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Rail Freight in Development

*Eight ways to manage it better and five ways governments can help*
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EXECUTIVE SUMMARY

This Paper is about how railway freight can best be organized to contribute to economic development. Nearly all the freight that railways carry, could be carried by one or more other modes of transport. But railways have a particular role to perform. They can convey a much wider range of freight types than pipelines. They are faster and more universally available than inland waterway routes. They have infinitely greater carrying capacity and carry at a fraction of the costs of air transport. And, if they are well designed and managed, they can, for a wide range of commodities, deliver both higher capacity and lower costs of operation than road haulage, at lower external costs to the community.

The Paper advises on actions that railway managements and governments in developing countries can take to help railways to be more efficient and effective in serving freight markets. It argues that such commercial success in the marketplace is also the key to securing the wider external community benefits of use of railways compared to the alternative of road freight transport. The Paper pleads no special case for conveyance of freight on steel rails rather than by any other means. If competitive and community advantage cannot realistically be attained, which is sometimes the case, rail freight can only be marginal to development, with no reason for favoring railways over any other transport modes.

Managers, policy-makers and other stakeholders in the railway industry are the main target audience of this Paper. The bibliography directs readers to more specialized technical issues.

The Paper provides an overview of the industry, moves on to the specific management and policy guidelines summarized above, and then illustrates examples of their implementation in a series of case studies.

Section 2 gives a helicopter view of the global ‘landscape’ in rail freight. It starts with a brief history that is important to understanding not only the very fundamental changes that have occurred in this very mature industry, but also the origins of both physical and policy characteristics that still endure in many countries. It also summarizes the scale of the industry worldwide, the geographic distribution of rail freight, the nature of rail freight, the public/private balance of service provision in the industry, the degree of integration of rail freight services with rail infrastructure, and volumes of rail freight compared with other modes.

Section 3 describes in more detail the nature and justification of the eight ‘good practice’ industry management recommendations summarized in Section 1. The recommendations are based on a broad range of geographic experiences and over a long period of time, and are illustrated by reference to the Case studies contained in the Report.

Section 4 sets out five specific recommendations of ‘good practice’ with regard to public policies for the governance of the sector. Guidance is given in the form of general principles, but alternative approaches to implementation are cited which might match different policy positions with regard to the contentious issues such as public or private ownership of railway infrastructure. Again, the recommendations are based on a broad range of geographic experiences and over a long period of time, but are illustrated by reference to the Case studies.

Section 5 describes three Case-study programs in the railway industry. They include China’s Rail Modernization Strategy, India’s Financial Turnaround Strategy, and sub-Saharan Africa’s recent experience of Concessioning railways to the private sector.
Annex A contains a brief account of evidence supporting the external community benefits of rail transport over road transport in specific contexts (EU, USA and China). Annex B contains a more detailed analysis of railway cost drivers, drawing attention to features which underpin many of the recommendations contained in the main Paper. A bibliography directs readers to more detailed literature on rail freight industry restructuring and reform.
NOMENCLATURE

Rail freight is used generically to refer to freight, cargo or goods transported by railways, which terms are variously used in different regions of the world. It does not include the parcels or baggage transport services associated with railway passenger services.

Rail freight provider is used generically to refer to any entity that provides railway freight train services whether private or public, incorporated under company law or established as a state-owned enterprise, and irrespective of whether the provider is a stand-alone train operating entity or vertically integrated with a rail infrastructure and/or passenger services provider. However, the different structural forms are an important topic in their own right and are addressed in specific sections of the text.

Freight customer, is used generically to those companies on behalf of whom rail freight companies haul freight: they may be the owners of the freight, the receivers of the freight, or a third party freight forwarding or logistics company.

Tonnes refer to metric tonnes (often called metric tons). Most railways around the world measure freight volumes in these units. However, some statistics for US railways are provided publicly in short tons (about 10 percent less mass than tonnes) and have been converted to tonnes in this paper unless otherwise stated.

Finally, national statistics and comparative statistics given are for ‘public railways’ or common user railways that are generally available to the public for the carriage of a variety of freight types (whether or not the railways are owned by the public sector). The statistics exclude isolated rail networks that are not generally available for public carriage of goods such as exclusive-use mining railways; industrial railways (e.g. railways wholly within industrial complexes); agricultural railways (e.g. sugar-cane railways); or dedicated military railways.
1 RAIL FREIGHT AND DEVELOPMENT: THE KEY ISSUES

1.1 RAIL FREIGHT IN DEVELOPMENT

*Rail freight is important to economic development because of its comparative economic advantages in serving certain forms and flows of freight, its wider community benefits compared to road transport, and its sometimes significant implications for national budgets.*

The *economic development* benefits of freight transport accrue when it allows developing country producers, at affordable cost, to access necessary inputs of raw materials, intermediate goods and other resources, and to consign their final products to markets. Well-run railways do the ‘heavy lifting’ of economic development, offering the capacity and services required by many types of heavy industries at a cost much lower than road transport. In doing so rail freight can facilitate trade, economies of scale, economic specialization and economic growth.

In some regions characterized by groupings of many smaller countries, such as the European Union, south-eastern Europe, sub-Saharan Africa, south-east Asia, rail freight can also contribute to closer economic integration. Efforts to improve economic integration and the connectivity of land-locked countries in several regions are frequently seen to require strengthening of trans-regional railway routes.

Freight railways can also deliver *external community benefits* that are increasingly valued by policy-makers, particularly in the areas of safety, environment and lower greenhouse gas emissions. The last decade has seen the emergence of an increasing body of knowledge about the external costs of different modes of transport, including the impact on greenhouse gas emissions. Evidence from Europe, the USA and China that is cited in Annex A indicates that rail freight haulage can have significant environmental and safety advantages over road haulage.

Sustainable transport policies in any particular country may therefore suggest trying to enhance the role and scale of rail freight transport within national transport strategies. But developing countries would rightly be reluctant to back greater use of railways if this were to mean that their industries would have to endure a poorer freight transport service that adds to their overall logistics costs. The better that freight railways are managed, the bigger will be their contribution to development and the higher their overall community benefits. It is the achievement of dense traffic flows, with well-loaded and low-cost trains, running on reliable (and so well-maintained) infrastructure that produces not only benefits to customers and economic development but significant energy, emissions and safety advantages over road haulage.

The *budgetary impact* of rail freight transport is also frequently an issue for transport policy-makers and an issue for development. Freight railways that are poorly conceived in terms of mismatch between the public resources spent on them relative to the role they can realistically perform, or which are poorly managed and maintained, can simply be a drain on national budgets, resulting in a squandering of scarce resources that could be used more productively in other sectors. Unfortunately in some, (but by no means all) developing countries, railways lack market focus, have poor equipment utilization, low labor productivity and deficient infrastructure. These railways invariably have a large negative budgetary impact, either in fact or in the making.

While rail freight can be important to economic development, sustainability and national budgets its contribution to poverty alleviation as such is more indirect. Freight railways are mainly about bulk and line-
haul transport and they make little direct contribution to the needs of the rural poor in getting their products to, or consumables from, local markets. Nor are railways suited to serving the intra-urban freight distribution needs of increasing urbanized populations that involve a wide assortment of relatively small consignment sizes to and from a multitude or origins and destinations. Nevertheless, the secondary and indirect implications of rail freight on poverty remain profound: freight railways can get coal to power stations at costs that can make the power needs of the rural and urban poor more affordable; it can deliver the bulk fertilizers and fuels that farmers need to regional depots for local distribution; it can carry the vast quantities of building materials (sand, gravel, timber, steel and cement) that underpin the physical development of cities; and it can help carry the containers that underpin production and trade in increasingly sophisticated consumer and industrial goods.

This paper offers guidance as to how to make rail freight more successful commercially, that is, in the overall market for freight transport, because in this way it will contribute directly to environmentally sustainable economic development, and indirectly to poverty alleviation.

1.2 Key Management Issues

The rail freight industry operates mainly in competitive and contestable markets in which commercial success is mainly determined by management actions.

Generally-accepted management principles are as relevant to the rail freight industry as any other but they are not the main focus of this Paper. Instead the Paper concentrates on eight principles that are most particularly associated with the commercial performance of rail freight transport. They have been selected by good and bad experiences in a range of countries and are prompted by the conviction that the industry could do more for development if its management adopted these recommendations. The eight recommendations to management are to:

- **Target markets and tailor products**: freight railways are a ‘niche’ mode serving discrete customers and not mass markets. Successful freight transport companies are those that strategically target markets which best suit their modal capabilities and then adapt specific performance to meet customer needs.

- **Be the low cost carrier**: global experience suggests that being the low cost carrier is the most compelling potential source of rail freight’s competitive advantage.

- **Measure costs and monitor margins**: to become and maintain the status of a low cost carrier, and make returns, rail freight providers need to understand their cost structure and what it costs to serve different customers. In practice, many railways have little or no knowledge of the costs or margins of serving individual markets.

- **Price to market**: While cost knowledge helps to target markets and set price floors, it is competition not costs that should mainly determine rail freight pricing strategies. This also requires close market knowledge and orientation

- **Treat infrastructure as investment in business, not in ballast**: Long-term technology choices, investment and maintenance policies for rail infrastructure are critical to the underlying competitiveness of railways yet much rail infrastructure capital expenditure is standards-based, undertaken with little hard market analysis or prioritization of highest returns.

- **Haul more freight with less metal**: Well-loaded trains of high net/tare weight, operated with well-utilized rollingstock are the most potent drivers of freight train operating costs and
suggest high returns from increasing axle weights, higher train loadings and greater capital utilization.

- **Downsize and upskill**: Modern rail freight companies are much less labor intensive than in the past, but some are still seriously overstaffed and lack core competences to be successful in the market.

- **Link trains into supply chains**: Intermodalism and multimodalism (these terms are defined in Section 3) are ways that railways can increase market reach without increasing network length.

While the implementation of these recommendations is clearly a matter for managers of rail freight entities these messages are relevant not only to those managers but others in the industry or related ministries as well. Most railways in developing countries are actually or effectively part of the government and many have no realistic authority to act according to commercial principles (to set tariffs, to decide the investment policy, to stop non-economic services, etc.). The implementation of the eight recommendations is therefore closely linked to the political will to adopt policies that will allow commercial behavior by rail freight providers and to establish an institutional framework that provides incentives for them to do so.

### 1.3 Key Policy Issues

**Government strategies and policies are always influential and often decisive in helping or hindering a successful national rail freight industry.**

The direction of national transport strategies, the articulation of transport policies, the nature of public institutions, and the design of legal and regulatory instruments that govern transport are matters that fall within the sphere of public policy choice. These public choices affect, inter alia, who is qualified to enter the rail freight industry, how competitive it is, the level and incidence of taxation, the environmental and safety standards that it pursues, the amount of public infrastructure investment it enjoys and much else.

It is therefore not surprising that railway policies should often form an important component of transport strategies and policies. But, again, this Paper is not about the general principles of transport sector governance but about those most immediately relevant to the business of rail freight. Many countries have adopted practical policies that have supported a more efficient and effective freight rail system. Section 4 of this Paper focuses on five policy approaches that international experience suggests will enhance the future role of rail freight and its contribution to sustainable development.

- **Make rail freight a business**: Freight transport is a fast-moving game and those playing it need both arms free if they are to stand a chance of winning. Nevertheless, governments in some developing countries continue to constrain the commercial instincts and freedoms of rail freight companies that they own in ways which are contributing to their long-term market decline.

- **Let the private sector play**: Private participation in rail freight has been successful in improving performance just about everywhere it has been tried; there are many options for such participation of which full-privatization is only one.

- **Encourage competition**: Even though freight transport markets as a whole are already contestable, there is a prima facie case for contestability in the rail freight market itself when such markets are not too thin to sustain it.
- **Don’t let borders become barriers**: Many railway networks are nationally-owned so it is inevitable that national borders are often also railway borders; inward-looking policies by both governments and railways have often hindered the development of international rail corridors.

- **Level the playing and the paying field**: Freight transport demand is market-driven but its ‘supply’ partly depends on government policies for funding public rail (including passenger rail) infrastructure. Public funding of each network is rarely decided in accordance with any overall national transport strategy or multi-modal assessment, and policies for infrastructure regulation and pricing are for the most part independently formulated.
2 RAIL FREIGHT: THE GLOBAL LANDSCAPE

2.1 TRACKS FROM THE PAST

Technologies define railways but railways have always depended on their integration with other modes. Transport of freight using fixed rails has a very long history. There are examples of vehicles being pushed or pulled along rails by humans and animals for at least two thousand years. Then during the 18th century, the industrial revolution began to generate unprecedented demand for high capacity movement of raw materials, especially of coal. The inflexibility of canals and the very poor state of roads led to experimentation and rapid technological progress with a wide range of rail materials (stone, timber, cast iron, wrought iron) and of locomotion (people, animals, gravity, racks, steam). The result was the emergence of a convention of coupled freight wagons equipped with flanged steel wheels on steel rails, and pulled by a powered locomotive. This configuration still characterizes freight railways today.

Most rail freight has always been part of a longer supply chain. Early railway routes in England connected coal mines to canals for on-transport to factories (see Figure 2-1 where gravity on one way and horse power the other is used for this 18th century built railway in the UK). In the USA, mid-west stockyards assembled cattle herds that had been driven on foot for rail consignment to eastern slaughterhouses. Nineteenth century Russian railways carried timber, wheat and even refrigerated butter to Baltic ports for shipping to Western Europe. Early Australian railways collected grains from silos that were sited to be no more than one day’s return drive from farm for a bullock cart, and delivered it to city mills for processing and onward delivery by road or ship. In India and China early railways connected inland cities to ports to facilitate international trade. These and numerous other examples are an enduring reminder that the overall success of the rail freight industry has always depended not only on its own distinctive technology but how well it is integrated into overall supply chains.

By the end of the nineteenth century the more industrialized countries, particularly in North America, Europe, European Russia and Japan and some other countries such as India and Argentina, had identifiable and generally (at least within countries) interoperable national railway networks, though ownership was often divided between many railway companies. These national networks provided rail connection between industrial and population centers and major ports. Except where there were parallel commercial waterways they more or less monopolized long-distance overland freight transport. But in other parts of the world, particularly in Africa and Asia (but also for example, in Australia), railways often consisted of isolated lines or small networks, feeding into ports, but lacking wider regional connectivity. China has undertaken a massive program of network development to overcome such a deficiency that is show-cased in Section 5.2. By 2020, China expects to increase its railway route-kms five-fold since 1950. In much of sub-Saharan Africa, the deficiencies remain, as is evident from the case study on Africa railway concessions highlighted in Section 5.4.
The development or the internal combustion engine and its application to road haulage in the early twentieth century were followed in due course by massive investments in national road systems. There was inevitably a decline in railways’ modal shares of freight as the new technology of motorized road haulage staked out and (with technological improvements) expanded its territory of competitive advantage. Nevertheless, this process was gradual; the extensive pre-existing railway networks in many countries remained the dominant mode of inland freight transport until well into the twentieth century. It is instructive to recall that while the first U.S. trans-continental railway was completed in 1869, the first paved roads outside of U.S. cities did not appear until 1907 and it was not possible to drive a road truck across America on a continuously paved road until the 1930s. But once road trucking industries were established and road networks developed to serve them, railways lost their overland monopoly and in due course much of their modal share.

The post-second world war decline of rail freight modal share (and in many countries in terms of absolute tonnages too) has been widely documented and is not repeated here. It was variously accompanied by dramatic upheavals: company bankruptcies; industry consolidation; often nationalization (typically outside the USA, but in the case of Conrail in the 1970s in the USA too); massive reductions in railway labor forces; abandonment of low traffic density lines; and many other survival measures. These various elements of industry restructuring were often underpinned by government financial support. However, this support was in most countries driven more by the political sensitivity of rail passenger services than by the interests of rail freight, which typically shared not only the same tracks as passenger services but the same set of financial accounts.

