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RAIL TERMINAL FACILITIES

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CASE STUDY

Jawaharlal Nehru Port: Terminal and Transit Infrastructure
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Asian Institute of Transport Development
13, Palam Marg, Vasant Vihar,
New Delhi-110 057 INDIA
Phone: +91-11-26155309
Telefax: +91-11-26156294
Email: asianinstitute.del@gmail.com, klthapar@gmail.com
Website: www.aitd.net

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Introductory Note

When one looks back over the development of the global economy, there are three major features that stand out. One is the increasing use of technology; the second is the increasing amounts of capital employed in any economic endeavour; and the third, as a result of the first two, the enormous increase in the scale of goods produced and distributed.

This has led to an ever-increasing need to transport ever-increasing quantities and volumes. Indeed, in case of mineral traffic, it is figuratively almost akin to 'moving the mines'. This explosion in scale has brought to the fore the critical importance of facilities for loading and unloading of goods at either end of the transport networks. The railways have the advantage of moving goods in large lots over long distances.

Historically, most of the metropolitan towns and industrial centres in the country were endowed with well-developed rail terminal infrastructure. For example, Kolkata had several sprawling freight terminals, such as, Howrah Goods, Chitpur, Shalimar, Budge Budge, Cossipore, etc. Most of these have, however, gradually been usurped for passenger operations and related maintenance facilities.

Another factor is the emergence of multimodal transport, which is largely based on the container traffic. This has further added to the type of the facilities required at either end of the transport columns. Need has also been felt for developing integrated logistics at the terminals with value-additions like packaging and labelling of goods. This has often led to the terminals being used as distributive nodes.

The sea change in the economy, the shifts in the manufacturing locations, expansion of cities and development of new nodes has brought to fore the importance of developing modern terminals. These terminals are often called mineral depots, freight centres, dry ports, inland container depots, logistics parks, freight villages, industrial sidings, etc. performing specific functions.

However, the arcane subject of terminals has hitherto not received due importance in the railways. The Institute, therefore, felt that there was an urgent need for stimulating research in this area, encompassing economic, financial, technological aspects. It was with this objective that this special issue of the Asian Journal was conceived.

The papers contained in this issue have been written by experts in their respective fields. In their analysis, they bring to bear their vast professional experience. I trust their expositions and suggestions would help the railways to develop a roadmap for modernizing rail terminals, involving the various stakeholders. Though, the much-needed investments in this area would only be a fraction of the total investments in the main transportation business, the resultant benefits would be huge.

K. L. Thapar
Chairman

INFRASTRUCTURAL CHALLENGES FOR INDIA'S FUTURE ECONOMIC GROWTH: HOPES FROM RAILWAYS

G. K. Chadha*

Introduction

The Indian economy has become the centre of global attention due to its fast growth performance during the recent years. Many countries, international development agencies and research institutes believe that India is poised to become a global economic player in the near future. India's gross domestic product and per capita income have been growing very fast; we are now in the league of the fastest growing economies of the world.

The structure of our economy has been undergoing a sweeping transformation; we are no more an agrarian economy. The annual rates of savings and investment have scaled unprecedented heights; we are fast catching up with China. We are now an open economy with free inward and outward movement of goods and services; export of services, particularly, is now a very strong segment of our external trade. Our share of world trade in merchandise is rising steadily; in services, it is rising much faster. We are becoming an attractive destination for foreign direct investment; the FDI inflows and technological hook-ups have increased manifold in recent years. Indian capitalism is 'maturing' and expanding its investment vision to foreign destinations; the list of 'Indian multinationals' is expanding. We have numerous other economic indicators to show the multifaceted growth of the Indian economy, and its steadily improving station in the ongoing process of globalization.

The international community has started regarding India as an indispensable player in reshaping the world economic order. Backed by a highly creditable growth record, strong science and technology base, and capability of throwing up innovative solutions to problems of sustainable development, and issues related to trade and finance for development, India now enjoys a fairly high standing among the developing economies in general, and the main emerging economies in particular. It has duly earned its presence in the diverse international economic fora, a respectful standing among the regional economic groups, besides forging many bilateral trade agreements and development partnerships, especially in South Asia.

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* *Member, Prime Minister's Economic Advisory Council, Prime Minister Office, India.*

The pace and pattern of the country's economic growth are affecting the Indian society in many ways. Apart from freer and more frequent movement of people, capital, technology, and ideas, the speed and intensity of movement of goods is also rising steadily – on the one hand, in the form of a fast expanding and technology-intensive basket of inputs for sustaining an accelerated pace of output growth, and a vastly multiplying variety of finished consumer goods and intermediate inputs, on the other hand. Thanks to the increasing volume, complexity and sophistication of production, practically in every sector of the economy, not only more goods have to move around, but these have to move faster. Thus, ensuring an uninterrupted supply-chain, spread over the entire fabric of our economy, is an indispensable prerequisite for sustaining a higher pace and pattern of growth. Indeed, a typical Indian manufacturing unit of tomorrow has to be markedly different from its predecessor of yesterday, in terms of the speed and the form in which it receives the production wherewithal and dispatches its finished products to consuming destinations. Today, speedier movement of goods is of much greater significance, compared with yesterday; tomorrow, it is bound to be far more so.

This paper attempts to sketch out, *albeit* only through proxies, the steadily increasing flow and intensity of goods traffic in recent years, and projecting the direction in which the goods transport system should go in the years ahead. The railways being the most vital link in the criss-cross movement of goods, the paper concentrates on recent developments in this sector alone, to the extent the available data permit. However, a few significant aspects of the country's recent growth experience itself may better be underlined first.

Recent growth performance

India's recent growth experience has many far-reaching ramifications that a single paper cannot go into. Accordingly, we pick up what, in our view, is the bare essential for understanding the pace and pattern of India's growth experience, especially the pointed after-effects of growth that have already started affecting the movement of goods or the mobility of people, and are likely to intensify their impact in the coming years.

Growth profile of Indian economy

Table 1 gives the distribution and growth profile of India's GDP since 1950-51. In this context, many important developments need to be underlined. First, the structure of the economy has undergone a radical transformation. For example, the over-dependence on the primary sector has witnessed a steep decline; less than 20.0 percent of the GDP now originates in the primary sector. The share of the secondary and the tertiary sectors in GDP has been steadily increasing, over time. However, while the tertiary sector's share in GDP has been increasing uninterruptedly, that for the secondary sector stopped growing significantly beyond 1990-91. In net terms, the Indian economy is now heavily dominated by the tertiary sector; the secondary sector has yet to expand its presence in a big way. Had the commodity sectors, especially the secondary sector, or more particularly, the manufacturing sub-sector, expanded their share of GDP, as has happened in many other developing economies, the transport multiplier effect would have been many times more than what has been in India.

Table 1: Distribution and growth of India's real GDP (at 1999-2000 prices)

1950-51/2007-08

Year	Share of gross domestic product (GDP) – Percent					Per capita net national product (Rs.)
	Primary	Secondary	Manufacturing	Tertiary	Total GDP	
1	2	3	4	5	6	7
1950-51	56.5	13.6	-	29.9	100	5708
1960-61	52.3	17	-	30.7	100	7121
1970-71	45.9	20.4	12.6	33.7	100	8091
1980-81	39.9	22	13.8	38.1	100	8594
1990-91	34	23.2	16.6	42.8	100	11535
1995-96	29.9	24.3	-	45.8	100	13402
2000-01	26.2	23.5	15.3	50.3	100	16172
2004-05	22.4	24	15.1	53.6	100	19325
2005-06	21.7	24.3	15.1	54	100	20858
2006-07	20.5	24.6	15.4	54.9	100	22553
2007-08	19.7	24.7	15.4	55.6	100	24321
Growth Rate						
50-51/60-61*	2.8	6.2	-	4.3	3.8	1.9
60-61/70-71*	2	5.4	-	4.6	3.5	1.2
70-71/80-81*	1.8	4.5	4	4.6	3.4	0.7
80-81/90-91*	3.1	6.9	7.6	6.9	5.5	3.1
90-91/02-03*	2.7	6	10.4	7.9	6	4.1
2000-01/2001-02	5.9	2.8	2.5	7.2	5.8	3.7
2001-02/2002-03	-5.9	6.9	6.8	7.5	3.8	2
2002-03/2003-04	9.3	7.8	7.1	8.5	8.5	7.1
2003-04/2004-05	0.7	10.5	8.1	9.1	7.5	5.5
2004-05/2005-06	5.8	10.6	9	10.3	9.4	7.9
2005-06/2006-07	4	11.5	12	11.1	9.6	8.1
2006-07/2007-08	4.5	8.6	8.8	10.8	9	7.5

Source:
1. Government of India, *Economic Survey of India, 2007-08*, Ministry of Finance, Feb 2008: A-3, A-5
2. Reserve Bank of India, *Handbook of Statistics on the Indian Economy, 2005-06*, RBI, September 18, 2006: 8-12.
3. Government of India, *Press Note on Revised Estimates of Annual National Income, 2007-08*, Central Statistical Organisation May 30, 2008: 6-7

Second, the rate of growth of India's GDP was stuck around 3.5 percent during the first three decades: the 1950s, 1960s and 1970s. This was euphemistically called the

'Hindu Rate of Growth'. The 1980s, aggressively followed by the 1990s, and more so by the 2000s, left behind the 'Hindu Rate of Growth', maybe as a starting interlude in India's post-Independence history of economic development. Admittedly, it is the jump in GDP growth rate from 3.5 percent during the 1970s to 5.5 percent during the 1980s, and now as high as 8.5-9.0 percent during the 2000s, that has put India in the league of the fastest growing economies of the world. The remarkable step-up in its GDP growth rate makes India's post-Independence economic progress an envy of the developing world. A high growth regime essentially implies a step-up in the movement of goods, leaving aside the changing composition of the goods carried over time and space.

Third, the steadily rising GDP growth rate has been contributed by a similar growth performance of the tertiary and secondary sectors; the primary sector has been experiencing very low, and highly fluctuating, growth rates. As a matter of fact, the tardy and fluctuating growth rate of the primary sector is feared to be a drag on a faster growth for the rest of the economy. Many public analysts believe that the Indian economy can climb up on a two-digit growth trajectory if only agriculture grows steadily by 4.0 percent.

Fourth, the steadily improving rate of growth of per capita income has been yet another strong point of India's growth experience. The substantial mark-up since 1980-81, more spectacularly during the 2000s, compared with the earlier decades, is an outstanding achievement which has very few historical parallels, including India's own growth performance during the past one hundred years or so[1]. It is this fast rate of growth of real per capita income that provides convincing explanation for the fast expanding domestic market, heavily supported by the expanding size of the middle and upper-middle classes in the Indian society, irrespective of the growing income inequalities across sectors and persons. That the impressive step-up in the rate of growth of real per capita income has had a decisive impact on the rate of growth of the transport system in general, and goods transport, in particular, is a truism, most ostensibly because of fairly high magnitudes of income elasticity of demand for transport, education and health services (Government of India, 2005: A240, A276).

Finally, its steadily improving growth profile has brought India to the centre-stage of international investment. India is becoming a popular destination for foreign investment. Multinational companies are flocking in; so are foreign technology, management practices and marketing acumen. Again, India is becoming a big work-site for global workforce in whose reckoning, time and speed command the highest premium. In short, things are moving fast and, with that, goods and people too have to move fast. Faster movement of goods is thus an inescapable consequence of a fast growth regime, whether in India or elsewhere.

However, we may also take note of a structural weakness of our economy, even in the midst of many good things happening, in the interest of framing an enlightened future growth strategy. The size of the manufacturing sector, both in terms of its share in GDP and employment, is still very low. The recent years have been particularly disappointing. For example, the share of manufacturing in GDP (at 1999-2000 prices) rose from 13.8 percent in 1980-81 to 16.6 percent in 1990-91, and stubbornly got stuck at 15.0 percent for the next about 15 years. In contrast, the corresponding percentage figures for the tertiary sector were 38.1 in 1980-81, 42.8 in 1990-91, 50.3 in 2000-01 and 55.6 in 2007-08 (RBI, 2006: 8-12; Government of India, 2008: A3-A5).

Incidentally, manufacturing commands a much higher position in the national economies of many other Asian and South Asian countries. For example, in 2005, it had a share of 34.0 percent of GDP in China, 35.0 percent in Thailand, 31.0 percent in Malaysia and 28.0 percent in Indonesia and South Korea (World Bank, 2007: 194-196). It is time, therefore, to enhance our policy attention to manufacturing so that the prevailing imbalance between the commodity sectors (agriculture and industry) and the services sector gets rectified, and it becomes the basis for high growth, on a sustained basis. If the pro-manufacturing drift in development priorities does occur in the coming few years, it would pose a great challenge to the transport sector in general, and the railway system in particular, as outlined later in the paper.

India in global reckoning

Table 2 sketches out, *albei*t conjecturally, the future standing of the top ten world economic players. Admittedly, the projections, based as they are on a mix of assumptions, may not dish out the precise magnitude of a country's or the world's GDP, especially for the more distant future, yet, the changing ranks may be taken as reflective of the forthcoming realities. A few trends clearly seem to be in the offing. First, very soon, the world economy will no more be uni-polar. In less than a decade, USA may cease to be the locomotive of the world economy. Around 2015, China would climb to the top while USA would slide down to the second position. It would clearly be a bi-polar economic landscape. In 2035, it would be a tri-polar world when India would closely vie with USA, in terms of the sheer size of its GDP, while China would surge far ahead of USA, again, on the strength of its formidable share of world GDP. In plain terms, the future puts India on a fairly high pedestal among the major economies of the world, if only it continues with its onward march of high and sustained growth rate.[2]

Second, and more credible, is the increasing gap between India's share of world GDP and of those countries which are currently behind it, as we move into the next three decades. For example, while India's share of the world GDP is projected to increase from 6.2 percent in 2004 to 8.2 percent in 2015, 11.2 percent in 2025 and 14.3 percent in 2035, Japan's share is expected to be 6.6 percent, 6.2 percent, 5.5 percent, and 4.8 percent, respectively. Likewise, Germany's share may lag behind at 4.2 percent, 3.5 percent, 3.0 percent, 2.6 percent, and so on. Imagine, in 2035, Indian economy may be just about 11.0 percent smaller than the US economy, while it would be three times bigger than that of Japan, six times those of Germany and Russia, seven times those of France and United Kingdom, and nine times that of Italy.

Table 2: World share of GDP for select countries at purchasing power parity

Economy	Current: Uni polar			Projected (2002 prices)					
	-2005			2015: Bipolar		2025		2035: Tripolar	
	(Int$bi)	Share (%)	Rank	Share (%)	Rank	Share (%)	Rank	Share (%)	Rank
China	8815	14.5	2	19.5	1	25.2	1	30	1
USA	12407	20.5	1	19.5	2	17.8	2	16	2
India	3779	6.2	4	8.2	3	11.2	3	14.3	3
Japan	3995	6.6	3	6.2	4	5.5	4	4.8	4
Germany	2336	4.2	5	3.5	5	3	5	2.6	5
France	1850	3.1	7	2.7	6	2.4	7	2.1	8
UK	2002	3.3	6	2.7	7	2.3	8	2	9
Russia	1552	2.6	10	2.6	8	2.6	6	2.5	6
Italy	1672	2.8	8	2.5	9	2	9	1.6	11
Brazil	1566	2.6	9	2.2	10	1.9	12	1.6	12

Source: 1. For 2005, UNDP, *Human Development Report 2007/2008 - Fighting Climate Changes: Human Solidarity in a divided World*, UNDP, 2007: 277-280

2. For 2015, 2025 and 2035 Projections, Virmani, A., *Economic Performance, Power Potential and Global Governance: Towards a New International Order*, ICRIER Working Paper 150, December 2004

We may not be swayed by absolute figures; the sheer size of the Chinese and the Indian economies is to be interpreted, at least partially, in terms of the size of their population. In terms of per capita income (in ppp terms), these economies have miles to go to reach the present levels of most of the developed countries given in Table 2. The moot point is that big countries, such as China and India, would have tremendous advantages in global economic arena if they command big and expanding domestic markets, if their production frontiers continuously improve technologically, most ostensibly through steady expansion of their technical and scientific education systems, if their physical, economic and soft infrastructures continue improving, and above all, if their system of governance becomes responsive, efficient and transparent. Without making a fetish of any kind, it could be conjectured that things are improving, slowly but steadily, on all these fronts, and the economic ascendancy that India aims at for itself may not be a dream in the wilderness. But then many of these pre-requisites need a clear policy perspective, and timely initiatives. Infrastructure, in general, and quick means of transport, in particular, brook neither complacency nor delay.

Size and structure of foreign trade

Table 3 briefly introduces us to the changing structure of India's foreign trade. Three important developments need to be underlined in particular. First, Indian economy opened up its frontiers to external trade, fairly sizably after the onset of economic reforms in the early 1990s; both exports and imports, as a proportion of GDP, rose steadily during the 1990s and the 2000s. At present, nearly one-third of India's GDP is involved in foreign trade vortex, as far as merchandise is concerned. If export and import of services are added, it would touch nearly one-half of the country's GDP. It is a seachange from the 1960s and the 1970s when no more than one-tenth of the GDP was involved in export and import of merchandize.

Table 3: Structure of foreign trade: 1960-61/2004-05

Year	% Share of GDP			% Share to total exports	
	Export	Import	Total	Agriculture	Manufacturing
1	2	3	4	5	6
1960-61	4	6.9	10.9	44.2	45.3
1970-71	3.6	3.9	7.5	31.7	50.3
1980-81	4.5	8.5	13	30.7	55.8
1990-91	5.8	8.8	14.6	19.4	72.9
2000-01	9.9	12.6	22.5	14	79
2001-02	9.4	11.8	21.2	14	77.1
2002-03	10.6	12.7	23.3	13.2	77.9
2003-04	11	13.3	24.3	12.4	76.9
2004-05	11.8	17.1	28.9	10.5	73.7
2005-06	13.1	19.6	32.7	10.2	72.4
2006-07	20	29.3	49.3	10.3	68.6
2007-08	20	30.4	50.4	10.1	84.2
Growth Rate*					
1980-81/90-91	8.8	5.3	-	2.4	13.3
1991-92/00-01	9.8	11.5	-	6.4	11.6
2001-02/06-07	24.2	30.1	-	12	19.4

Note: * Growth rates are estimated by fitting semi-log curve.
Source: Government of India, *Economic Survey of India (various years),* Ministry of Finance, New Delhi

Second, while the share of agriculture in total exports declined hugely from 44.0 percent in 1960-61 to just about 10.0 percent in 2007-08, that of manufactured goods increased impressively from 45.0 percent to more than 80.0 percent. The steady transformation from a predominantly agrarian economy, with exports heavily dominated by agriculture and related commodities, to an industrial economy contributing an ever-expanding share of manufactured products in total exports, is a development that links the domestic transport system to the requirements and exacting standards of the world trade.

Finally, export growth rates, including those for manufactured goods, have also improved over time, most impressively during the 2000s. Again, during the past 15 years or so, India's share in the world trade of goods and services has also been witnessing a steady increase. However, it is still very low, especially in comparison to China's. In plain terms, much is still to be done to promote external trade in tandem with the pace and pattern of growth of the domestic economy. Much also needs to be done to modernize to-and-fro transport linkages with the ports. In short, the domestic transport system, including the railway network, has to gear itself to international standards and performance yardsticks.

Future growth and faster movement of goods

The accelerated pace of India's recent economic growth is triggering reverberations which can be felt in all sectors of the economy and all segments of the society. That faster, and uninterrupted, movement of goods is inextricably woven into the very process of fast economic growth, needs hardly to be emphasized. A fast growing economy entails an expanding and more frequent movement of goods, firstly, crisscrossing the length and breadth of the economy, and secondly, through movement of raw materials and finished products to and from other countries. We can visualize some of the major developments for the Indian economy, in the foreseeable future, that may put substantial pressure on the pace and pattern of movement of goods.

Enhanced focus on manufacturing

For two strategic reasons, India would need to focus on manufacturing, as a part of its medium- and long-term strategies of economic development. First, for sustaining a high tempo of economic development in future, manufacturing will have to become India's strong point, nationally as well as internationally. Keeping aside the slowdown in certain branches of manufacturing in India, caused by and linked with the current spate of global meltdown, we have already demonstrated remarkable breakthroughs in pharmaceutical, automobile, textile and steel industries, leaving aside the ICT, machinery and other industries, as also the phenomenal expansion of outsourcing vis-à-vis foreign companies in many other branches of industry (Anandalingam, 2004:12). In plain terms, India must reorient its development strategy in order to achieve a much faster growth of its manufacturing sector which, in our view, would rectify the structural imbalance, currently prevailing in the Indian economy, and help India sustain a high growth profile. That being the main plank of our future development strategy will necessitate the development of an efficient and modern logistics wherewithal, especially integrated an intermodal system with a significant share for railways.

Second, it would absorb a sizeable proportion of the future job-seekers, who would have a variegated mix of educational, training and skill backgrounds. Compared with any other non-farm sector, manufacturing can strike an optimal balance between the available skills and the demand for a wide range of skills. For example, food products, beverages, cotton-wool-jute textiles, textile products, wood and leather products under agro-based industries, and non-metallic mineral products, metal products and other miscellaneous manufacturers can absorb workers with middle level of schooling and medium level of skills. At a higher level of educational and skill requirements would be paper, rubber and chemical products, basic metal products, machine tools, electrical machinery, and transport equipment. Industrial chemicals, pharmaceuticals, computers, communication equipment and semi-conductors, aircraft and scientific instruments would need top level skills and technical knowledge. The next ten years are likely to witness a substantial expansion of manufacturing activities that would entail low to medium level of skills and educational accomplishments and would be fairly bulky in weight and wider in expanse (Government of India, 2006a). The implications for heavier, bulkier and quicker movement of goods for accommodating the emerging pattern of manufacturing are obvious. The railways would need to expand and modernize.

