of the Railway Board would be appointed for a minimum tenure of 3 years through a process of selection to provide policy continuity and accountability.
- c) Instead of functional identification of members with different cadres and services, the Board should reflect reorganization on business lines. There would be the Members responsible for infrastructure, rolling stock, freight services, passenger services, and business development, PPP, HR, R&D and Finance. Each of the business lines would be subdivided into distinct profit centres such as bulk freight, non-bulk freight, parcel services, intercity passenger services, regional passenger services and commuter services etc. Each business unit will have clearly defined performance targets with a system of penalty and incentives. The organization at Zonal Railway and divisional level will also need to be restructured on business lines.
- d) Accounting system will be reformed to align it on business lines and also to facilitate accounting of different cost and profit centres.
- e) Through Accounting Reform and Accounting separation, a system of internal MOU/contracts would be set up to reflect costs and efficiencies of various services. System of incentives and penalties will be built in.
- f) The Zonal Railway Organization would mirror the reorganization at Railway Board level. GM would be responsible for financial, service delivery and safety/operational targets.
- g) Railway Board would be freed from day-to-day issues to concentrate on policy making and bring out generational changes. Railway Board would be responsible for long-range planning, infrastructure creation and periodical monitoring. Day-to-day operation would be divested to an Executive Board headed by a Director General.
- h) Ministry of Railways would set up an empowered PPP Directorate under a new Member (PPP) with officers drawn from all relevant disciplines (including Finance) and necessary support staff to formulate, process and award PPP projects. PPPAC architecture for internal processing and approvals within MoR would be replicated; in other words, PPP Directorate will circulate proposals for consideration of a Empowered Committee of Board. A Railway PPP approval committee will be created comprising CRB, FC, Member (PPP) and concerned Member to consider and clear PPP projects/proposals. PPP projects would be taken up through standardized documents and processes. Appraisal and approval would conform to Cabinet

approved PPPAC/CCI procedure. There will be similar PPP units at regional/zonal level on a need-based manner.

- i) Railway Act, 1989 would be suitably amended to provide for a PPP ombudsman (to resolve disputes that may arise between PPP concessionaire and Railways) and a tariff regulator. It should also facilitate construction of railway lines by Non-Government Railways and allow Railways to operate in a market-focussed manner providing premium services at a higher tariff.
- j) Multiple services and cadres of Railways would be rationalized and coalesced into fewer services.
- k) On the basis of financial performance of the various profit and cost centres, activities which are non-organic to Railways and can be profitably hived-off will be separated. Activities and businesses having significant growth potential and requiring greater focus will be corporatized.
- l) Projects will be divided into two groups. Capacity creation, modernization and safety-related projects will be implemented through a system of financial closure within the system of annual budgetary allocations. Special funds will be created for each of them. The projects will be implemented in programme mode. Project heads will be given tenure posting till project completion.
- m) RDSO will be restructured - Standard Setting and Inspection activities will be separated from R&D.. A separate R&D organization will be created as centre of excellence in various fields. It will be society having its own recruitment, promotion and cadre. It will largely follow the model of TTCI of USA, RTRI of Japan and CDOT/DRDO of India.
- n) Government would appoint Consultant to prepare a roadmap for Organizational Reform and move towards it in a time-bound manner.

Chapter-15

Human Resource

15.1 HR management would be critical to achieving the challenging goals set for Indian Railways for the year 2030. The foremost challenge for HR would be to create a system in which good performance is rewarded and protected from hindsight based witch-hunting and non-performance is penalized and not tolerated. This would require that personnel at all levels are recruited and trained with a view to building skills and attitudes required for attainment of the organizational goals.

15.2 The first step towards this end would be to compile an inventory of skills required at various levels to transform IR into a smart organization through a constant process of technological upgradation and stress on customer – focused growth. IR would work closely with academic institutions to devise and impart specialized courses, curricula and diplomas to impart these skills. This would help create a large pool of eligible candidates available for recruitment. Induction of unskilled staff would be reduced and eventually eliminated altogether. The recruitment process would be supplemented by well researched and meticulously developed induction and in service training to constantly upgrade the skills of employees. Skilled workers and supervisors, recruited and trained this way would be able to meet the challenges of absorbing new technology and business orientation as IR rapidly modernizes and upgrades its systems. At the top tier, IR would still require a professional generalist management cadre and top-flight specialists in technical and disciplines.

15.3 Rationalization of multiple services and cadres would be attempted to bring unity and coherence in the organization without sacrificing the benefit of specialization and business oriented capabilities in project execution, procurement, operations, maintenance and marketing etc. While the recruitment process through UPSC may continue to provide the core cadre of railway officers in the medium term, for specialist functions, recruitment from highly qualified PhDs from IIMs/IITs and lateral recruitment from the market for jobs in R&D, marketing and finance, HR could be thought of. Government would appoint Consultant to prepare a roadmap for HR Reform and move towards it in a time-bound manner

15.4 A system of reward for collective performance and variable pay linked to incremental surplus generated by various units of the organization would be implemented to incentivize superior performance.

Composition and TOR

No.-3/1/2010-Tpt
GOVERNMENT OF INDIA
Planning Commission
National Transport Development Policy Committee (NTDPC)
Capital C
Munir

Subject: Working Group on Railways for the National Transport Development Policy Committee (NTDPC).

It has been decided by the National Transport Development Policy Committee (NTDPC) to constitute a Working Group on Railways Sector. The Committee's references of the Working Group are as under:

1. Composition

1	Chairman, Railway Board - Chairman
2	Shri K.L. Thapar, Member, NTDPC
3	Shri M. Ravindra, Member, NTDPC
4	Member Secretary/Co-ordinator, NTDPC
5	Ms. Sowmya Raghavan, Financial Commissioner of Railways.
6	Member Traffic, Railway Board
7	Adviser (Infrastructure), Railway Board
8	MD, Container Corporation of India (CONCOR)
9	Professor S. Sriraman, Walchand Hirachand Professor of Transport Management, University of Mumbai
10	Dr. Ram Singh, Associate Professor, Delhi School of Economics, Delhi
11	Shri S.K.N. Nair, Sr. Consultant, National Council for Applied Research (NCAER), New Delhi
12	Shri Saurabh Srivastava, Chairman, CA Group
13	Shri R. Gopalakrishnan, Executive Director, Tatasons.
14	Representative of financial sector (nominated by Secretary, Department of Finance)
15	Representative of IT Sector
16	Shri S.K. Mishra, Executive Director/Traffic/PPP- Convenor

2. Terms of Reference

1. Determine the role of railways in meeting transport requirements of the country over the next two decades, keeping in view the need to
 - a. Conserve energy and protect the environment,
 - b. Promote safety, sustain future quality of life and reduce logistics costs,
 - c. Create an optimal intermodal mix.