Irrespective of individual country responses, the commercial survival of the rail freight industry everywhere fundamentally required its transformation from a general carrier in near-monopolistic markets to a specialist carrier in mainly contestable markets. This required a recognition that the technology that defines railways brings with it certain physical and economic capabilities and limitations, as does the technology of any other mode. The modes are not perfect substitutes (and in some markets, like urban freight distribution, are not substitutes at all). Modal choice will be examined in more detail in Section 3. It is sufficient here to note that successful freight companies within any mode are those that best adapt the capabilities of their particular technology to the willingness of freight customers to pay for them. So there is inevitably specialization, but specialization is also accompanied by significant areas of overlap in modal capability where market share depends not on the modal technology per se, but on how well it is managed and marketed.

In overland freight markets today, railways most often compete with road haulage. In only a few corridors globally there is strong competition from inland waterways. Pipelines compete on strategic routes for bulk movements of crude oil, gas and sometimes petroleum products. And sometimes competition exists in the form of the opportunity that the users of freight have to source that product from other producers, or from other countries that can offer cheaper transport. Sometimes competition is created by a mixture of these things.

The key point is that except when rail transport is specifically mandated for certain traffic movements by government policy (which is increasingly rare) rail freight these days operates in contestable or competitive markets. They are characterized by demanding customers, a vigorous struggle to retain and win traffic, and long-term downward pressure on financial margins. This fact is not always evident in the policy settings within

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1 Notably in the Mississippi Basin (USA), the Rhine/Meuse-Danube corridor (EU) the Yangtze River and its tributaries (China), the Mekong (Vietnam/Cambodia), the Great Lakes of Africa, the Amazon (Brazil), Parana (Paraguay), Volga-Don canal and Baltic- Black Sea axes (Russia) and a few others.
which the rail freight industry operates or in business plans prepared by railway managements. But before addressing such issues in Sections 3 and 4, it is useful to complete our helicopter view of the landscape in which those issues now reside.

2.2 **WHERE IS TODAY’S RAIL FREIGHT?**

Nearly two-thirds of all rail freight in the world is carried in developing countries and over three quarters of that is carried in three countries: China, India and the Russian Federation.

In global terms, the public railway network consists of nearly a million route-km. About 56 percent of this network (or 512,000 route-kms) is in the World Bank’s regions of operations (defined hereinafter as developing countries)\(^2\). Compared to population, rail network length per capita in developing countries is only a fifth of developed countries; but in 2005, about 63 percent of the world’s rail freight (measured in tonne-kms) was carried in these countries and the proportion is growing. A breakdown of rail network and rail freight by region is given in Figure 2.2.

The density of freight traffic per route-km also varies greatly by region. As is clear from Figure 2.3, it is highest in the East Asia Pacific region (dominated by China) and lowest in the Middle East and North Africa region and Sub-Saharan Africa. However, if Sub-Saharan Africa were taken without South Africa the average would be less than a million tonnes. The economics and market prospects of rail freight in such disparate circumstances are obviously quite different, and this is reflected in the case studies.

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\(^2\) The World Bank’s regions of operations are: LAC (Latin America and Caribbean); SSA (Sub-Saharan Africa); MENA (Middle East and North Africa); ECA (Eastern Europe and Central Asia); EAP (East Asia and Pacific); SAS (South Asia). The acronym ROW is used to denote ‘rest of world’.
Over the last twenty years the total amount of freight hauled by railways in developing countries (measured in net tonne-kms) increased by nearly 50 percent, although with great disparity between regions (Figure 2.4). The highest rates were in East Asia Pacific, South Asia and Eastern Europe and Central Asia, driven by growth in China, India and the Russian Federation respectively. By comparison, rail freight in the African regions hardly grew at all.

The only significant additions to the world’s railway network length in the latter half of the twentieth century were the BAM line in Russia (built for strategic reasons in parallel with eastern parts of the Trans-Siberian railway) and some new lines in China. The overall trend was a ten year reduction of about 5 percent as low density branch lines fell into disuse or were closed. More recently, in China and India, high rates of economic growth have imposed freight and passenger demands which, despite declining mode share, have led to very high capacity utilization and serious bottlenecks. The network enhancement programs that are being implemented by the Chinese and Indian governments presages the biggest international burst of railway building activity since the nineteenth century. These programs are highlighted in the Case studies.

2.3 What Kind of Freight Is It?

Resource producers, heavy process industries and the building industry generate most of the volume of freight carried by railways, particularly in developing countries. Rail freight services in virtually all countries mainly carry bulk raw materials (coal, ores and minerals, crude oil, sand and gravel, grains, logs) and semi-processed industrial goods (oil products, chemicals, iron and steel, cement, fertilizer, sawn timber). This generalization is demonstrated in Figure 2.5 which gives the breakdowns of freight by commodity class for railways in a number of countries. These kinds of freight are particularly prevalent in developing countries.

It is noteworthy that the general industrial, consumer and mixed freight categories are much more significant in the United States, a large proportion representing the successful intermodal transport of freight in containers and trailers. In the EU and some other countries containerized freight has also been attracted to rail in significant volumes. But most developing country rail freight providers have so far had minimal success in penetrating these markets. India provides a case-study where there has been positive progress (Section 5.3).
Figure 2.5: Distribution of rail freight task by commodity (percent)

USA: distribution of rail freight task (%)

China: distribution of rail freight traffic task (%)

Pakistan: distribution of rail freight task (%)

Russia: distribution of rail freight task (%)

South Africa: distribution of rail freight volume (%)

Croatia: distribution of rail freight task (%)
2.4 WHO PROVIDES RAIL FREIGHT TRANSPORT?

State-owned railways carry about 61 percent of the global volume of rail freight and nearly all that carried in developing countries. The 39 percent of freight volume (measured by net tonne-kms) carried by private rail freight providers is nearly all in the developed world. Private ownership and operation dominates rail freight transport in Australia, Canada, Japan, New Zealand, the UK and the USA, while a number of private third-party national and international freight train operators are emerging in Germany, Sweden and several other countries of the European Union.

In the Bank’s regions of operations, private rail freight provision is nevertheless also now the norm in Latin America and prevalent in most of Sub-Saharan Africa (though not South Africa), with over 40 private rail freight companies and concessions in these two regions. But because of the relatively low rail traffic levels in most of the countries concerned they collectively carry less than 6 percent of all rail freight in developing countries. There are also third-party access operators in the Eastern and Central European region in the Russian Federation, Kazakhstan, Poland, Romania and elsewhere.

Taking the six World Bank regions as a whole, around 94 percent of rail freight in developing countries is still carried by publicly owned operators.

Many state-owned rail freight providers were privatized in the last two decades of the twentieth century in Latin America, Sub-Saharan Africa, Canada, Japan, UK, New Zealand and Australia. However, although nearly all the privatized railways have experienced considerable traffic increases the global trend has been dominated over the last ten years by traffic growth in the mega publicly-owned freight railways of China, the Russian Federation and India. The proportion of freight volume carried by the public sector is therefore probably now increasing from its 2005 level.

The rail freight landscape fundamentally altered in the ECA region after 1990. The ending of political unions of the USSR, Yugoslavia and Czechoslovakia led to the emergence of over twenty newly independent national railway companies. Some of them (RZD in Russia, KTZ in Kazakhstan and UZ Ukraine) are among the world’s largest freight railway businesses. Others, like the Baltic railways in Estonia, Latvia and Lithuania have restructured to prosper in the competition for heavy transit traffic from the Russian Federation and Kazakhstan. Two countries, Azerbaijan and Georgia have benefitted from oil transit flows from the Caspian region. But several others, in south-east Europe and Central Asia, are very small and challenged by relatively short transport distances and low traffic base. Indeed, the transition country railways of ECA as a whole have faced momentous changes in the scale, nature and direction of traffic demands as they moved from a role mandated by a centrally planned economy to new roles which depend on market forces and management competence, very often within a completely new economic geography.
2.5 Whose infrastructure do the rail freight providers use?

Over 95 percent of freight carried globally is carried by train operators who are vertically integrated with a railway infrastructure provider. Vertical integration exists if an entity which operates freight trains is contained within a corporate entity that manages a railway network (including within a holding company). Naturally the great majority of the freight carried by vertically integrated freight train operators is carried over their own tracks (again over 90 percent at the global level), but there is also a substantial volume of freight carried via track access rights over the tracks of other railways. In the USA, about 37,000 km of route operated by private railway companies is on track owned by another railway - equivalent to around a quarter of the total route-length of the US network. Examples of such access to neighboring vertically integrated railways occur, but on a smaller scale, in Canada, Mexico, Brazil and Australia.

In the European Union and Australia there are statutory rights of access to railway infrastructure for all properly licensed rail freight train operators, rights that in the EU have been extended both to purely domestic as well as international operations. In most EU countries, new third-party freight train operators run over tracks owned by a national railway that also has its own freight transport operation.

In a small number of countries the national railway network is managed by an entity that is corporately and managerially independent of train operations: they include the United Kingdom, the Netherlands, Sweden, Romania, Poland, and a portion of the Australian interstate corridors. In these jurisdictions, a number of public and private (in the UK only private) freight train operating companies use the network on the basis of track access agreements. However, the total amount of freight carried on these networks is less than 3 percent of the global total. Access rights are addressed in more detail in Section 4.3.

2.6 How does rail freight volume compare with the other modes?

The contribution of railways to the overland freight task differs enormously between countries. For illustrative purposes Figure 2.6 gives examples ranging from over 60 percent railway volume modal share of volume in China to barely 5 percent in neighboring Cambodia. There are big divergences in the developed world too – in the USA railways carry around 40 percent of the total volume of freight, in the EU less than half of that.

Differences in rail freight modal shares occur because of differences in the underlying profile of freight demand available, because of differences in network availability and because of differences in how well services are managed and marketed.

In terms of freight demand, railways cannot attain high modal shares in economies where there is little freight to which the railway mode is suited. Small countries whose freight corridors are short, which have little mining or heavy industry, and which perform no transit role, invariably have modest rail freight traffic and modal share, however well their railways might be managed.

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3 A detailed description of US railway industry structure and traffic can be found at the Association of American Railways’ website at www.aar.org.

4 Rail volume is not the only way of assessing modal share. The average value per tonne of rail freight tends to be much lower than that of road freight, an issue discussed further in Section 3.8 in the context of intermodal freight.
Turning to *network availability*, a market can only be shared by any mode where that mode exists (or exists in a reasonably good condition). As the world’s paved road system is around 12 times larger than that of railways, there are many freight corridors (though not very many heavy freight corridors) where there is no railway service to share the market. It is therefore always necessary to assess the development value of a railway not in terms of its national share of volume, but the contribution it makes in the corridors that it serves.

Finally, assuming that reasonable markets and competing infrastructure actually exist, *sound management* of the mode can make a difference to mode share in many freight sub-markets, even outside the pure bulk areas of coal and ores. This is a good point then at which to move from the general landscape of rail freight to explore the key management issues identified.
3 MANAGING RAIL FREIGHT COMPANIES: EIGHT WAYS OF DOING IT BETTER

3.1 TARGET THE MARKETS, TAILOR THE PRODUCTS

Successful freight transport companies are those that strategically target markets which best suit their modal capabilities and then adapt specific performance to meet customer needs. Freight customers choose modes on the basis of many criteria, including physical capacity to carry, service characteristics, prices, and other more strategic factors. For some customers and cargoes the decision is an easy one: they want the lowest tariff; or the fastest possible delivery time; or the most reliable delivery schedule. However, in many markets the matter is more complex involving both long-term and short-term trade-offs between the various factors. This complexity is illustrated in Table 3.1 which lists the many criteria which may be involved in freight mode choice.

Table 3-1 Freight customer mode choice criteria

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Attributes</th>
<th>What the customer might ask?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity availability</td>
<td>Infrastructure availability</td>
<td>Is the mode physically available on the route(s) required to meet my demand?</td>
</tr>
<tr>
<td></td>
<td>Capacity to meet demand</td>
<td>Does it have sufficient capacity within the timescale of the haulage contract that I would like to sign?</td>
</tr>
<tr>
<td>Service</td>
<td>Reliability</td>
<td>Can I depend on this mode and what is the likely variability of performance?</td>
</tr>
<tr>
<td></td>
<td>Service frequency</td>
<td>How well matched is the service schedule to my business needs, or those of my own customers?</td>
</tr>
<tr>
<td></td>
<td>Delivery time</td>
<td>How long will it take to deliver the freight from origin to destination (door-to-door)?</td>
</tr>
<tr>
<td></td>
<td>Risk of loss/damage</td>
<td>What is the likelihood of my freight being stolen or damaged; what will it cost to insure this using this mode?</td>
</tr>
<tr>
<td></td>
<td>Availability of ancillary services</td>
<td>Does the freight transport provider offer me e.g. storage services, consignment tracking, insurance?</td>
</tr>
<tr>
<td>Price</td>
<td>Door-to-door price</td>
<td>What will I pay to deliver the freight from origin to destination (door-to-door) if I choose this mode?</td>
</tr>
<tr>
<td></td>
<td>Price incentive structures</td>
<td>What price incentives does the company offer me to send more volume by this mode?</td>
</tr>
<tr>
<td></td>
<td>Inventory cost</td>
<td>What will be the cost to me or my customers of inventory held in-transit?</td>
</tr>
<tr>
<td>Strategic</td>
<td>Option value</td>
<td>What is it worth to use this mode to make sure there remains competition between alternative suppliers?</td>
</tr>
<tr>
<td></td>
<td>Relationship value</td>
<td>What is the long-term value of maintaining relationship with supplier instead of chopping and changing for short-term advantage?</td>
</tr>
<tr>
<td></td>
<td>Corporate image</td>
<td>Will the mode help deliver a positive corporate image for me or the freight owner (e.g. safe/green)?</td>
</tr>
</tbody>
</table>

The choices in Figure 3.1 may be exercised by a freight owner, or by an intermediary freight forwarder, or by a logistics company working under contract (all three of which are captured in the use of the term ‘Freight Customer’ as used in this paper). Customers with different kinds of freight, and even different customers offering similar types of freight, make different trade-offs. One element of market focus by rail freight management is market selectivity; that is, ignoring markets that consist of customers whose needs simply
cannot be met by rail (either on its own or in combination with other modes), or which cannot be commercially attractive in the volumes and/or over the distances involved. The willingness to be selective is primarily a matter of management initiative. But this initiative is heavily influenced by the institutional framework in which railway managements have been allowed to exercise managerial judgment. In many countries, and for political reasons, managements of publicly-owned rail freight companies have not been given effective freedom to withdraw from non-viable freight markets or divest freight assets or staff not necessary to serve viable markets. Section 4 returns to these issues.

The second element is then to tailor products to the target markets. Unlike passenger markets where there are very large numbers of customers whose mode choice behavior can be statistically assessed (and quite well represented in econometric forecasting models) most freight is consigned by relatively few corporate customers, who employ a small number of logistics decision makers. It is therefore both necessary and feasible for marketing and business development managers to segment markets often to the customer level, get close to these customers, understand their businesses, assess their needs, determine whether railways can meet these needs economically, and match product to customer.

It sounds easy, perhaps even trite. But even today in some countries rail freight providers see the main function of the Marketing Department, if they have one, as taking wagon orders and handling complaints, and so they employ the skills and experience appropriate to clerical tasks. Such providers usually have only rudimentary knowledge of their customers’ businesses, passing interest in their service needs, no clear marketing strategy, and an undifferentiated product that is undemanding on train operating managers. General trains of mixed freight consignments work their way through the system, often with frequent re-marshalling. Such services tend to be unreliable, that is susceptible to high variability in freight delivery times, because the emphasis is generally on the management of train movements not the transit of specific customer consignments.