Global play and partnership

Thanks to the sweeping economic reforms initiated in 1992, and steadily carried forward thereafter, India has been gradually increasing its integration into the world economy (refer Table 3). The abolition of import licensing and the gradual reduction in customs duties have enabled Indian manufactures to compete with foreign manufactures. Apart from effecting many other operational improvements, the Indian manufacturing has to keep its inventories of raw materials and intermediate products down and keep pace with the imperatives of just-in-time manufacturing. The Indian manufacturing would not be able to achieve this unless it has the back-up of world-class transport and other services, at internationally competitive prices and quality of services. In transport services, it is not only the cost that matters, the quality and reliability of the service matter as well. In India’s context, all this is not possible unless the railways as the nation’s lifeline reorient themselves to a customer-oriented approach for providing on-time and high-quality services. That it would entail a dramatic break from their traditional operational content and style, is indeed a big challenge for them.

Going by the emerging international perspective, the Indian economy is poised to climb up steadily on the ladder of globalization: international collaborations, technological tie-ups, joint production ventures, and trade agreements, leaving aside acquisitions and mergers, are bound to increase further. Today, many major multinationals have their R&D centres in China and India so that the locus of technological advance will soon shift, if it has not already shifted in some branches, away from the advanced countries – the historical lead of these countries in innovating high-tech products is clearly diminishing (Freeman, 2005: 3). Besides, the huge number of highly educated workers in India (and China) is breaking down the advanced countries' monopoly of scientists, engineers and technologists. Again, the traditional pattern of trade between advanced and less developed countries is facing a dramatic transformation. Yet again, the most important change that has been taking place is that Indian firms are learning to play the game of globalization by dint of improved knowledge of science and management. This shift from an inward-looking India to an outward-looking India is central to *understanding the new status that India is carving out for itself* (Shah, 2007:15; italics ours).

In this context, to accommodate the rising demand for heavier, safer and quicker movement of goods, from foreign production hubs into Indian production and consumption outlets, as also from Indian production locales to ports and air cargo centres, railways have to play a major role. For this, many organizational and operational improvements are called for in the railways.

Urbanization and consumer preferences

The rising pace of urbanization would have its own impact on the speed of movement, and composition of goods, in the years ahead. Preponderantly involved in industrial and service sector activities that entail, *inter alia*, considerably higher resource-use intensity per unit of investment or value-added, and more intense commercial inter-changes, the expanding urban economic base of the Indian economy, coupled with the rising pace of urbanization would necessitate more frequent, efficient, and faster movement of goods. Specifically, the increasing emphasis on accelerated pace of development of urban economic infrastructure, most ostensibly under the pressure of global competition, the pace of construction activities would increase manifold, and with that, the movement of diverse types of building and construction material, largely carried by the railways, would intensify, both in time and space.[4] This is not to deny the rising importance of social infrastructure, both in the urban and rural areas, in the form of educational and training campuses, hospital and other healthcare buildings, community centres, recreational facilities, etc., which may add their own share to the movement of goods and people through railways.

Like in any other growing economy, India too has been witnessing structural changes in the demand for goods and services, most markedly after the level of per capita income started witnessing a sizeable improvement in the 1980s and 1990s (Table 1). The available consumer expenditure data for three decades, from 1972-73 to 2004-05, unambiguously show that food items have been receiving a dwindling priority and the non-food items have been receiving a consistently higher priority at the hands of an Indian consumer, whether residing in rural or urban areas. The direct implication of this change is that the consumer choices, now and in the future, are to be met through long-haul carriage of goods, since the assorted basket of non-food items is served through variously located production locales, against food consumption being served through haulage from local or nearby locations, in most cases.

Even within the food items, considerable reshuffling of demand is likely to take place in the days ahead. The demand for cereals would understandably yield, more and more, in favour of non-cereal items, such as milk and its products (e.g. ghee, butter, curd, cheese, ice-cream, baby foods, etc.), egg-fish-meat, processed fruits and vegetables, and beverages (e.g. tea, coffee, mineral water, soft drinks, fruit juices, green coconut water, soda water) biscuits, cakes, pastries, pickles, sauce, jam, jelly, salted snacks and sweets, etc., all of which involve a varying degree of value-adding in processing beyond the frontiers of agricultural production. In plain terms, the future demand for a large variety of non-cereal items would address itself jointly to agriculture and food-processing industry. A steady transformation of consumption from agricultural products to agro-processed products would inevitably involve larger dependence on transport system, varying from region to region (Chadha, 2007:12).

In the coming years, the process of agro-industrialization in general, and food-processing in particular, is bound to intensify, firstly, because the level of agro-industrial development in India is painfully low at the moment, and that by itself points towards a large unexplored potential for growth, and second by, because the demand tilts, especially from the middle and upper strata of the rising urban population, would lend impetus to food-processing. Importantly, going by the recent experience of the Indian economy, in general, and the striking pace of economic diversification of the rural economy, in particular, it is for sure that the agro-industrialization in the coming years would encompass rural areas no less than their urban counterparts (*ibid*: 15-16). That, by itself, should put the Indian railway system on an alert, most ostensibly because the transport-content of agricultural raw material going to agro-processing units as well as of semi-processed and processed products moving out to various commercial outlets and consumption centres would be fairly high, because the haulage would have to cover wide-spread rural production points.

Major developments in goods traffic

What has been the experience of goods traffic on Indian Railways, especially after the onset of economic reforms in the early 1990s, and the subsequent years of faster and more diversified growth. For any country, the four major modes for long-haul of goods are railways, roads, ships and airplanes. While the domestic movement of goods is *largely* sustained by railways and roads, ships and airplanes are the usual means for international movement of goods.

In India, railways constitute a critical component of transport network, both for passenger as well as freight services. In fact, the railways have traditionally been the main arteries of the goods transport network, that criss-cross the length and breadth of the country and carry to and fro all varieties of agricultural inputs and outputs, industrial raw materials, semi-finished and finished products, over varying distances. At present, the freight segment accounts for nearly 70.0 percent of the total railways' revenues, and within this segment, bulk traffic accounts for nearly 84.0 percent of revenue-earning freight (Government of India, 2008: 215). Again, the Indian Railways have been well-recognized for their cost-effectiveness as well as environmental friendliness (Government of India, 2006b: 3). Indian Railways has been contributing to the industrial and economic development of the country for more than 150 years.

In a single paper, we cannot look into all these transport developments. As such, we confine our analysis, first, to rail transport and, second, to taking note of a few broad transport after-effects of growth, already set in, and/or those that are likely to emerge as we go up on the growth trajectory. In this section, we take note of the main developments in the growth of freight traffic of Indian Railways, mainly to ascertain if, and the manner in which, it has been responding to the changing transport requirements of India's recent growth milieu. The temporal profile of the railways' freight traffic needs to be seen in relation to the pace and pattern of commodity sector growth of the Indian economy, to ascertain the major milestones in the goods traffic section of the Indian Railways, on the one hand, and the transport bottlenecks that may have already started cropping up because of the demand-supply gaps in the transport sector, or, may get intensified when the Indian economy gets more enmeshed into the global economic system.

Growth of goods traffic

Table 4 shows operation of Indian Railways for nearly six decades, beginning 1950-51. Many interesting features need to be underlined. First, all economic aspects connected with the operation of Indian Railways, e.g., originating traffic, goods carried, earnings from goods carried, average rate per tonne km., etc., have shown an upward trend, decade after decade. Clearly, railway operations have been keeping pace with the upward movement of the economy, more discernibly during the 1990s and the present decade. Second, the non-commercial component of goods carried has been declining, since 1960-61, in absolute terms, and far more steeply in terms of the total of goods carried. Again, it is clear that, contrary to a misguided perception in certain quarters, the Indian Railways has been intensifying its commercial sinews, decade after decade, especially since the beginning of economic reforms in the early 1990s; non-revenue earning goods carried by the Indian Railway network have been reduced to negligible levels since the beginning of the present decade.

Table 4: Operation of Indian Railways: goods sector (1950-51/2007-08)

Year	Item Description									
	Originating traffic (million tonnes)			Goods carried (billion tonne-km)			Earnings from goods carried (Rs. crore)		Average rate per tonne km (paisa)	
	Revenue earning	Other	Total	Revenue earning	Other	Total	Current prices	Constant prices (1999-00)	Current prices	Constant prices (1999-00)
1	2	3	4	5	6	7	8	9	10	11
1950-51	73.2	19.8	93	37.6	6.5	44.1	139.3	3216	3.2	74.03
1960-61	119.8	36.4	156.2	72.3	15.4	87.7	280.5	5603	3.9	77.9
1970-71	167.9	28.6	196.5	110.7	16.7	127.4	600.7	6616	5.4	59.48
1980-81	195.9	24.1	220	147.7	10.8	158.5	1550.9	7492	10.5	50.73
1990-91	318.4	23	341.4	235.8	6.9	242.7	8247	17352	35	73.64
2000-01	473.5	30.7	504.2	312.4	3.1	315.5	23045.4	22308	73.8	71.44
2001-02	492.5	29.7	522.2	333.2	3.3	336.5	24587	23087	73.8	69.3
2002-03	518.7	24	542.7	353.2	2.8	356	26232	23714	74.3	67.17
2003-04	557.4	24	581.4	381.2	2.8	384	27403.2	23978	71.9	62.19
2004-05*	602.1	24.1	626.2	407.4	3.9	411.3	30489.2	25276	74.8	62.01
2005-06*	666.5	15.8	682.3	439.5	2.1	441.6	35534.7	28357	80.8	64.48
2006-07*	727.8	16.8	744.6	481	2.4	483.4	41073.2	31092	85.4	64.65
2007-08*	793.0	–	–	511.8	–	–	47434.9	34580	92.7	67.49

Note: 1. * excludes Konkan Railways Corporation Ltd. loading
2. In columns 9 and 11, the figures at constant (1999-00) prices have been derived by using the deflator for gross national product

Source: 1. Government of India, *Economic Survey (various years)*, Ministry of Finance.
2. Government of India, *Statistical Abstract India 2004*, CSO, p.247.
3. For 2007-08, Courtesy Railway Board, Ministry of Railways, Government of India.

Third, the story of railway operations moving in tandem with the improving pace of economic growth, decade after decade, unfolds itself far more unambiguously when we look at the growth rates. Table 5 clearly shows that during the fifties, the sixties and the seventies, when the economy grew at an average rate of 3.6 percent, the corresponding rate of growth of originating traffic was 3.0 percent and that of goods carried was 4.4 percent. During the eighties, the economic growth rate improved to 5.5 percent, and the corresponding growth in railway output improved to 4.5 percent and 4.4 percent, respectively. During the most recent years, 2000-01/2007-08, the economy grew at an average rate of 7.7 percent, and the corresponding growth rate on the railways improved sizably to 6.8 percent and 7.4 percent, respectively. Indian Railways has been duly expanding its operations, in the goods sector, in due response to the expanding demand for railway services, and, in the process, the railway system itself has been consistently improving its revenue-earning base as the economy moved from low growth regime during 1950-1980, to medium growth regime during 1980-81 to 2000-01, and far more sizably during 2000-01 to 2007-08.

Table 5: Growth rate of the Indian economy and of goods traffic on Indian Railways: 1950-51/2007-08

Period	Economic growth rate	Growth rate of goods traffic originating traffic goods carried				Growth rate of earnings from goods carried	
		Revenue earning	Total	Revenue earning	Total	Current prices	Constant prices (1999-00)
1	2	3	4	5	6	7	8
1950-51/1960-61	3.8	5.1	5.4	6.8	7.1	7.2	5.7
1960-61/1970-71	3.5	3.6	2.3	4.4	3.8	7.9	1.7
1970-71/1980-81	3.4	1.6	1.2	3.0	2.2	10.0	1.3
1950-51/1980-81	3.6	3.4	3.0	4.7	4.4	8.4	2.9
1980-81/1990-91	5.5	5.0	4.5	4.8	4.4	18.1	8.8
1990-91/2000-01	6.0	4.1	4.0	2.9	2.7	10.8	2.6
2000-01/2007-08	7.7	7.6	6.8	7.3	7.4	11.0	6.5

However, the sad part of the story is that the average rate per tonne-km witnessed no improvement, in real terms, over all these decades, although, in money terms, the railways may claim to have 'hiked up' the rate continuously since the beginning of planned development in 1950-51 (Table 4). That the rate, in real terms, has started moving up, *albeit* sluggishly, since 2004-05, may be attributed to better management practices introduced by the present government, but, it is no more than a cold comfort. To say the least, the 'populist tariff policies', and the consequent near-stationary tariff rates that ruled during all the past decades, can no more remain the guiding principle. It is time, the Indian railway system is guarded against the past trends and gears itself up to provide extended, more reliable and high quality services, to sustain the high growth regime of the Indian economy in the years ahead. It is plainly an issue of striking a balance between what commercial considerations demand or the market can bear, and what extra-market parameters, such as social justice, inclusive growth or balanced regional growth justify. The all-encompassing approach may not serve the future growth of the railways.

Commodity composition of goods traffic

Like in any other developing economy, in India too, the railways have been contributing their share to the augmented and diversified movement of goods to sustain the process of economic development. The changing composition of originating traffic or goods carried by the railways, during the past five decades, corroborates our contention. Let us concentrate on the two-dimensional (tonne-km) concept of goods carried. Table 6 shows some characteristics of the goods traffic handled by the Indian Railways from 1960-61 onwards.

Table 6: Composition and share of goods carried by Indian Railways: 1960-61/2007-08

Year	Commodity – group description									
	Coal	RM/SP	PI-FS/ SP	IO/ exports	Cement	Food-grains	Ferti-lizers	Mineral oil	Other goods	Total goods carried
	Goods carried (billion tonne-km.)									
1	2	3	4	5	6	7	8	9	10	11
1960-61	20.5	2	3.3	-	2.5	9.6	-	2.6	31.9	72.3
	{28.4}	{2.8]	{4.6}	-	{3.5}	{13.3}	-	{3.6}	{44.1}	
1970-71	27.8	2.7	6.2	5.5	7	14.5	3.8	5.3	37.9	110.7
	{25.1}	{2.4)	{5.6)	{5.0}	{6.3}	{13.1}	{3.4}	{4.8}	{34.2}	
1980-81	36.4	4.3	8.6	7.3	7.2	24.3	8.9	11.7	39.1	147.7
	{24.6)	{2.9}	{5.8}	{4.9}	{4.9}	{16.5}	{6.0}	{7.9}	{26.5}	
1990-91	85.9	7.5	11.6	7.5	18.9	35.6	17.3	15.1	36.4	235.8
	{36.4}	{3.2}	{4.9}	{3.2}	{8.0}	{15.1}	{7.3}	{6.4}	{15.4)	
2000-01	133.4	13.5	12.1	7.9	24.9	33.1	23	19.9	44.5	312.4
	{42.7}	{4.3}	{3.9}	{2.5}	{8.0}	{10.6}	{7.4}	{6.4)	{14.2}	
2001-02	141.1	14.7	12.4	8.3	24.8	42	22.8	19.8	47.3	333.2
	{42.3}	{4.4}	{3.7}	{2.5}	{7.4}	{12.6}	{6.8}	{5.9}	{14.2}	
2002-03	141.7	13.4	13.3	8.6	24.8	63.9	22.6	19.2	45.7	353.2
	{40.1}	{3.8}	{3.8}	{2.4}	{7.0}	{18.1}	{6.4}	{5.4}	{12.9}	
2003-04	147.9	15.4	13.9	13.2	27.6	67.9	22.1	18.7	54.5	381.2
	{38.8}	{4.0}	{3.6}	{3.5}	{7.2)	{17.8}	{5.8}	{4.9}	{14.3)	
2004-05*	161.9	15.8	14.2	19	28.9	62.6	21.7	21	62.3	407.4
	{39.7}	{3.9}	{3.5}	{4.7}	{7.1}	{15.4}	{5.3}	{5.2}	{15.3}	
2005-06*	170.3	17.4	18.7	21	32.8	55.1	25.7	24.3	73.3	439.6
	{38.7}	{4.0}	{4.3}	{4.8}	{7.5}	{12.5}	{5.8}	{5.5}	{16.7}	
2006-07*	191.5	16.8	22.4	20	41.1	47.9	25.5	23.4	92.6	481
	{39.8}	{3.5}	{4.7}	{4.2}	{8.5}	{10.0}	{5.3}	{4.9}	{19.3}	
2007-08*	194.5	18.3	22.5	28.8	43.8	48.6	30.3	23.5	101.5	511.8
	{38.0}	{3.6}	{4.4}	{5.6}	{8.6}	{9.5}	{5.9}	{4.6}	{19.8}	

Note: 1. RM/SP is raw materials for steel plants (except coal); P1-FS/SP is pig iron and finished steel from steel plants; IO/Exports is iron ore for exports.
2. * excludes Konkan Railways Corporation Ltd. loading.
3. Figures in parentheses are percentage share of commodity-groups in total goods carried.

Source: Government of India, *Economic Survey of India* (various years), Ministry of Finance.

First, the goods carried have been duly facilitating the process of development of the commodity sectors, agriculture and industry, through expanding the magnitude of both the forward and backward linkages. For example, the rising quantum of foodgrains carried from production and surplus locales to storage and distribution outlets, most discernibly till the beginning of the 2000s, and the rising quantum of fertilizers carried from various production centres and ports to farms and distribution centres throughout the length and breadth of the country, reflect the forward and the backward linkages in respect of agriculture. Similarly, the rising quantum of cement, pig-iron and finished steel from steel plants, and, coal and raw material for steel plants, carried over varying distances and destinations continuously since 1960-61, are telling examples of the forward and backward linkages, in respect of industry.

Second, the manner in which the traffic share of different commodity groups has been changing clearly testifies to the contribution that the Indian Railways have been making to technology upgradation, on the one hand, and the process of industrialization, on the other. For example, the rising share of fertilizers is a surrogate of technology improvement in agriculture, while the rising share of coal, cement and raw material going to steel plants is reflective of industrial expansion.

Third, an analysis of Table 6 clearly shows that goods traffic on Indian Railways has been contributing, in its own right, to the augmentation of energy supplies, most ostensibly, through the direct movement of coal, and indirect movement of cement. The fact that the proportion of coal in the total of goods carried by the Indian Railways increased from 28.4 percent in 1960-61 to 42.7 percent in 2000-01 adequately testifies to the significant contribution that the goods sector of the Indian Railways has made to the growth of the thermal power sector. Again, the decline of coal's share during 2000s, say, from 42.7 percent in 2000-01 to 38.0 percent in 2007-08 does not negate the important role that Indian Railways has continued to play in the area of energy generation. On the contrary, the steady advances that India's energy sector has been making, with varying degree of success, through non-conventional (non-coal) sources of energy, have already started showing their impact on energy supplies which, in turn, may boost commodity production, most markedly in the manufacturing sector, with augmented multiplier effects on the movement of goods and the future demand for railway services (Government of India, 2008: 207, 27A).

Finally, the steadily increasing share of foodgrains in the goods traffic till about the beginning of 2000s, and the declining share thereafter, directly reflects a lesser movement of foodgrains from areas of surpluses to areas of deficits, and indirectly hints at an increasing degree of local self-sufficiency in recent times. Nevertheless, we believe, the multiplier effects on the transport side are clearly operative through the rising share of fertilizers and cement.

Lead profile in Indian Railways

The changing numerical relationship between originating tonnage and the distances over which the goods are actually carried, typically known as lead factor, shows interesting contrasts among individual sectors of goods traffic. Table 7 shows a mingled profile of the lead factor in respect of individual commodities or commodity groups. The average lead for total goods carried by the railways increased steadily from 604 km in 1960-61 to 741 km in 1990-91, declined to 660 km in 2000-01, and remained nearly static for all the subsequent years. During the sixties, the seventies and the early eighties, when the Indian economy and its constituent regional policy outfits were chiselling and streamlining their respective development strategies, and the targeted growth poles necessitated the inflow of men and materials from varying distances, movement of goods over relatively larger distances was a natural corollary.

Table 7: Lead factor in Indian Railways

Year	Commodity - group description									
	Coal	RM/SP	PI-FS/SP	IO/ exports	Cement	Food-grains	Fertilizers	Mineral oil	Other goods	Total goods carried
	Goods carried (billion tonne-km.)									
1	2	3	4	5	6	7	8	9	10	11
1960-61	663	190	868		385	756	0	553	683	604
1970-71	580	168	1000	561	636	960	809	596	786	659
1980-81	568	208	1147	658	750	1328	1099	780	929	754
1990-91	635	290	1160	560	654	1402	940	604	995	741
2000-01	596	348	1025	541	580	1240	849	548	859	660
2001-02	614	373	1000	529	620	1280	838	556	851	677
2002-03	601	327	978	515	536	1401	853	563	771	681
2003-04	588	351	972	494	558	1496	857	584	801	684
2004-05*	597	357	934	522	537	1346	753	656	844	677
2005-06*	579	339	1056	510	536	1321	786	725	789	660
2006-07*	611	316	1067	515	562	1146	743	738	769	661
2007-08*	575	335	1018	535	554	1293	832	646	752	645

Note: 1. RM/SP is raw materials for steel plants (except coal); P1-FS/SP is pig iron and finished steel from steel plants; IO/Exports is iron ore for exports.
2. * excludes Konkan Railways Corporation Ltd. loading.

Source: Government of India, *Economic Survey of India* (various years), Ministry of Finance

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Thanks to the consistently diversifying economic base of different regions right up to the close of the eighties or the beginning of the nineties, newer and diversified production locales had already sprung up throughout the length and breadth of the country. A small year-by-year decline in the average lead during the 1990s and the 2000s is consistent with a denser industrial map of India, say, in 1990, more so in 2000, and far more so in 2007-08, compared with that of the 1960s and the 1970s. It testifies that the operation of railways has been consistent with the requirements of the Indian product and raw material markets that have witnessed a constant change over time and space. The moot point for the future development of Indian Railways is how the changing transport requirements of regional market outfits and production conglomerates as well as, income-consumption linkages and the future vision of consumption patterns, etc., are scientifically synergised and provided for.

The share of rail-borne traffic of even the bulk commodities has witnessed hardly any change for about a decade now. The most glaring evidence is discernible in respect of coal, raw materials going to steel plants, iron ore for exports, cement, fertilizers, etc. The most plausible explanation seems to lie with capacity constraints on the Indian Railways, especially because some freight routes have become highly saturated. Undoubtedly, the recent initiatives to augment asset utilization, such as increasing the intensity of wagon and track utilization, have released some of the traffic stress, yet, the effect has been incremental rather than substantial, and in no way, an answer to the more exacting freight-related demand of a fast growing economy (Government of India, 2008: 280). Hence, the railways losing some freight business to roadways was natural to follow.