The group may also keep in view the recommendations of various committees, including those of National Transport Policy Committee, 1980, and the Expert Group Report, 2001.

2. Estimate the share of railways in total transport in 2020 and 2030 consistent with the role envisaged for Railways and the projected macro-economic scenario.
3. Estimate:
 - a. Passenger traffic for the year 2020 and 2030 along with broad break-up of passenger traffic in terms of long distance (1000 km and above), overnight, intercity (250 km to 1000 km), local and suburban in both premium and value segments.
 - b. Freight traffic for the year 2020 and 2030 including expected composition in terms of specific segments and leads.
4. Consistent with the above, assess the current capacity and recommend the magnitude and type of capacity creation/augmentation/modernization required in the railway system. The following aspects may also be kept in view while assessing the requirements:
 - a. Special problems of remote and underdeveloped areas including the north-east region.
 - b. Rail connectivity with power plants, water fronts and mines.
 - c. Rail connectivity with neighbouring countries.
 - d. Development of regional and international railway corridors.
5. In light of the above,
 - a. Assess the investment required to achieve the projected traffic growth.
 - b. Identify sources of funding and assess fund requirements from budgetary, non-budgetary and private sources for different areas in rail infrastructure.
 - c. Identify areas for PPP and the requirement of private and public funding in these areas.
 - d. Examine the existing PPP policy framework and policy initiatives including regulatory and institutional framework and suggest changes necessary to attract greater private investment.
 - e. Suggest measures for greater commercial orientation of railways.
6. Assess the full costs of rail transport, including the costs of externalities, and suggest appropriate pricing regimes for various transport products in both passenger and freight traffic, including institutional arrangements for rational pricing.
7. To suggest policy framework for provision of rail connectivity to remote areas and under developed areas.
8. Estimate the energy requirements necessary for rail infrastructure and suggest measures to put the railways sector on a sustainable low carbon path and promote energy efficiency, emission reduction and environment protection.
9. Suggest the role of railways in promoting the development and growth of integrated logistics solutions and reduction in intermodal interface impedances. This would include the development of sustainable integrated rail/road, rail/air, and rail/port transport systems.
10. Assess the availability of human resources for the railways and suggest measures for skill development and institutional capacity building for various stakeholders.
11. Suggest measures for promotion of research and development and technology upgradation in the railways, including institutional development.

12. Indicate broad areas and investment for IT in the railways to improve customer interface/satisfaction and internal efficiency.
13. Examine the issue of land availability as a critical resource and technological solutions to reduce potential land requirements. Also, suggest measures for speedy acquisition of land for railway infrastructure, along with rehabilitation and resettlement of persons affected.
14. Identify data deficiencies in railway sector and suggest measures for improving, maintaining and updating the database, including institutional measures.
15. Suggest broad areas for business process re-engineering in railways to improve its customer and business orientation as well as project execution capability.
16. Study and evaluate the international experience in rail transport with particular stress on institutional design, business strategies and freight and passenger transport products (heavy haul high speed and customer focused services), quality of service (reliability, speed, elimination of accidents), productivity and technology and development of competitive world class rail equipment industry and its relevance to IR.

3. Additional guidance for the Working Group

1. The Group may get special studies carried out by experts.
2. The Group may visit such places and consult such stakeholders, key users and experts as may be considered necessary for its work.
3. The Group may examine the laws, rules and regulations pertaining to roads in connection with the TOR above and suggest legal, organizational, institutional and procedural reforms as necessary.
4. The Chairman may co-opt up to two additional members.
5. The expenditure on studies commissioned by the Working Group would be borne by the Ministry of Railways.
6. The Working Group shall submit its report within nine months.
7. The non-official members of the Working Group will be paid TA/DA in accordance with the guidelines of NTDPC. The official Members will be paid TA/DA as per their entitlement by concerned Ministry/Departments where they are working.

B.N. Puri

(B.N. Puri)

Member Secretary (NTDPC)

Copy to

1. Chairman, NTDPC
2. All the Members of the Working Group

International Experience in Railway Reforms

Country -1	Japan National Railway
Problems of Railway and Aims of Reform	<ul style="list-style-type: none"> - Erosion of market share - Heavy debt burden
Institutional and Regulatory Framework Prior to reform	<p>JNR's management reported to a board of directors. The governor of the board was appointed by the Cabinet and s/he in turn appointed other directors with the approval of the Minister of Transportation. As public corporation JNR was not subject to same civil and commercial laws of private companies. Its employees and officers were public servants, they had right to organize into unions and negotiate labour contracts, but did not have right to strike. It had obligations beyond profit making objective. It also had to operate in low density lines that were not economically viable under the political directions.</p>
Reform	<p>Restructuring of JNR involved the reorganization and reassignment of core businesses, assets and operations, organizational structure, work force, management, liabilities, and commercial orientation among the successor companies.</p> <p>JNR operation was divided into six separate passenger and a freight companies. The passenger rail companies were organized into three contiguous regions on the main island and one region on each of the three islands of Hokkaido, Shikoku, and Kyushu. The main reason for this division was the fact that 95% of all the trips originated and terminated within one of these services territories.</p> <p>Freight operations were organized into a separate company with a nationwide service territory. This freight operation company had no ownership of tracks but would get the access to the rail network through track usage contract with other newly formed regional rail companies.</p> <p>All non-core assets and liabilities of the former JNR in excess of those assigned to the individual companies were conveyed to a new entity i.e. JNR Settlement Corporation, a government agency. The Settlement Corporation, which held the shares of each of the seven operating companies that emerged from the restructuring, was intended to liquidate the assets it held, including the most important i.e. excess real estate, to pay back as much as possible of its outstanding liabilities with the proceeds of this liquidation.</p> <p>The new regional companies were transformed as joint stock companies, each with its own board of directors and management. The organizational structure was similar in JNR and the regional companies, except that in the regional companies departments</p>