High variability of performance is unwelcome to all customers. For bulk commodity customers it means they have to carry larger inventories in warehouses, stockpiles and silos etc. And it is particularly damaging to shippers and forwarders of higher value intermodal freight who base their marketing commitments to their own customers not on the best or average performance that the freight provider can deliver, but on the performance level they can reasonably depend on. The higher the variation in transit time the more they will penalize an already slower transit time than road haulage by padding the actual rail performance with ‘buffer’ time.

A commitment to and focus on markets, in terms of both targeting and service diversification, does not come from marketing departments, but from a Board and Senior Management who value what an effective marketing function can do. This is partly a matter of institutional structure and partly a matter of policy settings (This is further discussed in section 4)

### 3.2 Be the Low Cost Carrier

**Being low cost carrier is the most compelling potential source of rail freight’s competitive advantage.**

International experience reveals that if the rail service can meet a customer’s minimum service performance thresholds, the ability to carry at lower tariff than the competition is the most potent force for attracting traffic.

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3 It is not uncommon to find that no more than 15-20 corporate customers account for over 90 percent of a railway’s freight.
Service attributes other than cost are of course crucial in transport of industrial and consumer products, but even in transport of bulk raw materials there are challenging thresholds of regularity and reliability to be met. But rail freight companies can only sometimes match, and rarely surpass road haulage on many of the service criteria indicated in table 3.1.

This is because road haulage consists of relatively small units (typically between 15 -30 tonnes/large truck) that use a ubiquitous road network many times larger than the rail network and which the community would still provide (albeit in a modified form) even if road trucks didn’t use it at all. As the Bank’s Transport Business Strategy Update puts it:

‘Roads are multi-functional and can be readily accessed by a wide range of users. They provide the infrastructure used by private passenger transport (cars and motorcycles), buses, trams, taxis, paratransit services, own-account goods transport, commercial road haulage services, emergency services (ambulances, police vehicles, fire vehicles), utility vehicles (such as for refuse collection) and a variety of personal and freight transport functions carried out by foot, bicycle or animal-drawn vehicles. They frequently also provide convenient rights of way for electricity, gas, telecommunications, water and drainage systems. It is because of their high and diverse functionality, versatility and wide range of beneficiaries that roads have become such a central and essential component of all national transport systems, usually consuming the greatest proportion of public and private investment resources in both infrastructure and services’.

Road haulage services are therefore more penetrative than rail services, are more immediately responsive to urgent orders, are faster door-to-door, can be dispatched more frequently, and can be used more flexibly. A rail freight provider, who charges the same or higher tariffs than road haulage, when the latter has capacity to carry, is at the same sort of disadvantage as a card player who declines to lay out their trump card. However a rail freight provider’s cost advantage is not a card that it is automatically dealt, but one that it must secure for itself.

Railways can obtain the lowest cost levels in heavy haul of bulk freights which provides both high traffic density which delivers low unit costs of infrastructure, and large train sizes which deliver low train operating costs. The reasons for this are outlined in Section 3.3 and Annex B. Because of terminal costs (and the loss of equipment utilization while in terminals) the potential unit cost advantage of bulk rail freight (cost/tonne-km) tends to increase with distance. Nevertheless experience shows that railways can be the lowest cost alternative even over relatively short-distances if traffic flows are heavy and require no additional transshipment compared to other modes: Examples of such markets are short distance runs from coal mines direct to ports or power stations, iron ore mines to steelworks, grain silos to mills, quarries to cement works, oil refineries to regional storage depots, and so on.

Bulk and semi-bulk transport freight is sometimes dismissed as being only ‘low value’ or ‘slow-growing’, but this misses the point that these are the ‘high volume’ markets that well-run railways can serve at low cost. In virtually all profitable railways they underpin the recovery of fixed infrastructure costs, and this allows the development of niche markets in higher value but smaller volume freight markets. Except on capacity constrained lines, the marginal cost incurred from the use of track infrastructure is considerably less than the average cost (see Section 3.3) so that high base traffic density from bulks can greatly enhance the competitiveness and commercial viability of serving new markets.

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6 Commercially successful bulk rail-hauls of less than 50km occur in many countries.
The so-called ‘high value’ industrial and consumer freight is more logistically demanding than bulk freight. In most circumstances it exhibits a lower net/tare ratio than bulk freight (the significance of which is highlighted in Section 3.3) and so is more costly for railways to carry. So, although market tariffs for industrial and consumer freight are much higher than for bulk and semi-bulk products, their unit contribution to rail freight profit margins is rarely so. The challenge to rail technology is also increased by the fact that these are traffics where universal door-to-door availability, service frequency and delivery times are usually more crucial to freight customers. Railways are rarely available to deliver transport traffic door-to-door between its disparate and scattered origins and destinations without transshipment. The combination of traffic transshipment time (to interface with pick-up and/or delivery modes), train assembly time plus lower train speeds typically produce a distinct disadvantage in delivery time of general freight compared to road haulage. Moreover, many general traffic routes offer traffic managers an unenviable choice between running low-cost large trains but at unattractively low service frequency for customers, or running at an attractive service interval but with short, high-cost trains.

The challenges of general freight can be met on the busiest routes (where sufficient traffic can be won by rail freight companies to be able to offer the required service frequency) and over sufficiently long distances (where transshipment costs and transfer times become a smaller proportion of the totals). Arguably, the railways of North America have been most successful in serving these markets aided by very many long-distance transport corridors of relatively dense freight flows. But exclusively general freight corridors, which have sufficient volume of and distance to permit railways to be low-cost carriers while still contributing to recovery of infrastructure costs, are a minority of route-km on most national railway networks, and in some countries hardly exist at all.

Yet new market niches for rail freight do emerge. Rapid containerization over the last thirty years has given railways the opportunity to carry general freight much more economically. In effect, international containerization has transformed what was a more diffuse, non-bulk general freight transport market, into a bulk-market for transport of boxes usually concentrated on busy routes between major ports and distribution hubs in industrial cities. This market has thereby become better matched to the physical capabilities of railways. Many railways have successfully won a good share of such markets and others have the potential to do so. But it doesn’t just happen. The requirements for success in intermodal traffic markets are described in section 3.8.

### 3.3 Measure Costs and Monitor Margins

*To become and maintain status of low cost carrier, and make returns, rail freight providers need to understand their cost structure and what it costs to serve different customers.* This Paper is not the place to present a detailed account of railway costing, and a glossary is given that outlines some useful sources. But an understanding of the main cost drivers is important to understand how rail can attain comparative cost advantage over road transport, and an outline guide to rail freight costs is given in Annex B.

The analysis in Annex B demonstrates the substantial ‘economies of scope’ in rail infrastructure costs, through which marginal costs of rail infrastructure are typically only a fraction of average costs. This signals the importance of carrying high volumes of traffic to the ability of public railway lines to recover their costs. Annex B also notes the nearly proportionate relationship between train operating costs and traffic levels for a given train operating strategy and technology level, which implies the importance not only of short-term adjustments of resources to demand, but continuously seeking long-term management and technological efficiency improvements to pull the whole cost curve down (examples are given in subsequent sections).
Finally, Annex B notes that corporate overheads are often comparatively high in public railways. But managements that decentralize decision-making to business units, control finances and budgets, seek opportunities to competitively outsource corporate services, and run a ‘leaner’ ship, can dramatically reduce corporate overheads. There is little evidence of inherent economies of scale in rail organizational size.

Railway managers can seek commercial advantage by attaining the most efficient base cost levels in all its cost categories, which allows customers to be offered specific services at attractive tariffs, and by exploiting the economies of traffic density to attract additional traffic at low incremental cost. However, to do this they need activity-based management accounting tools encompassing the variable costs of infrastructure, train operations and corporate administration. Such tools allow them to assess, to a reasonable level of approximation, the incremental or avoidable costs of different market segments, and to make this assessment against both short and long-run time horizons. This process is sometimes called traffic costing. The revenue from each traffic segment can then be compared with key thresholds: first, with train operating costs, then with both train operating and rail infrastructure costs, and finally with fully allocated costs (including corporate overheads). This process is sometimes called financial contribution analysis.

Traffic costing models and financial contribution analysis can help railway business managers to decide which markets to target and which to avoid. And through the cost breakdowns they provide, they can inform operating managers how they might cut costs to increase the margin of a viable segment or to convert a non-viable segment to one which at least returns its train operating costs.

Many rail freight managers in developing countries have only the most superficial ways of undertaking service and traffic costing, and to measure the financial contribution margins of different traffics. Many have none at all. Even those that have management accounting capability often confine its use to Finance Department functions, rather than use it as a tool of business management. But the root cause is not lack of costing models or expertise to operate them. As with marketing information (and other management information systems) the value of traffic costing information is ultimately determined by its users not by its generators. If rail freight is not structured as a business and incentivized to act like one, then its senior managers will have little interest in business information. Yet without this information they cannot actively plan the business even if they wanted to, but can only project future performance on the basis of either broad past trends and/or wishful thinking.

3.4 Price to Market

While cost knowledge helps to target markets and set price floors, it is competition not costs that should mainly determine rail freight pricing strategies. As was indicated in Section 3.3 and Annex B, most railway infrastructure costs are fixed (in relation to individual traffic movement) within the period of most rail freight contracts. Expressed in economic terms these costs are joint between customers, so any allocation of them to individual customers is for the most part technically arbitrary.

As a result, except in a few situations, there is no unambiguous answer to the question of what a particular freight segment costs and the prescription sometimes given that railway freight rates should be based on

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7 Technically these costs include a mixture of genuinely joint costs which do not vary with traffic level, plus common costs that may vary with overall scale of traffic in the long-run, but which are not realistically incremental with or avoidable to any specific traffic contract.

8 An exception is where there is an overwhelmingly dominant customer or traffic that is ‘prime-user’ where it is reasonable to justify the existence of the line, and hence its fixed costs, to that user.
costs is, unless more precisely qualified, meaningless. As long ago as 1905, railway economist Sir William Acworth observed:

‘Volumes have been written to show that railway rates ought to be based on the costs of carriage...such a basis is impossible, as no one knows, or can know, what the cost of carriage is. Cost of carriage of a particular item may mean the additional cost of carrying that item; this is normally so small as to be negligible. It may mean the additional cost plus a fair share of the standing costs of the organization... an arbitrarily estimated proportion of a sum that can only be ascertained very roughly.’

The basic principles of commercially efficient rail freight tariff setting are well-established\(^9\). Unless there are special circumstances, such as the need to nurture an infant traffic, the rate set should be the highest that the market will bear taking account of the price charged by an actual or potentially competing alternative. This rate should at least return the avoidable or incremental cost of carrying the traffic\(^{10}\) in question (the price floor) over the period within which it is anticipated it will be carried.

By contrast, average cost pricing\(^{11}\) in rail freight in which fixed costs are spread on some ‘fair’ basis over all traffic will lead to the discouragement of some traffic that would otherwise make a positive contribution to the recovery of fixed costs. And such discouragement will result in less traffic overall and so higher fixed cost burden for the remaining traffic. In (exceptional) cases where the railway does have significant market power the ‘market’ may be a regulatory body. This should not change a freight railway provider’s general market-based pricing philosophy, (except that railway will typically then try to allocate as many costs as possible and the regulatory body will ultimately decide how much of these ‘it can bear’).

Many railways in developing countries do not exploit the economics of railways to price market segments differentially and to manage overall revenue yields more effectively. Sometimes this is their own choice, preferring standard and sometimes crude rating schedules to entering into the sort of market engagement and contract negotiations that market pricing would entail. But sometimes the absence of market-pricing is because governments are reluctant to bestow the necessary pricing freedoms, despite the fact that more flexibility in pricing in markets where railways do not have market power could help to optimize use of capacity, assist in attracting new customers to railways so creating community benefits, and generate additional contribution to the recovery of public infrastructure costs. Some reasons for government restrictions on freight pricing, and the problems that it can create, are set out in Section 4.

### 3.5 TREAT INFRASTRUCTURE AS BUSINESS ASSETS, NOT AS BALLAST

*Long-term technology choices, investment and maintenance policies for rail infrastructure are critical to the underlying competitiveness of railways.* All railways face situations in which non-investment capital must be spent for personnel, safety or environmental reasons. Yet experience indicates that there is considerable other capital expenditure on railway infrastructure that is also not ‘investment’ in the normal sense of having a clear rationale or commercial return. Instead of putting money where the market is, or where cost savings may be greatest, infrastructure spending too often contains a deal of metaphorical ‘ballast’, weighing down on the

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\(^9\) And they coincide approximately with the economically optimum approach known as Ramsey pricing, which refers to marginal rather than avoidable or incremental costs.

\(^{10}\) avoidable cost for an existing traffic, incremental cost for a new traffic.

\(^{11}\) Also known as fully distributed or fully allocated cost pricing.
business, responding to technical aspirations or untested commercial judgment without any serious assessment of likely market impact or cost saving.

Most of the decisions to be made about infrastructure investment are of course about renewing or upgrading an existing infrastructure. Most of the world’s railway lines have already been around a long time and managers are rarely starting from a blank sheet. The original alignments were often driven by passenger service or by freight of different kinds that has been consigned to economic history by industrial change. The corridors they created may or may not now contain promising freight markets; and both their horizontal and vertical alignment and the current needs of passenger service may affect the options for improvement. Even so, assuming that promising rail freight markets do exist, investment choices in infrastructure can substantially determine the extent to which they can realistically be attracted to rail.

Typical infrastructure upgrading choices faced by rail infrastructure managers relate to number of tracks, source of motive power, maximum train speed, length of crossing loops, weight of rail, rail connections, loading gauge, method of train control, and methods of maintenance. Choices made in all these areas can enhance or limit the comparative advantage of railways, as summarized in Table 3.2.

Clearly, specific projects to upgrade railway infrastructure need to be justified in the context of local markets and economic conditions. Infrastructure enhancements that reduce costs can always be translated into value for customers or higher returns for the provider. But creation of more capacity is only valuable if there are growth markets available to use it. Similarly, train performance improvements are only useful to customers who value that performance.

The most transforming investments for freight railways are those that simultaneously deliver cost savings, capacity that can be sold and service improvements that can attract new rail freight markets. In Section 5.2, the China case-study is an example of how combined improvements have not only nearly doubled overall network capacity since 1990 but also delivered improvements in train operating performance and economics.
### Table 3-2: Some potential impacts of railway infrastructure on competitive advantage

<table>
<thead>
<tr>
<th>Feature</th>
<th>Potential Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Track duplication</td>
<td>Increases the capacity of a rail route by a factor of about 4X. Typically also improves transit times, reliability and train utilization by reducing potential traffic conflicts and creating system ‘redundancy’ to handle such situations.</td>
</tr>
<tr>
<td>Motive power source</td>
<td>Electrification typically allows higher operating performance (e.g. speed and higher freight loads/Kw motive power) particularly in hilly territory, reduces locomotive maintenance costs and may save energy costs (depending upon long-term costs of diesel fuel vs. electricity and locomotive efficiency improvements).</td>
</tr>
<tr>
<td>Length of sidings</td>
<td>Longer siding length (and crossing-loop length on single track lines) increases the maximum freight train length in normal operations.</td>
</tr>
<tr>
<td>Max. train speed</td>
<td>Higher maximum train speeds may create service value for more time-sensitive traffics on longer routes, though for most natural rail traffic commercial speeds of 30-50km/h are often perfectly adequate for markets.</td>
</tr>
<tr>
<td>Weight of rail</td>
<td>Weight of rail increases track life but, in particular, can allow higher axle-loads, allowing freight wagons to be used with both higher capacity, and higher net/tare ratio.</td>
</tr>
<tr>
<td>Rail connections</td>
<td>Continuous welding of rail can reduce track maintenance costs (and increase wheel life).</td>
</tr>
<tr>
<td>Loading gauge</td>
<td>Wider loading gauge can handle wagons with better volumetric, and higher gauge can allow double stacking of containers, though is more costly to attain where the loading gauge is constrained by electric catenary.</td>
</tr>
<tr>
<td>Mode of train control</td>
<td>Automatic block signaling can add 15-25 percent capacity to double-track line. On low density freight lines, use of train radio (GSM-R) for train control can reduce train control costs to much lower levels than conventional signaling.</td>
</tr>
<tr>
<td>Maintenance</td>
<td>Mechanized maintenance techniques such as automated track lining and leveling, ballast cleaning, rail grinding and others can substantially improve rail performance and increase track life.</td>
</tr>
</tbody>
</table>

### 3.6 Haul More Freight With Less Metal

**Well-loaded trains of high net/tare weight, operated with well-utilized rollingstock deliver the most competitive train operating costs.** Improvements in the mechanical and electronic control elements of locomotives over the past thirty years has led to big performance gains in many areas: tractive efficiency (haulage capability relative to power rating); energy efficiency (fuel or electrical energy/gross tonne-km); availability (proportion of fleet available for service at any one time); reliability (distance traveled between breakdown); maintainability (maintenance intervals compared to utilization); and environmental performance (e.g. emissions standards). All these improvements can deliver potential cost savings. But they mean that modern locomotives are sophisticated and expensive capital assets, high utilization of which in moving freight is needed to convert advances in technology into market advantage.