The conventional rail-road dichotomies in the goods traffic sector seem to have sharpened, in recent years. While the railways retain their relative advantage mainly in natural resources and intermediary goods markets in which there are large volume movements and relatively low value-to-weight ratios, they tend to lose it in the case of items with high and increasing value-to-weight ratios. In recent years, the changing composition of Indian manufacturing has lent greater weight to the second category of freight traffic, and the relative decline in the demand for railway services, most convincingly on medium and long hauls (Government of India, 2006b: 6). In order to retain and even increase its market share, the railways have to provide high quality container services, particularly on medium and long hauls; it needs to reposition itself all the time to meet the challenge of competition from the road sector which, in any case, is bound to increase further with the upgradation of the National Highways on the Golden Quadrilateral. To remind ourselves, the 1997 survey of the users of rail freight services rated railways below roadways practically for each parameter of its operation, reliability, availability, price, time, connectivity, suitability, damages, adaptability, customer-friendliness, and so on (*ibid*: 7).

Demand elasticity and traffic projections

We have already witnessed the decade-by-decade up- and-down-swings in the demand growth rate for goods traffic (Table 5). The seventies and nineties were notorious for a sharp decline in demand growth rates; it was only during the 2000s that the demand for goods traffic services witnessed a marked improvement in its growth rate. Table 8 reflects the temporal behaviour of demand, *now*, in terms of income elasticity of demand[5], for each of the preceding five decades and for each of the three major sectors of the Indian economy. Table 8 invites a few comments.

Table 8: Income elasticity of demand for railway freight services in major sectors of the Indian economy

Demanding sector#	Income elasticity of demand					
	1960-61/ 2006-07	1960-61/ 1969-70	1970-71/ 1979-80	1980-81/ 1989-90	1990-91/ 1999-00	2000-01/ 2006-07
1	2	3	4	5	6	7
Primary	1.132* (35.81)	1.109** (2.10)	0.951* (3.11)	1.198* (4.54)	0.628* (5.68)	1.946* (5.77)
Secondary	0.637* (59.72)	0.741* (15.34)	0.632* (5.21)	0.835* (8.68)	0.350* (6.77)	0.821* (15.82)
Commodity Sectors	0.872* (47.08)	1.226* (4.72)	0.917* (4.61)	1.056* (6.17)	0.474* (6.51)	1.182* (15.82)
Tertiary	0.561* (52.90)	0.977* (15.03)	0.612* (4.77)	0.711* (11.18)	0.308* (8.55)	0.802* (44.72)
Total Economy	0.707* (49.48)	1.179* (6.92)	0.810* (5.09)	0.895* (8.28)	0.382* (7.70)	0.950* (33.44)

Note: 1. The figure in parenthesis is the t value.
2. * is significant at 0.05 level; ** is significant at 0.01 level.
3. # For definitions see page 25.

First, the elasticity of demand has been consistently higher in the primary sector, compared with the secondary and the tertiary sectors. A relatively heavier dependence on the railways, in respect of goods moving from and into the primary sector is understandable, for obvious reasons. The average lead for final products moving out of agriculture as well as the production inputs going into agriculture is far higher than its counterpart in the secondary sector. Table 7 typically corroborates this contention for, say, foodgrains (2007-08, average lead: 1293 km) and fertilizers (average lead: 832 km) against, say, cement (average lead for 2007-08: 554 km) and raw material going to steel plants (average lead: 335 km). The longer haulage for agricultural products, a by-product of national policy on regional food distribution, usually on government account, imposes a kind of economic compulsion to use railways; it is far more economical than most other means of transportation. Again, the subsidized tariff structure consistently sustained by the state-run railway system, most certainly for specific commodities or commodity groups, and specific transport routes, has had its own appeal to the service users.

Second, consistent with an *a priori* expectation, the elasticity of demand for the commodity sectors (primary + secondary) has all along been much higher than that in the tertiary sector. The tertiary sector activities are far more intensively associated with the movement of persons, in contrast to the relatively more intense movement of goods in the case of the commodity sectors. This has significant ramifications for the future of the Indian transport sector, in general, and railways, in particular. In the coming years, the tertiary sector is likely to lose, and the secondary sector is likely to gain weight in the national economy. The increase in the relative significance of the secondary sector, particularly the manufacturing sub-sector, appears to be an inescapable strategy for sustaining a high growth profile of the Indian economy. In the coming years, the relative decline of the primary sector would not be of high order. In total terms, the tertiary sector is likely to lose some of its weight, directly in favour of the secondary sector, and to that extent, it will pave the way for greater, and increasing, demand for goods traffic services. More importantly, the quality of services would also have to improve substantially, if the expanding secondary sector or its manufacturing sub-sector, has to gain a competitive edge. The railways have a clear agenda for expansion if only the changing demand structure is grasped well, and the needed qualitative improvements in services are put in place.

Third, the demand for goods traffic services on the railways picked up well with the onset of the twenty-first century, especially in contrast to the sagging demand scenario during the 1990s. That the railways has introduced many new and innovative practices to effect operational improvements, and to 'snatch' some of its clientele back from the road transport services, during the past few years, is well recognized. In fact, such improvements have caught the eye of many observers, public analysts and even renowned academic institutions, outside India.

Finally, let us venture some guess about the demand for goods traffic services, say, at the end of the Eleventh Five Year Plan. Which elasticity coefficients would realistically capture the emerging demand patterns? In our view, the best, and possibly the most realistic procedure would be to use the latest available demand elasticity coefficients for the period 2000-01 to 2006-07, derived on the basis of sector-wise growth rates. In as much as the sectoral growth targets set for the Eleventh Plan are very close to *albeit* slightly higher, than the growth rates actually realized during the Tenth Plan period[6], the elasticity coefficients derived for the Tenth Plan may well be closest to those that would eventually emerge during the Eleventh Plan. Moreover, we are on a firmer footing in our demand projections, since we are in a position to look forward to sector-wise hikes in the demand, thanks to sector-specific elasticity coefficients available in Table 7. For attempting sector-specific projections, we also need the share of each of the three major sectors in India's gross domestic product. As discussed above, the sectoral shares of gross domestic product are likely to tilt in favour of the secondary sector, with a small decline in the share of the primary sector. The most realistic scenario would assign 15 percent share of gross domestic product to the primary sector, 40 percent to the secondary, and the remaining 45 percent to the tertiary sector.

The Eleventh Plan growth target for industry is expected to vary between 10 and 11 percent, that for services between 9 and 11 percent, and for agriculture, it is expected to go up to 4 percent[7]. Accordingly, we have attempted two sets of demand projections, one corresponding to lower sectoral growth targets, and the second based on the higher growth targets, the other two coordinates (i.e. sectoral shares of GDP and income elasticity of demand) remaining the same[8]. Our projections clearly show that even if the Eleventh Plan growth enthusiasm is not fully realized, and there is a slight downward revision of the sectoral growth targets, the demand for railway freight traffic would increase, on an average, by 7.5 percent. On the other hand, if we are able to reach the upper ends of the Eleventh Plan growth targets, in each of the three sectors, the overall demand for railway freight traffic would grow between 8.55 percent and 8.75 percent, which is almost identical with the 8.6 percent Eleventh Plan projections for the originating railways freight, and very close to the 8.1 percent projection for goods to be carried[9].

It is worth emphasizing that, during the Eleventh Plan, a major chunk of the demand pressure would come from the industrial sector for which the railway freight services need to effect substantial improvements. But then, the services sector too, with its variegated, diverse and time-sensitive mix of activities, would demand a user-friendly and demand-driven service regime from the Indian Railways. The 8 percent growth in the railway freight traffic, realistically set for the Eleventh Plan, would dictate numerous qualitative improvements in the existing operational network at the top of newer and/or deeper penetrations into the areas that are freshly surfacing on the industrial map of India.

Summing up

Undoubtedly, the Indian Railways has travelled a long distance, and seen vicissitudes in its career; the improved performance in recent years is particularly discernible and well acknowledged, and that, in turn, holds promise for further expansions and improvements in days ahead. That, for a country as big and populous as India, rail transport has to bear the major responsibility of the to-and-fro movement of goods and people, is no more an issue of debate. Further, that the railways have the advantage of moving goods in large volumes over long distances, is, by now, a well accepted economic reality. Again, it is inevitable that with a faster pace of economic growth, there would be a steady increase in the size of the parcel, on the one hand, and, a change in the composition of the parcel, on the other. In the case of mineral traffic, it would be more like 'moving the mines'. Yet again, the fast expanding scale of movement of goods would lend critical significance to loading and unloading facilities at either end of the transport networks. The list of new prerequisites and essentials for progressive modernization of Indian Railways is rather long and we need not juggle with the same.

Instead, it would be better if, in the remaining part of the paper, we take a quick look at the ongoing strategic initiatives and the modernization projects contemplated, say, for the Eleventh Plan and beyond, and the likely qualitative improvements that would take place in the operation of the Indian Railways.

The *short-term strategy* essentially aims at capacity enhancement. It focuses, first, on maximum utilization of the existing assets by addressing the directional and seasonal variations in demand. In tandem with the operational strategy that worked well in recent years, generating traffic in the traditional empty flow directions and managing seasonal fluctuations in demand, using a system of differential pricing would be carried forward. The second strategy would be investment in identified mineral routes and feeder routes to dedicated freight corridors. It is envisaged that the entire 6,873 km of iron ore route will be upgraded for running 25 tonne axle load trains during the Eleventh Plan period. Track and bridge structures will be strengthened concomitantly. It is also envisaged that 4,220 km of existing feeder routes joining the DFC will be upgraded to 25 tonne axle load. With investments directed into identified mineral routes, it should be possible to switch over to 25 tonne axle load concurrently with the availability of requisite rolling stock (Government of India, 2008: 284).

The *medium-term strategy* has to operate on many fronts. First, to create capacity and improve quality of services, *dedicated railway freight corridors* (DFCs) need to be built on the western and eastern routes. It will take around five years to complete the full length of 1,469 km of the western, and 1,232 km of the eastern corridors[10]. To reduce the cost of operations, the DFCs are designed to run double-stack container trains with 25 tonne axle load, running at a speed of 100 km/hour. Besides reducing the unit cost of transportation, it would enhance reliability and quality of services, including more efficient inventory management, competitive advantage of Indian goods in the international market, and so on (Government of India, 2008: 283).

Second, the railways have to play an increasing role in the *integrated multimodal transport system* to capture the new traffic generated by the growing Indian economy. The emergence of multimodal transport, largely based on a 'box' commonly called container, further adds to the type of the facilities required at either end of the transport columns. Alongside, is the growing acceptance of integrated logistics incorporating value additions such as packaging and labelling of goods. Again, the distributive functions may also be increasingly performed at the terminals themselves. The small goods sheds of yesteryears have, inevitably, to make way for modern terminals, often called mineral depots, freight centres, dry ports, inland container depots, logistics parks, freight villages, and so on. Gradually, these terminals get spread over large areas, where sophisticated handling facilities come up as an inescapable functional necessity. Such terminals start acting as efficient interfaces between different modes of transport – rail to road, rail to ship, etc, that injects faster and economical ways of movement of goods over long distances. The Eleventh Plan envisages provision of complete logistics solutions to its freight customers by developing *logistics parks* that would integrate bonded warehousing, logistics processing, commodity exposition, and logistics distribution (*ibid*: 286). A sizeable, and expanding, involvement of private capital in the development of multimodal logistics parks would be a big departure from the past policy regimes.

Third, *renewals, rehabilitation*, and *replacements* have to be accomplished with an overall objective of reduced asset failure and, more importantly, enhanced security. The Eleventh Plan envisages maintenance of existing assets by timely rehabilitation and replacements, besides massive modernization for improved level of utilization.

Four, *speed differential between the freight and passenger trains* has to be narrowed down by inducting high-speed freight stock and upgrading freight terminals and their approaches to obtain additional capacity in the medium term as also to increase the reliability of service in freight business.

It is heartening to note that the Ministry of Railways is deeply committed to keep pace with the *technological developments* in diverse aspects of the railway transport system. Apart from numerous other aspects of technological upgradation, introduction of longer trains and optimum utilization of carrying capacities are high on the Eleventh Plan agenda (*ibid*: 284).

To conclude, a discerning eye would readily testify that, as of now, the Indian Railways is agog with innovative ideas, most ostensibly the expanding PPP regime, modernization plans, user-friendly policies and schemes. As many as 270 projects are under way; approximately 8,000 km of new lines, 7,900 km of gauge conversion, 3,300 km of doubling, 2,200 km of electrification, etc. are targeted to be accomplished in the next couple of years. Hopefully, the Indian Railways, in general, and its freight transport sector in particular, would acquire the needed dynamism, operational efficiency and service-reliability so that slackness in carriage of goods over longer distances, encompassing diverse commodity-mixes and quality requirements, becomes a thing of the past, as the Indian economy plunges more deeply and more competitively into the world economic system, in the coming years.

Footnotes

1. During the first half of the twentieth century (1900-1947), the average annual growth rate of real per capita was negligible, e.g., 0.22 percent according to Sivasubramonian (2000) and 0.04 percent according to Maddison (1985). According to another set of estimates, it was 1.07 percent during 1885-1910 and -0.20 percent during 1911-1950 (Maddison, 1985). Decade-wise, 1911-20, 1931-40 and 1941-50 were the most depressing phases, when per capita real income grew negatively.

2. Undoubtedly, guided by their own perception of the impact of the on-going process of global slow-down on India's economy, some academic and policy circles in India, and possibly abroad, are pessimist about India's capability to stay on, for long, on the high growth trajectory. Some slow-down in India's own growth rate is anticipated for 2008-09. A varying degree of growth slow-down for India's economy may well occur in the next few years but it does not detract from the fact that India would steadily improve its share in the world GDP, and would, at some time-point, be an economic force to reckon with. The tri-polar configuration of the world economy may be delayed a bit, but, who knows, it may come off a bit earlier. In the ultimate analysis, much depends on India's own re-shuffling of development policies, to meet the on-going contingencies as also to capitalize on the growth opportunities that may come her way in years ahead.

3. According to the available projections, the urban population for India would increase sizably from 331.1 million in 2007 to 427.7 million in 2020 and 470.3 million in 2026. It would constitute 34.0 percent of total population in 2026 against 29.0 percent in 2007. In the relatively more urbanized and industrialized states, the proportion would continue to be much higher than the national average. For example, in Delhi, it would be 98.0 percent in 2026 against 95.0 percent in 2007; in Maharashtra, it would be 52.0 percent against 45.0 percent; in Tamil Nadu, 69.0 percent against 51.0 percent; in Gujarat, 45.0 percent against 39.0 percent, and so on (Government of India, May 2006: 64-99). As a matter of fact, the projected size of urban population in some of the Indian states would be much higher than the total population of a preponderant majority of individual countries (World Bank, 2007:40-42). It is time India projects the future demand for transport services, especially the one induced by rising urban population and rising urban incomes.

4. On a rough counting, investment in the construction industry is served by nearly 40 other industrial sectors, most weightily by cement and steel. The transport multiplier effects are too obvious to be emphasized.

5. Income elasticity of demand for goods traffic services is *roughly* calculated as the percentage change in the real (1999-2000 prices) gross domestic product (GDP) originating in the goods traffic segment of the Indian railways with respect to a one-percent change in GDP originating in the concerned sector of the economy. The elasticity coefficient is derived through a simple, bivariate regression exercise. The empirical limitations of our exercise should be fairly obvious. The elasticity coefficients should be taken only as reflective of the decade-wise demand trends.

6. Sectoral Growth in Recent Plans.

(% per annum)

Sector	8th Plan	9th Plan	10th Plan	11th Plan
Agriculture	4.72	2.44	2.30	4.0
Industry	7.29	4.29	9.17	10-11
Services	7.28	7.87	9.30	9-11
Total	6.54	5.52	7.74	9.0

Source: Government of India, *Eleventh Five Year Plan 2007-2012, Vol I, Inclusive Growth,* Planning Commission, 2008: 26.

7. See footnote 6 above.

8. Demand Projections for Railway Freight Traffic during the Eleventh Plan

Economic sector	Set – I	Projection			Set – II	Projection		
	Target growth rate (%)	Share in GDP (%)	Elasticity coefft.	Demand growth rate (%)	Target growth rate (%)	Share in GDP (%)	Elasticity coefft.	Demand growth rate (%)
1	2	3	4	5	6	7	8	9
Agriculture	3.0	15.0	1.946	0.876	4.0	15.0	1.946	1.168
Industry	10.0	40.0	0.821	3.284	11.0	40.0	0.821	3.612
Services	9.0	45.0	0.802	3.248	11.0	45.0	0.802	3.970
Total	8.0	100.0	0.950	7.60	9.0	100.0	0.950	8.55
				(7.41)				(8.75)

Note: The figure in parenthesis is the sum total of the projected demand for the three sectors.

9. Projection of Freight Traffic in the Eleventh Five Year Plan

Traffic description	2001-02	2006-07	2011-12
Originating Traffic (million tonnes)	492.5	728.4 (8.2)	1100.0 (8.6)
Goods to be Carried (billion tonnes km)	332.2	475.0 (7.4)	702.0 (8.1)

Note: The figure in parenthesis is annual compound growth rate over the previous plan.
Source: Government of India, *Eleventh Five Year Plan 2007-2012, Vol. III Agriculture, Rural Development, Industry, Services and Physical Infrastructure,* Planning Commission, 2008: 287.

10. It is planned to introduce other such corridors, in due course of time.

= *Primary Sector:* The primary sector of the economy extracts or harvests products from the earth. Activities associated with the primary sector include agriculture, mining, forestry, farming, grazing, hunting and gathering, fishing, and quarrying. The packaging and processing of the raw material associated with this sector is also considered to be part of this sector.

Secondary Sector: The secondary sector of the economy includes manufactured finished goods. All of manufacturing, processing and construction lies within the secondary sector.

Tertiary Sector: The tertiary sector of the economy is the service industry. Activities associated with this sector include retail and wholesale sales, transportation and distribution, entertainment (movies, television, radio, music, theatre, etc.), restaurants, clerical services, media, tourism, insurance, banking, healthcare, and law.

Commodity Sector: As retail and wholesale sales usually come under the purview of tertiary sector, the commodity sector basically comprises the trading of various commodities, agricultural and non-agricultural, that takes place in the commodity exchanges like multi-commodity exchange (MCX) in India.

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TERMINALS ON INDIAN RAILWAYS

S. B. Ghosh Dastidar*

Indian Railways (IR) have taken great strides in stepping up loading of freight traffic for the last over four years. IR loaded 518.74 million tonne (mt) in 2002-03, 557.39 mt in 2003-04, 602.10 mt in 2004-05, 666.10 mt in 2005-06, 728.77 mt in 2006-07 and 794.21 mt in 2007-08. Commodity-wise break-up of the revenue-earning freight traffic for the two years 2006-07 and 2007-08 is shown in the table below. This table also shows the type of the rolling stock normally used for carrying different commodities.

Table 1: Commodity-wise freight traffic on IR

Commodity	2006-07		2007-08		Type of rolling stock normally used
	Million tonne	% of total	Million tonne	% of total	
Coal for steel plants, washeries, powerhouses	252.39	34.64	275.04	34.63	BOXN
Raw material for steel mills	11.52	1.58	10.95	1.38	BOBRN, BOXN
Iron ore	115.01	15.78	136.75	17.21	
Total	**378.92**	**52.00**	**422.74**	**53.22**	
Pig iron and finished steel	22.75	3.12	27.13	3.42	BRN, BOXN
Coal for public use	61.56	8.45	63.24	7.96	BCN
Cement	73.09	10.03	78.98	9.94	
Foodgrains	40.40	5.54	37.65	4.74	
Fertilizers	35.59	4.87	36.53	4.60	
Balance other goods	61.63	8.46	67.19	8.46	
Total	**295.02**	**40.47**	**310.72**	**-**	
POL	35.24	4.84	36.43	4.59	BTPN, BTPG
Containers	19.59	2.69	24.32	3.06	BLC
Total revenue-earning traffic	**728.77**	**100.00**	**794.21**	**100.00**	

Source: Indian Railways Year Book

Note: BOXN = eight wheeler open wagon, BRN = eight wheeler flat wagon, BCN = eight wheeler covered wagon, BTPN = eight wheeler tank wagon for petroleum products, BTPG = eight wheeler tank wagon for LPG, BOBRN = eight wheeler open wagon with bottom discharge facility, BLC = eight wheeler flat wagon for carrying containers

It has been estimated that at present nearly 94 percent of the revenue-earning freight traffic is carried in eight-wheeler wagons. These wagons have been designed to carry higher payload per unit of length. *Pari passu*, the train loads have become much heavier. Another significant feature is that most of the traffic moves in rake loads.

The Indian Railways network, particularly on trunk routes is saturated. This position will worsen until the dedicated freight corridors materialize. This means that IR will not be able to sustain the increases in throughput as achieved in the recent years. The challenge, therefore, will be to devise new techniques to improve throughput of the

* *Former Member Traffic, Railway Board, Ministry of Railways, Government of India.*

system. One way would be to enhance the productivity of rolling stock by reducing their turnround time. Table 2 shows the turnround of wagons since 1980-81.

Turnround is defined as the time that elapses between two successive loadings. It has two components: (i) transit (running) time, and (ii) terminal detention. It has always been the railways' prime effort to reduce the transit time by increasing the average speed of goods trains. However, notwithstanding colossal investments made for the upgradation of tracks and rolling stock, including the induction of high capacity locomotives, there are inherent systemic operational limitations in this regard.

Table 2: Wagon turnround (days)

Year	Broad gauge	Metre gauge
1980-81	15.2	15.3
1985-86	12.0	14.3
1990-91	11.5	13.3
1995-96	9.1	15.1
2000-01	7.5	12.9
2005-06	6.08	NA
2006-07	5.49	NA
2007-08	5.23	NA

On the Indian Railways' network, both freight and passenger trains use the same tracks. This means that, at any given time, there is a mixed traffic regime. As things stand, the goods trains are generally not allowed to take precedence over even the slowest moving passenger trains. This makes it difficult for the average speed of goods trains to increase in any appreciable manner. In fact, it has already reached a plateau as is evident from Table 3.