	<p>related to railway operation were put together within the new Railway Administration unit, so that operation-related decisions can be taken in a more coordinated way. Since the regional departments of regional companies were smaller than that of JNR, meeting local needs was manageable because of smaller size.</p> <p>The Supervisory Committee estimated that JNR had approximately 93,000 excess employees. The restructuring plan made specific provisions for surplus employees:</p> <ol style="list-style-type: none"> 1. A special fund was set up for early voluntary retirement of 20,000 employees 2. Provisions were made to transfer 32,000 employees of the newly formed regional passenger companies to other parts of JNR 3. Remaining 41,000 excess employees were assigned to the Settlement Corporation <p>In spite of these, JNR restructuring faced union oppositions from the employees and were dragged to the court of law. JNR Settlement Tribunal failed to manage the debt was later dissolved. Its assets and liabilities were inherited by Japan National Railways Construction Cooperation, a government entity.</p>
Improvement in finances of railways	The market share of railways both in passenger and freight transport increased substantially after the reform process. The financial health of the privatized firms improved. The market share of the high speed railway was as high as 65% to 80% on various routes.

Country - 2	Chinese Railways
Problems of Railway and Aims of Reform	<p>Aims of reform</p> <ul style="list-style-type: none"> - Requirements of transport capacity and quality of service - Separating state control from economic activities - Orienting railway institutions towards transport market
Institutional and Regulatory Framework Prior to reform	Chinese railways functions under the ministry of railways and has 14 regional administrations. The government is involved in planning, operation, and regulation of Chinese railways. There are no separate suburban railway operations. New operators do not have access to infrastructure.
Reform	<p>The transportation department in the Ministry consists of all functions that are required to deliver rail transportation including maintenance of assets.</p> <p>Asset Operation Liability System, which was started in 1999, has made managers of regional railways administrations (RRA)</p>

	<p>accountable for returns on capital, output, profitability and safety. RRAs are accountable for capital expenditure. Individual managers also receive financial incentives for better performance. It has focused on improving its employ productivity and reducing staff costs.</p> <p>Chinese railway has also done away with below cost provision of passenger services. It has separated non-core activities such as enterprises dealing with construction, manufacture, telecom, design, education and social activities. Many of these enterprises now provide services to China Railways on a competitively tendered basis. In the area of rolling stock, this has resulted in very rapid modernization of products as a result of several joint ventures with foreign firms that became possible due to separation of production units.</p> <p>Chinese railways also removed a whole layer of management by eliminating the 44 sub-regional administrations. Management was consolidated at the level of the 18 regional administrations and some 60,000 staff positions were removed. All stations and depots now report directly to RRAs and train control centers were also consolidated at RRA level. This was made possible by advances in communication and information technologies. This change brought together management responsibility and accountability at the regional level. It also facilitated and encouraged higher utilization of locomotives and crews, which had normally been changed at sub-regional boundaries.</p>
Improvement in finances of railways	The Chinese railway has performed well with these changes. It adopts a market culture and tries to match its services with customer requirements. It has been able to progress on creating one of the largest networks in a very short span.

Country -3	Russian Railways
Problems of Railway and Aims of Reform	<ul style="list-style-type: none"> - Rapid fall in traffic - Efficiency of the system - Inadequate investments
Institutional and Regulatory Framework Prior to reform	<p>Russian federation has a monopoly and carries half of the freight ton as compared to 8% in the European union. The road network is comparatively weaker and is not able to provide competition.</p> <p>Under the federal rail transport law, railways were unified under the direct management of Russian federation. The infrastructure and operations were not accounted for separately. There was no open access for other operators either for freight or passenger transport.</p>
Reform	<p>The first stage was corporatization of Russian Railways Limited (RAO RR) and creation of subdivisions for</p> <ul style="list-style-type: none"> - Freight - Infrastructure maintenance and development - Locomotive traction - Long distance passenger service - Seventeen regional suburban railways - Maintenance of carriage and locomotives - Construction - Research and development <p>In the second stage, private sector was encouraged to involve into freight traffic movement and maintenance activities. Increasing passenger and suburban operation competition is also on the anvil.</p>
Improvement in finances of railways	The performance has improved and better accountability has been achieved.

Country – 4	German Railway Reform
Problems of Railway and Aims of Reform	<ul style="list-style-type: none"> - Poor performance - Loss of market share - High amount of government subsidy/debt - EU directive to open up infrastructure
Institutional and Regulatory Framework Prior to reform	<p>The West Germany system was referred as Deutsche Bundesbahn (DB). The Governance of Deutsche Bundesbahn was heavily centralized and had several public service obligations. The workforce enjoyed the status of being civil servants. It was speculated that it under reported deficit.</p> <p>The state owned railway carrier of East Germany i.e. ‘Deutsche Reichsbahn’ (DR). The infrastructure of DR was in poor state. It was state owned monopolist undertaking and the socialist nature of political system meant that there was no objective of earning</p>