Wagon technology has likewise advanced in areas such as; loading/unloading times (through design characteristics); carrying capacity (through bigger wagons and/or higher axle loads); better bogies (that permit faster speeds and fewer derailments); and better braking systems and draw-gear (that allow longer trains). There has also been an extensive R&D effort by wagon manufacturers to allow production of specialized rollingstock for specific traffics and even for individual freight customers. Just a few examples include high capacity motorcar carriers, ‘well’ wagons that allow double-stacking of containers, pneumatic discharge wagons for cement; road-railer wagons that can be hauled on rails or on highways; pressurized wagons for LNG; and scores of others. The effort is driven by the need to adapt railway technology to specific market segments.
While rail freight train managers will need increasingly to match train types and service characteristics to the markets offering, they will need to do so against the primacy of maintaining transport cost advantage. In train operations, the most effective ways of pursuing cost advantage are to maximize both the utilization of rollingstock (net tonne-kms hauled day per loco and per wagon) to avoid unnecessary capital acquisition costs, and to increase the ratio of net freight tonne-kms/tare tonne-kms hauled. As explained in Annex B, train operating costs vary, to a first order of approximation, with one or both of these two performance indicators. Indeed, most of the proportion of infrastructure costs that does vary with traffic, varies with gross tonne-kms over the line. So a higher ratio of freight tonne-kms /tare tonne-kms means more revenue tonnes carried relative to the incremental cost of providing both trains and infrastructure.

Increasing the net/tare ratio is partly a matter of minimizing dead running and empty return of wagons and partly an issue of axle loadings. Axle-loads are an area of close interaction of train operations with infrastructure. Increasing the weight of rail and strengthening track formation and engineering structures are required to increase the wagon load/axle. Figure 3.1 for example shows the evolution of axle loadings and corresponding net/tare in the United States since about 1950. Put simply (and approximately), compared to the 1950’s the increase in net/tare on certain operations means that a given cost of hauling metal will deliver nearly 50 percent more haulage of freight. The Case studies described in Section 5 show how more recently both India and China have also adopted higher axle-loading as a key part of their rail freight development strategies.

3.7 DOWNSIZE AND UPSKILL

Modern rail freight companies are much less labor intensive than in the past, but some are still seriously overstaffed, undermining the potential role of rail freight. There are many functions in which labor requirements have declined substantially over the last few decades and some examples are summarized in Table 3.3. As a result a modern efficient freight rail operation needs only a fraction of the staff numbers that were needed in the past to handle a given level of traffic. There have been major reductions in labor levels in many railways (for example in the Bank’s ECA region alone, railway employment has reduced by over 1.5 million since 1990).

Labor productivity varies greatly between railways in different parts of the world. Part of the differences is due to the level of traffic, recognizing the economies are gained when traffic density is high. Part is due to differences in traffic mix; passenger and general freight traffic is much more labor intensive than bulk freight.
And part of the differences arises from the quality and quantity of capital invested. But even after allowing for these factors, some railway organizations remain heavily overstaffed in all areas (infrastructure, freight and passenger services).

<table>
<thead>
<tr>
<th>Changes</th>
<th>Impact on employment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanized track maintenance</td>
<td>Requires fewer and smaller maintenance gangs for track and other infrastructure.</td>
</tr>
<tr>
<td>Automatic and centralized signaling</td>
<td>Replaces large numbers of individually staffed signal-boxes.</td>
</tr>
<tr>
<td>Shift of LCL traffic to road</td>
<td>Reduces need for loading, unloading and transshipment staff.</td>
</tr>
<tr>
<td>Containerization of freight</td>
<td>Underpins mechanization of freight handling and reduces need for loading, unloading and transshipment staff.</td>
</tr>
<tr>
<td>Point-to-point unit and block train operating strategies</td>
<td>Cuts out need for many small sidings and stations and intermediate marshalling yards, reducing staff requirement.</td>
</tr>
<tr>
<td>New locomotive and wagon technologies</td>
<td>Need more sophisticated maintenance resources but with fewer people working in fewer depots and workshops.</td>
</tr>
<tr>
<td>Higher loco utilization, bigger trains, better communications</td>
<td>Requires fewer crews and smaller crew sizes required per train and per traffic unit.</td>
</tr>
<tr>
<td>Automated customer billing systems</td>
<td>Cuts out the need for large numbers of freight accounting clerks at stations and sidings.</td>
</tr>
<tr>
<td>Competitive outsourcing of non-core competences</td>
<td>Reduces in-house staff and their overhead requirements while cutting costs through competitive procurement strategies</td>
</tr>
</tbody>
</table>

Overstaffing is usually due to political or institutional constraints rather than management neglect. But labor costs typically account for 40-50 percent of total railway operating costs, so whatever the reasons for it, overstaffing is clearly something that will inevitably undermine the competitiveness and long-term development of railway freight.

Trade Union resistance to changes that are threatening their members is one reason why overstaffing endures in many railways. The railway industry is a comparatively old industry in which trade unionism has a long and proud history. Because of the many technical specializations involved it has also often been characterized by a multiplicity of craft unions (or branches of unions) so that downsizing is not only a threat to members but also to viable membership levels at craft or branch level, on which union finances and influence may depend. It is reasonable that those who pay the short-term price of change should look to sharing in its benefits, but often the expectation of union resistance leads not to the adoption of ‘fair’ change, with reasonable compensation to those displaced, but avoidance of change. This is especially so when political power aligns with union power to send a ‘hands-off’ message to management on matters of labor restructuring.

Overstaffing usually also leads to insufficient investment in human resources. The skills mix of an efficient modern rail freight provider is richer than in the past, requiring train crews who can minimize energy and maintenance costs through driving techniques, terminal staff who can drive modern materials handling equipment, train and traffic controllers who can use sophisticated IT systems, marketing staff who can manage client relations and not just waybills, and so on. Rail freight providers that are heavily overstaffed invariably lack either incentives or corporate culture to deepen and widen individual skills.
The future of the rail freight industry, perhaps their only future, is with a smaller, more professionalized staff, with wider skills, higher productivity and with much higher value-added per employee. Chronic overstaffing can only stand in the way of that evolution.

### 3.8 Link Trains into Supply Chains

*Intermodalism and multimodalism are ways that railways can increase market reach without increasing network length.* The development by railway managers of intermodal and multimodal transport products has been evident since the beginnings of railways. In the 1880’s the Long Island Rail Road in New York became the first US railway to offer ‘piggyback’ services. They carried horse-drawn farm carts: the horses were then re-hitched to the carts when they arrived in Manhattan. That service was the lineal ancestor of the first rail piggyback services for road truck trailers established in 1926 on the Chicago North Shore and Milwaukee Railroad. And from 1928, the LMS Railway in UK offered door-to-door intermodal rates using 5 and 10 foot containers on flat wagons.

In the last few decades of the twentieth century, there was substantial growth in the carriage of road truck trailers on rail flat-cars (TOFC) in North America and Australia particularly, though the modest net/tare ratio of such arrangements\(^\text{12}\) and the sometimes cumbersome and labor-intensive loading process inevitably raises the costs of train operations and potential margins are at best thin. However, rapid maritime freight containerization over the last thirty years has given railways the opportunity to carry more general freight, more economically. This is particularly so for routes to/from international ports where containerization makes transshipment relatively cheap, when containerized freight needs anyway to be transshipped to an inland mode, where concentration of flows leads to high volume movements, and where the extra transit time due to slower average speed of railway transport compared to road truck is usually only a small fraction of the total international door-to-door transit time.

![Figure 3-2: Growth of intermodal rail traffic USA (millions of units - Source AAR)](image)

\(^{12}\) Caused by the combined tare of both the wagon and the trailer and low loading density of trailers.
much higher than the average of traffic carried just by rail or just by road. Although the definitions are not identical¹³ Figure 3.4 shows clearly that intermodal rail services can allow railways to tap into higher value freight markets, though it can still only do this if it can offer a lower cost of transport than road transport on its own, which means that higher freight value does not usually mean higher financial contribution margins.

The success of US railways in winning intermodal freight, at what are presumably acceptable financial margins, is due to close attention to customer logistics needs while minimizing railway operating costs. This attention has given rise to the adaptation of rail to double-stacking of containers, thereby improving average train load and net/tare ratio, as argued in Section 3.6, are the two most compelling drivers of cost-efficiency of train operations. Double stacking has been facilitated by USA’s high average axle-loads (more than 50 percent higher than Europe), and the fact that primarily diesel locomotive haulage provides higher loading gauge than that provided by electrified system with overhead wires. Figure 3.2 shows not only the impressive growth in intermodal traffic in the USA in total but also the gradual eclipsing of the less cost efficient trailer transport by container transport.

In the last few years, intermodal traffic as a whole had overtaken coal as the single biggest generator of revenue in US railways (though not of profit). Can developing countries’ railways mirror America’s success in transport of intermodal traffic? Certainly around two-thirds of international general cargoes are now containerized and the underlying trend is still upwards (for trade between advanced countries, the proportion is already 90 percent). So a vast and still growing volume of containerized traffic already exists around the world that needs delivering to and from seaports. But the number of developing countries or regions that have transport corridors of sufficient distance and traffic density to support large and frequent container-trains are relatively few, and not all have the investment resources, and management commitment to competitive advantage that can turn a transport opportunity into a rail market? Currently, some of the most promising developments

¹³ Intermodal in Fig 3.2 is more widely defined than ‘freight carried by a combination of road and rail’ in Fig 3.3.
are in China and India which are described in the Case-studies in Section 5. But other countries are trying to improve rail freight services to capture such markets.

Imbalances in the international trade to/from inland container destinations also provide surplus capacity to build domestic rail container service, which was earlier important in helping railways build similar markets in North America. But whether international or domestic traffic trends alter, success will depend not only on cost but also on how successfully rail services connect with other modes both in a physical sense and in terms of being able to become integrated into a seamless transport service using a single electronic consignment note. Freight railways are inherently bound by location and alignment.

One way, in which rail can respond to competition from other modes of transport, is to seek better connections with them. The long-term role of rail will naturally be supported by improving physical connections with container hubs, logistics centers, river ports and seaports and by looking for markets where connectivity of rail with other modes will improve service and/or reduce costs. But commercial connectivity is equally important to exploit fully the potential for intermodality and multimodality. Railway freight managers should therefore assess the opportunities not to replace but to co-operate and partner with shipping companies, road haulage companies, freight forwarders and logistics services providers. Unless they do so they will become disconnected from final markets, and become price-takers from middlemen (freight forwarders and logistics companies) who, though not new, are increasingly responsible for overall transport organization under contract to ultimate freight shippers or receivers.
4 CREATING THE POLICY SETTINGS: FIVE WAYS GOVERNMENTS CAN HELP

4.1 MAKE RAIL FREIGHT A BUSINESS

Freight transport is a fast-moving and fast-changing game; those playing it need both arms free if they are to stand any chance of winning.

Despite the competitive nature of the freight industry governments in some developing countries continue to constrain the commercial management of the rail freight companies that they own in ways which can only contribute to their long-term market decline.

Most types of state-owned enterprises are vulnerable to bureaucratic pressures that can lead to a flagging of commitment to the main business of serving customers. Other constraints may include: dependence on short-term national budgeting process that undermine longer-term business and investment planning (though the private sector is also not immune to the vicissitudes of investment resources); public service norms and procedures that lead to commercial inflexibility; and Board and senior management selected on the basis of political patronage or seniority rather than on merit.

There are numerous examples of all these phenomena among the rail freight providers of developing countries. While the intensely competitive and nearly wholly privately-owned road freight industry is also rightly subject to regulatory influence, bureaucracy is generally something it has to deal with, and not something of which it is a part. The challenges that public ownership pose to competitiveness are generic to all manner of government trading enterprises, and are not necessarily insurmountable, but three specific factors that impinge on state-owned rail freight operations are worth particular mention: mixed business structures, support of passenger services, and support of other government businesses.

**Mixed business structures**: Because freight trains and passenger trains for the most part run on the same tracks, railways historically normally treated both as different parts of the same business, which they conceived as the business of running trains. Traditional management structures were then based on functional divisions that contributed to this business (e.g. track, signaling, locomotives, traffic operations etc.) or (in larger countries) on regional management divisions as well.

Such structures were found to be less effective in an increasingly competitive commercial environment, for three main reasons:

- Being structures based on cost-centers, the most compelling incentives on railway managers (as in most organizations structured according to cost-centers) are first, to maximize budget, and secondly to spend it all. The result is a tendency to empire-building as staff numbers and budget, not profit contribution, and are key to influence and rewards.
- The responsibility for overall commercial performance is dispersed over, and therefore shared between, many branches; since none has much influence over the others none can...
reasonably be held accountable for overall corporate performance. Only at the level of the CEO does commercial responsibility and accountability come together.\(^{14}\)

- The functional structures (and to a lesser extent) the regional structures did not correspond to the way in which transport markets were organized, which often weakened the ability to align operational products to market needs.

However, the real business of a railway is serving transport markets, not running trains, and passenger and freight transport markets are quite different: different customers, different service needs; different economic drivers. And most particularly, different political profiles that mean that where both are shoehorned into the same corporate structure, passenger service is often given priority in investment, in allocation of track capacity, and in management attention and resources. Despite much restructuring of public railway managements in the developing world such priorities still remain in many countries, adversely affecting, and sometimes crippling, the capabilities of rail freight operations.

**Support of the passenger sector**: because political priority is so often given to passenger services in a mixed railway, one of the ways freight rail can suffer is financially. Overt cross subsidy of passenger services from freight is now less common than it once was but it still happens in many developing country railways, large and small, and in other cases persists by less direct means. For example, freight trains which use infrastructure that is planned around passenger service can suffer serious disadvantage by being allocated infrastructure costs commensurate with the technical and maintenance standards of the passenger rail operation, or disproportionate to their usage of the capacity. Cross-subsidy not only makes it harder for freight managers to compete in an already tough freight market, but is effectively a tax on freight transport with wider impacts on economic development.

**Support of other government businesses**: In some countries governments have ownership stakes in mining operations, oil production and refining, steelworks etc. This can be accompanied by intense pressures on rail freight managers, often extending to direct instruction, to keep tariffs artificially low to the benefit of these so-called ‘strategic’ industries. Strategic in this context often simply means industries with more political influence than the rail freight industry. In one sense this influence does of course keep rail tariffs low and the traffic on rail, but in the longer-run it does nothing to provide the income or motivation for railway managers to build genuine competitive advantage into the business.