In view of this limitation, the only other way to reduce the wagon turnround is to minimise the terminal detention (loading/ unloading) of wagons. Table 4 shows the lead of traffic, transit time, terminal detention for different types of wagons for the period April-June 2008.

Table 3: Speed of goods trains: km/hour (broad gauge)

Year	Steam	Diesel	Electric	All traction
1980-81	15.0	21.5	23.0	21.7
1985-86	15.1	23.3	23.2	23.2
1990-91	17.5	23.0	23.0	23.0
1995-96	-	22.7	23.9	23.4
2000-01	-	22.5	25.4	24.2
2005-06	-	23.8	25.0	24.5
2006-07	-	24.1	25.8	25.0

Table 4: Transit time, terminal detention and turnround (April-June 2008)

Type of wagon	Lead of loaded traffic (km)	Transit time		Terminal detention		Total TR (days)
		Days	% of TR	Days	% of TR	
BCN	933.13	4.66	70.53	1.95	29.47	6.61
BOBRN	261.41	1.57	66.91	0.77	33.09	2.34
BOXN	608.72	2.90	67.23	1.41	32.77	4.32
BRN	912.61	6.54	69.37	2.89	30.63	9.43
BTPN	699.65	3.51	70.15	1.49	29.85	5.01
BLC	1188.06	5.08	74.49	1.74	25.51	6.85
Others	507.58	3.77	67.85	1.79	32.15	5.55
Average	**705.11**	**3.51**	**69.13**	**1.57**	**30.87**	**5.08**

It is clear from the above that the transit time accounts for about 67 to 70 percent of the turnround time, while the terminal detentions account for the rest. In absolute terms, the terminal detention varies from 18 hours 30 minutes in case of BOBRN wagons to as high as 46 hours 50 minutes for BCN wagons and more than 69 hours in case of BRN wagons. In the case of BRN wagons, it is particularly high because of the prevailing nature of loading/unloading operations in steel plants/yards. This is one area where there is scope for substantial reduction in their terminal detentions. Likewise, there is considerable scope for reducing terminal detention of BOXN and BCN wagons as well.

The key to the realization of this objective is to promote the concept of 'engine-on-load' system, to develop proper terminal layouts, to adopt efficient operational practices, to operate trains end-to-end, and to use proper handling methods/systems for loading and unloading operations. This would involve use of payloaders, rapid loading systems, rotary tipplers, multiple wagon track hoppers, etc. In other words, specialized mechanical handling systems need to be introduced.

In the paragraphs that follow, an attempt has been made to provide typical terminal layouts and describe operational techniques consistent with the type of wagons deployed for carrying different commodities. These are discussed separately for bulk commodities, homogeneous, free flowing commodities in unpackaged form, commodities normally moved in packaged form, POL products, and containerized cargo.

I. Terminals for loading/unloading of bulk commodities
(coal, ores, limestone, dolomite, gypsum, bauxite, etc.)

These commodities are carried in large quantities. It is, therefore, necessary that the loading operations are carried out by using payloaders, with 3-4 of them working in tandem round-the-clock. To facilitate movement of these machines, a loading platform, one metre high, should be constructed alongside the loading line. This way, it should be possible to complete loading of a rake of BOXN wagons in 4-5 hours. By increasing the number of payloaders, the loading can be completed even within 2-3 hours. The capital investment required to provide the requisite infrastructure should necessarily be kept to the minimum so that the siding holder has an incentive to provide the required facilities.

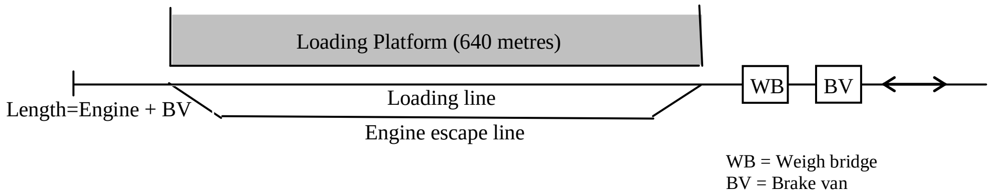
The loading operations could be outsourced. This would entail payment of about Rs. 2-3/tonne depending upon the volumes dealt with at the terminal. The handling charges should go down with increase in the volumes of commodities dealt with. The free time allowed for loading should also vary depending on the volume of traffic handled: higher the volume shorter the free time. The contract document should have a clause that if the handling contractor takes longer time in loading the rake, he will have to pay the demurrage charges.

Example:

Volume of traffic	Free rime for loading hours per rake		Volume of traffic	Free time for loading hours per rake
1 rake/day	5		3 rakes/day	3
2 rakes/day	4		4 rakes/day	2

(a) Terminal for loading bottom discharge and side opening wagons: As mentioned above, payloaders should be used for loading the commodities. The loading operations should be carried out round-the-clock and the allowable free time for loading should not be more than 2-3 hours per rake. A typical terminal layout for this purpose is shown in Figure 1.

Figure 1: Typical terminal layout



In such a layout, an efficient operational sequence would involve the following steps:

– The empty rake arrives at the loading line, engine foremost;
– The engine stops short of brake van board at the buffer end of the loading line.
– Brake van is placed on weigh bridge or just short of it.
– Brake van is detached and the empty rake is pulled ahead. (This way, while placing the rake, all empty wagons are weighed on the weigh bridge.)
– Engine picks up the brake van via the engine escape line and attaches the brake van in the rear of the rake.
– Engine goes to the entry point and attaches in front of the rake, creates air pressure and gets ready for dispatch.

The above sequence would ensure that by the time the rake gets loaded, the train is ready for dispatch in all respects. Further, as the train moves, loaded wagons get weighed on the weigh bridge. The terminal detention would be in the range of 2-5 hours per rake, depending on the volume of traffic handled and the number of payloaders deployed. Four to five rakes/day can easily be loaded at such a terminal.

Loading arrangement that involves a central handling plant (CHP) should normally be avoided because it involves large initial investment, heavy consumption of energy, and deployment of a number of staff, all leading to high running costs. Not only the unit cost of loading goes up but the loading time/terminal detention also increases due to heavy incidence of likely disruptions in the plant.

(b) Terminal for loading bottom discharge and side opening wagons with mechanized rapid loading systems: The mechanized rapid loading system consists of overhead storage bunkers which can store 30,000 - 40,000 tonnes of free flowing commodities. Before loading each wagon, pre-weighed commodity equivalent to the carrying capacity of the wagon reaches a small overhead bunker, which holds the material for discharge in the wagon.

This system ensures fast rate of loading and sixty BOXN/BOBRN wagons can comfortably be loaded in 1½ - 2 hours. This translates into loading of 8-10 rakes/day at one rapid loading terminal. Since coal or any other similar commodity is pre-weighed, the chance of overloading is minimized.

In this arrangement, the engine is always kept attached with the rake for continuously drawing wagons ahead for loading operations. If empty wagons are also to be weighed for arriving at the exact quantity of material loaded, either two rail weigh bridges are installed (in case of merry-go-round) or shunting operations are carried out which involve extra time.

Figure 2: Typical layout for rapid loading (i)

Suitable for merry-go-round system

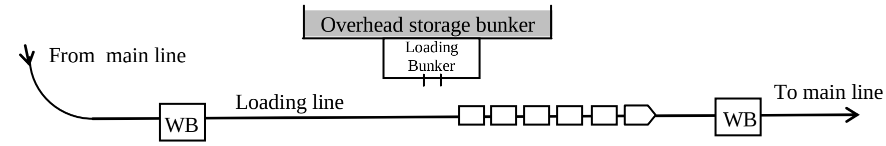
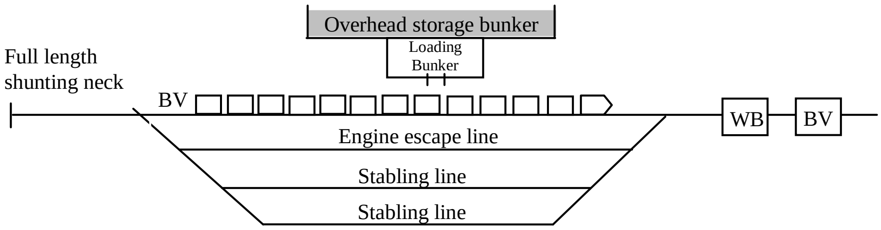


Figure 3: Typical layout for rapid loading (ii)

Non-merry-go-round system



In the above layout (Figure 3), the operational sequence is almost the same as in the case of merry-go-round layout except that reversal of engine and BV is required. The rake is pulled by the engine for loading the commodities from the overhead bunker.

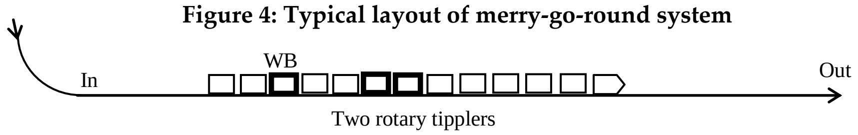
(c) Terminal for unloading, side opening wagons with mechanized tipplers: Presently, BOXN wagons are fitted with conventional centre buffer couplers which requires each wagon to be separately dealt with. To overcome this constraint, the future stock of wagons should be provided with rotary couplers. Indeed, even existing BOXN wagons may be retrofitted with rotary couplers and their CBC couplers used in the manufacture of covered wagons and bottom discharge wagons.

Major customers like steel plants and powerhouses need to be persuaded to switch over from existing conventional tipplers to rotary tipplers. Should it be considered necessary, a scheme for conversion of existing tipplers to rotary tipplers on cost-sharing basis may be formulated.

With a rotary tippler in place, a rake of 60 BOXN wagons can be tippled within 1½ - 2 hours. This would help in reducing the turnround time of the rolling stock as well as the unit cost of transportation. At the same time, the terminal handling capacity would increase manifold. Typical layouts of terminals provided with rotary tipplers separately for a merry-go-round system and buffer ended terminus are shown below.

Layout in the shape of a bulb/merry-go-round system: Rotary tipplers are ideally suited for merry-go-round systems or for a track layout in the shape of a bulb. In these types of layouts, no shunting operations or reversal of engine/BV is required. Wagons are tippled, while the train engine slowly pulls the rake.

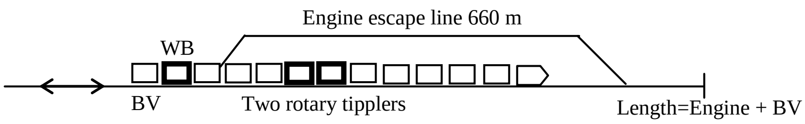
Figure 4: Typical layout of merry-go-round system



Since conversion of centre buffer couplers to rotary couplers on the entire BOXN fleet will take considerable time, it is advisable, in the interim period, to have one or two conventional tipplers along with one rotary tippler at a siding, depending on the quantum of traffic dealt with.

Layout for a buffer ended terminus: In this layout, wagons are tippled while the train engine slowly pulls the rake. The brake van is detached on the weigh bridge (short of the facing point) while pulling the rake. After completion of tippling, the engine is detached and brought to the entry end via the engine escape line. The engine then picks up the BV, goes to the buffer end via the escape line and is attached in the rear of the released empty rake. The empty rake is thus able to leave the terminal within two hours.

Figure 5: Typical layout of buffer ended terminus



It may be mentioned that since the wagons are not detached, there is no incidence of lateral shifting of bogies, as happens during conventional tippling of wagons. The sanctity of the closed circuit rakes is also maintained. These advantages help in increasing the operational worthiness of the rolling stock, minimizing the need for frequent maintenance. As a natural corollary, the 'brake power validity' of closed circuit rakes needs to be increased from 7,500 to 9,000 km.

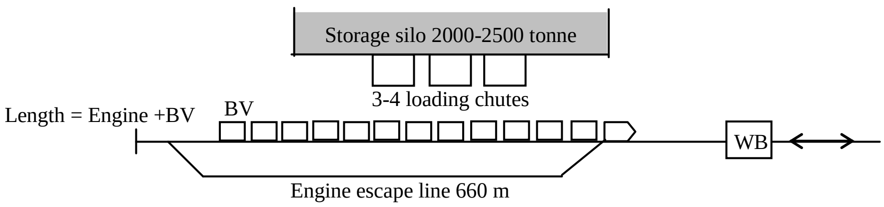
(d) Unloading of bottom discharge wagons: BOBRN wagons, etc. have an unfavourable payload to tare ratio compared to BOXN wagons. The only redeeming feature of a BOBRN is that it takes much less time to unload in comparison with a BOXN wagon. With a rotary coupler, even unloading time of a BOX wagon is less compared to a bottom discharge wagon.

In view of these inherent demerits of a bottom discharge wagon, it should be used only for short lead circuits, each having a track layout in the shape of a bulb (not buffer-ended terminal), as in the merry-go-round system. The layout and system of operation will be the same as described in the case of terminals having a track layout in the shape of a bulb/merry-go-round except that, instead of rotary tipplers, there will be 3-4 wagon track hoppers for 8-10 rakes to be unloaded per day.

II. Terminals for loading/unloading of homogeneous, free flowing commodities carried in unpackaged form (cement, foodgrains, fertilizers, etc.)

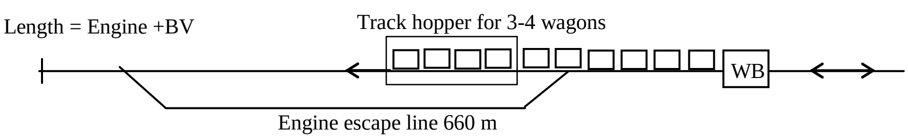
Cement, foodgrains, fertilizers, etc. are normally carried in packaged form. However, some of these commodities, being homogeneous and free flowing, can also be carried in unpackaged form in special type of rolling stock. This type of rolling stock has arrangement for loading from the top and discharging the commodities from the bottom or the sides of the wagons. The layouts of terminals for loading/unloading these commodities are described below:

Figure 6: Layout for loading systems



Loading operations: Same as given above under 'terminals for rapid loading system': 8-9 rakes can be loaded per day.

Figure 7: Layout for unloading systems



Unloading operations: The special type of wagons, carrying these commodities are normally fitted with pneumatic discharge facility for the contents to be evacuated and then stored in silos or bins. The operational sequence will be the same as detailed for Figure 6: 8-10 rakes can be unloaded per day.

III. Terminals for loading/unloading of commodities in packaged form
(Goods sheds, railside warehouses)

Commodities like foodgrains, fertilizers, cement, etc. properly packaged, can either be carried in covered wagons or open wagons depending upon the availability of the stock. At present, the ratio of loaded to empty run for BOXN wagons is of the order of 60:40 and that for BOBRN wagons is 50:50. For back-loading of BOXN wagons or loading in empty direction, railways have extended concession in freight charged. However, despite concession, back-loading of empty BOXN wagons with bagged/packaged commodities has not been encouraging. This is presumably because loading the packaged consignments in BOXN wagons is difficult and loading in BOBRN wagons almost impracticable. To overcome the difficulty, loading and unloading of packaged consignments in the form of pallets by the use of low-capacity road cranes may be explored.

The typical terminal arrangements include traditional goods sheds or modern railside warehouses. It is necessary that round-the-clock loading/unloading operations at these terminals are maintained. The full train length railside covered sheds should be provided. Other facilities would include rest house for the crew, canteen, toilets, etc. Adequate parking facilities for trucks should be made available. Scope for future extension should be incorporated in the layout plans. This sort of layout and arrangement adds value to the services provided to the industry compared to a normal railway goods shed.

The trade should be permitted to store their unloaded commodities in the warehouse at reasonable rates (much less than railway wharfage rates) till they find a suitable buyer/warehouse so that a trader may partly unload his consignment in the warehouse and load the rest directly from the wagons to trucks. The net result will be that a rake would be released in 2-3 hours without mobilizing a large fleet of trucks. Moreover, with proper sequencing, while unloading the rake, the wagons so released may be loaded with outbound cargo simultaneously so as to reduce the overall releasing-cum-loading time substantially. With two railside warehouses of appropriate layout and size, eight covered wagon rakes (of BCN/BCX) can be unloaded and also back-loaded within 24 hours.

For increasing productivity, railways should modify the provisions of Goods Tariff suitably, so that even though L/U conditions may apply, the terminal operator may unload the consignment, keep the goods in the warehouse and release the rake, if the consignee fails to start releasing the rake within 30 minutes/1 hour of the placement time.

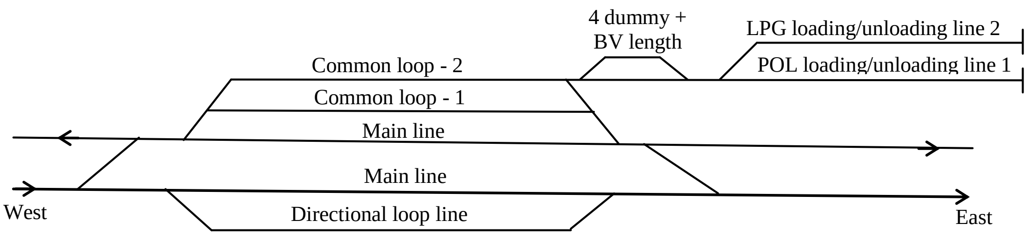
For improving the working of existing goods sheds, IR has entered into an MoU with Central Warehousing Corporation (CWC) for constructing and operating railside warehouses at 22 important goods sheds sidings. A few of these have already been constructed and the rest are nearing completion (details can be seen in the article by Mr. R. K. Jain, published in The Asian Journal (Vol. 15, No. 1, April 2008). There is a proposal to extend this arrangement to 50 more goods sheds in the rail network.

In order to improve the productivity of existing goods sheds/terminals as well as to finance the projects through public-private partnership (PPP), a policy for the construction of railside warehouses by private players has been under active consideration of the Ministry of Railways for quite some time. A quick finalization of the scheme will help realize associated benefits.

IV. Terminals for loading/unloading of POL products and LPG

The POL sidings are invariably buffer-ended. The engine (diesel/electric) is not permitted to enter into the loading gantry/unloading line. In case of POL products, the train engine can go just short of the loading gantry or unloading sumps. But, in case of LPG, the engine has to be at least 50m (4 dummy wagons) away from the loading/unloading gantry. Keeping in mind these constraints, the layout of an ideal terminal for handling LPG/POL products is shown in Figure 8.

Figure 8: Layout for handling POL products



Note: Loading/unloading lines should accommodate a full rake load.

Presently, loading and unloading of a full POL rake consisting of 48 bogie tank wagons on one line has become a common and accepted practice. Earlier, one such rake used to be loaded on 2-3 spurs. The shunting operation for placement and withdrawal used to be cumbersome and time-consuming, leading to heavy detention to the stock and consequently high unit cost of transportation. In this context, it is suggested that the serving station having two common loops should be panel-interlocked for faster and safer operations.

Loading operations

(a) ***POL:*** In the event of a train carrying empty wagons coming from the west side and eventually going to the east side, after wagons are loaded, the sequence of operations will be as follows:

- incoming train bringing empty wagons is received on common loop line No.2.
- the train engine is detached and reversed via common loop line No. 1, then attached in the rear of the empty wagons rake.
- empty wagons are pushed to POL loading line No.1 for loading.
- engine is detached and moved to the loop earmarked for BV.
  (The engine may sometime be required to be despatched to some other station to work another train).

On completion of loading, the engine on arrival for carrying the loaded rake is taken to POL loading line.

- outgoing loaded rake is pulled on common loop line No.2.
- engine is reversed, attached to the rake, pressure created, and train despatched.

(b) ***LPG:*** If the incoming rake brings BTPG wagons for loading LPG, the sequence of operations will involve:

- detaching and reversing the engine.
- empty wagons rake being pushed beyond the east end of BV loop line.
- engine being detached and moved for attaching to the four dummy wagons kept at the west end.
- thereafter pushing the empty wagons on to the LPG loading line.
- engine being detached. The engine may be detained at the siding or sent elsewhere as decided by the controller.

After the loading of BTPG wagons is completed, the engine received for working the outgoing train pulls up the rake to the east end of BV loop.

- dummy wagons are detached and kept on BV loop.
- engine is reversed via the west end and attached to BV.
- engine pulls the loaded rake on common loop line No. 2.
- engine is then reversed on the east end, attached to outgoing rake, pressure created, and train despatched.

If the POL/LPG loaded train is required to go in the western direction, the operational sequence will be:

- incoming rake of empty wagons, placed clearing the east end of BV loop line.
- engine is attached to the four dummy wagons at the west end, to be pushed and attached to the rake.
- empty rake is placed on the loading line.
- BV and dummy wagons detached, to be put on BV loop line (east end).

The engine is sent out as per the control instruction. After loading is completed, the following sequence will be maintained:

- attaching dummy wagons and BV to the loaded rake.
- pulling the rake ahead, to stop short of BV loop line.
- detaching dummies and BV.
- reversing the engine to pick up BV, to be attached to the loaded rake.
- pulling the rake on common loop line No.2.
- reversing BV and engine via common loop line No.1
- attaching BV to the rear of the outgoing rake.
- Reversing the engine, attaching to the train, creating the pressure for despatch.

If the empty rake comes from the east end, similar reverse operation has to be undertaken. In case of unloading of loaded rakes also, similar operation will have to be undertaken.

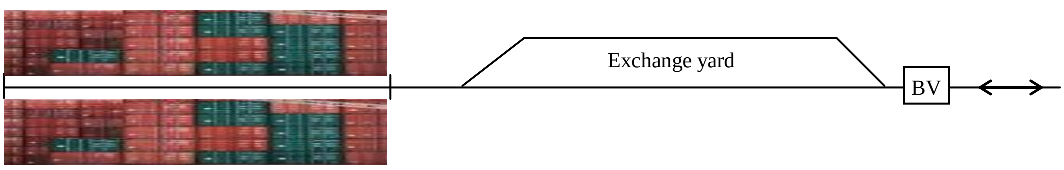
The rake may be loaded in 3-4 hours. Therefore, more than six rakes per loading line may be loaded in 24 hours. Loading and unloading operation should be round the clock, with proper floodlighting arrangement.