	<p>profit from the business. In 1975 an attempt to focus on high ridership routes was made, however it was stalled by the federal states, town halls, and unions due to the fear of closing of various routes.</p> <p>The railway had to compete with a well developed road network and a population with high car ownership rate.</p>
Reform	<p>In 1980, the accounting method of Deutsche Bundesbahn was changed to introduce higher degree of detail, in order to identify the origins of the deficit, particularly in local and regional passenger transport. Three cost centres were identified:</p> <ul style="list-style-type: none"> - Public service obligations, i.e. local and regional passenger transport - The remainder of the transport - Infrastructure as a public obligation <p>However, the accounting did not separate the profits between infrastructure and operation and ended up as becoming a means to justify public subsidy.</p> <p>Another round of reform started with merger of DB and DR in January 1994. It also attempted to separate commercial activities from liabilities. DB AG, the commercial division, was formed as a joint stock company under private law. BEV, the public division, administered by the Federal Transport Ministry and the Federal Finance Ministry, was created to take the liabilities. Infrastructure was separated from operations. Subsequently, the rail was also opened up of the rail network for third parties against the payment of track charges. The federal railway agency was founded as a regulatory agency, while the financial and contract responsibilities for regional services were transferred to states.</p> <p>In 1999, five joint stock companies were created:</p> <ul style="list-style-type: none"> - DB Reise und Touristik AG (long distance passenger transport); - DB Regio AG (local and regional passenger transport); - DB Cargo AG (freight transport); - DB Netz AG (infrastructure); - DB Station and Service AG (passenger stations) <p>DB Reise & Touristik AG and DB Regio AG, the companies responsible for long-distance and regional passenger transport respectively were merged for better control on passenger transport.</p> <p>In December 2007, DB AG reorganized again bringing all passenger services under DB Bahn, freight and logistics services under DB Schenker, Infrastructure and operations under DB Netz. In June 2008, passenger and logistic services were brought under a new company DB ML AG. In 2008, Federal Government and the</p>

	parliament agreed to the partial privatization (24. 9%) of the DB ML AG. IPO of DB Mobility Logistics AG was planned in October 2008 but was deferred due to economic recession in the market.
Improvement in finances of railways	The reforms were able to arrest decline in modal share. Major traffic growth in overall passenger and freight market was observed. The freight share also increased. The open access operations, primarily run by private sector also grew over the years.

Country -5	British Railway
Problems of Railway and Aims of Reform	<ul style="list-style-type: none"> - Shrinking market share - Poor financial health
Institutional and Regulatory Framework Prior to reform	<p>British railways was operating as a single integrated entity including track maintenance, train operations, and supporting activities. It functioned under British railways board. Around 1980, ancillary activities (hotels, ferry service, rail vehicle manufacturing business) were sold to private player.</p> <p>The service was organized on business service lines including intercity operations, network south east, regional railways, euro passenger service, train load freight and rail freight distribution.</p>
Reform	<p>The reform process was an extreme case which involved fragmented structure in order to introduce competition. Infrastructure was separated and privatized in 1995. By 2001, it was considered as failed move due to poor maintenance. The renewal contracts were found to be badly designed. It was bought back.</p> <p>The passenger operation was split into 25 companies later consolidated into 19. Three passenger rolling stock leasing companies were established for leasing rolling stock and were ultimately sold. Freight operation was sold with open access.</p> <p>Network Rail was named as the infrastructure company. The government sets the expectations for Network Rail and specifies the passenger service requirement. The regulator determines the efficiency targets and decides on the competition issues.</p>
Improvement in finances of railways	<p>Some aspects of reform have been successful:</p> <ul style="list-style-type: none"> - Privatization of freight operators - Privatization of passenger rolling stock leasing companies <p>After privatization, both passenger and freight traffic have increased. Along with the traffic, costs have also increased.</p> <p>One aspect of reform which has not been very successful is managing the interface between infrastructure and operations, both for investment decision making and operations</p>

International Experience on High- Speed Rail (HSR)

1. Japan

Japan pioneered the modern high-speed railways with construction of the world's first high speed line called [Tōkaidō Shinkansen](#), between Tokyo and Osaka. Construction began in 1959 and the line opened to the public in 1964 at an operating speed of 210 km/h. Japan is an extremely densely populated country: more than 70% of the land surface is mountainous and thus uninhabitable or unsuitable for road travel and parking. With such a population density, the only practical possibility for transport across the country is rail. The recognition of the interrelationship between land development and the high-speed rail network led, in 1970, to the enactment of a law for the construction of a nationwide [Shinkansen](#) railway network. By 1973, construction plans for five additional lines and basic plans for twelve others was approved. Despite the approval, financial considerations intervened; the cost of the five lines, combined with the [oil shock](#) and the recession of the 1970s and early 1980s, resulted in some lines being cancelled and others delayed until 1982.

While the speed has been subsequently increased to 260 km per hour and beyond, Shinkansen trains with a top speed of 405 km/h and an operational speed of 360 km/h are currently being tested and are scheduled to enter service in 2011.

2. France

In France, the conventional rail line between Paris and Lyon was projected to run out of capacity by 1970. Following the example of Japan, a new line with a straighter alignment that permitted higher speed was decided upon. Called the TGV, the high speed service commenced on 27 September 1981. Contrary to its earlier fast services, French Railways (SNCF) priced the TGV service for all types of passengers at the price as for trains running on the parallel conventional line. To counteract the popular misconception that the TGV would be another premium service for business travelers, SNCF started a major publicity campaign focusing on the speed, frequency, reservation policy, normal price, and broad accessibility of the service. The TGV was considerably faster than normal trains, cars, or aeroplanes. The trains became widely popular, the public welcoming fast and practical travel.

In time, there was an explosion in ridership and the commercial success that inspired an expansion of the high speed rail networks. The Eurostar service began in 1994, connecting continental Europe to London via the Channel Tunnel with a version of the TGV designed for use in the tunnel and in the United Kingdom. The high speed rail links needed at the United Kingdom end were completed in two phases, the first one in 2003, and the second phase in November 2007. The fastest trains take 2 hours 15 minutes on the London-Paris and 1 hour 51 minutes on the London-Brussels routes.

3. Germany

Construction on the first German high-speed lines began shortly after that of the French TGVs . Legal battles caused significant delays and the Inter City Express (ICE) trains were deployed ten years after the TGV network was established. The first regularly scheduled ICE trains ran from 2 June 1991 from Hamburg-Altona to München Hbf on the new ICE line 6. The ICE network is more tightly integrated with pre-existing lines and trains as a result of the different settlement structure in Germany, which has almost twice the population density of France. ICE trains reached destinations in Austria and Switzerland soon after they entered service, taking advantage of the same voltage used in these countries. Starting in 2000, multisystem third-generation ICE trains entered the Netherlands and Belgium. The third generation ICE trains has a service speed of 330 km/h (205 mph) and has reached speeds up to 363 km/h (226 mph).