All in all, the best combination of policies to ensure the long-term decline of a state-owned rail freight provider is to keep it firmly tacked onto a loss-making passenger railway while also requiring it to subjugate its freight tariffs to the interests of ‘strategic industries’. Although such an arrangement seems impossibly conflicted, it is in fact a combination that is not uncommon, and one that is sometimes accompanied by an even more bizarre exhortation by government to behave more commercially.

Governments that want state-owned freight railways to attain long-term prosperity and growth should do all possible to convert freight railways into companies that are managed independently of passenger railway services and are at genuine arm’s length from government. This is not of itself sufficient to improve commercial performance but if governments are willing to grant commercial freedoms to public enterprises it is a necessary enabler of more far-reaching reforms such as: a more professional and independent board of

\(^{14}\) In many such railways it was not uncommon to see a succession of CEO’s come and, after the inevitable failure, go while the most astute individual branch heads remained powerful and near-permanent rulers of enduring functional empires.
directors; management selected on merit; management accountability through short and medium term business planning targets; business segmentation and concentration on core functions; greater freedom of pricing; use of internationally recognized commercial accounting and auditing standards; and formal agreements between enterprises and government for reimbursement of any public service obligations imposed by governments on freight service through mandated service or tariff conditions. Arm’s length or semi-autonomous supervision also facilitates more transparent oversight of safety and environmental performance, which can be more easily overlooked when government departments are responsible both for regulatory and commercial functions.

Making rail freight a business means splitting off the rail freight function from passenger service and transferring its staff and the train operating assets into a new incorporated structure with its own accounts, board and a shareholding held separately from that of other parts of railway business. When freight services substantially dominate network utilization it may be best that the freight company also manages the infrastructure. Those opposing separation of passenger and freight operations often point to the potential loss of utilization of crews and locomotives when these are split between the businesses, but the potential efficiency gains from business-led structures far outweigh these ‘resource-sharing’ losses which can anyway be minimized by cross-hiring of resources between businesses when there are mutual benefits in so doing.

4.2 Let the private sector play.

Private participation in rail freight has been successful in improving performance just about everywhere it has been tried. It is not always clear why governments wish to stay in the business of carrying rail freight at all. As noted, it is an arduous, low-margin business in which success often depends upon being able to outsmart a highly decentralized, competitive and entrepreneurial road haulage industry that faces few barriers to entry or movement. Indeed, the thrust of road transport policy in most countries, has been towards greater economic deregulation of the road haulage industry and the phasing out of any public sector service delivery role in the sector.

There is strong evidence of the benefits of private rail freight operations (whether vertically integrated or train operating companies only). A review of rail freight privatization on three continents, Latin America (sample of 7 freight railways), Africa (12 freight railways) and Australia 5 freight railways), between 2004-2006 showed that while privatization is not a panacea when the fundamental market circumstances are weak, it has almost always had a positive result on the pre-existing business efficiency and effectiveness in the freight sector. 15

The conclusions are summarized in Table 4.1.

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15 These studies are cited in the references and can be accessed at the World bank’s transport website.
<table>
<thead>
<tr>
<th>Latin America</th>
<th>Africa</th>
<th>Australasia</th>
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</thead>
<tbody>
<tr>
<td>‘the overall assessment of its results is positive, particularly for freight railways’</td>
<td>‘despite the vicissitudes, the results are encouraging’</td>
<td>‘the main freight railway privatizations were successful’</td>
</tr>
<tr>
<td>‘measures of productive efficiency almost uniformly show post-concession improvements…concessioning brought impressive improvements in labor productivity and other efficiency measures’</td>
<td>‘productive efficiency has clearly improved… labor productivity has increased steadily in all the concessions …asset productivity has also generally increased.’</td>
<td>‘freight railway privatizations were generally successful in raising revenue for governments, removing or reducing governments’ risks, achieving efficiency improvements and achieving increased freight volumes’</td>
</tr>
<tr>
<td>‘railway traffic volumes have climbed, with some improvements in surface transport market share’</td>
<td>‘the active searching for new traffic by concessionaires and the improvement in internal business practices have all improved railway cost structure and…lifted the level of service, thus helping to attract traffic’</td>
<td>‘new operational and logistics management skills could be applied to discipline costs, innovate, and increase traffic and revenues’</td>
</tr>
<tr>
<td>‘private investment has rarely met concession promises or led to major network upgrade or expansion’</td>
<td>‘substantial investments in infrastructure but almost fully funded by international donors…little private investment’</td>
<td>‘problems of investment in low density lines remains: governments will need to be investor of last resort’</td>
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</table>

Many of the individual freight railways in the above countries are relatively small, with thin market potential, and it is instructive that all three studies concluded with skepticism as to whether the private sector would actually make major long-term investments in new or substantially upgraded rail infrastructure – this is an issue to which we return in Section 4.5, and in the Africa Case-study in Section 5.4. However, the benefits of private sector participation are not confined to small railways or small underdeveloped countries. The experience of rail freight privatization in Canada and the UK, and increased private sector participation in freight in Germany, Sweden and elsewhere in the EU using third-party access rights, all provide evidence of its benefits. Moreover, by far the most successful freight railway industry in the world is that of the United States, that has for the most part always been operated by the private sector.  

Privatization of any public industry is of course not only an economic decision but a political decision too. Country differences in the balance by which public and private sectors contribute to freight transport service delivery stem from history, culture, and circumstances. Many governments are uncomfortable with the notion of fully private ownership or free-market operation of transport networks. They point to the issue of natural monopoly; the practical or economic difficulty of fully recovering infrastructure costs from user charges; the ‘lumpy,’ long-term, immovable and therefore risky nature of much transport infrastructure that can render it unattractive to private investors; and the common public view that ‘common user’ transport infrastructure is an inherent part of the public patrimony which should be run for the public good rather than for commercial gain.

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16 Though originally built with large injections of public funds and of real estate inducements, and benefiting (in terms of freight planning, investment and operations) from the minimal or zero presence of passenger services on most of its lines.
Whatever the rights and wrongs of these arguments, the reality is that most rail freight in the world is carried on lines that were built as passenger routes and/or on which the majority of trains that use them are passenger trains. That fact will generally dominate political debates over whether rail infrastructure can be privatized. In developed and underdeveloped countries, all over the world, the political consensus has most frequently been not to privatize those rail networks that have a significant passenger service function. However, none of the arguments against rail network privatization generally applies, or needs to apply, to freight train operations. They are not a natural monopoly, indeed usually operate in highly contestable markets, they can usually be made to earn a margin above operating costs, and so contribute something to the common infrastructure; do not depend on lumpy long-term investment, leasing options and second-hand markets exist for most locomotives and rollingstock; and are no more part of the public patrimony than would be the trucks that use the public roads or the barges on a canal. Private sector participation in rail freight transport services can be attained in a variety of ways without giving up public ownership or operation of railway infrastructure, or passenger services, as shown in Table 4.2.

Table 4.2: Opportunities for private participation in rail freight provision

<table>
<thead>
<tr>
<th>Method</th>
<th>Framework</th>
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<tbody>
<tr>
<td>Cooperation</td>
<td>Partnership or JV of the state-owned rail freight provider, or specialist parts within it, (like major freight terminals or container trains), with a private transport or logistics company.</td>
</tr>
<tr>
<td>Management contract</td>
<td>A contract with a management services supply to come in and manage the state-owned railway for a defined period.</td>
</tr>
<tr>
<td>Concessioning</td>
<td>Separating the state-owned rail freight train operating entity into a separate company and franchising it to the private sector; the franchised freight company would then pay infrastructure access charges to the infrastructure provider.</td>
</tr>
<tr>
<td>Sale</td>
<td>As above, but selling the freight company outright rather than franchising it.</td>
</tr>
<tr>
<td>Hook &amp; pull</td>
<td>Maintaining the state-owned rail freight provider in public ownership but granting rights to other companies to offer or perform freight rail service through use of their own wagons, while using the state-owned operator to actually haul the private trains with its locomotives and crews.</td>
</tr>
<tr>
<td>Access</td>
<td>Maintaining the state-owned rail provider in public ownership but granting general access rights (as in EU and Australia), restricted access rights (as in Canada and Mexico) or contractual access rights (as in the USA) to third-party private freight train operators.</td>
</tr>
</tbody>
</table>

While rail infrastructure and freight train services are most often tied closely together into one vertically integrated entity, this need not be so, and separation can enable governments to maintain a controlling interest in the infrastructure and rail passenger services if they so wish while encouraging the private sector to participate; either by joint venturing, sale or concession of public rail freight operations, through hook and pull options, or through various levels of access rights. (Section 4.3 considers the issues of third-party access in more detail).

In short, there are ways of encouraging private delivery of rail freight services, in whole or in part, with or without vertical separation from infrastructure, and with or without privatization of a main state-owned freight operator. However, they do all pre-suppose a policy commitment to the first proposition in Section 4.1 that rail freight should operate as a business.
4.3 ENCOURAGE COMPETITION

As stressed earlier, rail freight providers already mainly operate in contestable freight transport markets. This is evidenced in what is often quite low market shares, which makes it all the more surprising that some governments continue to pursue policies premised on the concept of railways as a natural monopoly! In fact any monopoly power that they have is usually a monopoly in respect not to freight transport but of rail freight transport, and far from being ‘natural’ it is a monopoly that is usually bestowed not by market forces but by government fiat.

But even if freight transport markets as a whole are already contestable, there is a prima facie case for contestability in the rail freight market itself. The potential benefits of competition are as real in provision of rail freight service as in other sectors. Competition creates incentives to managers to meet freight market needs at the lowest possible cost; and it encourages them to innovate in service to obtain market advantage. It is, for example, impossible to conceive that the road freight industry internationally would be the formidably fierce competitor to rail that it is if it were, like the rail freight industry, confined to one state-owned operator.

In making a case against contestability, it is sometimes asserted that competition between rail freight companies will mean that the economies of scale of railways will be lost and average costs will then rise. But as argued in Section 3.3 and Annex B, most of the so-called economies of scale in railways are actually ‘economies of scope’; that is, they arise out of decreasing average costs of adding additional traffic to a pre-existing railway infrastructure (until capacity is reached); in other words, the higher the traffic density the lower the unit infrastructure cost. These infrastructure economies are not materially affected by whether a given traffic volume over the track is generated by just one train operating company or multiple companies. Nor is there any reason to expect any loss of economies in corporate administration as there seem to be few administrative economies of scale, if any, in rail company size. In any event, evidence of economies in management overheads would rightly be rejected as a reason for artificially restricting competition within the road haulage or other industries, and there is no reason why it should be accepted in the rail freight industry.

Where some loss of economies might be expected, particularly in thin markets, is in train operations where there are considerable economies by operating large trains, maximizing net/tare ratio and attaining high utilization of resources. In some countries, amongst which Africa has many examples and will be discussed as a Case-study in Section 5, the potential traffic available even to a successful freight train operator might be too low to sustain competition without danger of undermining viability of train operations. In such circumstances there is a case to be made for exclusivity. It is also possible to contemplate benefits in granting exclusivity to a rail freight provider in order to encourage or in return for a commitment to making long-term investment, particularly in infrastructure but also conceivably in rollingstock.

However, there are many countries and corridors in the developing world that have sufficient traffic flows to make competition an option and whose railway system would undoubtedly make greater contribution to economic development through the existence of a contestable rail freight market. Such an outcome would usually imply that governments permit the granting of limited or general access rights to third-party operators as discussed in the previous section. Despite reasonably high financial barriers to entry, such as the costs of acquiring or leasing rollingstock and of establishing a qualified management and staff, a positive but not excessive level of competition, or at least the credible threat of competition, is likely to result and to benefit the performance of the industry.
This is not as radical an option as is sometimes presented, and misrepresented. Early British and American railway law was in fact based on the anticipation that this would be the normal pattern of use of new railway lines, as it had been on canals, and in the early days multiple operators on a line was not uncommon. Since the invention of railways there have been many situations in which the trains of one railway entity operated over the tracks of another railway entity and paid for that use of tracks. Today it generally occurs in one of three main institutional frameworks:

- Countries in which negotiated rights of track access occur at specific locations through private agreement between different railway entities (e.g. USA, Canada)
- Countries in which, in addition to some private agreements, there are some mandated rights of access defined in national laws, but where these rights are confined to more narrowly defined locations and/or circumstances (e.g. in Canada, Mexico, Russian Federation)
- Countries where there are mandated rights of access which are much more widely defined, based on a precept of the general desirability of broadening access to public infrastructure (e.g. in the European Union and its member states and in Australia).

As a result, there are now well tried-and-tested ways of licensing independent private train operating companies and of managing the operational interfaces that a multi-operator regime entails.

There is a case for avoiding the policy disconnect that seems to be implicit in policies that lead to the encouragement of private freight train operations in competition with a continuing state-owned freight train operator. Such a policy configuration inevitably raises questions of unequal terms of competition due either to access of state-owned companies to public finance; or conversely, due to ‘bureaucratic’ constraints on the state-owned operator versus their less fettered private competitors. In the latter case, ‘cherry-picking’ by the private operator is inevitable. Once a government has decided that it is not wedded to the idea of exclusive public operation of rail freight, it would seem prudent to pick its own cherries first by selling the state-owned rail freight provider and capturing its value before new operators enter the orchard. A judicious and consistent approach for a government seeking both private sector participation and competition in this sector would be to separate and sell its own rail freight operations against a commitment to introduce wider access rights at a pre-agreed date in the future.

Finally, in circumstances where governments rule out competition ‘in the market’ for rail freight transport and decide that some measure of market exclusivity in the rail freight industry is justified, rail freight can still be made contestable by ensuring a transparent and competitive process is followed in the granting of exclusive rights, thereby creating at least periodic competition ‘for the market’. This was basically the approach followed in most of the African rail concessions described in the Case studies in Section 5.4. There is an extensive literature on the best ways of concessioning small railways and the issue is not discussed further here.

4.4 **DON’T LET BORDERS BE BARRIERS**

Many railway networks are nationally-owned so it is inevitable that national borders are often railway borders; but inward-looking policies by both governments and railways have meant that their impact on the development of international rail freight corridors has sometimes been profoundly negative.
As indicated in Section 2, most rail freight volumes are transported by a small number of large countries: USA, Russia, China, and India. Their rail freight markets have favorable commercial characteristics: dense and long-distance national freight corridors; strong flows of bulk products, a high proportion of freight with origins and destinations within one national network; and comparatively high average freight transit distance. In other parts of the world that have a number of small contiguous national railway networks it is vital to develop regional programs for developing successful long-distance railway Corridors for both bulk and non-bulk freights. Because of the international relationships involved, it is government responsibility both to encourage the international co-operation between railways that can bring this about, and to adapt its own border controls to minimize the delays and unreliability that plague many international rail borders.

There are many problems at national railway borders and they differ from country to country but can include:

- **Absence of transit management**: International train transits are not always actively managed so as to achieve a specific origin-destination train path. National railways may move trains from border to border according to their own ways of working. Trains are allocated to train paths available following border processing. Since the processing time can vary markedly the actual train paths used will vary from those planned (if any). Moreover international trains will not necessarily get priority in allocation of train paths, locomotives, mechanical repair or management attention. Things that go wrong at borders often do so in remote places at inconvenient times and local decision-makers will not always give priority to the international traffic.

- **Unnecessary or incompatible train inspections**: When carrying out mechanical inspections of wagons, receiving railways will avoid acceptance of wagons in poor condition which might cause safety problems or require repair while it is on the system. Further, if a wagon is ‘marked-off’ it will need to be shunted out of the train-consist and the train will need to be re-marshaled, which takes time. But there is often lack of consistency in the inspections between countries. One train examiner may authorize a wagon fit to proceed which another examiner in the adjacent country might mark it off for defects.