V. Terminals for handling containerized cargo

Terminals for handling containerized cargo may be shared by more than one private container operator (PCO), so that the time required for collection of containers for formation of full trainload is reduced to the barest minimum. It is important that the loading and unloading of containers is entrusted to a single terminal operator. Otherwise, detention owing to mixed loads will be high. Also, valuable space at the terminal will be sub-optimally used for first unloading the containers from ships/trucks at nominated space for individual operators and then shifting them to railside stacking area. Incidence of lift-on will increase, so also the unit cost of operation.

To achieve optimal levels of productivity, operations should be carried out round-the-clock adopting 'engine-on-load' system. The terminal yard must necessarily be suitably designed for high levels of productivity, for diesel or electric traction.

Figure 9: Layout for container terminal



Note: (i) The lines in the exchange yard should be capable of holding full train loads.
(ii) In the electrified territory, the exchange yard lines should be fully wired but the container handling lines will not be wired

An efficient sequence of operations will involve the following steps:

– Incoming train is received on full-length loop line for engine and BV reversal, short of container handling (loading/unloading) terminal.

– BV and engine are reversed as detailed under loading bottom discharge open wagons (BOBRN, etc.).

– The engine should create full pressure before the incoming train is pushed to the container handling line.

– The engine should remain attached to the rake, in a state of readiness for dispatch. Procedure is the same for electric or diesel traction. In case of electric traction, however, the loading/unloading lines of the container-handling terminal will be top-wired (as shown in Figure 9).

– The incoming crew should preferably work the outgoing train. Rest room and canteen facilities may be provided for the crew. Normally, closed circuit rakes having valid brake power certificate (BPC) should be used for running the container trains. The BPC should be made valid for longer train runs up to 9,000 km. No safe-to-run or any other train examination be conducted at the terminal. Only one TXR with two fitters may be kept there to check that there is no disturbance in the wagons after unloading the containers by crane.

– Loading operation should follow unloading operation simultaneously from both sides. Both operations taken together may not take more than 3 hours. Adequate number of cranes/reach-stackers may be deployed. Each line at the terminal may thus unload/load 6-8 trains per day. If volume of traffic increases, additional handling line may be built.

As explained earlier, a common operator should handle containers meant for different terminals. The outgoing containers having the same destination, if stacked along the line in advance, will help expedite their loading. The common operator may be the owner of the terminal, or the dominant terminal operator, or the port authority, or an appointed operator. If necessary, a JVC may be formed, involving all the stakeholders. Individual stakeholders must not individually operate their containers separately.

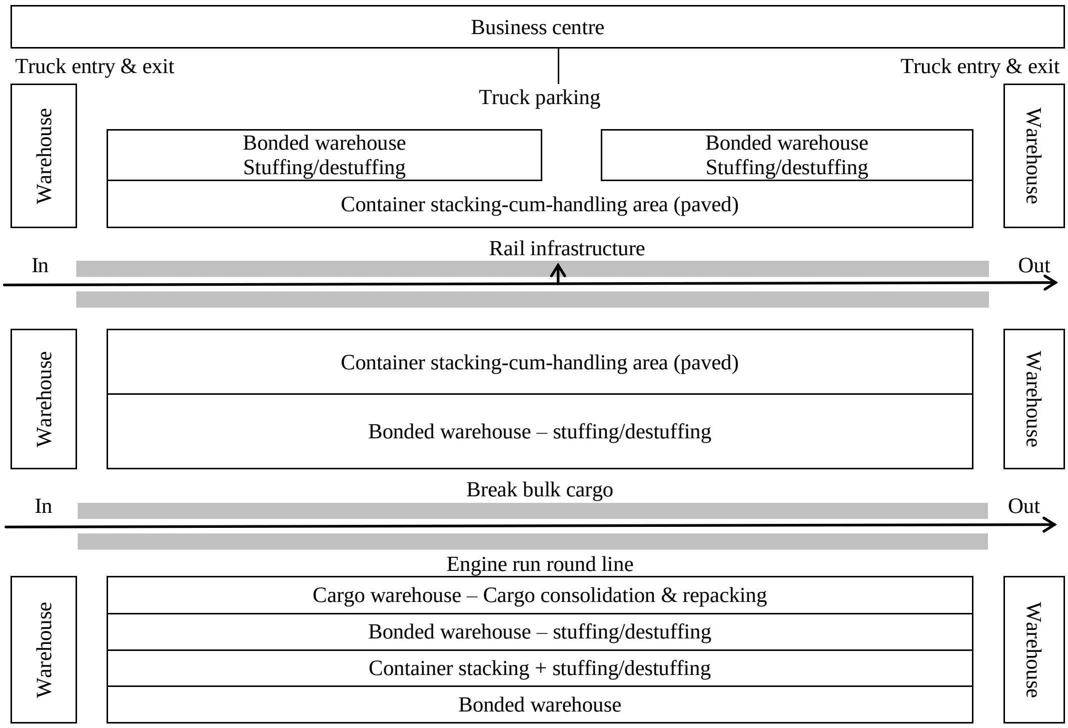
VI. Rail terminal component in logistics parks

A logistics park should ideally be situated near a large industrial city/town so that finished products from the industries located nearby can be transported to various distribution centres speedily and economically. Similarly, raw materials required by the industries can also be brought in conveniently through the logistics park at the cheapest cost.

Ideally, such a logistics park should be located near a gateway port/airport and within easy reach of the main motorways and railway network. The park should be set up on a large tract of land. If the area and character of the logistics park warrants, it may be designated as free trade warehousing zone and all the facilities of a dry port made available.

A logistics park should not just be a cargo handling and warehousing-cum-distribution centre. It should better be developed as a well-run business centre, to meet the varying needs of trade and offering a vast range of products and services. As a trading-cum-distribution centre it should have a number of large trading clusters and provided with efficient ancillary services and facilities. A schematic plan of a 'Logistics Park' is shown in Figure 10.

Figure 10: Layout for logistics park



Note: (i) The rail tracks should be to top wired. The tracks should be at the same level as the paved road.
(ii) Shaded area denotes the paved road surface.

The range of facilities and infrastructure available in a logistics park should enable it to run independently. It should include facilities for business and entertainment, banking, security, hospitality, health, recreation, travel and transport, etc. besides the facilities for customs, shipping and airlines, logistics service providers and for commercial, fiscal and insurance transactions.

PORT BASED RAIL FREIGHT TERMINAL DEVELOPMENT – DESIGN AND OPERATIONAL FEATURES

Poul V. Jensen* & Niraja Shukla**

Introduction

India has 12 'major' ports under the jurisdiction of the Central government and about 185 'non-major' ports under the control of respective state governments along its coastline of approximately 7,000 km. The 12 'major' ports handle 75 percent of India's total port traffic. Apart from the 'major' ports, some 'non-major' ports are also gaining rapid traffic, particularly the ports of Mundra, Pipavav, Hazira, Dahej and Magdalla in Gujarat, Dharamtar in Maharashtra, Karwar in Karnataka and Gangavaram and Krishnapatnam in Andhra Pradesh. For the development of state sector ports, maritime boards have been developed in various states. Gujarat Maritime Board (GMB) was the first board to be established, followed by those in Maharashtra and Tamil Nadu.

India is experiencing a strong economic progress and foresees itself to rise as one of the leading global players in trade. Various trade agreements with a number of countries will further boost the country's trade. India's contribution to global trade has risen from 0.7 percent to 1.3 percent in the last three years. Sea trade is 95 percent of the total Indian trade by volume. With this rapid development, Indian seaports require due attention and world-class infrastructure upgradation.

The Indian government has taken constructive steps towards the development of ports and has planned for considerable investments in upgrading their infrastructure. Hinterland connectivity is also receiving more attention now, as it has been recognized as a major catalyzing factor for traffic increases at the ports. However, the inadequacies in the infrastructure at the ports and in the hinterland connectivity have been leading to delays in evacuation of goods from the ports, thereby hampering the efficiency of the international trade transactions. The committee on 'Rail-Road connectivity for major ports' formed under the Committee of Infrastructure chaired by the Prime Minister provides an action plan to develop adequate road and rail hinterland connectivity to the major ports of the country. The main requirement mentioned in the action plan is to have at least four-lane road connectivity and double-track rail connectivity to all major ports in the country.

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* *Mr Poul V Jensen is the Managing Director of TransCare Logistics India Pvt. Ltd., New Delhi.*

** *Ms Niraja Shukla is a Business Analyst with TransCare India.*

To determine the regional distribution of the projected cargo to different modes of land transport, type-wise modal split assumptions are shown below (Table 1). These assumptions have been made depending upon the features of the respective regions, nature of cargo, quantum of cargo and the spread of hinterland.

Table 1: Modal split by cargo type for major ports

<table>
<tr><th>Cargo group</th><th colspan="2">Moved by:</th></tr>
<tr><td>Crude oil</td><td colspan="2">Pipeline – 100 percent</td></tr>
<tr><td rowspan="3">POL</td><td colspan="2">Rail – 25 percent</td></tr>
<tr><td colspan="2">Road – 25 percent</td></tr>
<tr><td colspan="2">Pipeline – 50 percent (Including coastal movement)</td></tr>
<tr><td rowspan="2">LPG</td><td colspan="2">Rail – 50 percent</td></tr>
<tr><td colspan="2">Road – 50 percent</td></tr>
<tr><td>LNG</td><td colspan="2">Pipeline – 100 percent</td></tr>
<tr><td>Thermal coal</td><td colspan="2">Rail – 100 percent</td></tr>
<tr><td>Loading port</td><td colspan="2">Conveyor – 80 percent</td></tr>
<tr><td>Unloading port</td><td colspan="2">Rail – 20 percent</td></tr>
<tr><td>Coking coal</td><td colspan="2">Rail – 100 percent</td></tr>
<tr><td rowspan="6">Iron ore</td><td rowspan="2">Mormugao</td><td>IWT – 80 percent</td></tr>
<tr><td>Rail – 20 percent</td></tr>
<tr><td>New Mangalore</td><td>Pipeline – 100 percent</td></tr>
<tr><td>Tamil Nadu</td><td>Rail – 100 percent</td></tr>
<tr><td>Andhra Pradesh</td><td>Rail – 100 percent</td></tr>
<tr><td>Orissa, West Bengal</td><td>Rail – 100 percent</td></tr>
<tr><td rowspan="2">Foodgrains</td><td colspan="2">Rail – 70 percent</td></tr>
<tr><td colspan="2">Road – 30 percent</td></tr>
<tr><td rowspan="4">Fertilizers; Raw Materials</td><td colspan="2">Rail – 30 percent</td></tr>
<tr><td colspan="2">Road – 30 percent</td></tr>
<tr><td colspan="2">IWT – 15 percent</td></tr>
<tr><td colspan="2">Conveyor – 15 percent</td></tr>
<tr><td rowspan="2">Other dry bulk</td><td colspan="2">Rail – 30 percent</td></tr>
<tr><td colspan="2">Road – 70 percent</td></tr>
<tr><td rowspan="3">Other liquid bulk</td><td colspan="2">Pipeline – 20 percent</td></tr>
<tr><td colspan="2">Rail – 20 percent</td></tr>
<tr><td colspan="2">Road – 60 percent</td></tr>
<tr><td rowspan="2">Containers</td><td colspan="2">Rail – 45 percent</td></tr>
<tr><td colspan="2">Road – 55 percent</td></tr>
<tr><td rowspan="2">Break bulk</td><td colspan="2">Rail – 20 percent</td></tr>
<tr><td colspan="2">Road – 80 percent</td></tr>
</table>

Source: Report of the Committee of Secretaries on Rail – Road Connectivity of Major Ports

It would be observed from the above table that following the current trend of movements, certain cargo like thermal coal, coking coal, iron ore and foodgrains are made captive to Railways in the projections. Movement of liquid bulk like crude oil, POL and LNG are considered captive for pipeline transport. Even though the container rail share is projected to be 45 percent, currently none of the major ports exhibits this level of rail share. Ports like JNPT, Mundra and Pipavav and forthcoming ports like Rewas might achieve a rail share of 45 percent in the future as their major hinterland is North India which is located at a distance of about 1,500 km. On the contrary, Southern ports like Chennai, Tuticorin and Kochi would rather be dominated by road as the major catchment of these ports lies within 500 km range.

The railway movement to the major ports is largely dominated by bulk cargo. During the last decade, even though containerization has gained fast momentum, container rail movement to ports remains largely unexploited. The rail share for containers at various 'major' ports during 2006-07 is mentioned below (Table 2).

From the scenario presented in Table 2, it can be inferred that huge potential of rail transportation is yet to be exploited.

Table 2: Rail modal share of containers at major ports

Port	TEU handled (2006-07)	Approximate rail share
JNPT	3,298,620	26.0 percent
Chennai	885,422	7.0 percent
Kochi	226,806	6.0 percent
Kolkata	239,431	7.0 percent
Haldia	109,638	1.4 percent
Tuticorin	377,102	0.0 percent
New Mangalore	17,290	1.0 percent
Mormugao	13,242	0.0 percent
Mumbai	138,201	2.0 percent
Paradip	2,476	0.0 percent
Vizag	55,769	0.0 percent
Kandla	177,787	0.4 percent

Source: IPA, 2006-07

Private container train operation, initiated by IR in 2005 to break the monopoly of CONCOR, is initiating container traffic also at ports which traditionally handle bulk cargoes. Fifteen new rail operators have registered till now and many of them have started operations. Though the container movement by rail has been negligible at Vizag port, recently, rail operations have been started by private container operators like BOXTRANS from ICD Loni in North India for Vizag port. The overall rail share at this port is about 65 percent. As such, it is expected that the container rail share will gain momentum in the future.

As container cargo is largely a time-bound cargo, lack of timetables for goods trains and inadequate rail infrastructure are becoming the main reasons for the low utilization of rail. The Dedicated Rail Freight Corridor (DFC), particularly between Mumbai and Delhi in Phase I, has been conceptualized as a solution to the above issues. This corridor will have dedicated goods trains running on the track according to a timetable. The projection of about 100 trains per day for Delhi - Mumbai corridor for the year 2021-22 with a speed of about 100 kmph shall require large-scale upgradation of the rail infrastructure. But this DFC is just a link in the entire multimodal container transport chain. The nodes where this rail link ends and connects to other infrastructure, viz, ICDs, ports, logistics parks, etc, deserve equal weightage for rail infrastructure upgradation.

The rail infrastructure developed within the port premises has largely been developed at the instance and cost of the port trusts. The efficiency and desirability of rail infrastructure and operations inside the ports is the port's own domain. But the container operations, in some cases, are assigned to third parties like CONCOR or Indian Railways (IR). IR utilizes a rake as its unit of loading/unloading. This leads to a large amount of mixed trains arriving at the port, triggering delays in port operations. As the responsibility of sorting the wagons is in this manner transferred to the terminal operators, they are facing inefficiencies and high cost. In practice, the cost of shifting of containers from one terminal to another is passed on ultimately to the cargo owner. The inefficiencies faced by the terminal operators are thus a part of the high domestic supply chain cost experienced in India.

The present article specifically addresses these trends and issues of rail terminal design and operations within the port premises, highlighting the impact that an efficient design has on productivity, economies of scale and costs.

European ports have already encountered these issues and are, in fact, still encountering similar issues. Thus, benchmarks have been set by European ports, and these will be used to assess the design methodology being followed and the issues being faced by the Indian ports. Here, two case studies from India, namely, those related to JNPT and Chennai port are being examined and compared with Hamburg Port.

Background of the ports

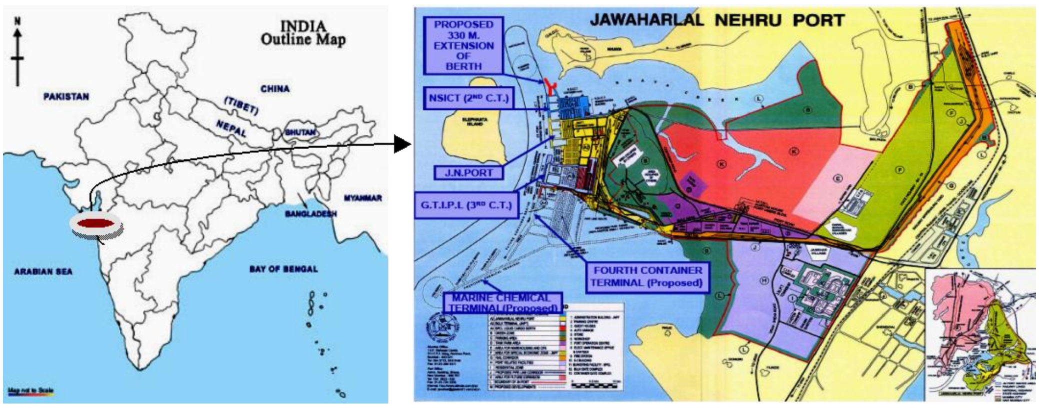
Jawarharlal Nehru Port in Mumbai and Port of Chennai are the leading container ports of India. They together handle more than 75 percent of the country's total container cargo. These ports, like all the ports in the country are gateway ports. Rotterdam and Hamburg are the leading ports of Europe handling about 34 percent of the container cargo of the top 15 European container ports. Rotterdam leads them all with 10.7 million TEU (in 2007) followed by Hamburg with 9.8 million TEU. Rotterdam commands the sixth position among the top world container ports while Hamburg has the ninth position. The proportion of transshipment in Hamburg is about 25 percent. Even though the infrastructure at JNPT is inadequate in terms of evacuation of containers, the growth in the volume of its container traffic has been impressive. Whilst Hamburg has recorded a volume increase of 3.5 times during 1995 to 2007, JNPT has experienced its volume increase by as much as 11 times.

Jawaharlal Nehru Port

Jawaharlal Nehru port is the leading container port in the country handling about 60 percent of the total container cargo at the Indian ports. India's increasing trade handled on the west coast necessitated the development of additional container handling facilities, particularly in the context of highly congested Mumbai port. The need of an additional port in the vicinity led to the development of JNPT which commenced operation in 1989. Today, JNPT ranks 31st amongst the world's top 100 container ports. Ninety seven percent (by volume) of the cargo handled at the port is containerized cargo.

JNPT is located at the eastern end of Mumbai in the Nhava Sheva area. The draught is 13.5 m at berths and JNPT can take in vessels having laden draught up to 12.5 m. The port is connected to the hinterland mainly by road and rail, its rail share being around 25 percent. Some movement also occurs by coastal shipping. Although the port is connected to 27 ICDs across the country, most of its cargo originates from and is destined for Tughlakabad, Ludhiana and Sabarmati ICDs.

Figure 1: JNPT location and layout map



Source: JNPT

There are currently 20 CFSs in the vicinity of the port and 20 more are planned to come up in the future.

The port currently has three operating container terminals, JNP Container Terminal (JNPCT), Nhava Sheva International Container Terminal (NSICT) and Gateway Terminal India Ltd (GTIL). The infrastructure for all the three container terminals is as follows:

Table 3: JNPT container terminals: infrastructure: 2008

Terminal	JNPCT	NSICT	GTIL
Handling capacity (million TEU)	1.2	1.4	1.3
Actually handled (million TEU)	1.31	1.36	0.63
Quay length (m)	680	600	712
Container yard area (hectare)	48	29	54
RMQC	6 post-Panamax, 2 super post-Panamax	4 post-Panamax, 4 super post-Panamax	8 super post-Panamax
RMGC	5	3	3
RTGC	18	29	29

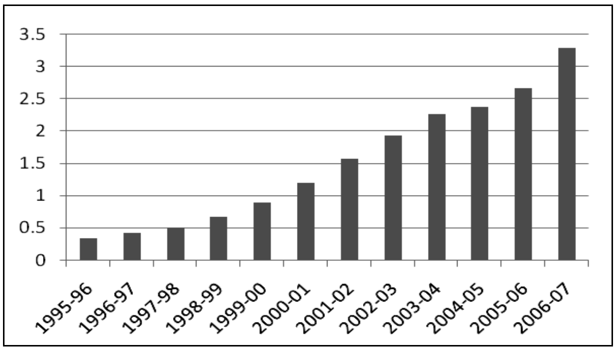
Source: JNPT

The port has experienced a massive growth in terms of container traffic which rose from 0.3 million TEU in 1995-96 to 3.3 million TEU in 2006-07. The container traffic recorded for the year 2007-08 has reached 4.06 million TEU. JNPT's share in the total container traffic at Indian ports grew from 23 percent in 1995-96 to 60 percent in 2006-07.

Chennai port

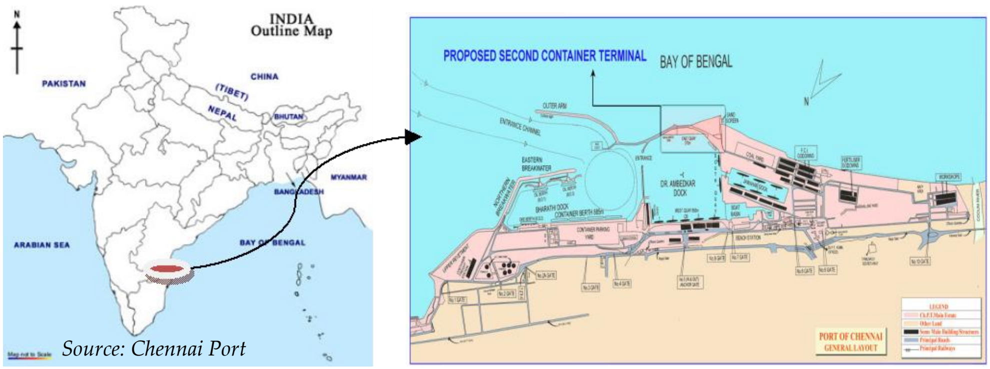
Chennai port is located on the east coast of India in the state of Tamil Nadu. Among the country's three premier gateways traditionally handling international trade traffic and serving as catalysts for its industry and commerce, the Chennai Port (Madras Port) dates back to more than 100 years. It has a draught of 13.4 m.