Since then, ICEs connect France, Belgium and Switzerland.

4. United Kingdom

United Kingdom (Britain) introduced first regular above-200 km/h-service, albeit with a small margin, and without building new lines, on the East Coast Main Line. Called the Inter City 125- called so because of their maximum speed at 125 mph (201 km/h)- they are diesel electric trains. The journey time was reduced by an hour and the passenger numbers soared. The IC 125 was planned to be followed by a tilting train, APT, to maximize the speed on twisted lines from the Victorian times – but the tilting mechanism brought on nausea in some of the passengers, and the APT project was shelved.

5. Spain

Spain's first high speed line was opened in 1992 between Madrid and Seville. In 2005 the Spanish Government finalized an ambitious plan of infrastructures (PEIT 2005-2020); it envisions that by 2020, 90 percent of the population will live within 50 km of a station served by a high speed line. Spain is building the largest HSR network in Europe: four new lines have been opened (Madrid-Zaragoza-Lleida-Tarragona-Barcelona, Córdoba- Malaga, Madrid-Toledo, Madrid-Segovia-Valladolid) and another 2219 km are currently under construction.

6. China

China launched the sixth "speed up" campaigns in April 2007, when CRH (China Railway High Speed) commissioned some 6,003 km of tracks, using 52 CRH trainsets

By 2007, the top speed of Qinshen high speed line was increased to 250 km/h; and on 19 April, 2008 China opened its second high speed rail line between Hefei and Nanjing, also with a top speed of 250km/h. On 1 August 2008, the Beijing-Tianjin Intercity line was opened, and its top speed reaches 350 km/h. Currently the fastest service is between Wuhan and Guangzhou, opened on 26 December, 2009. A distance of 968 km is covered in 3 hours reaching top speeds of 350 km per hour and averaging 310 km per hour;

Currently China has the world's longest high-speed rail network with about 7055 km of routes in service as of September 2010, including 1,995 km of rail lines with top speeds of 350 km/h . According to its "Mid-to-Long Term Railway Network Plan", revised in 2008, the National High-Speed Rail Grid is composed of 8 high-speed rail corridors, 4 north-south lines and 4 east-west lines, together with some less important lines; the total length will be about 12,000 km.

7. Taiwan

The Taiwan High Speed Rail, also known as the THSR, is Taiwan's high-speed rail network, approximately 335.50 km long from Taipei City to Kaohsiung City. Service began

on 5 January 2007. The total cost of the project is currently estimated to be US\$15 billion, and is one of the largest privately funded transport schemes to date. Express trains capable of travelling at up to 300 km/h travel from Taipei City to Kaohsiung City in roughly 90 minutes as opposed to 4.5 hours by conventional rail.

In the first year of operation, ending 31 December 2007, THSRC's trains were 99.46% on-time, and carried 15.55 million passengers.

8. United States of America (USA)

California has made the most progress towards establishment of a "true" high-speed line; in the 2008 elections voters in the state approved a ten billion dollar bond to fund construction of an initial line running between Los Angeles and San Francisco. The full network is planned to also include San Diego and Sacramento. The system will run as fast as 220 mph (350 km/h) using steel wheel on steel rail technology. Maglev propulsion was previously considered but dropped as an option in 2001. The project is being administered under the California High-Speed Rail Authority.

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Annexure-4

BEST RAILWAY TECHNOLOGY AVAILABLE IN WORLD AND ITS PRESENT STATUS ON INDIAN RAILWAYS

1.0 TRACK

S.No.	Features	Best Railway Technology available in World	Present status on Indian Railways	Road map for change over
1.1	Track Structure	71 kg rails on PSC Sleepers (USA)	60 kg rails on PSC sleepers	Adoption of 68 kg rail & other components for axle load >25 t is under study
1.2	Axle Load	40 t (Australia)	25 t	DFC planned with formation and bridges fit upto 32 t axle loading and the rest, for 25 t axle load.
1.3	Speed Passenger Freight	415 kmph (China) 100 kmph Freight (France)	150 kmph on selected route 100 kmph on empty condition	Vision 2020 aims at – <ul style="list-style-type: none"> • Running passenger trains on segregated routes at speeds upto 160- 200 kmph • and freight trains at speeds upto 100 kmph. • Running of Bullet trains at 250-350 kmph on separate elevated track
1.4	Rails	JNR-60 kg/m DB- 60 kg/m USA-71.0 kg/m (60 m long rails)	52.0 kg/m 60.0 kg/m 72 m long rails	Facilities for rolling of 68 Kg/m rail have been developed in Bhilai Steel Plant. Requirement of 71 kg/m rail for IR's projected axle load requirement is not foreseen.
1.5	Ultra sonic Testing of rails	Testing by SPURT CAR followed by Manual Ultra sonic Rail Tester, (U.K, Australia)	Testing by Manual USFD Tester.	Specification for vehicular USFD through outsourcing finalized.
1.6	Sleeper	PSC Sleeper (Mono/Twin Block) 35 t axle load. (Sweden)	PSC Sleeper (Mono Block) 22.9 t axle load is in use.	PSC sleeper developed for 25t axle load and trial is in progress.
1.7	Fastening for ballasted track	Elastic fastening with toe load of 1200 – 1300 kg. (Germany)	Elastic fastening with toe load of 850-1100 kg is in use. Elastic fastening with toe load of 1200-1500 kg is developed and is under trial.	Need to develop rubber pad of longer life for existing track. For higher axle load, complete fastening system is to be developed
1.8	Track Maintenance System	Fully mechanized.	Largely mechanized on important routes. On other routes, it is manual or partially mechanized.	Report on Mechanized maintenance system by machine & man power development committee for Track Maintenance has been finalized and technologically. there is no gap and only implementation is to be done.
1.9	Machinery for construction of Track formation	Advance machineries like JCB excavators, dozer, leveler, vibratory, sheep foot and heavy rollers are being used for dredging, transportation, dumping, leveling	Guidelines for earthwork in railway projects GE:G-1 recommends use of similar advanced Machinery. Most of these are being used	Efforts are being made to stay at par with world technology.