- **Loco and driver change**: Locomotives and drivers may be changed at each border. Although the actual process of locomotive change need not take long, this presumes that the fully-crewed locos are ready and waiting at the changeover yard. This will not always be the case, particularly if schedules are disrupted. For example, a domestic train which may supply the locomotives for an international train may be late. Or the local train dispatcher may allocate the waiting locomotives to a domestic train if it looks as though the international train will be late. When a new train-consist has been formed, the train brakes also need testing for continuity, which also adds delay.

- **Bunching and queuing**: As noted there may be a high degree of variability in border processing times. Combined with inevitable perturbations in train running performance, trains may bunch together creating ‘queuing time’ at borders waiting for processing. The problems are self-amplifying. High variability of processing times at borders is itself a major cause of schedule disruptions.

- **Information flow**: Sometimes the wagon or train manifest only arrives with the train. Without this information there is little opportunity for any advanced processing by Customs or other border agencies.

- **Customs and other border procedures**: Customs and other border procedures are also subject to variability, partly because of variability in the railway operations and partly
because of their own processes. However, the border services will inevitably be delayed if train bunching occurs: also passenger trains will tend to be given priority when a conflict occurs between freight and passenger train processing. For general freight trains, if Customs officers want to make a full inspection of a wagon, then it is normally shunted off the train. For block trains the railway is then faced with a difficult decision whether to detach the wagon and allow the train to proceed or whether to accept inspection while the train-consist remains whole. Detaching helps to keep the train moving but will create a major delay for the detached cargo.

Such problems are complex and require close and coordinated political and managerial attention across borders over many years for a ‘seamless’ international rail freight corridor to be established.

Sometimes, the political and managerial boundaries are magnified by technological boundaries that may require investment solutions. For example, the European rail network is a patchwork of inherited national systems of different technical standards containing 4 main track gauges, 8 main signaling systems (and 12 others), 6 main electrification systems plus sundry differences in loading gauge, pantograph headroom, maximum axle-loads, direction of running, safety systems and others. Not only does this create inevitable operating constraints but means that the suppliers of equipment for railways lose the opportunity to exploit scale economies. It is necessary at an intergovernmental level to encourage standardization and interoperability if international rail freight corridors are to be successful in the market.

4.5 LEVEL THE PLAYING AND THE PAYING FIELD

Freight transport demand is market-driven but its ‘supply’ partly depends on government policies for funding public infrastructure. Nearly all rail freight in developing countries travels on publicly-owned networks, as does road haulage and inland waterway transport. Public funding of each network is rarely decided in accordance with any overall national transport strategy or multi-modal assessment, and policies for infrastructure regulation and pricing policies are for the most part independently assessed and applied.

In most developing countries, as in developed countries, governments treat the road system as a ‘public good’, and apart from the relatively few privately funded toll-roads the public sector is responsible for the planning and funding of highway network enhancement, expansion and maintenance. Governments may not exactly spend this money with a glow of munificence but it is not a responsibility that is widely questioned. All countries understandably employ large permanent administrations to plan, fund and manage the road network.

By contrast, in most countries railway network financing policy proceeds on the presumption that the railway network is predominantly an internal company matter (even when it patently isn’t), that should ideally meet its own capital needs (even when it patently cannot). So although large amounts of public funding are often actually spent on the railway system, the use of funds tends to be handed over sporadically, in arbitrarily fluctuating amounts, for what is often an ill-defined mix of supporting cheap ticket passengers, making up any other cash losses, maintenance back-logs that management can classify as urgent capital renewals, plus any really urgent capital renewals.

It is commonly and rightly hoped by many governments that the private sector should make a greater contribution to transport infrastructure needs, but the financial contribution of governments themselves in developing transport infrastructure will be decisive in achieving this goal. It is difficult to transfer to private
sector the full responsibility of large investment programs for building new railway lines or developing railway networks in most developing countries. In Africa for example, spotlighted in Section 5.4, most of the existing private rail concessions simply do not have the traffic to generate sufficient surpluses for major rebuilding or upgrading of existing lines, let alone build new lines to create an interconnected network of rail corridors. For the latter, public investment support would be needed as is unquestioned in the development of Africa’s road network.

Of course it makes no economic sense to say that just because large amounts of public money are spent on road infrastructure, similarly large amounts should be spent on railway infrastructure. But a government’s broad policy aims and principles in transport should apply in the sector as a whole, independent of mode. Similarly, the instruments of policy such as public investment, infrastructure charges, transport taxation policy, environmental and safety regulations and so on, while not amenable to perfect harmony, should at least not be in obvious conflict.

For example, many countries profess that for environmental and road safety reasons they would like to see more use of railways relative to roads, while at the same time investing very heavily in road network construction and relatively little in railway network upgrading. Public investment decisions are not the only (or main) determinant of modal shares but it would be surprising if large disparities in public infrastructure funding levels relative to traffic task did not have any long-term effect. Such effect might or might not always be the decisive factor, but the truth is that it is hardly ever brought into the decision.

Similarly, differing standards of and compliance with safety and environmental regulations can influence modal operating costs and modal choice. Examples of such regulations include market-entry licensing, standards of driver training, vehicle environmental standards, vehicle overloading, driving hours, movements of dangerous cargoes, and so on. Standards in different transport sub-sectors are often quite different, for no articulated reasons, with implications for modal competitiveness.

Finally, infrastructure pricing and cost recovery policy between railways and roads is typically determined by different groups of people, in different authorities, using different economic principles, and implemented with different instruments. Bringing inter-modal consistency to this area is certainly not easy. The difficulties are well illustrated by responses to the EU’s policy to support the development of more transparent and consistent charging principles in all modes of transport. The policy requires development of common accounting and cost allocation methodologies for infrastructure, and common principles for charging to avoid distorting competition between modes (the European Commission’s preference is to set prices according to marginal social costs). The methodological challenge of applying consistency between modes is more than matched in the EU by the political challenge of getting 25 member states with very different transport systems and policy priorities to agree to implement them. Nevertheless, even if there cannot be a perfect methodology, the policy process in a single country should ideally try to establish a system of infrastructure charges as between competition that, after taking account of safety and environmental values, does not tip the price of using one transport network rather than another other in the opposite direction to their respective long-run marginal social costs.

This is not meant to make the case for a specific set of modal roles and market shares. National transport policies should not be excessively prescriptive about the precise roles of the different modes of transport: road, rail, airlines, waterway transport etc. They should instead try to establish broad policy principles and settings, such as: how the sector will be governed; public and private sector roles; establishing the extent of competition and the nature of regulation; attainment of consistent pricing principles across modes to reflect
costs and avoid distorting user choices; integrating global warming policies into transport policy; ensuring transport equity to meet the needs of disadvantaged groups and remote areas; and safety and security. Establishing and implementing such principles is not straightforward but it is better done imperfectly than not done at all.
5 CASE-STUDIES

5.1 INTRODUCTION

The diversity in scale and nature of freight transport markets, railway systems and policy environments worldwide mean that there can be no single implementation formula for improving the development performance of the rail freight industry.

The management and policy approaches outlined in Sections 3 and 4 are expressed as general principles, recognizing that local context and constraints must shape the nature and degree of their implementation. For example, while it is clear that North America has the most productively efficient freight railways in the world, and has many lessons relevant to other regions, it benefits from almost exclusive use of rail infrastructure which is not the case in countries like India or China that have massive passenger transport operations sharing the same infrastructure. Another railway model is that of the European Union, which has promoted a policy of vertical separation of infrastructure and train operations that has been implemented to varying degrees (depending on member country) and to statutory infrastructure access rights for freight train operating companies. But the geo-political reasons that have led Europe to adopt this model do not automatically apply to other regions and the sophisticated legal and institutional apparatus available within Europe to enforce and regulate it do not always exist in other jurisdictions.

The examples described below are therefore not presented as models for other countries but as very particular examples of where some of the ideas discussed in this paper are being pursued and in disparate forms. The first example is China and the second from India and the third from Africa. The sources of information are three reports commissioned by the World Bank into railways in these regions. 17 18 19

5.2 CHINA’S COMPREHENSIVE RAILWAY DEVELOPMENT PROGRAM

Several factors make railway transport extraordinarily well-suited to China and its economy. China’s economy depends heavily upon coal and coke, metal ores, iron and steel, petroleum products, grain, fertilizers and other bulk products. As indicated in Section 3, the technology and economics of rail transport are well suited to this traffic. Moreover, the average transit distance of China Rail’s freight is 762 km (2006), relatively high by world standards. With favorable traffic profile and distances, the Chinese rail system carries about two-thirds of the country’s inland freight task (that is including inland waterways but excluding coastal shipping). China also has a high population density in its settled areas and numerous large cities. With increasing purchasing power to back up their growing propensity to travel this is fuelling some of the most intense inter-city passenger flows in the world.

In these circumstances it is appropriate that the first case-study presented is China, which has by far the biggest, most far-reaching and most comprehensively planned and financed railway sector development program anywhere in the world. But it was not always so. In 1949, China had only 22,000 km of poorly maintained and war-damaged railway lines, less than 1000 km double-tracked and none was electrified. Since

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then, the Government has transformed the railway sector into a vital element of China’s national transport system and a key contributor to China’s extraordinary record of economic growth. Today, with a network of around 80,000 km, China Rail is the world’s biggest rail carrier (in 2008, it carried 773 billion passenger-kms and 2,512 net tonne-kms of freight).

Market forces now increasingly shape all facets of China’s transport demand: the types of freight and passenger transport demanded; the volume of demand; its geographic distribution; and the proportions of traffic carried by each mode. The Ministry of Railways, and its constituent regional railway administrations and other entities, have responded by creating a modern rail system adopting proven international practices and technologies, giving them distinct Chinese characteristics, and adapting them to Chinese circumstances.

China is pursuing many initiatives that fall within the scope of the management principles set out in Section 3 above. The main initiatives are summarized in Table 5.1.

Table 5-1: Examples of management approaches applied in China

<table>
<thead>
<tr>
<th>Principles</th>
<th>Examples of application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market segmentation</td>
<td>Establishment of specialist companies to run some major coal lines and to organize rail container services, express small freight and special freight.</td>
</tr>
<tr>
<td>Cost efficiency</td>
<td>Continuous improvements in labor productivity and asset utilization; previously declining market share has been stabilized.</td>
</tr>
<tr>
<td>Traffic financial performance</td>
<td>Adoption of Traffic Management Information System (TMIS) that can provide data to facilitate detailed traffic costing (though this is not yet routinely done)</td>
</tr>
<tr>
<td>Market pricing</td>
<td>Prices remain heavily regulated</td>
</tr>
<tr>
<td>Investment in Infrastructure</td>
<td>Targeted investment in duplicated, new and improved infrastructure that will create substantial additional capacity for unmet demand for freight traffic</td>
</tr>
<tr>
<td>Efficiency of train operations</td>
<td>Progressive increase in average axle-load; larger trains; specialized high capacity wagons; block trains; double-stack container capability.</td>
</tr>
<tr>
<td>Labor restructuring</td>
<td>Total workforce reduced substantially since 1990; direct railway labor productivity increased by 6-7 percent annually for last 20 years; extensive training in management and operation of new and locally-adapted rail technologies</td>
</tr>
<tr>
<td>Intermodal transport</td>
<td>Joint venture with international companies to build a network of modern centralized intermodal rail container terminals served by dedicated container trains from ports</td>
</tr>
</tbody>
</table>

China has yet fully to embrace the policy approaches recommended in Section 4. Rail freight is not a specific business within China Rail but is integrated together with passenger services and infrastructure within regional management structures. However, government policies now enable private sector participation: two specialized coal transport companies (Guangshen and Daqin) are partially listed on the stock exchange and a large number of joint-venture railways have been set up as investment vehicles to encourage external capital, though little of this has to date been purely private (most has been from provincial government and SoE shareholders). Competition between railways is not at all encouraged (either as between existing regional railway administrations or between those administrations or new train operating companies). And finally, China does not have a top-down sector-wide national Transport Strategy that might provide a more stable and consistent basis for allocating and recovering public investment resources across sectors and for transport industry regulation.

China’s railway policy-makers have nevertheless recognized the long-term commercial need to respond to competitive challenges of road transport. Its development of heavy-haul coal operations and double-stacked
Electrified container routes builds upon gradual improvements to freight handling capability over a long period.

It has recognized that the triple challenge of capacity growth, operational efficiency and service quality would be best attained by application of value-adding railway technologies throughout the railway, in construction, maintenance, operations and management. China’s railway network is matched by an equally impressive network of railway institutes, specialist universities, testing facilities and laboratories that have given it the capacity to absorb best international practices and creating Chinese technologies and processes aimed at solving operating challenges specific to China.

The separation of non-core functions and ancillary businesses, progressive improvements in labor productivity, higher asset utilization, and the flattening of the organization structure (eliminating sub-administrations) have delivered step-changes in efficiency, and while China’s regional Rail’s freight providers are not corporately a ‘business’ most are increasingly acting like a business. The separate companies within China Rail that have been set up for Container Transport; Express small freight, and Special Goods have yet to emerge as independently strong units but they may point the way ahead for specialist businesses.

Despite the successes of the program, China still faces major capacity problems on many of its routes and the rail expansion program is being accelerated. These plans, which are already ahead of schedule in implementation, are set out in the Ministry of Railways (MOR) Mid to Long-Range Network Plan (MLRNP) to 2020 (and subsequent modifications). Its objectives are to expand transport capacity and improve service quality, while supporting both rural and urban development in a sustainable manner. It encourages both domestic and foreign private capital investment. It defines the Government’s regulatory role and responsibilities within a market framework. MLRNP represents the biggest railway development program in the world since the nineteenth century. The key elements are: the upgrade of existing lines; a new high speed passenger network; network expansion into less developed regions; three new regional agglomeration networks; high capacity coal corridors; and an upgrade of railway container services.

**Upgrading of existing lines:** Lines will be upgraded to support the Government’s overall national development strategy to attain a more balanced development among the regions, with accelerated development of the western regions and reconstruction of the north-east industrial base. The general objective is to ensure all major corridors are double-tracked and electrified, as a minimum, with further segregation of freight and passenger services on the busiest routes.
**Dedicated high-speed passenger network:** Partly to free up capacity for rail freight expansion the Plan will create around 12,000 km of high-speed dedicated passenger lines between major provincial centers. The existing tracks will be used to accommodate growing freight demand and slow local passenger trains. This strategy will more than double the rail transport capacity in such corridors.

**High capacity coal corridors:** High-capacity coal corridors will be based on China’s ten major coalfields to provide an annual coal transport capacity of 2 billion tonnes in 2020. Immediate priorities in the Plan are increasing the west-east capacity to the north China ports. High axle-load wagons, of 80 tonne carrying capacity will be used.

**Container services:** MOR has set up a joint venture with international investors to build central container terminals in 18 major centers and ports which will be linked by regular container train services. The first two of these, Shanghai and Kunming, have already begun operations. A further 37 satellite terminals will be established by redevelopment of existing freight terminals, with a further 150 conventional stations being equipped to handle containers. Some major routes with heavy container traffic are being upgraded to allow double-stack container trains.

**Network expansion:** Regional economic development will be supported through expansion of the western railway network and improvements in the central and eastern areas of China. In total, about 16,000 kilometres of new lines are planned. They include:

- Four new lines to international borders in the north-west and south-west (1,600 km)
- Twenty new lines to augment the regional network serving Xinjiang, Sichuan, Gansu, Inner Mongolia and Tibet (9,600 km)
- Seven new lines in the central and eastern regions (1,500 km).

The four new lines to international borders will provide new rail transport corridors to Kyrgyzstan, Vietnam, Laos and Myanmar. The expansion of the western regional network includes six new corridors linking the region to the remainder of the network as well as 14 internal links.