Figure 2: JNPT container traffic: growth - million TEU



Source: JNPT

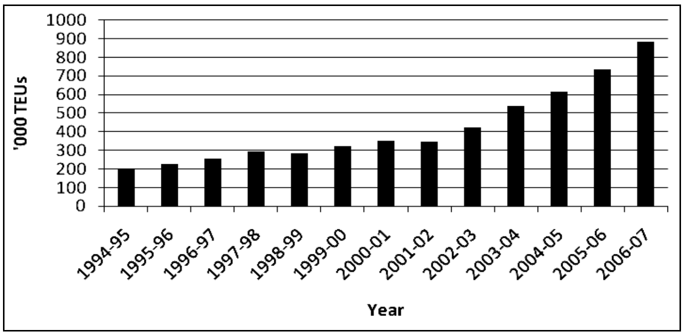
Figure 3: Chennai port: location and layout



Source: Chennai Port

Chennai port stands second among the ports in India in terms of container handling, after JNPT. Eighteen percent of the total cargo handled at the port is containerized cargo. It handled 1.128 million TEU in 2007-08. It has only one container terminal, operated by DP World. A second container terminal is under construction and will be operated by PSA/SICAL. The port contemplates a mega container terminal to come up in future. The operational terminal has 885 m quay length with four berths and seven rail-mounted quay cranes, five of which are super post-Panamax and two post-Panamax. With a dedicated terminal for car handling, it is the leader in terms of car exports. About 24 CFSs cater to the port in and around Chennai. The container traffic at the port has grown almost four times during the period 1995 to 2007.

Figure 4: Chennai port: container traffic: TEU: 1000



Source: Chennai Port

Rail terminal design and operations at the ports

The premier ports of Kolkata, Mumbai and Chennai were developed during the British rule in India. The rail network was well laid and the modal split was nearly 100 percent in favour of rail, which steadily plummeted from 80 percent in the 1950s to 20 percent in 2000. The road network developed considerably during the period and thus road kept on taking a leading share in the modal split.

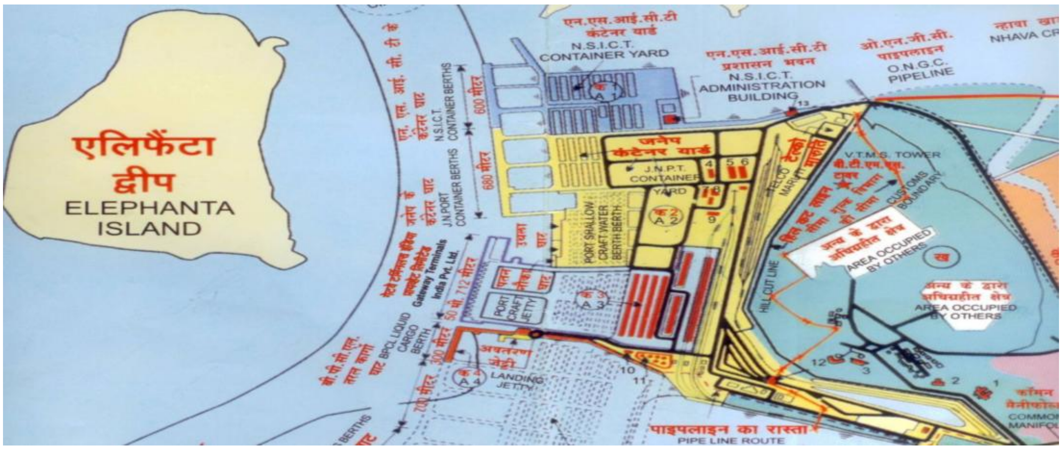
Since 2004, there has been a significant operational and financial turnaround in the Indian Railways which are gradually gaining back their share in transportation of goods. Also, with the rising GDP and trade, the volumes handled at the ports by the Railways have increased manifold leading to large-scale upgradation of existing and development of new logistics infrastructure. The recent emphasis on multimodal transport optimization has led to the focusing of attention on areas which had been overlooked earlier. Investments are planned in upgrading the existing and laying new rail networks, road networks, and port infrastructure. However, nodes like ICDs, internal port logistical optimization and, most importantly, the complete multimodal logistical chain optimization has not been given due attention. Though this is gaining momentum now, the area of rail terminal design and its critical impact as the link between the port and the hinterland railway network still remains untouched.

To further analyze particularly this important issue, the current port terminal design and operation planning for the ports of JNPT and Chennai are discussed as case studies below:

Jawaharlal Nehru Port

The rail infrastructure within the port premises has been developed by the Port Trust. Earlier JNPCT was the only container terminal operating at the port. After the port container terminals were thrown open for private sector participation, NSICT was established in 1999, now operated by DP World. The third terminal, GTIL, is operated by a consortium between APM Terminals and CONCOR. This third terminal was developed, replacing the original bulk terminal at the port. GTIL thereby got the advantage of a dedicated rail terminal. The rail terminal at JNPCT has two lines earmarked for NSICT. All the three terminals together handled about 4.06 million TEU in 2007-08.

Figure 5: Jawaharlal Nehru Port: layout



Source: 'Surging Ahead', JNPT, 2007

Performance at rail facilities of the three container terminals in 2007-08 is summarized below:

Table 4: Sidings and rakes received at JNPT container terminals

Parameters	JNPCT	NSICT	GTIL
Rail lines	4	2	3
Rakes handled	2,081	1,884	952

Source: JNPT

Rail Operations in the Port: The Jasai road junction is the exchange yard for the port and the Indian Railways. The rail infrastructure from Jasai road to the terminals is developed and maintained by JNPT. The rail link from the hinterland up to Jasai road has electrified double track while the rail link from Jasai road to JNPT terminals is double track with diesel traction. Locomotives get changed at the Jasai yard. The rail lines on the port terminals are based on the model of assisted sidings. IR operates the trains.

Indian Railways uses a full rake as a unit of loading point-to-point and treats all terminals in the port as a single user. Initially, when the agreement between the three terminal operators, CONCOR and IR was signed, the mixed train operation was earmarked at 30 percent of the total container throughput. However, during the early operations it reached 90 percent and today it stands at about 75 percent. This aspect is creating sorting as one of the major internal handling issues between the three terminal operators.

Since the major hinterland for JNPT is North India, the Ministry of Shipping had projected the rail modal share of about 40 percent for this port. However, after the implementation of the DFC concept, some industry experts expect this share to be even higher in future. DFC planners are also considering the feasibility of running double-stack container trains as well as doubling the train length to 1,500 meters in the future. Taking into account this factor, and the issue of sorting of containers, it is extremely important to upgrade the design and operations of the port-based rail terminals to an efficient standard.

According to port officials, considering a turnround time of 8hrs for one rake, the 9 sidings of three terminals have a capacity to handle 27 rakes each way per day. Currently, these sidings are handling about 18 rakes per day. About one rake per day from private container train operators like CWC, Hind terminals or GDL is also received at this port. Among the export trains, 4 trains are block trains destined to single terminals whereas 14 are mixed trains. The four trains are mainly received from Ludhiana, Nagpur and Sabarmati ICDs, whereas the mixed trains are mainly received from Tughlakabad ICD. More than 70 percent of the total export cargo is received from the three ICDs, viz, Tughlakabad, Ludhiana and Sabarmati. As regards import trains, 15 trains are dedicated trains to single ICDs and the remaining 3 trains are mixed trains. The port is linked to 27 ICDs in the country.

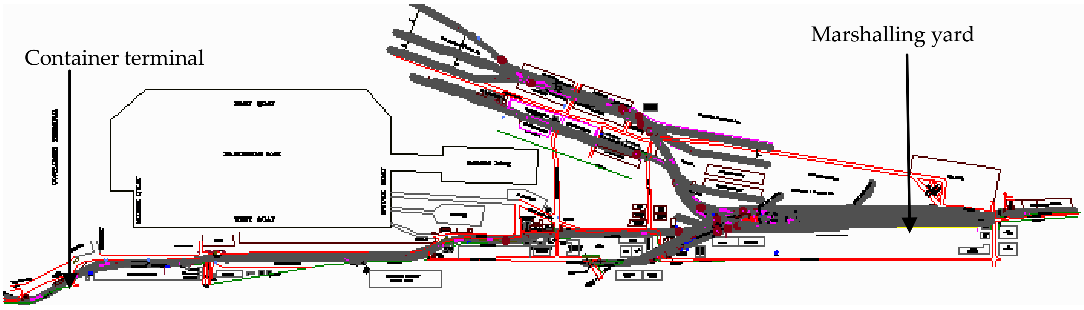
When a mixed train arrives at the port, between Panvel and Jasai Road, the report about the status of the train is received by CONCOR at the port and they decide the placement of the train. About 4 hours are taken for loading/unloading operation and the total turnround time is about 8 hrs. The master plan for the port envisages a loop system for the future rail network wherein the entry and exit lines for trains shall be different, as opposed to the present arrangement, where the trains enter and exit the port terminal area from the same line. A loop line is expected to lead to a lower turnround time and more handling of trains at the terminal.

The container train which is received at any of the nine terminal sidings is unloaded and the containers pertaining to the other two terminal operators are picked up individually by the respective terminals from the unloaded terminal yard. For example, if a mixed train arrives at JNPCT terminal, all the containers are unloaded. NSICT and GTIL have to pick up their respective containers from JNPCT yard. As the sorting of trains does not occur at the ICD or during the rail transport, the mixed rake is simply unloaded at the terminal where the train has arrived and, as such, sorting becomes the responsibility of the container terminal operator.

Chennai port

Chennai port has only one rail container terminal which handled 1.128 million TEU in 2007-08. It is currently operated by DP World. The port has planned a new container terminal which is under construction and shall be operated by PSA/SICAL. A mega container terminal is also planned for the future with a capacity of 5 million TEU. The rail infrastructure, including locos, has been provided by the Port Trust but is being operated by CONCOR. Maintenance of the infrastructure is being done by the port itself and even the manpower is that of the port.

Figure 6: Chennai port: layout



Source: Chennai Port Gate No 9

Chennai port receives container trains only from ICD Bangalore and ICD Hyderabad. One train per day is received from ICD Bangalore and one train per week from ICD Hyderabad. Initially, the port was linked to ICD Tughlakabad and ICD Nagpur as well, but due to lack of capacity, currently these trains end at Tondiarpet ICD. All the movement from Tondiarpet ICD is by road. The port has the capacity to handle only two container trains per day as it has only one rail siding for container trains.

Rail operations in the port: The marshalling yard receives container trains through Gate No 9 (Figure 6). This yard also receives trains with other cargo, such as coal, iron ore, fertilizers, foodgrains and cars. Only for iron ore the entry to the port is separate.

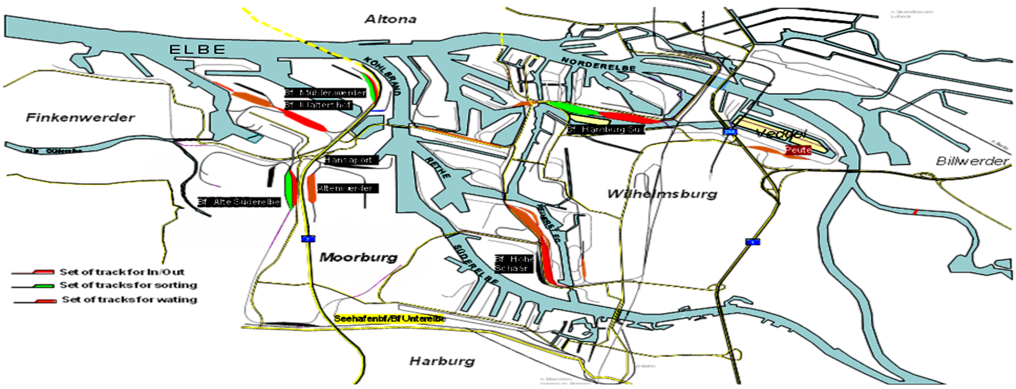
The train enters the marshalling yard on the reception line. The loco of Indian Railways is detached and port loco is attached to the rake. This train is then taken to the container terminal situated next to Bharati Dock. As there is currently only one container terminal, sorting of trains is not an issue. It is felt that after the development of the PSA/SICAL terminal and the future mega terminal, sorting would become necessary. In view of this, an alternative rail operation plan for these new terminals is under consideration. Chennai port can learn from JNPT how not to operate container trains for multiple terminals. Part of the operational design will include the selection of the operator of the new port-based railway system, considering the stiff competition faced today.

Sorting of trains would remain the most important issue for the port in the future and needs to be looked into at this stage itself. Also, in Phase II of DFC project, the Kolkata–Chennai and Mumbai–Chennai corridors are proposed to be linked. Currently, the port has a designed capacity to handle only 5 trains per day in the marshalling yard, but is actually operating 10 trains per day. Out of these 10 trains, 2 trains are container trains. Thus, due to the over-utilization of the marshalling yard, the port cannot handle more than 2 container trains per day. The modal share at the Chennai port for container trains is about 7 percent. After the development of DFC and the two new container terminals, this share is likely to increase and thus further capacity needs to be created and the related infrastructure upgraded.

Benchmark – Hamburg port

Hamburg port is situated on River Elbe in Northern Germany with a draught of about 16 m. It is accessible to the largest ships of the world. The port in total has 320 berths with 41 km of quay length. It is traditionally a railway port and is the largest rail container handling centre in Europe. It has a total of 350 km of railway track within the port premises. The port has in excess of 1000 rail sidings.

Figure 7: Hamburg port railway: layout



Source: Hamburg Port Authority/TransCare Analysis

As can be seen from Figure 7, there are five shunting yards for railway operations in the port. For container terminals there is a separate shunting yard which sorts the trains and creates block shuttle train for the respective container terminals. Presently, there are four container terminals operational at the port. The container terminal infrastructure at the port is as follows:

Table 5: Hamburg container terminals: infrastructure

Terminal	Eurogate	HHLA CTB	HHLA CTA	HHLA CTT
Handling capacity (million TEU)	4.5	5.2	3.0	2.0
Actually handled (million TEU)	2.6	2.8	2.4	0.95
Quay length (m)	2050	2850	1400	995
Container yard area (hectare)	48	29	54	
RMQC	18 (15 post-Panamax)	20 (13 post-Panamax)	15 (13 post-Panamax)	7 post-Panamax

Source: Hamburg Port Authority

Apart from the four container terminals, there are eight multi-purpose terminals which also handle containers. The overall modal share of rail in container traffic is about 18 percent. This share is generated considering the transshipment volume. The transshipment share at Hamburg port is about 25 percent.

The container volume on the port reached 9.8 million TEU in 2007, from 2.8 million TEU in 1995, increasing 3.5 times. Sixty-eight percent of total throughput is containerized cargo. There is movement of around 740,000 rail wagons per year from container terminals.

The port is a major customer of Deutsche Bahn (Railion). Rail has a market share of about 70 percent for long distance traffic. About 50 rail companies are involved in container rake movement to and from the Port of Hamburg. The departure and arrival times are determined on daily basis and rail timetables are carefully coordinated, offering reliable service.

Rail operations in the port: The Hamburg port has sorting stations along with in-and-out and waiting stations in one area (Figure 7). These stations sort the mixed trains arriving at, and leaving, the port. There are 8 tracks in the in-and-out station and about 24 tracks in the sorting station. This facilitates the mixed trains to be sorted according to each train's destined terminal. There are 4 container terminals at the port with a total capacity of about 14.5 million TEU. The port is handling about 45 trains per day each way.

At the sorting station, a hump arrangement is provided which allows the wagons on the train to get sorted according to the terminal. Terminal-specific block trains are created for each terminal. Trains are also created for a group of terminals. These shuttle trains run continuously between the sorting station and the terminals. The terminals normally have a track length of about 100 to 200 m, with a capacity to handle 5-6 wagons simultaneously. Thus, earlier sorting becomes an important function for container terminals for the rail-bound cargo.

Within Hamburg port, the Hamburg port railway is responsible for infrastructure development and operations of the railway.

With this infrastructure and operational efficiency, the container rail share has increased by 100 percent during 2002 to 2007. The port now needs to develop more rail infrastructure to meet the requirements of its rapidly increasing rail share.

Figure 8: Rail sorting station

Comparison of rail infrastructure and operations at the ports

At all the three ports, namely, Jawahar Lal Nehru Port, Chennai Port and Hamburg Port, the train traverses the exchange yard/sorting station and reaches the container yard of the terminal. With numerous tracks available at the Hamburg Port, the train takes the same track for export and import containers. Facing the detention issues at JNPT, a loop system is proposed in which the exit trains (i.e. import trains) from the terminals shall be taking a separate route and meeting at Jasai Junction for exchange of locos and further movement. Even at the Chennai port, consideration is being given to having a different track for SICAL terminal and providing a direct entry to the existing CCTL terminal and avoiding the marshalling yard.

There are mainly three types of rail routings in a port with respect to the rail movement:

- On-dock terminal – The main rail operations are handled at the container terminal yard. All Indian ports have this model.
- Off-dock terminal – The rail operations are carried out in the port premises before reaching the terminal yard. European port model – having a sorting/exchange station before the yard and sending only short block trains through to the terminal.
- Quayside terminal – the train directly reaches the quayside for direct loading and unloading from the vessel.

The time spent in the on-dock terminal operation is maximum at the yard thereby occupying the siding of the operator. In the case of off-dock terminal, since all operations are carried out before the train reaches the yard and only short trains arrive at the yard, the time spent at the siding of the operator is minimum, i.e. only wagons carrying containers meant specifically for the given terminal are brought to the terminal.

In the case of quayside terminal, the rail reaches up to the quay and does the loading/unloading operation directly to/from the ship. This model requires extremely efficient rail operations and extremely transparent information transfer and co-ordination with other port activities. The time taken should also not be excessive leading to blocking of locos and vessel detention. Also, the operation needs to be continuous and requires constant feeding to the train. Such an operation is justified only if the rail share is significant. In terms of physical layout, having tracks at the quay would require more space than normal berth area. The rail terminal operation performance with respect to the traffic handled at the three ports is given in Table 6 below. The figures pertain to the year 2006-07.

Table 6: Rail traffic, infrastructure and operations comparison

Parameters	JNPT port	Chennai port	Hamburg port
Container handling (million TEU/year)	3.3	0.89	9.8
Container terminals capacity (million TEU/year)	3.9	1.2	14.7
Container share in total throughput	91 percent	26 percent	67 percent
Transshipment share in total throughput	Negligible	Negligible	25 percent
Container rail share	26 percent	7 percent	18 percent (low due to high transshipment share)
Current handling - Container trains per day	18 – one way	1 – one way	45 – one way
Container terminal operators	Three (JNPCT, NSICT and GTIL)	One CCTL	Four Eurogate, HHLA CTA, HHLA CTB and HHLA CTT
Rail companies within the port premise	CONCOR and 4 private container operators	CONCOR	2 public and about 50 private companies
Rail turnround time	8 hrs	8 hrs	12 hrs (Including sorting operation)
Rail infrastructure (track and traction) developer within the port premises	Track - JNPT Traction - IR	Track and traction – Chennai Port Trust	Track and traction – Hamburg Port Authority
Rail operator within the port premises	Indian Railways	CONCOR	Hamburg Port Railway

Source: Port Authorities

A striking difference in terms of infrastructure and operational process would be observed from the above table. The Hamburg port is among the top 10 ports of the world handling annually about 9.8 million TEU. In the year 2008, it is expected to cross the 10 million mark. Corresponding to this volume, the rail infrastructure is well laid out and operational process is competent enough to cater to the container terminal growth. JNPT with its current growth rate of about 25 percent is fast moving towards the 10 million mark. Projections expect the port to reach this volume by 2014. The Chennai port, growing at a rate of 27 percent annually, has crossed the 1 million mark in 2007-08. Thus, the rail infrastructure and operations need due attention to reach the expected rail modal share (50 percent expected at JNPT) and adhere to efficient and timely operations. With respect to coordination with DFC, which is expected to come up by 2014, these ports need to have focus on rail operation improvement.

Today, at Hamburg port, the turnround time of a rake is 12 hours which includes the time from when the train enters the port premises and reaches the sorting station, including the sorting operation, movement to the container terminal, loading/unloading and return to the port exit. At JNPT, claiming a turnround time of 8 hrs, the train moves straight from the entry at Jasai Road Junction and reaches the terminal, loads/unloads, leaves the terminal and goes back to the exit at Jasai Road Junction. The 8 hrs time does not include the waiting time at Jasai Road Junction, which can be substantial, and also does not include the sorting operation, which has in effect been shifted onto the terminal operators. The total distance covered for the above operation is about 40 km at Hamburg port whereas at JNPT it is about 26 km. This highlights the requirement of more efficient rail operations at JNPT. At Hamburg port, with 24 tracks for sorting and 8 other tracks for in and out movement, the sorting operation is carried out in just 1-2 hours. This operation also facilitates the container terminal operators in handling more throughputs. At JNPT even with this higher turnround time the sorting operation is not carried out and remains the responsibility of the terminal operators. This has led to congestion and delay in operations at the terminals.

From the commercial perspective, there are four terminal operators at Hamburg with one more to be added in the near future. The rail operations are handled by the Hamburg Port Railway which is an entity under the Hamburg Port Authority (HPA). Also, the infrastructure development in terms of tracks and traction is done by the port railways. The operations are thus a responsibility of the port and are neutral to all the container terminal operators. In the case of JNPT, the operator is Indian Railways. The infrastructure has been developed by JNPT but the traction is currently done by IR. In case of Chennai port, the rail infrastructure developer within the port premises is the port authority which also provides locos while the operation is handled by CONCOR using the port’s locos.

Interestingly, Chennai port handles the rail operations itself for cargoes other than containers. The kinds of models used by JNPT and Chennai ports are hampering the rail operational efficiency within the ports. This is an important aspect which needs to be given due attention looking at the competitive market created in container train operations and the demand for better infrastructure. Absence of a dedicated rail operator is leading to a non-neutral environment both at Chennai and JNPT ports.

In India, rail operations in the port premises are currently not considered as an essential service provided to the customers. When this fact is recognized, efficient infrastructure and operations will be designed which, in turn, will lead to higher throughput at the terminals, a higher rail share and lower costs. With huge investments on the quay and yard side the rail part has been neglected and thus is leading to lower rail share and higher turnround times.

Issues in rail operations

The Indian port sector is in the process of investing billions of dollars for the purpose of upgrading and developing new infrastructure at the ports. Creation of large-scale capacity at the quay and at the yard involving huge investments for equipment including import of world-class post-Panamax cranes etc. has the focus. Indian ports largely are gateway ports and thus rail connectivity is mentioned in the port feasibility or planning reports, but it is only in recent times that the criticality of efficient and fast hinterland connectivity has started getting due attention.