S.No.	Features	Best Railway Technology available in World	Present status on Indian Railways	Road map for change over
		and compaction (Worldwide)	also.	

2.0 BRIDGE & STRUCTURE

S.No.	Features	Best Railway Technology available in World	Present status on Indian Railways	Road map for change over
2.1	<p>Bridge Design Loads</p> <p>a) Vertical Load -axle load(A/L)</p> <p>-Track Loading Density (TLD)</p> <p>b) Longitudinal Force</p>	<p>Coal – 26.0 t (South Africa, China)</p> <p>Iron ore - 40 t (Sweden, Australia)</p> <p>Coal – 10t/m (South Africa)</p> <p>Iron ore – 12t/m (Sweden, Australia)</p> <p>10 to 15% of Live Load Shock Transmission Units (STU) are used to distribute longitudinal forces. (Worldwide)</p>	<p>25.0 t</p> <p>32.5 t 8.25 t/m</p> <p>12.13 t/m (proposed)</p> <p>Braking Force (BF)- 13.4 % of Live load Tractive Effort (TE)-53 t/Loco</p>	IR loading standards are comparable to the global standards.
2.2	Design Techniques	<p>a) Limit State Method of design (European Countries & USA)</p> <p>b) Stress Range Concept as fatigue criteria for steel bridges. (European Countries & USA)</p>	<p>Working stress method of design of steel bridges and limit state methods for design of concrete bridge super structures.</p> <p>Stress ratio as fatigue criteria for steel bridges.</p>	<p>The steel bridge code needs revision for adoption of limit state method of design.</p> <p>Revision of fatigue provisions in steel bridge code is under consideration of Railway Board.</p>
2.3	Inspection/ Monitoring Techniques	<p>a) Mobile Inspection Units for bridge inspection. (World wide)</p> <p>b) Use of NDT Techniques for</p>	<p>Annual inspection mostly visual or with rudimentary equipments. Recently mobile units have been procured for inspection.</p> <p>NDT techniques are being used</p>	<p>More units of mobile inspection vehicle have to be procured.</p> <p>This needs to be put in use for regular inspection. Specialized trained staff has to be deployed for this purpose.</p> <p>Specialized agencies with professionally qualified</p>

S.No.	Features	Best Railway Technology available in World	Present status on Indian Railways	Road map for change over
		<p>inspection. (World wide)</p> <p>c) Video camera based equipment for under water inspection, with engineer divers. (USA)</p> <p>d) Instruments for recording scour levels using SONAR. (USA, New Zealand)</p> <p>e) Remote Health monitoring instrumentation (USA & Europe)</p>	<p>for investigative purpose only.</p> <p>Under water inspection is being done scarcely with the help of divers.</p> <p>Mostly being measured by taking soundings with sounding rods etc.</p> <p>Mostly being done by rudimentary methods. Instrumentation of selected bridges is being done for heavy axle load.</p>	<p>divers and state of the art equipment alongwith analysis techniques for interpretation of collected data need to be developed for routine and detailed underwater inspection.</p> <p>A project for identifying the most suitable technology/ equipment is in progress with IIT/KGP.</p> <p>A project has been proposed to be undertaken with IIT/KGP (CRR) for remote health monitoring using wireless sensors.</p>

3.0 COACHING

S.No.	Features	Best Railway Technology available in World	Present status on Indian Railways	Road map for change over
3.1	Speed potential	415 (China)	150	<p>Vision 2020 aims at –</p> <ul style="list-style-type: none"> Running passenger trains on segregated routes at speeds upto 160- 200 kmph. Running of Bullet trains at 250-350 kmph on separate elevated track
3.2	Shell	Carbon Steel, Stainless and extruded Aluminum for coach body. (World Wide)	Corten Steel for ICF coaches. Stainless steel, light weight shell.	Crashworthy shell designs of ICF, LHB Coaches under series production. Light weight coaches with shell body made from extruded Aluminium required for high speed trains.
3.3	Brake System	a) Air-Brake, Disc Brake with wheel slide protection for higher speed.	Air Brakes rakes. Composite brake blocks are used. Disc Brakes are used in	Disc Brakes suitable for higher speeds beyond 160 kmph, improved & lighter Disc Brake pads, Magnetic tread brakes required.

S.No.	Features	Best Railway Technology available in World	Present status on Indian Railways	Road map for change over
		Magnetic Brake for Super fast trains. b) Phosphorous, Blocks in Europe, Composition Brake Block in Japan, US & Europe.	LHB Coaches.	
3.4	Suspension	Helical Springs, Rubber Springs & Air Springs, Bolster less Bogie with Air Suspension. (World Wide)	Helical Springs, Air Springs, Bolster less Bogie with Air Suspension.	Rubber Springs under trials in EMUs/DEMUs.
3.5	Toilets	Close Toilet systems (No discharge on tracks) e.g. Vacuum Toilet System. (Europe)	Open toilet system (discharge on tracks).	Trials in hand on Vacuum Toilets, Zero discharge toilets and an open toilet systems with environment friendly discharges on tracks (Bio Toilets)
3.6	Train power supply	Head on Generation System (HOG) (World wide)	EOG system for Shatabdi & Rajdhani. For other trains Coach mounted Alternators	Saptagiri Express between Chennai- Tirupati is working on HOG supply since Nov 2007. The trial of HOG system with bulk converter in WAP-7 loco is also completed successfully in one Shatabdi rake.
3.7	Energy efficient traction system for EMU	3-phase system (World wide)	Conventional system with rectifier/3 phase EMUs with converter and inverter	30% energy efficient 3 phase AC –DC EMUs are working in Mumbai suburban area and planned for future rakes also.