China, like many other large countries such as the USA, India and the Russian Federation, is good rail freight territory from the point of view of the traffics and distances offering. Its rail policy-makers and managers are responding to this with a long-term resolve and commitment to expand and modernize the system that is little short of astonishing. They are determined that rail transport will not become a bottleneck of economic development. While much remains to be done, they have made some progress in most of the areas of management suggested in Section 3 and to a lesser extent in the policy areas described in Section 4. It remains to be seen whether China will in due course embrace the pluralist rail freight industry advocated in this paper that could bring many more private sector train operators and competition to the delivery of core freight train services. But it would be surprising if, when the current priority being given to physical expansion achieves its goals, these issues do not come to the fore.

### 5.3 Indian Railways Turnaround Program

The last decades of the twentieth century saw a progressive decline in the market and financial fortunes of Indian Railways. By 2001 the system was run down, with huge arrears of renewals and replacements, high asset failure rates and a poor and deteriorating financial operating ratio. Yet by 2008, Indian railways had eliminated maintenance deferrals, paid back deferred dividends to government, replenished its depreciation reserves and earned record surpluses.
The Case-study summarized in this section was commissioned by the World Bank in 2007 to investigate what had brought this about. It found that accounting changes had had a favorable impact on the operating ratio, but that even after allowing for this factor, Indian railways had improved its real commercial performance and financial results substantially. The Case-study identified a number of factors in the freight area.

**Traffic growth:** this was a period of increasing volumes on Indian Railways. As is explained in Section 3.3, so long as management is disciplined in its budgetary controls, incremental traffic on a railway can usually be carried at a marginal cost much lower than average cost thus improving financial performance. During this period, Indian railways management were indeed disciplined in ensuring that the economies of scope were not frittered away but on improving both the balance sheet and reinvestment in infrastructure backlogs, and were able to improve the long-term performance of the railway.

**Tariff increases:** The gains due to higher volumes and lower average costs were magnified by real increases in freight rates during this period, implemented as part of a revised and simplified tariff system, better reflecting what Section 3.4 refers to as ‘pricing to market’ of bulk commodities. In many of the previous years, Indian Railways had been reluctant to increase these rates, either because of political reasons and/or because of an unwillingness to ‘test’ the market in terms of its willingness to pay for the service offered.

**Employment and labor productivity:** Labor productivity had been growing slowly but steadily in the last decade of the twentieth century but accelerated from about year 2001 and just about doubled between then and 2007. This reflected the implementation of a policy of ‘rightsizing’ dating from the year 2000. As indicated in Section 3.7, a combination of retrenchment of unnecessary labor functions, which effectively moves the production cost curve downwards, combined with increasing traffic can boost productivity dramatically and in a relatively short-period.

**Public Infrastructure Investment:** The Government of India took a far-sighted decision to set up a special Railway Safety Fund to be used to improve rail infrastructure. But it was directed not just to pure safety improvements but also to the sort of investments described in Section 3.5 to squeeze greater value from railway infrastructure. Over the next few years Indian railways renewed and upgraded much main line infrastructure with heavier rail, improved bridges, new signaling and upgraded information systems. This laid the foundation for higher axle loadings, higher line capacity and improved equipment utilization.

**Revenue density of trains:** What the Case-study refers to as improving the revenue density of trains is an example of what is described in Section 3.6 as hauling more (paid) freight with less metal. As part of its turnaround program, Indian Railways has increased average axle loadings for bulk commodities. Indian Railways had a nominal axle load of 20.3 tonnes/axle and tariffs for wagon-loads of traffic were traditionally based on the assumption of the standard loading. In practice, customers often overloaded with the result that customers could consign marginal loading for no charge while the average yield per tonne actually hauled was less than as recorded by Indian Railways. As part of its program, and after experimenting on track impact, Indian railways increased the permissible axle-loading for major commodities such as coal and iron-ore and charging accordingly, thus both capturing revenue in cases where they were already carrying the extra loading, and capturing real extra volume and revenue from shippers who had not previously loaded beyond nominal limits. The Case-study estimated that this change increased the average (charged) tonnes per train by 9 percent in 2003, the year of introduction.

**Wagon utilization:** Indian Railways attained a significant improvement in rollingstock utilization by improving wagon velocity through infrastructure improvements and management, incentives to customers to consign full rakes of wagons, incentives to avoid ‘hoarding’ of wagons but to get them turned round quickly instead,
rationalizing train examination procedures to reduce in service delays and reduce time that wagons are ‘marked-off’ out of service, and better tracking and management of wagons. The cumulative effect of these changes was to reduce wagon cycle times by 15 percent.

The financial turnaround of Indian Railways also illustrates one of the key messages of this paper. That is, while the implementation of performance improvements, whether in publicly or privately-owned railways is for railway management, radical improvement in publicly-owned railways is rarely possible without strong government support. In this case the Government, in the form of the Minister of Railways took the policy lead and gave solid commitment and support to the principle enunciated in Section 4.1 that the freight rail sector should be run as a business; the adoption of commercially-driven initiatives in growing commercial freight markets demonstrates just how effective combinations of measures described in Section 3 can be. In many countries, and arguably in India prior to this program, the measures could be effective but simply infeasible due to lack of political support. The Indian Government’s financial support of railway network investment, which laid the foundation for the operating improvements, is also an example of a government willingness (identified in Section 4.4) to move away from the rather limiting traditional policy paradigm that a road network is a ‘public good’ with access to full budgetary funding while a railway network should be more or less fully funded by the network’s users, or even more questionably, just its freight users.

5.4 **Sub-Saharan Africa’s Rail Concessioning Program**

At the other end of the spectrum from China’s and India’s large, well-utilized railway networks, are the small, low volume, largely disconnected railway systems of the sub-Saharan African countries, north of South Africa. Management approaches suggested in Section 3 are as relevant to managing small railways as large ones, though the financial constraints on, for example, investment are clearly much more challenging (particularly in infrastructure which, as argued in Section 3, requires high volume to recover cost). However, this case study is more concerned with the policy issues presented in Section 4.

The first railways south of the Sahara were built in South Africa in the 1860’s and 1870’s, with lines heading inland from the ports at Cape Town and Durban. The networks in what were then Cape Province, Natal and Transvaal continued to develop but it was not until the turn of the twentieth century that large-scale railway development began in other parts of the continent. In almost every case, the pattern was the same, with isolated lines heading inland from a port to reach a trading centre or a mine, and a few branch lines then being built over a period of time. As almost all the lines were constructed under colonial administrations, many of the lines were State-owned but several were also constructed by concessions or, in the case of some mineral developments, by the mining company as an integral part of its mining operation. This process has continued until recent times, with several lines having been built since the Second World War. But most of the African networks remain disconnected lines, either within a single country or linking a port and its immediate regional hinterland, with the only international networks being those centered on Zimbabwe and Zambia and, to a lesser extent, the old East African Railways network in Kenya, Uganda and Tanzania.

This pattern of economic development and the limited amount of inter-country trade has meant that African railways, more than almost anywhere else in the world, are closely linked to the ports (indeed, much of Africa had integrated port and railway organizations until recently) and, where railways traverse more than one
country, freight traffic is generally almost all transit with comparatively little originating or terminating in the intermediate country\textsuperscript{20}.

Some of the railways were struggling financially from the start but they generally managed to operate reasonably successfully up to the 1960’s. Thirty years ago, many of the railway systems were carrying a high share of their country’s traffic, either because competing road transport had poor infrastructure or restrictive regulations, or because rail customers were established businesses who were locked into rail either through physical connections or (if they were parastatals) through policies which directed them towards the use of a fellow parastatal. Since then, both the economies, in general, and transport, in particular, have become liberalized. Coupled with the general improvement in road infrastructure this has led to much stronger competition and, generally, a significant loss of their market by railways. As the road system developed and larger trucks were introduced, the higher-value general freight was gradually captured and rail traffics increasingly comprised bulk mineral and agricultural traffic and semi-bulks such as fuel. Whilst this has in many cases provided enough funds to cover working expenses, railways have rarely been able (or allowed by government if they had the potential) to collect enough reserves to fund asset renewal; this has almost universally been provided on an intermittent basis through loans from multilateral or bilateral agencies, often leaving railways with poor infrastructure and a patchwork collection of disparate kinds of rollingstock.

The steady degradation of the asset base has meant that even when, as in recent years, efforts have been made by railways to capture higher-value traffics such as containers, the quality of service has been so low that they have only achieved a limited market share wherever there is road competition. Railways have also suffered severely during the various wars and conflicts that have occurred during this period: much of the Mozambican central and northern systems, Angola, Ethiopia, Eritrea and Ivory Coast have either been damaged or have been unable to operate for long periods, in some cases up to twenty years.

As a result of these many factors, most of the railways that were presented for concessioning in Africa have been badly run-down public railways, requiring substantial rehabilitation of both infrastructure and rollingstock. Even where they may have significant traffic volumes by local standards, these are very low by world standards and the concessions often come with requirements to continue operating a loss-making passenger service. In a sense, concessioning was selected as a last resort way. Between 1993 and 2005, thirteen concessions were awarded in Africa, shown in Table 5.2.

\textsuperscript{20} A significant exception is Kenya; the railway was originally built to access Uganda but Kenya has since developed to such an extent it is now by far the larger traffic generator.
Table 5-2: Concessions of African Railways 1993-2005

<table>
<thead>
<tr>
<th>Country</th>
<th>Year Awarded</th>
<th>Concessionaire</th>
<th>Year Started</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ivory Coast/Burkina Faso</td>
<td>1995</td>
<td>Sitarail</td>
<td>1995</td>
</tr>
<tr>
<td>Cameroon</td>
<td>1998</td>
<td>Camrail</td>
<td>1999</td>
</tr>
<tr>
<td>Gabon</td>
<td>1999</td>
<td>Transgabonais</td>
<td>1999</td>
</tr>
<tr>
<td>Malawi</td>
<td>1999</td>
<td>CEAR</td>
<td>1999</td>
</tr>
<tr>
<td>DRC</td>
<td>1995</td>
<td>Sizarail</td>
<td>1995</td>
</tr>
<tr>
<td>Zimbabwe</td>
<td>1997</td>
<td>BBR</td>
<td>1997</td>
</tr>
<tr>
<td>Togo</td>
<td>N.A.</td>
<td>WACEM</td>
<td>2002</td>
</tr>
<tr>
<td>Maputo Corridor</td>
<td>2002</td>
<td>NLPI/Spoornet</td>
<td></td>
</tr>
<tr>
<td>Senegal/Mali</td>
<td>2003</td>
<td>Transrail</td>
<td>2003</td>
</tr>
<tr>
<td>Zambia</td>
<td>2003</td>
<td>RSZ</td>
<td>2003</td>
</tr>
<tr>
<td>Madagascar (north)</td>
<td>2003</td>
<td>Madarail</td>
<td>2003</td>
</tr>
<tr>
<td>Mozambique (Beira)</td>
<td>2004</td>
<td>Beira Rail</td>
<td>2004</td>
</tr>
<tr>
<td>Mozambique (Nacala)</td>
<td>1999</td>
<td>CDN</td>
<td>2005</td>
</tr>
</tbody>
</table>

An independent assessment of the results of privatization, though acknowledging short periods of operation, and the paucity of good data, concluded that just about all the private concession operators more actively sought and encouraged new traffic opportunities and operated these railways with fewer staff and with better asset utilization than before. In some cases the latter reflects greater use being made of assets that were previously lying idle (this is particularly the case with wagons). In others it reflects the previous bureaucratic difficulties in writing-off publicly-owned assets that are surplus to requirements that were left behind by the concessionaire. Nevertheless, whichever asset class was examined, and whether infrastructure or rollingstock, it was achieving better productivity under private concessioning than before. 21

The study also found that Concessionaires take a vigorous approach towards dealing with some of the dubious practices that are long engrained in some railways. Railways have traditionally provided many opportunities for employees, whether individually or in groups, to operate "businesses within businesses.

Concessionaires were found to have established a lower cost structure. This is not to say it is the ideal cost structure; operating cost on railways is a function of capital as well as operating efficiency and many of these railways have been starved of capital where it is required, thus substantially increasing overall operating costs. Whilst rail is generally competitive with road over medium-long distances, this is not necessarily so if rail can only operate at 10-15 km/hr. Railways need to be “fit for purpose” if they are to compete effectively.

The Study also drew attention to the issue of road costs. Road haulage operators in Africa are notorious for overloading with consequent damage to road infrastructure. Road has an articulate and well-organized lobby; counter-arguments from government railways, if they appear at all, have generally been ineffectual and poorly-prepared. Experience has shown concessionaires were less likely to let this rest and to lobby hard for some protection from the more egregious abuses.

Concessionaires were therefore found to be more likely to encourage more rational allocation of traffic between modes merely through doing business in a commercial and business-like manner; pricing the service to market by using value-of-service pricing and ensuring that all the other service attributes are also as

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21 The CEAR locomotive productivities ignore the scrap locomotives that were purchased for spare parts.
competitive as possible. These actions have all combined to make rail more competitive in the market place and ensure that its potential advantages are realized in practice.

One of the chief characteristics of the African concessions is that they have nearly all been associated with substantial investments (principally in infrastructure). But these investments have been financed for the most part by bilateral and multilateral lending agencies. Concessioning has thus been, in most cases, a necessary condition to investment in the sense that much of the finance would not have been made available if governments had not adopted a concessioning policy. Much of the investment has been to catch up with maintenance and renewal backlogs, and without which there would often be no functioning railway. It can thus be characterized as a “once-off” investment to get the systems back on their feet.

But the Study questioned whether the concessions really are self-sustainable in the sense of being sufficient to ensure renewal of assets in the longer-term? The study concluded that little has been put into infrastructure to date that has not come from concessional loans although there has been some private investment in rollingstock. Even the investment that has been made has often been slow to mobilize e.g. over four years in Cameroon and five years on the Nacala line; this is a long time to wait when a business is barely breaking even.

In summary, concessioned railways in Africa are operating more efficiently and are more competitive. Concessioning has helped revitalize many systems. Most of the policy prescriptions in Section 4 are supported by the outcomes. The evidence is still that these railways run more efficiently as businesses, run by the private sector, and in circumstances where government’s offer a level playing field vis a vis infrastructure investment, pricing and regulation. However, low volume traffic markets mean they are simply too small to sustain significant on-rail competition and even then will usually require governments to support network investment beyond their location, or reinvestment beyond the life of the rail system or of existing assets.
ANNEXES

ANNEX A: SOME EVIDENCE ON THE EXTERNAL IMPACTS OF RAIL AND ROAD FREIGHT

The Concept of Sustainable Development first entered public policy debate twenty years ago in the Report of the Brundtland Commission, 22 convened in 1983 by the United Nations to address growing concern:

‘About the accelerating deterioration of the human environment and natural resources and the consequences of that deterioration for economic and social development.’

The environmental impacts that were of concern to Brundtland’s notion of sustainable development naturally included clean air. But in those days little was known about the issue of greenhouse gas emissions (GHG) and their contribution to global climate change. In the last few years the issue of climate change has moved to the centre of discussions about the environmental dimension of sustainable development, particularly in the energy and transport sectors.

The last decade has seen the emergence of an increasing body of knowledge about the many environmental impacts and external costs of different modes of transport, including now the impact on greenhouse gas emissions. Figure 5.2 derives indicative estimates 23 of the external costs of road and railway freight derived from the EU’s Social Costs Handbook which synthesizes European research in the area 24. Detailed estimates will naturally vary by country, income levels, load factors, degree of urbanization, proportion of diesel and electric railway operation, and nature of the road haulage fleet. However, the estimates shown in Figure A.1 are within a wider range of differentials that show road haulage in Europe having higher external costs per tonne-km than rail freight of up to five times.