Large-scale road and rail connectivity projects have been planned and are under construction for the major ports of India. Private ports like Mundra have developed their own railway line of about 64 km length connecting the port and the nearest rail station to facilitate cargo movement and thereby connect the port to its markets. This is the longest private rail line developed in the country till date.

Let us take the example of the NSICT terminal at JN Port. This terminal is handling about 1.3 million TEU per year. The capacity and actual handling of the terminal is indicated in Figure 9. From Figure 9 and Table 3, it would be observed that huge investments have in this case been made in the development of quay and yard. The quay has two berths and with an average berth blocking time of vessel of about 18-20 hrs and parcel exchange of 1,500 TEU, it is handling 1,800 TEU per day. Thus, considering both ways the quay is handling about 3,600 TEU per day. This explains the handling of 1.3 million TEU per year for this terminal. The capacity at the terminal, with respect to the cranes and its efficiency is about 1.4 million TEU p.a.

Figure 9: Performance of NSCIT terminal

Quayside		Container yard		Rail terminal	
					
Capacity	1.4 m TEU	**Capacity**	3.5 m TEU	**Capacity**	Current 0.4 m TEU Maximum 0.8 m TEU
Parcel exchange	1500 TEU	**Ground slots**	6222	**Rakes handled/yr**	1884
Berth blocking time by vessel	18-20 hrs	**Avg. dwell time of container**	2.63 days	**Train turnround time**	6 hrs
Crane productivity	22 moves/h	**Yard throughput**	4200 TEU/day	**Sidings**	2

Source: NSICT

The yard has 6,222 ground slots including 772 reefer slots. With a stacking height of about 4 containers, it creates a capacity to store about 25,000 TEU at any time. With an average dwell time of 2.63 days, the storage capacity of the yard is about 3.5 million TEU p.a.

The rail terminal of NSICT has two sidings and is currently having a train turnround time of about 6 hrs. The train from Jasai Road to the terminal takes about an hour, the loading/unloading operation takes about 2.5 hrs and it takes about 2-2.5 hrs for the train to return to the Jasai exchange yard. Thus, the terminal is handing about 8 rakes per day. During the year 2006-07, the rakes handled were 1,884 per year, i.e. 5 rakes per day but, currently, it is handling about 8 rakes per day. Thus, about 1,440 TEU are moved by rail out of the total of 3,600 TEU handled at the quay, which gives rail a modal share of about 40 percent. Looking at the turnround time it would be observed that the return journey time is more than double and there is congestion at the rail terminal due to the problems related to the availability of locos and single entry and exit. With the current turnround time, the capacity of the rail terminal is only 0.4 million TEU per year. The officials claim that if this turnround time is reduced, the terminal can easily handle about 12 trains per day. This means that the terminal will have the capacity to handle about 0.8 million TEU per year.

The above analysis points out that there is great disparity in terms of capacity at all the three nodes. The yard has a very high capacity in terms of storage of containers and, in fact, the area demarcated under the yard still has the potential to expand and create more slots for container storage. The quay can also have more productivity with lesser vessel time at berth and higher crane productivity or expansion of quay length. But the rail terminal has a very limited capacity with only two tracks and very high turnround time. This share can, however, easily be increased with more investments in improving the rail infrastructure and increasing the efficiency of operations.

The main agenda in operational efficiency is sorting. It is an important activity at Hamburg port even with a rail share of 18 percent, including transshipment traffic. Well laid out rail network with efficient operational performance shall be able to cater to the future growth of container traffic. In India, the pace of growth in throughput is much faster than at the European ports and thus the development of rail infrastructure, which has been neglected in the existing and planned investments, needs much greater attention.

Following reasons have been observed due to which the rail operation at the terminal is inefficient:

- Sorting of trains – The trains arrive unsorted and thus it becomes the responsibility of the terminal operators to sort the containers. This leads to delay in operations and increases cost. Besides, a terminal operator puts a cap of 15 percent to maximum possible shifting of containers.
- Single entry and exit – The entry and exit to the port is the same and as a result the departure of trains from the terminal gets delayed.
- Passenger and freight trains on the same network – The passenger trains are given greater importance in terms of adherence to time and thus when container trains arrive at the port, they at times arrive in large clusters. This leads to 5 lines getting blocked by trains simultaneously and the terminal operators facing delay. At the Chennai port, the main line is passing through the port premises and thus the passenger trains also run along the same line as the goods trains. There are two tracks catering to both modes of traffic. This leads to congestion. There is a plan to increase the tracks from 2 to 4, but what is required is separating the passenger and goods rail operations.
- Inadequate infrastructure – Lack of locomotives for operations has been a concern with all the terminal operators.

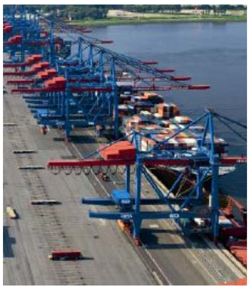
– Inadequate planning of rail operations – The terminal operators are not intimated in advance about the train arrivals on their siding leading to hold-ups in train handling.

– Location planning of the port – Location of traditional ports like Chennai, Mumbai and Kolkata within the cities was suitable as they were ports doing small-time trading then. Now, with the current cargo handling and need for faster movement, the cargo movement to these ports is becoming a problem as it has to move through the congested city roads.

Conclusion

With the above comparison of rail terminal design and operations at the three ports it would be noticed that the degree of investments and infrastructure upgradation reduces from the quay to the rail terminal side in the case of an Indian port (Figure 10). There is a clear asymmetry in the investment pattern. The port is treated as an island by itself and the facilities are planned accordingly. Effective coordination with the hinterland in terms of efficient rail terminal creation and hinterland connectivity have not been paid due attention. At the end of the day, an effective supply chain is not formed for the cargo owners, who are footing a bill higher than necessary due to inefficiencies.

Figure 10: Infrastructure investment scenario at the port

Vessel	**Quay**	**Yard**	**Rail terminal**
			
Decreasing levels of investment			

For the container train operation, sorting is by far the biggest issue at the port. The worst affected service provider is the container terminal operator at the port and ultimately the end customer, both in terms of time and costs. The rail operator within the port should ideally be able to create a neutral and non-discriminatory environment, and provide efficient services to all its clients. Port-based railway terminal design, infrastructure and operations, must become the order of the day now.

Earlier, when only CONCOR was operating the container trains and the volumes were not much, these aspects of sorting were never of much importance. But, in the past five years, significant changes have occurred in the Indian economy and also in the logistics sector. Huge investments, both Indian and FDIs, have taken place and large-scale infrastructure plans have been initiated. Significantly, the container train operations have been privatized and thus large-scale private infrastructure has also started developing. With the overall economy rising, leading to increase in trade, and especially with the container trade growing at more than 20 percent, the development of existing and proposed infrastructure needs effective co-ordination with other nodes and links to form an effective supply chain for the user.

The Indian port sector along with other related stakeholders has to seriously consider these requirements for the efficient logistical flow of containers. Without early planning for efficient port-based railway terminals, the ports, the major gateway to India's trade, will continue to remain congested – maybe not at the quay, maybe not in the yard, but certainly in the crucial link between the port, the hinterland and the port-based railway terminal system.

The authors would like to extend sincere thanks to the officials at Chennai port, JNPT and Hamburg Port for the information provided. Acknowledgment is also extended to colleagues at TransCare for their support.

NEW MANAGEMENT MODEL FOR RAILWAY FREIGHT TERMINALS

Indra Ghosh*

Railway freight terminals are a reflection of railway operations and have generally kept pace, albeit with a bit of time lag, with the twin requirement of changes in railways' operational strategies as also the increasing customer demands.

Background

Till the late 1970s, with railway operations being mostly confined to piece-meal loading and movement, individual goods sheds were designed to handle low volume of traffic that was being dealt with at most stations. Inward wagons were received on a day-to-day basis by means of work trains and also cleared in a similar manner. Hence, at the goods shed level, even at reasonably bigger ones, the requirement was for daily handling capacity of 20-30 wagons at the most with covered sheds may be for 50 percent of the capacity. Second aspect was that these goods sheds were mostly located adjacent to passenger stations, since both passenger and freight services were meant to serve requirements of the same city.

In those days, for dealing with piecemeal traffic, the need of the times was huge marshalling yards, big transit/repacking sheds, massive transshipment sheds, along with a host of smaller versions of the same interspersed at regular intervals along the section. Since wagons were detained at these so-called graveyards of railway wagons for an average of almost 14 hours a day, maximum stress was laid on improving their efficiency. It was an accepted fact that a division's operational efficiency as also mobility of wagons depended less on the speed of goods trains on the section than on the efficiency of its numerous marshalling yards, transshipment sheds and transit/repacking sheds – in that order.

Changes in railway operations that began with dieselisation of traction saw longer run for the limited number of full train loads which were running, mostly carrying coal to powerhouses, etc. Block rake movement in early eighties revolutionised railway operations like never before and sounded the death knell of major marshalling yards as they existed at that time along with their allied repacking/transit sheds. Gauge conversion in the early nineties put the final nail in the coffin of these cesspools making railway operations practically seamless. With the above changes, railway operations consisted of block rakes getting loaded on coal/iron ore sidings, cement/fertilizer

* *Adviser (Rates), Railway Board, Ministry of Railways, Government of India.*

factories, steel plants, ports, etc. before moving on to their final destinations, with hardly any halts in between except for change of crew.

With the elimination of 'graveyards' of an earlier generation, new and smaller graveyards started emerging in the form of inefficient goods sheds. It was here that wagons started getting detained both for loading and unloading and it was a matter of time before railways' attention got drawn towards this aspect. For improving railway operations further it was now imperative that railway goods sheds should be so geared up as to handle an entire block rake as expeditiously as possible.

With block rake operations, the first bottleneck to improved efficiency was the absence of full-length goods shed lines capable of releasing an entire rake in a single placement. While movement had been speeded up as a result of bypassing of marshalling yards, loading and releasing was still being done in multiple placements at most locations. It took the railways almost a decade before full length lines could be provided at busy goods sheds, while the attendant facility of direct reception and despatch was made available in due course.

Placement and release of full rakes in a single placement threw up a host of allied issues. Releasing a full rake within hours of placement required sufficient number of labourers to begin with. With a consignment of an entire rake getting unloaded at the same time it was no longer feasible to have secured covered sheds for keeping the goods in safe custody overnight as also protecting them from vagaries of nature. Rake-load of consignments had to be evacuated at the earliest after unloading which, in turn, required spacious circulating areas for a large number of trucks to operate simultaneously. While all these facilities could be provided at most important goods sheds, many of them started reaching saturation levels with increase in traffic volumes. Expansion of cities and gradual congestion of city roads resulted in imposition of restrictions on the movement of trucks during daytime within city limits. This made it increasingly difficult for trucks to operate especially from goods sheds located within the city limits for clearing of unloaded consignments. Public awareness of the perils of pollution, etc. have further compounded the problem, resulting in demands for shifting of existing goods sheds from congested areas of the town to outside the city limits.

Present situation

At most places, railways are presently encountering a peculiar situation of facing popular pressure both from the public as also the district administration for shifting of most of their major goods sheds to outside the city limits. While, on the one hand, it means giving up whatever investments have been made in these goods sheds over the years, at the same time, it also calls for incurring substantial fresh investments in creating freight terminals at new locations. With the new doctrine of public-private partnership being successfully tried out in many areas, it is high time that railways explored the possibility of the PPP model in the management of the freight terminals as well. The positive fallouts to the shifting of goods sheds are: that the space released by them can be gainfully utilized for further augmenting passenger amenities; and that this would bring about complete segregation of goods and passenger services and facilities at most of our important stations, and open up a new window of providing state-of-the-art railway freight terminals instead of indulging in cosmetic surgery at the existing locations. Shifting of the goods shed from New Delhi station in the mid-1980s and its conversion to a purely passenger terminal was a precursor of things to come as far as segregation of passenger and freight services was concerned.

There are two options available with the railways at present. First is to permit private players to go in for their own freight terminals on private land with railways providing the connectivity from the nearest station. These can either be commodity specific warehouses (for bagged consignments), open unloading spaces for ores and minerals in loose, iron & steel consignments to be handled by cranes, containers, etc. or they could be like a comprehensive logistics park depending upon the extent of land available as also the amount of investment the private operator is willing to provide. Second option available with the railways is to go in for their own freight terminals on railway land which can be managed either by the railways themselves or outsourced to private operators. The ideal solution would probably be a combination of both these options depending on the location.

Classification of goods sheds

To begin with, railways should classify all goods sheds into three categories depending upon the level of traffic handled by them. The quantum of traffic handled should include all commodities that are unloaded at different sidings of the same goods shed. The lowest class or Category – III goods sheds would be those handling up to 10 rakes per month; the next higher class of Category – II goods sheds would be the ones handling between 10 to 20 rakes per month; and, lastly, the highest one of Category-I goods sheds would include those handling more than 20 rakes per month. The *modus operandi* for each of the three categories would have to be different, since their requirements, and traffic potential differs.

Goods sheds in category – III are ones where least amount of growth is expected in the next 20-30 years since these are mostly serving smaller towns where traffic is expected to keep pace with the growth in the population of these towns and their surrounding areas. In the most likely scenario, traffic volumes at these goods sheds would at best double over the next thirty years. For catering to these goods sheds for the next three decades, railways should draw up a master plan for their upgradation by way of full length unloading lines, conversion of all half-rake sidings into full-rake sidings, direct entry from both directions, paved unloading area, circulating area for trucks, proper lighting, customers' waiting room, labourers' waiting hall, provision of FOIS terminals, etc., with e-payment of freight facility. Commercial exploitation of air space should also be explored and gone in for, wherever feasible.

For upgrading all the goods sheds in category – III, divisions should make out a list of all such goods sheds along with developmental works required. For carrying out these developmental works financial powers should be delegated to DRMs by the Railway Board for works up to Rs. 1 crore per goods shed so that sanctions can be given at the local level without going through the red tape of providing justification and getting sanction at the headquarters level. These works should be planned to be carried out within the next 5 years starting with the ones handling 9-10 rakes per month in the first year, those handling 7-8 rakes per month in the second year, and so on. These goods sheds would be operated by the railway staff and their recurring ongoing maintenance would be carried out by means of annual zonal contracts. In case of commercial exploitation of air space, it may be possible to outsource the maintenance to some extent.

Goods sheds in category – II are ones where substantial growth is expected in the next 20-30 years, since these are presently serving medium-sized cities where traffic volumes are expected to grow along with faster growth in population of those cities as also their satellite townships. In the most likely scenario, traffic volumes at these goods sheds would more than double to a level of more than 30 rakes per month. In case of all such smaller cities where substantial growth in population is expected, there would be increasing pressure on the railway administration to shift them to outside the municipal limits of the city due to air and noise pollution. In addition, curbs on the movement of trucks during daytime within city limits which will gradually get enforced at all such locations will make operation of these goods sheds more and more difficult from the customers' point of view. From the railways' point of view also, it does not make sense to undertake substantial investments at these locations only to give up the same within the next 10 years or so; much before the life of the asset that is created.

For catering to these goods sheds for the next three decades, like in the case of category-III goods sheds, railways should draw up a master plan for their relocation to smaller roadside stations nearby, along with their upgradation by way of full-length unloading lines, direct entry from both directions, paved unloading area, circulating area for trucks, proper lighting, customers waiting rooms, labourers' waiting hall, provision of FOIS terminals etc. along with e-payment of freight facility. Commercial exploitation of air space should also be explored and gone in for wherever feasible. It would be preferable to have segregation of traffic so that high level covered platforms can be provided for locations handling bagged commodities and ground level unloading areas sufficing for bulk handling of ores/minerals at an adjoining station.

For relocation and upgrading all the goods sheds in category – II, divisions should make a list of all such goods sheds along with developmental works required. For carrying out these developmental works, full financial powers should be delegated to the General Managers for works up to Rs. 10 crore per goods shed so that sanctions can be given at the local level itself. These works should be planned to be carried out within the next 5 years, starting with the ones handling 19-20 rakes per month in the first year, those handling 17-18 rakes per month in the second year, and so on. These goods sheds would be operated by the railway staff and their recurring ongoing maintenance would be carried out by means of annual zonal contracts. Once segregation of traffic is done based on types of commodities handled, all goods sheds handling more than 15 rakes per month should be planned for round-the-clock working.

Goods sheds in category – I are the ones which require immediate attention as far as railways are concerned, since it is here that maximum potential exists for future growth of traffic as cities grow and traffic demands increase. Most of these goods sheds are presently serving metropolitan cities and already there are growing demands for shifting them out of the city limits. For example, in Delhi area, there are vociferous demands for shifting of Shakurbasti goods shed and comparatively muted demands for shifting of Ghaziabad goods shed from their present locations due to environmental problems. Instead of waiting for a fiat from the civil administration for closing down of these goods sheds with no alternative arrangements in position before the deadline (which is quite likely before the 2010 Commonwealth Games), railways would do well to plan for their relocation well in time instead of firefighting and shifting them to hastily prepared temporary locations at the last minute. One possible option worth exploring at these locations, such as Shakurbasti or Ghaziabad can be a change in the type of traffic handled since switching over from handling of cement or coal (which cause pollution) to handling containers would be a better option, although the associated problems of noise pollution due to trucks and congestion of adjoining city roads would still remain.

Relocating goods sheds

For catering to these goods sheds in the next three decades, railways should draw up a master plan on a war footing since it is at these major goods sheds that time is running out. It makes sense to relocate them to places which are not likely to get engulfed within the expanding city limits in the next 30 years or so and direction-wise terminals can be planned there for different types of traffic. It would be preferable to have segregation of traffic so that high-level covered platforms can be provided at the goods sheds handling bagged commodities, whereas ground-level unloading areas may suffice at an adjacent goods shed planned for bulk handling of ores/minerals. For example, goods shed handling iron and steel consignments can be planned to be in the south of a metropolitan city in case majority of steel traffic comes from that direction, while planning the cement terminals in the north of the metropolitan city for similar reasons.

Adequate handling capacity should be planned at the initial stage itself at each of these commodity-specific goods sheds by taking into consideration projected growth in traffic over the next 30 years (three times the present volume) and making provision for bunching of rakes which is bound to worsen with the saturation of trunk routes (two times the normal daily traffic). While it is not necessary to provide for the entire handling capacity during the first year of operations, it would be worthwhile to make a comprehensive plan and get it approved in the beginning itself. Such a comprehensive plan should provide for handling of, let us say, two rakes per day in phase I to be augmented to four rakes per day in phase-II and finally six rakes at the last stage.

Model freight terminals

An efficient model can be developed by having unloading line in the centre and unloading platforms/areas on both sides with attendant circulating areas so that there can be three unloading lines with six unloading faces since unloading of rakes takes comparatively less time than removal of their consignments. Needless to repeat that each one should be of full length with direct entry from both directions, paved unloading area, circulating area for trucks, proper lighting, customers' waiting rooms, labourers' waiting hall provided with FOIS terminals, etc. along with provision for e-payment of freight. All these goods sheds should be planned for round-the-clock working. At these sheds, commercial exploitation of air space will be an attractive proposition.

A major objective of these new generation goods sheds should be to completely do away with the demurrage regime, since railways always lose more revenue by way of demurrage collected when compared to what they would have earned otherwise from productive utilization of the rake. For achieving this purpose, user-friendly measures will have to be adopted which should be location-specific, depending on the kind of commodity handled. To this end, features which would be common to all categories should include engine-on-load (EOL) system of working so that a rake gets unloaded in the minimum possible time after placement and gets cleared immediately after unloading, thereby increasing the handling capacity of each terminal as also the productivity of each rake. For encouraging customers to opt for the EOL concept, a revised version of the TIELS (Terminal Incentive and Engine on Load Scheme) can be offered by means of which suitable incentives would be given to the customer for releasing the rake much before the notified free time.

Today, Indian Railways are poised on the threshold of a challenging future where traffic offered is set to make a quantum jump after commissioning of the Dedicated Freight Corridors. With capacity constraints likely to be eased in the foreseeable future, thereby eliminating avoidable detentions *enroute*, it is time the railways started planning and executing a time-bound implementation scheme of improving their freight-handling capacities at railway goods sheds in order to make them more efficient in the times to come.

BULK FREIGHT TERMINALS ON INDIAN RAILWAYS: EVOLUTION AND OPTIONS

G. D. Brahma*

Key to seamless transport

Terminal management is one of the most vital aspects of railway operations but, surprisingly, the least attended to. More than 90 percent of the traffic on IR is either loaded or unloaded at the sidings. A wagon spends about 15 hours of its time in a day at a terminal – be at a siding or a goods shed, maintenance depot, yard, *et al*. Not only the common user facilities of IR like goods sheds but, more importantly, the private sidings of most of the major industries, which depend largely on rail transport, such as steel plants, collieries, iron ore mines, cement factories and ports have not received much investments to improve the terminal efficiency. This neglect, both by the Railways and the industries, has resulted in substantial losses in transport output, productivity and earning potential. Efficient terminal management plays an important role in the optimization of assets, particularly rolling stock, as well as for service reliability and consequently the reduction in the unit cost of transportation. From the customers' point of view, it also reduces the inventory cost. Remaining at either end of the transport continuum, properly designed terminals with suitable handling facilities and efficient management system constitute an essential prerequisite for an efficient and seamless transport system.

Freight terminals on IR

The concept of sidings on IR had its genesis during World War I when it became imperative to provide separate "side lines" taking off from the main line to deal with military traffic. The provision of sidings in India assumed significance because of the emergence of new integrated steel plants, like TISCO at Jamshedpur and IISCO at Burnpur, coal fields, power plants and other basic industries. The privately-owned railway companies, in order to attract traffic, offered their major customers various incentives, including private and assisted sidings. In those days of 'piecemeal' wagon loading, the seeds of block rake movement of bulk traffic were first sown by way of introducing customized special type side and bottom discharge wagons like BOBS, BOBX and KO for bulk movement and rapid discharge of iron ore and fluxes on the 'high lines' provided by the steel plants.