4.0 WAGON

S.No.	Features	Best Railway Technology available in World	Present status on Indian Railways	Road map for change over
4.1	Axle Load	Australia 40 t	25t	
4.2	Pay load to tare weight ratio	USA- 5.80	3.45	
4.3	Speed potential	France- 120 kmph South Africa - 120 kmph USA- 120- 160 kmph	Permitted speed 75 kmph in loaded condition and 100 kmph in empty condition	Bogie with improved suspension being developed with speed potential of 110 kmph in both empty and loaded
4.4	Maintenance cycle	USA-10 years- 1.6 million kms	4.5 years	More robust component design and better design of bogie and wagon being developed through global tendering

5.0 DIESEL LOCOMOTIVE

S.No.	Features	Best Railway Technology available in World	Present status on Indian Railways	Road map for change over
5.1	Horse Power	6000 HP	4500 HP	5500 HP already planned

S.No.	Features	Best Railway Technology available in World	Present status on Indian Railways	Road map for change over
	Rating (H.P.)	(USA)		
5.2	Fuel Consumption a) SFC at Rated Output (gm/bhp hr.) b) Idle Consumption (Kg/hr.)	149 (EMD-GM) 146-149 (GETS-GE) (4400 HP) 136-139 (6000 hp) 146-147 (MK-CATERPILLAR) (USA) 11.0 (EMD-GM) 10.8 (GETS-GE) 10.0 approx. (MK-CATERPILLER) (USA)	157.2 (3100 HP ALCO engine) 158.15 (3300 HP ALCo engine) 152.5 g/tcv/hr (4000 HP EMD engine) 11.22 kg/hr (3100 HP/3300 HP ALCo engine 350 rpm)	Electronic Fuel Injection (E.F.I) equipment is under development (would result in 1.6% to 1.9% reduction) Development of independent driven auxiliary machines, such as radiator fans has been implemented in WDG4 locomotives and that for TM blowers shall be implemented in WDG5 locos.
5.3	Starting Adhesion (%age of adhesive weight of the locomotive.)	41% (USA)	42%	At par with world standards
5.4	Brakes	Disc Brakes (Germany)	Tread	Development of disc brakes underway. Order placed for conversion of one locomotive.
5.5	Brake Control system	Electronic Type (EMD-GM & GETS-GE) Micro processor controlled (ABB) (USA)	Computer controlled brake system in all AC-AC locomotives.	At par with the world standards.
5.6	Disaster management	170 t cranes 120Kmph (Germany)	140 t cranes SPART i) <u>Goltwald</u> - 100 kmph on 52 kg 75 kmph on 90 R ii) <u>Cowans</u> - 100 kmph on 52 kg 75 kmph on 90 R iii) <u>Jessop</u> - 75 kmph on 90 R	Vision 2020 already aims for development of 170-tonne cranes with telescopic jib and self propelled accident relief train to improve response in the aftermath of accidents.

6.0 ELECTRIC LOCOMOTIVES

S.No.	Features	Best Railway Technology available in World	Present status on Indian Railways	Road map for change over
6.1	Horse Power rating (HP)	12000 HP (China 9.6 MW, HXD2, 120 Kmph supplied by Alstom)	6000 HP	Vision 2020 already aims for development of high horse power locomotives (9000 to 12000 HP)
6.2	Commercial Speed	TGV : 300 Kmph ICE: 280 Kmph (Europe)	160 Kmph	WAP-5 loco tested for 180 Kmph. Upgradation to 200 kmph under process.
6.3	Propulsion System	IGBT based 3-phase drive system (China , Europe)	3-Phase Locomotive from M/s. ABB have been procured with GTO 3- phase drive technology and are operating successfully since 1996-97	Development of IGBT based 3 phase propulsion system including traction control system with open platform control, on board and remote diagnostic system is planned in locomotives to be used in Dedicated Freight Corridors.
6.4	Energy efficiency	Regeneration of energy during	Regeneration of energy of the order	Further use of energy efficient devices/ equipment/ technologies.

S.No.	Features	Best Railway Technology available in World	Present status on Indian Railways	Road map for change over
		braking, use of energy efficient equipment on locomotives	of 10-15% has been achieved on 3 phase electric locomotives	

7.0 TRACTION INSTALLATION

S.No.	Features	Best Railway Technology available in World	Present status on Indian Railways	Road map for change over
7.1	Traction Supply	2x25 kV electrification is used extensively for heavy haul and high speed in Japan, UK etc.	Conventional 25 kV electrification has been adopted on IR. There is a small section of 2x25 kV on WCR and SECR.	2x25 kV technology is available in Bina-Katni section on IR and is being considered as part of the RE Roadmap.
7.2	Traction Power Control	Computer based Supervisory control and Data Acquisition System and Remote Terminal Units (RTUs) with dedicated optical fiber cable in Japan & many European countries.	PC based supervisory control and Data Acquisition System within door type (RTUs)	Development of RTU with communication & data transfer capabilities using open standard/protocols TPC/IP based e.g. IEC60870-5-104.
7.3	Hard Drawn Grooved Copper (H.D.G.C.) Contact Wire	Contact wire drawn out of i) Continuous Cast Copper Rod. ii) Continuous Cast Ag-Cu rod. iii) Continuous Cast Sn-Cu rod. iv) Continuous Cast Mg-Cu rod. Being used in Japan, China and many European countries.	Grooved Copper Contact (GCC) wire rods.	Silver bearing contact wire is being developed for speed upto 250 kmph having higher wear resistance and softening temperature.
7.4	Solid Core Insulators.	Porcelain /composite Insulators being used world over.	Alumina based Solid Core Porcelain insulators developed in 1992, since introduced.	Composite Insulators developed.

8.0 METALLURGICAL & CHEMICAL

S.No.	Features	Best Railway Technology available in World	Present status on Indian Railways	Road map for change over
8.1	Rail manufacturing technology -Sulphur -Phosphorous -H2 Level -Vacuum Degassing -Residual stress -Dimensional accuracy	0.029 % max 0.029%max 2 ppm Mandatory Less Very close	0.030%(Max) 0.030%(Max) 1.6 ppm Mandatory Less Laser profile measurement has been introduced to monitor dimensional	The Rail manufacturing technology has been elevated to international standards. However, technology in newer field like Bainitic rail, 110 UTS rail, Ni-Cu-Cr rail is also under exploration