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22 Formally, the World Commission on Environment and Development (WCED)
23 Estimates derived from Handbook, Table 53, using the European ‘daytime’ rates; it also assumes 75% electric train-km and 25% diesel train-km. For both rail and road transport the averages assume 85% of unit traffic task is interurban and 15% passes through urban (and therefore more sensitive) areas. Up/downstream. in the legend refers mainly to impacts of power generation at source (e.g. at coal-fired power stations)
24 This handbook is available on line at: 
In the United States the University of Texas Transport Institute (2007) has also made estimates of differentials in various impacts between road haulage and rail freight. Some of its results are summarized in Figure 5.3. Again, the results should be treated as indicative and like the European figures are context specific. In particular, freight railways in the USA are almost exclusively operated with diesel locomotives which have a higher impact on emission rates than electric locomotives (which predominate in Europe). Moreover, Europe is more urbanized than the USA which also affects external impact. Still, the much higher rate of external impact of road haulage over rail haulage is again shown clearly.

In China, using the proceeds of a World Bank loan, the Ministry of Railways commissioned the University of Leeds to try to measure social costs of roads and railways in the Chinese context. The consultants applied European methodology but derived values to be consistent with Chinese transport and income parameters. This study indicated that the total external costs of road haulage on expressways and national highways alone could be up to 6 times those of the rail freight system, despite the fact that railways carry much more of the traffic task (measured in tonne-kms) than the road system. When converted to a cost/tonne-km the external cost penalty of road freight may be nearly 28 times that of rail freight. Again, the numbers for China are as yet
rudimentary but they confirm the pattern of differentials evident in Europe and USA, though perhaps amplified in China by the high rate of road traffic accidents, the smaller and more polluting average road truck, and a comparatively high average freight train load (compared with Europe).

The impact of transport on global warming is perhaps currently one of the most politically compelling external impacts. There is a close relationship between the volume of transport activity, the amount of energy used for that activity by a particular mode and the generation of greenhouse gases. More than 95 percent of global transport energy use consists of oil-based fuels used in internal combustion engines. Policies that seek to make transport systems more ‘sustainable’ will need to be multi-modal, but will generally need to give particular attention to limiting emissions from private road transport that at a global level accounts for around 70 percent of emissions. Railways (freight and passenger) are only about 2 percent of total global transport emissions.
ANNEX B: STRUCTURE OF RAILWAY COSTS

Rail freight costs can be divided into three main types: infrastructure costs; costs of train operations; and corporate administration.

*Infrastructure costs* are often termed ‘below-rail’ costs. They have a component that is fixed in relation to usage of the infrastructure (though may vary with other factors) and a component that is variable with traffic levels, at least in the long-term. The main sources of costs of an existing railway infrastructure are:

- Track maintenance and renewal
- Structures maintenance and renewal
- Signaling system
- Electrification system.

Track maintenance and renewal. Maintenance consists of inspections, resurfacing, ballast cleaning, rail grinding, miscellaneous rail maintenance and track formation maintenance. Track renewals consist of mainly re-sleepering and re-railing. Using indicative estimates derived from extensive analysis of freight rail costs in Australia, Figure B.1 summarizes the main factors affecting track maintenance and renewal expenditure together with a broad estimate of the proportion of each cost in total track maintenance and renewal costs for a main freight line of light density line of, say, 2 million gross tonnes on timber sleepers, and a much busier 20 million gross-tonne line on concrete sleepers. (The majority of main freight lines in the world carry traffic somewhere in this range).

Figure B.1 shows clearly the huge economies of rail track costs that can be obtained with traffic density (technically, these are economies of scope). Although the higher-volume line costs more per kilometer to maintain and renew, its costs per gross tonne-km are less than a fifth of those of the secondary line.

### Table 6-1: Main factors affecting track maintenance and renewals

<table>
<thead>
<tr>
<th>Line speed</th>
<th>Volume</th>
<th>Elapsed Time</th>
<th>Standard of constr.</th>
<th>Climate</th>
<th>Curvature</th>
<th>Propn. of cost 2MGT* timber sleepers</th>
<th>Propn. of cost 20 MGT concrete sleepers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual inspection</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>2%</td>
<td>1%</td>
<td></td>
</tr>
<tr>
<td>Other inspection</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>0%</td>
<td>1%</td>
<td></td>
</tr>
<tr>
<td>Resurfacing</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>8%</td>
<td>10%</td>
<td></td>
</tr>
<tr>
<td>Ballast cleaning</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>8%</td>
<td>10%</td>
<td></td>
</tr>
<tr>
<td>Rail grinding</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>1%</td>
<td>3%</td>
<td></td>
</tr>
<tr>
<td>Miscellaneous maintenance</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>16%</td>
<td>18%</td>
<td></td>
</tr>
<tr>
<td>Formation maintenance</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>13%</td>
<td>8%</td>
<td></td>
</tr>
<tr>
<td>Resleepering</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>48%</td>
<td>25%</td>
<td></td>
</tr>
<tr>
<td>Rail renewal</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>4%</td>
<td>23%</td>
<td></td>
</tr>
<tr>
<td>Total cost</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>100%</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>Total cost/km (index)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>100</td>
<td>168</td>
<td></td>
</tr>
<tr>
<td>Cost/gtk (index)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>100</td>
<td>17</td>
<td></td>
</tr>
</tbody>
</table>

* MGT = million gross tonnes over track. Source: Consultant analysis (R G Bullock)

25 Although it would be more technically accurate to call them ‘below-wheel’ costs as they include the costs of the track itself,

26 Some of the benefit in performance is due to economies arising from the use of concrete sleepers but these are typically justified and used on higher volume lines.
**Maintenance of engineering structures:** Most maintenance costs of tunnels, embankments and overbridges are also determined by age, corrosion and environmental factors rather than railway traffic volume, though usage-related costs can be significant for some sorts of underbridges (particularly cast iron, timber and some masonry structures). However in most circumstances, the costs of maintaining engineering structures vary little with traffic volume.

**Signaling:** Historically, and still in some developing countries, signaling operations were undertaken by individual signalmen, located either at stations or purpose-built signal boxes, who were responsible for controlling a specific section of track. With the introduction of centralized traffic control (CTC) train control costs can be significantly reduced but remain relatively invariant to traffic level, with one controller responsible for a specific ‘board’ covering a given stretch of line. There is some scope for boards to be amalgamated during periods with lighter traffic but this is not done on an ad hoc basis throughout the day. Overall, these costs are ‘sticky’ in terms of reacting to traffic volume, requiring significant changes before the costs of freight transport are affected.

The periodic inspection and servicing of signaling components (typically degraded by chemical and physical ageing) is largely a function of elapsed time and renewals are generally driven by technological obsolescence, the need for significant layout changes or capacity enhancements, serious structural defects or large scale degradation, for example of wires and cables, rather than usage. Taken together, signaling maintenance and renewals is typically much less variable with traffic throughput even than track maintenance and renewal.

**Electrification:** The maintenance and renewal of electrification infrastructure which is in physical contact with the train has a significant usage-based component. The same holds true, but to a lesser extent, for the catenary and the connections between it and the contact wire. But other electrical equipment such as substations and feeder cables is less affected by variations in traffic level. In overall terms less than a quarter of the costs of maintaining an electrified system will depend on freight volumes.

**Train operating costs** consist mainly of:

- Diesel fuel or electrical energy
- Locomotive capital depreciation (or leasing cost)
- Locomotive maintenance
- locomotive crew
- Train guard (these are increasingly becoming redundant)
- Wagon capital depreciation (or leasing cost)
- Wagon maintenance costs, and
- Operation and commercial support costs.

The costs of operating trains themselves (that is all the above costs except the last) are more or less fully variable with traffic volume – the greater the freight volume the higher the level of resources needed for running trains to carry it. This relationship is not proportional in the short-term (except perhaps for fuel/electrical energy), but over a reasonable period managers using a given train operating strategy can also adjust other operating resources (crew costs, locomotive and wagon requirements, quantum of maintenance etc) to match trends in demand.
There are other costs (the last item listed above) of supporting the physical and commercial operations of trains such as the costs of train marshalling and yard shunting services, loading/unloading costs, train safety examinations, freight billing and IT systems etc, which vary less than proportionately with traffic throughput. However, in many freight railways some of these costs have been declining rapidly as a proportion of total railway costs. For example, the activity of train marshalling and shunting has declined as railways have put greater emphasis on unit or block trainload working (as opposed to general mixing of traffic types on a single train) creating through-trains from origin to destination. Average loading and unloading costs have declined as railways have withdrawn from labor-intensive small freight handling and because a greater proportion of traffic is in containerized or in other unit loads. And freight accounting and information functions have been centralized and computerized, with technologies such as GPS real-time tracking of wagons, which has replaced manual counts.

Crucially, while train operating costs are variable with traffic levels at a given level of technology, unit input costs and train operating strategy, this cost/output curve as a whole can be shifted down over time with management and technological improvements that enhance labor and equipment productivity.

To illustrate this point, Figure B2 shows the variation in operating cost per net-tonne-kilometer for three important parameters:

- The ratio between the net tonnes of a wagon and the tare (or empty) weight of the wagon
- The size of the train (normally measured in terms of trailing tonnes i.e. the tonnes hauled by the locomotive)
- The utilization of the rollingstock (normally measured in terms of either hours in operation or kilometers traveled annually).

The costs have been calculated in USD for a notional unit train working of 200 km each way for a typical medium-efficiency medium-density railway. The Base Case assumes a train of one 2500 hp locomotive hauling 26 wagons, each with a tare of 18 tonnes and a capacity of 50 tonnes. This train is assumed to travel one-way fully loaded and makes the return trip completely empty. The terrain is assumed to be gently undulating. The costs have been calculated using typical unit costs for such a railway but infrastructure costs have been calculated assuming access charges are applied, with two components per gross tonne-km and per train-km.\textsuperscript{27}

\textsuperscript{27} This is the most realistic way of reflecting costs on a busy railway but on a low-volume railway the below-rail cost will be independent of traffic for practical purposes.
The net:tare ratio in the Base Case is 2.8:1 giving a cost of 2.4 c/ntkm. In the worst case, likely to be encountered in current railways, the net: tare ratio is about 2 (this is typical for a low axle-load railway, for example), with a wagon weighing 15 tonnes and carrying 30 tonnes freight. At the other end of the scale, high axle-load railways typically have wagons with a net: tare ratio of 4 (e.g. a tare of 25 tonnes and a capacity of 100 tonnes). In this example, the size of the train has been kept constant at 1800 tonnes but costs still range from 2.9c/ntkm down to 2 c/ntkm.

Train size is another important variable. The same loco can often haul trains of considerably different size, for a variety of reasons, generally because of the grade of the line but also sometimes for other reasons (e.g. short crossing loops on single-line railways which limit the length of trains). In such cases, the locomotive-related costs remain more or less constant in absolute terms but vary considerably as a unit cost per net tonne-kilometer. The figure shows the impact of variations in train size over the range 700 tonnes to 2300 tonnes. The impact on cost is a range from 2.2 c/ntkm to 3.7 c/ntkm, with variations not only in the locomotive-related costs but also in the train-km component of the access charge.

Rollingstock utilization is a third crucial variable; rollingstock which is not being used in operations, whether it is a locomotive waiting in a depot for spare parts or a wagon in a terminal waiting to load or unload (or waiting in a marshalling yard en-route) is nevertheless incurring ownership charges of depreciation and interest (or, equivalently, foregone return on assets). The rollingstock charges in the figure have been derived using typical asset costs and lives and a real interest rate of 8 percent. The utilizations assumed in the Base Case are 4000 hours p.a. for the locomotive and 66,000 km p.a. for the wagons, which would be achieved by a reasonably
well-run railway and the figure shows the impact of a range of +/- 60% around these values. Utilization does not affect either the above-rail or below-rail operating costs but it has a direct impact on above-rail capital charges, with total cost ranging from 3.3 c/ntkm for the low utilization case to 2.2 c/ntkm if the high utilizations (6400 hours and around 100,000 km) can be achieved for locos and wagons respectively.

In practice, these parameters are often found in combination and the cumulative impact on unit operating costs is then dramatic. If the best of the net:tare ratios, train sizes and utilization can be achieved, the unit operating cost will be around 1.8 c/ntkm but if the worst cases are all that can be managed, the unit operating cost can reach 8 c/ntkm or more.

Some of these operating cost drivers are related to quality of management, some to geography and others to the initial investment in the railway as well as more recent investment (or lack of it) in modern rollingstock, appropriate maintenance facilities and an adequate supply of spare parts. These issues are explored in particular in Sections 3.5-3.7 of the Paper.

Corporate overheads include most of the headquarters functions of a railway such as Board and executive management, finance, legal, security, personnel functions etc. The more complex and bureaucratic the structure of the railway, and the less commercially streamlined, the more ‘corporate glue’ is necessary to hold it all together. Large monolithic state-owned railways typically have a significant proportion of corporate overheads, often between 8-12 percent of total costs. But for any given structure corporate overheads can also depend simply on management competence. Those managements who decentralize decision-making to business units, control finances and budgets well, seek opportunities to competitively outsource corporate services, and generally run a ‘leaner’ ship can reduce corporate overheads dramatically.

There is evidence that corporate overheads do (or can with good management) vary in the long-term with traffic levels though in public sector railways the process tends to be ‘lumpy’, occurring through the periodic upheavals of organizational restructurings rather than gradual change to match traffic volume. There is in fact little evidence of economies in scale of rail organizations (as opposed to economies that arise, for example, from traffic density or train size).

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28 The initial choice of track axle-load, and alignment (maximum grade and curvature) all affect train size and net:tare ratio.
LIST OF ABBREVIATIONS

ABS  Automatic Block Signaling
Above-rail costs  The costs of railway train operations (i.e., excluding railway infrastructure costs)
Below-rail costs  The costs of railway infrastructure (i.e., excluding train operating costs)
BN  Burlington Northern Railroad (USA)
CR  China Rail or China Railways (trading brand of rail transport services administered by MOR)
CO2  Carbon dioxide
CNY  Yuan (or Renminbi)
EAP  East Asia & Pacific: designation of an operating region of the World Bank
ECA  Eastern Europe and Central Asia: designation of an operating region of the World Bank
EU  European Union
GDP  Gross Domestic Product
GSM-R  Mobile telephone system for railway communications
ICD  Inland Container Depot
Intermodal  The movement of goods in one and the same loading unit or vehicle, which uses successively several modes of transport without handling the goods themselves in transshipment between changing modes
IT  Information Technology
JV  Joint Venture
km  Kilometer
km/h  Kilometers/hour
KTZ  Kazakhstan Railways
Kwh  Kilowatt hours
LAC  Latin America & Caribbean: designation of an operating region of the World Bank
MENA  Middle East and North Africa: designation of an operating region of the World Bank
MOR  Ministry of Railways of the People’s Republic of China
MLRNP  Mid and Long-Term Railway Network Plan (2004)
Multimodal  Use of at least two different modes of transport on the basis of a single multi-modal transport contract to move a load of goods from origin to destination.
Net/tare ratio  The ratio of weight of goods carried to weight of wagon and any carrying unit (e.g., container or trailer)
ntkm  A unit equivalent to the movement of one metric tonne of freight by one kilometer
pax  Passengers
pkm  A unit equivalent to the movement of one passenger by one kilometer
route-km  Kilometers of commercial railway route in network
ROW  Rest of world
RZD  Russian Railways
SAS  South Asia: designation of an operating region of the World Bank
SOE  State Owned Enterprise
SSA  Sub-Saharan Africa: designation of an operating region of the World Bank
tare  Weight of freight wagon excluding freight
TMIS  Traffic Management Information System
TOFC  Trailer-on-Flat-Car (main form of so-called ‘piggyback’ rail services
TOC  Train Operating Company
Tonne  Metric tonne of 1,000 kg
UK  United Kingdom
U.S./U.S.A.  United States of America
USD  United States Dollars
UZ  Ukrainian Railways
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Energy, Transport and Water Department
The World Bank
1818 H Street NW
Washington DC 20433
USA
www.worldbank.org/TRS