S.No.	Features	Best Railway Technology available in World	Present status on Indian Railways	Road map for change over
	-Ultrasonic testing	100% (Europe Norms)	accuracy closely 100%	
8.2	Ultrasonic testing a) Axle b) Flaw sizing in welds c) Crack growth monitoring	Microprocessor based flaw detector and special purpose probes. Ultrasonic C-scan/P-Scan are in use (Germany, UK) Acoustic Emission equipment in use (USA)	Improved & latest digital technology has been introduced Internationally Phased array technology is running. It is to be introduced Besides C-scan, P-scan latest technology is TOFD. This is still to be implemented It is in application in Bridge & structure	Phased Array, TOFD system is to be introduced. Phased Array system has already been procured. Project has been taken to standardize the process.
8.3	Cast steel wheel a) Wear b) Braking c) Rail wheel forces & wear	Griffin wheels used in USA show less wear Cracks are not observed during braking Relatively less (USA)	Improvement in process metallurgy like addition of Mo, V control in H etc have been introduced. The quality has been improved. Cracks are observed due to thermal stress developed during brake binding. Advance composite brake blocks may be developed. If wheel braking system is continued. Speed has been restricted to 110 Km/hr. Still prevalent. Rail grinding is to be introduced. Fatigue value of Cast wheel is almost at par with forged wheel	Further improvement in metallurgy has been developed. These are in trial stage. Project on advanced Composite brake block has been taken. Rail grinding is to be introduced.

9.0 SIGNALLING

S.No.	Features	Best Railway Technology available in World	Present status on Indian Railways	Road map for change over
9.1	Track Circuiting	Complete (Most of the European Countries like Germany, France, UK, Japan, Australia)	Available and partially completed	Vision 2020 already aims that Station sections will be completely track circuited to enhance safety in respect of verification of line occupation.
9.2	Automatic Warning System (AWS), and Automatic Train Protection.	Track to train digital transmission with capability of continuous speed control.	Earlier version provided in some sections on WR & CR.	Development of alternative technology TPWS has been taken up.

S.No.	Features	Best Railway Technology available in World	Present status on Indian Railways	Road map for change over
		(Most of the European Countries like Germany, France, UK, Japan, Australia)		
9.3	Centralised Traffic Control (CTC)	Computerised CTC System using Digital Transmission Techniques with Real Time train position display and On-line train control. (Most of the European Countries like Germany, France, UK, Japan, Australia)	Not available.	Work sanctioned in KfW project and under execution.
9.4	Cab signaling	Cab signaling along with ATC provided on all high speed routes. (Most of the European Countries like Germany, France, UK, Japan, Australia)	Not available.	Work of cab signaling has been proposed to Board.
9.5	Centralized operation of points and signals	Available (Most of the European Countries like Germany, France, UK, Japan, Australia)	Available and partially completed.	Vision 2020 already aims that Point and signal operation would be centralized at stations with provision of panels and electronic interlocking.

10.0 TELECOM

S.No.	Features	Best Railway Technology available in World	Present status on Indian Railways	Road map for change over
10.1	Emergency Communication.	GSM/R which provides communication between Control/Station to Driver/Guard is available. (European Countries, China, Australia etc.)	Work is in progress over certain sections of Indian Railway.	This may be deployed over A, B, & C Routes of Indian Railway.
10.2	Wireless Coverage inside tunnel for Locotrol in Heavy Haul Operation.	Communication inside Tunnel is provided using Leaky Coaxial Cable. (USA, European Countries, China, Australia and all Underground Metro Rail Systems World-over)	Communication inside Tunnel is not provided over Indian Railway.	To begin with it may be provided over section where Locotrol Operation is being carried out.
10.3	Provision of common TCP/IP Network Nodes at all Stations/Yards for Control Communication and Asset Management.	Online Data Transfer Technology for Monitoring & Asset Management available. (TCP/IP Technology is available across the World)	TCP/IP Nodes are existing at certain Stations only for the purpose of PRS/ UTS/FOIS.	Identification of Scheme to ensure Online Data Transfer for better Monitoring & Asset Management.
10.4	IP based Control Communication	VoIP/SIP (IP based Communication Technology is available across the World)	No System provided at Present	Feasibility for Control Communication using VoIP is under examination. After establishing the feasibility, Technical Specification to be drawn. To be deployed over Indian Railway Progressively.

11.0 LEVERAGING IT FOR PASSENGER COMFORT

S.No.	Features	Best Railway Technology available in World	Present status on Indian Railways	Road map for change over
11.1	Real Time Train Information System	Technology using GPS based Automatic Collection of Train Running Information is available. (GPS based similar Systems in USA, UK, South Africa etc.)	Indian Railways manually collect Train Running Information from Station over Control Telephone and feed it into Control Office Application(COA).	Recently Ministry of Railway has taken decision for implementation of Real Time Train Information System based upon SIMRAN Technology developed jointly by RDSO and IITK.
11.2	Onboard Information Display & Announcement System in Running Train.	Technology like Global Positioning System and Bidirectional Trunked Radio Communication are available which facilitate Onboard Information Display and Announcement in Running Train. (GPS based similar Systems in USA, UK, South Africa etc.)	Onboard Information Display & Announcement System giving Online Train Running Information inside Running Train is not provided over Indian Railway.	Onboard Information Display & Announcement System giving Online Train Running Information inside Running Train can be provided using Real Time Train Information System, which covers GPS as well as Bidirectional Trunked Radio Communication. A Project is being done in this regard by RDSO and IIT/Kanpur.
11.3	Video surveillance system for security on Running Train	Technology for Video Surveillance over Running Train using Wireless Communication is available. (Many European Countries, USA, Canada, U. K. etc.)	It has not been provided over Indian Railway.	RDSO is working on development of Scheme for this purpose.
11.4	Mobile ticketing	-	No such technology available	Recommended
11.5	On Board on line status of berths with commercial transaction and access	-	No such technology available	Recommended

12.0 SAFETY IN OPERATION

S.No.	Features	Best Railway Technology available in World	Present status on Indian Railways	Road map for change over
12.1	Private number exchange system on stations	IT enabled Biometric based system	Manual system	Recommended
12.2	GSM/R for Control/Station to Driver/Guard to communication.	GSM/R which provides communication between Control/Station to Driver/Guard is available. (European Countries, China, Australia etc.)	Work is in progress over certain sections of Indian Railway.	This may be deployed over A, B, & C Routes of Indian Railway.