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* *General Manager, Transportation and Economics, RITES Ltd.*

The passage of Indian Railways from the era of 'piecemeal loading' to block rake movement in the 1970s marked a new development in the area of terminal management. Terminals designed and developed to handle 'piecemeal' and 'smalls' traffic were soon found grossly inadequate and incapable of handling block rake traffic resulting in terminal congestion and heavy detention to stock. In order to circumvent the sub-optimalities in the terminal design and management system at its own goods sheds and in the sidings, the Railways adopted a two-pronged strategy. Major steps initiated by IR in this regard can be summarized as under:

Engine-on-load concept

Introduction of Engine-on-Load (EOL) concept at almost all the major bulk loading points for iron ore and coal in the early 1990s revolutionized terminal management and helped drastically reduce the detention to wagons by wedding locomotives to the rake. EOL has brought down terminal detention from the level of 16-24 hours to 3-4 hours. Engine-on-load, now a veritable discipline, has yielded remarkable dividends at busy bulk handling terminals by optimizing the capacities and improving turnround time of wagons, enabling greater availability of stock for subsequent loading.

Mechanised handling

As a corollary, Railway Board has now issued a policy directive under the Terminal Incentive-cum-Engine-on-Load Scheme (TIELS), making adoption of Engine-on-Load Scheme mandatory for all new sidings. The permissible free time under EOL scheme has been pegged somewhere between 2 and 5 hours, depending on the type of stock and loading/unloading operation. The policy has also made a string of concessions available to the existing siding owners who opt to adopt the EOL system of operation at their terminals. There has thus been increasing mechanization of unloading operations by way of provision of heavy duty tipplers with an assemblage of side arm chargers and pusher cars and track hoppers for bottom discharge wagons, etc. On the loading front, mechanized rapid loading systems like overhead bins and moveable wagon loaders in the iron ore and coal sidings have been put in place by the siding owners. To implement EOL system expeditiously, many siding holders have now gone in for deployment of pay loaders to facilitate faster loading. Coal loading in Talcher, IB Valley and Korba spheres typify the efficiency with which a coal rake of 3,500 tonnes is loaded within 2 hours.

Peripheral yard concept

As a logical extension of the EOL system, IR has now abandoned the concept of 'exchange yard' for all future terminals, replacing it by what is known as the 'peripheral yard' concept. The inbound train is taken to the activity centre directly instead of being dropped at the exchange yard, as has been the case with almost all existing mega terminals of steel and cement plants and those at ports, with the exception of SAIL's plant at Bhilai and RINL's plant at Visakhapatnam. The purpose is to eliminate an additional exchange yard terminal in the transport chain, thereby not only doing away with the detentions involved in dropping and picking of trains in this intermediate yard but also facilitating the operation of Engine-on-Load system.

Close circuit operation

Introduction of close circuit (CC) train operation in all important bulk and container traffic circuits and doing away with intermediate carriage and wagon examination at the terminal goes *pari passu* with EOL system. Under this system, rakes are given an extended run up to 6,500/7,000 km without any intermediate point-to-point examination, as has been the practice earlier. This has ensured better usage of wagons by saving the time spent on their examination.

Combination of transportation with information and communication technologies to improve 'visibility of cargo' is the hallmark of modern day transportation logistics. The Freight Operating Information System (FOIS) combined with Rake Management System (RMS) and Terminal Management System (TMS) modules implemented on IR provides key MIS inputs for efficient terminal and operation management. Extension of FOIS to all loading and unloading terminals with interface with Customer Information System, weigh bridges, etc. will go a long way in increasing the visibility of cargo which is a *sine-qua-non* for modern logistics and inventory management.

Some of the other policy measures and initiatives like liberalization of the siding policy, revival of the concept of assisted siding, development of common user facilities including Multimodal Logistics Parks (MMLP) on PPP model, integration of warehousing facilities with handling facilities at goods sheds through a joint venture with CWC, introduction of round-the-clock working at major goods sheds, extension of electrification to goods sheds, facilitating full rake placement and handling, reduction of free time in ports, steel plants, etc. are steps for optimizing terminal management.

Improved wagon turnround

As a result of the above innovations and policy initiatives in the area of operation and asset maintenance, there has been an unprecedented improvement in wagon usage in the IR during the last 5 years, manifested in reduction in wagon turnround on the BG system from 7.2 days in 2001-02 to 5.5 days in 2006-07. The improvement in wagon turnround is also partly attributable to increase in throughput per train, resulting from increase in average carrying capacity of the wagons by about 10-15 percent, although the average speed of freight trains on the BG system continues to remain, by and large, unchanged at 25 kmph.

It has been acknowledged by the Ministry of Railways' Working Group on the Eleventh Five Year Plan that "terminal capacity is an important determinant of carrying capacity affecting the flow of freight trains. Full benefits of line capacity works like new lines, gauge conversion, doubling and traffic facility cannot be derived unless terminal constraints are removed". In due recognition of the importance of terminals in rail transport planning process, IR has formulated an action plan during the Eleventh Plan period, as detailed below:

(a) Higher investment in rolling stock and routes for higher axle load and terminal capacity to universalize the concept of engine-on-load handling and eliminate waiting time for indents.

(b) Improvement in payload to tare ratio from the present level of 2.6 to 4.0, augmenting throughput per train.

(c) Developing the existing terminals and building new ones to facilitate full rake handling and for handling specific commodities. Plans are afoot to set up 50 new goods sheds/sidings and upgrade 200 existing goods sheds/sidings to cater to the additional traffic with a total investment of Rs 1,000 crore during the plan. With this, all the half-rake handling points are also expected to be converted into full-rake handling points.

(d) With a view to integrating rail transport with the total supply chain management and thereby to increase the modal share, developing multi-commodity multimodal logistics parks alongside the Dedicated Freight Corridor and other strategic locations through the PPP route.

A quantum jump

During the last five years, Indian Railways have made rapid strides, achieving new heights in freight loading. From a freight loading of 557 mt (million tonnes) in 2003-04, IR reached the 790 mt mark in 2007-08, CAGR in excess of 8 percent, made possible mainly by the decision to use the carrying capacity of the wagons optimally by increasing the payload of the wagons for selected routes and commodities up to 15 percent. Besides, other policy initiatives and innovations undertaken in the recent past in the area of optimizing rolling stock usage and terminal management also paid dividends. Encouraged by the outcome, IR has identified all the iron ore routes to be upgraded to 25 tonne axle load during the Eleventh Plan at an investment of Rs 2,000 crore. Whereas the proposed Eastern and Western DFC will be constructed with 25 tonne axle load, upgradable to 30 tonnes, the feeder routes serving the DFC will also be upgraded suitably. Another major strategy to augment throughput per train is to enhance the payload to tare ratio of wagons from the present level of 2.6 to 4.0. This strategy of higher axle load and enhancement of payload to tare ratio will increase the throughput per train by another 20 percent, warranting higher terminal capacities and very efficient terminal management.

Bulk commodities – A lion's share

Traditionally, three bulk commodities – coal, iron ore and cement – constitute the lion's share of about 65 to 70 percent of the originating loading of IR. The scenario is not likely to undergo much change during Eleventh Plan as evidenced by the commodity-wise projection made by IR for the terminal year (2011-12) of the plan. Of the total projected freight loading of 1,110 mt, coal traffic projected at 400 mt will contribute a share of 36 percent followed by iron ore 17 percent and cement 12 percent. Again, about 70 percent of the total coal loading will be to powerhouses, including both the indigenous coal loaded from coalfields and imported coal loaded from the ports. Similarly, whereas about 110 mt of iron ore will be handled at the steel plants, about 75 mt of iron ore meant for export will be handled at the ports. In aggregate, about 1,100 mt of coal and iron ore traffic will be handled at the powerhouses, steel plants, ports and coal and iron ore loading points both as inbound and outbound traffic. In other words, only about 150-200 terminals serving the major ports, steel plants, coalfields and powerhouses, out of a total of about 1,800 freight terminals on IR would be handling about 50 percent of the total inward and outward traffic projected for IR during the Eleventh Plan.

Thus, the importance of these bulk handling terminals in optimizing IR's transport output can hardly be over-emphasized. The ground realities, however, still present a very dismal picture. A recent study done by the RITES on the integrated steel plants located on South Eastern Railway brings out the enormous detention to rolling stock inside the steel plants, namely, Tata Steel (Jamshedpur), SAIL, Bokaro (BSL) and Rourkela (RSP) which together account for nearly 1/3rd of the rolling stock holding of South Eastern Railway. The table below illustrates the point.

(Detention in hours)

Steel plant	**Single operation**				**Double operation**
	BOBS/BOBSN	BOBRN	BOXN	BRN/BFNS	BOXN
TISCO	8.57	11.49	39.29	38.00	55.30
RSP	14.37	-	29.05	31.00	64.00
BSL	-	-	36.37	64.00	83.00

These detentions do not include the detention to the wagons on Railways' own account, which often exceeds 8-10 hours. Little has been done to overcome the deficiencies plaguing the rail terminals at the steel plants either in terms of rail infrastructure or the related handling systems. The very concept of exchange yard has proved to be the nemesis of engine-on-load system. With the incoming/outgoing stocks getting dropped at the exchange yard, short of the loading and unloading points, an additional terminal is created, negating the seamless movement. Besides, there is often a mismatch between the capacity of a loading/unloading system and the evacuation or feeding system. For example, though an overhead loading system may be designed to load a rake of iron ore or coal in two hours, the capacities of the related equipment like stacker, reclaimer and the conveyor system feeding the loading bins are either not designed to match the loading rate or become derated over the years operating at a sub-optimal level. This scenario is, by and large, universal in all the major steel plants and mechanized iron ore and coal loading points.

Another critical issue is the choice of the most suitable wagons depending on the nature of the commodity, the volumes, and the lead of traffic. As demonstrated in the above table, whereas bottom and side discharge wagons carrying iron ore are detained 9-12 hours inside Tata's steel plant and for 14 hours in RSP, the detention is as high as 37 hours in Bokaro Steel Plant for BOXN wagons for single operation and 83 hours for double operation. Similarly, lack of customized wagons to facilitate faster loading and to ensure optimal loadability has not only resulted in detention to stock but also contributed to progressive decline in rail coefficient of the high-rated finished steel traffic. The lack of adequate loading arrangements inside the plant to load a block rake in one go also plays a role in detention to rolling stock. The JSW plant at Taranagallu which is poised to soon touch the 10 mt production mark from the existing 5 mt, evolved a very efficient system for coil loading, achieving loading of a full rake within 4-5 hours with the help of a number of overhead cranes spanning across 4-5 full length loading lines. Introduction of new type of flat wagons with saddles (BFNS) by IR for HR and CR coil traffic is indeed a novel step towards customisation of rolling stock, doing away with the stringent packing conditions for such traffic.

The steel boom

With the steel sector growing at a fast pace poised to reach the total steel production capacity of about 80 mt by the terminal year of the Eleventh Plan, from the present level of about 50 mt, entailing an aggregate transport output of about 320 mt in terms of both raw material and finished steel traffic, the Railways will be hard-pressed to move the traffic unless capacities in all domains are enhanced accordingly. Optimization of terminal capacity will be a key issue if the anticipated volume of traffic has to be moved by IR. Adequate terminal capacity with efficient management can yield higher capacity and improve availability of wagons with better turnround.

Massive expansion plans are on the anvil in respect of all the major steel plants. Whereas Tate Steel is enhancing its hot metal production from 5 mt to 10 mt, all SAIL plants are collectively increasing their hot metal production capacity from 14.37 mt to 22.37 mt. Similarly, all other steel plants like the Jindals', Essars' are also going in for large-scale expansion with corresponding expansion of their captive mines. Tata Steel is expanding the production and loading capacity at its captive mines in Noamundi and Joda from the present level of 9 mt to about 16 mt. SAIL has also plans to almost double its loading capacity at Bolani, Gua, Kiriburu/Meghahataburu and Dallirajhara iron ore mines.

There has been a mushroom growth of steel and sponge iron plants during the last decade and a number of mega integrated steel plants with production capacity ranging from 6 mt to 12 mt are on the horizon. All these developments will usher in a new era in bulk transportation, warranting high-capacity mega terminals, both at the mineheads as well as at the plant ends. Whereas the loading point at the minehead will have to have capacity to load 10-12 mtpa, each of the future steel plant terminals will have to have capacity and wherewithal to handle 30-50 mt of traffic annually. Augmenting line capacity and throughput per train with higher axle load will be the only answer. All the benefits accruing from these measures will be negated if the terminals are not equipped to handle the traffic efficiently and seamlessly.

The emerging port scenario

The scenario is, by and large, similar in the port sector where the anticipated growth is staggering. As per projection of Working Group on Ports (Eleventh Plan), the total traffic at the ports will register a quantum jump from the level of 635 mt (2006-07) to 1,009 mt by 2011-12 – a growth of 59 percent. Though POL and other liquid traffic, which will be mainly pipeline-borne, will constitute almost 40 percent of the total port traffic, bulk traffic like coal and iron ore will be about 267 mt, mostly rail-borne. Though the Railways have reduced the free time in the ports to 15 hours and 24 hours respectively for single and double operation, most of the major ports are still plagued by abnormal detention to stock. Reasons attributable to higher turnround are similar to those in the steel plants, e.g., absence of through running of trains to the loading/unloading points rendered impossible by the present system of dropping the train at the exchange or R&D yard, non-electrification of the port lines, including loading and unloading lines, located on the electrified territory, absence of full length loading/unloading lines involving multiple placement of rakes and their subsequent amalgamation, etc. Absence of adequate mechanized loading facilities and poor productivity of dock labour also contribute to detention to rail stock.

All these have made adoption of EOL concept a far cry, except in some areas of activities like a 'Merry Go Round' system for thermal coal unloading on track hopper in Paradip Port. The result is: a rake of 58 BOBRN wagons unloaded in less than 2 hours time with a total turnround of 3.5 hours. In contrast, a BOXN rake carrying iron ore detains for nearly 44 hours for single operation in the same port. As the Plan document envisages port handling of 2 billion tonnes by the year 2016-17, serious planning to augment commodity-specific rail handling capacity has to be initiated. The grandiose plan of providing rail connectivity to ports should not be confined to connectivity alone, but should also take note of concomitant terminal facilities inside the ports.

New dimensions in the power sector

The third critical sector for bulk transportation and handling is the power sector. Not only the IR will have to move 275 mt of coal to the powerhouses as projected by IR for 2011-12, all the new powerhouses planned for the future will be much larger in size and even the existing ones will add new units enhancing power generation capacity. Though most of the Ultra Mega Power Plants (UMPP), having capacity in excess of 4,000 mw each, will be either pithead or port-based (depending on imported coal) not dependent on IR, the other non-pithead super thermal power plants having capacity ranging between 2,000 mw and 4,000 mw will require rail terminals, each capable of handling 10 to 20 mt of coal per annum. The choice of the most optimal wagons with appropriate handling facilities capable of faster loading and unloading will be the most critical issue, while planning the mega terminals of the super thermal power plants.

Bulk transportation of cement

With a projected loading of 135 mt, cement traffic, the third largest single commodity after coal and iron ore, constitutes 12 percent of the total originating traffic of IR. With the cement production projected at 250 mt in 2011-12, the railways are looking at an increase of rail coefficient from 42 percent to around 55 percent with almost a two-fold increase in absolute terms. An aspect of cement transportation which has so far not received adequate attention is bulk transportation of cement. World over, almost 70 percent of cement is transported in bulk. In India, it accounts for a paltry 5 percent. Modernization of construction industry is heavily dependent on availability of cement in bulk and Ready Mix Cement (RMC) plants near consumption centres. The need for adopting large-scale bulk transportation of cement is particularly relevant in the case of India, in the context of mega complexes, infrastructure projects, large housing complexes, shopping malls, SEZs and other large construction activities. IR could be a major beneficiary due to its faster turnround and higher loadability. So far, in India, there are rail bulk cement terminals only at Kalamboli and Bangalore. This aspect needs more attention, not only to increase throughput per train which can be 30 to 35 percent higher than the present payload of about 2,500 tonnes in a BCN rake, but also to improve the turnround of wagons at the loading/unloading points.

RITES had conducted a study for the Ministry of Industrial Development, financed by the World Bank, for bulk movement of cement to Mumbai, Kolkata and Delhi. While some implementation in this regard has taken place for Mumbai area, much more needs to be done to bring a larger share of cement traffic into the fold of bulk transportation if the rail coefficient has to increase to 55 percent as envisaged during the Eleventh Plan.

Issues and options

The foregoing paragraphs bring out the existing scenarios in four major sectors, namely, steel, ports, power and cement, with the suboptimalities and constraints in their terminals and present a growth profile of all these sectors in the years to come. This brings to the fore the various issues that the IR and the respective industry sectors need to address. The issues are:

(a) Seamless integration of the railway system with the in-plant terminal handling system to universalize engine-on-load system of operation.

(b) Suitable mechanized rapid loading and unloading systems with backup facilities to facilitate faster loading and unloading, keeping in view the production capacity and loading/unloading requirements.

(c) Choice of most appropriate commodity-specific customized wagons to derive best turnround of wagons as well as best throughput.

(d) Ensuring least damage to wagons in handling and rationalizing carriage and wagon examination to eliminate detention on that account.

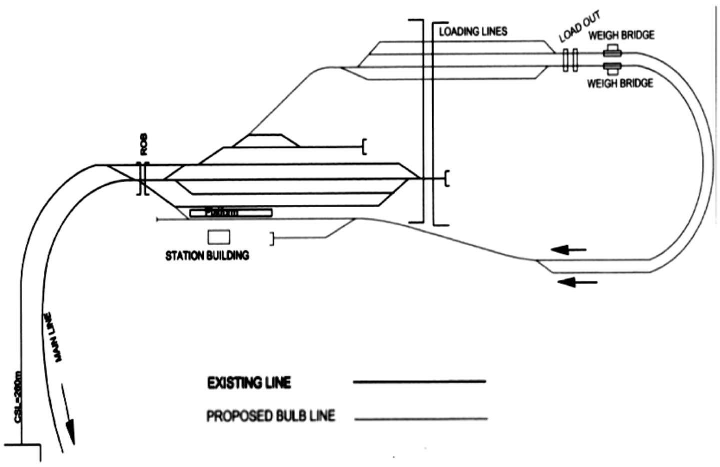
(e) Suitable technology to ensure loading/unloading under the wire in view of progressive electrification of IR's routes.

(f) Transition from existing system to heavy-haul rail operations.

Seamless integration

In order to facilitate engine-on-load system at all bulk terminals, it is necessary to integrate seamlessly the railway system with the in-plant terminal handling system. This will entail abandonment of exchange yards and R&D yards, as exist presently in most bulk terminals served by IR, ensuring that the trains are taken through to the loading/unloading points without change of traction and handled with

Figure 1: A typical bulb type railway layout planned at an iron ore loading point on south eastern railway



the train engine under EOL system. The railway layout has to be so designed that there is always a forward movement without involving detachment of locomotives or reversal of brake vans. In some of the existing bulk terminals, where it is not possible to have a bulb type arrangement, at least the layout and system of working should provide for direct reception and despatch of the trains from the respective activity centres.

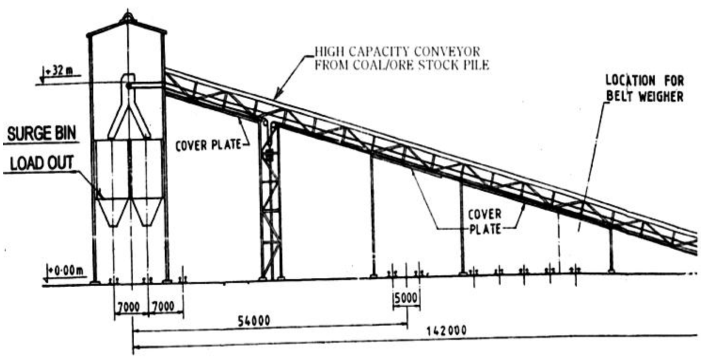
Rapid loading and unloading systems

Provision of mechanical rapid handling systems for loading and unloading operation is a crucial factor for optimizing the capacity utilization of both the terminal as well as the rolling stock. To achieve higher throughput required in all mega bulk loading freight stations at ports, steel plants and mineheads, alternative designs of loading stations are available for rapid loading, like surge bin load out, silo load out, static multiple-point loading system and movable wagon loaders.

In-motion load outs

In surge bin load outs, a large ground stock is held in a self-flowing bunker, with high capacity stacker, reclaimer and feeder belts having capacity ranging between 3,600 and 5,000 tph. The surge bin is provided with fast-acting gates to control the flow which can be automatically actuated by the wagon. Centralised controls are provided in the cabin for activating the feeders, starting and stopping the feeder belt, and operating the loading gates.

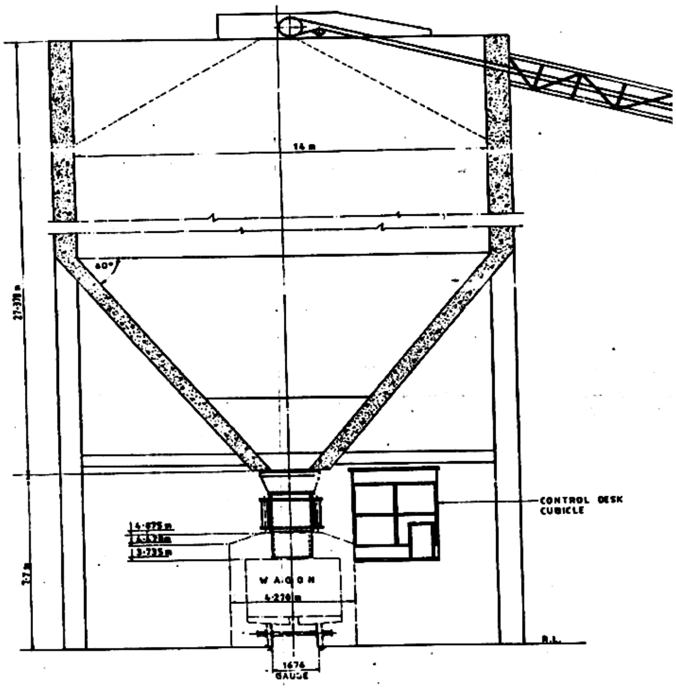
Figure 2: Surge bin load out



In contrast to a surge bin load out, in a silo load out, a large capacity vertical silo is provided over the tracks which holds adequate quantity of material for a complete train load. The silo is continuously fed from the mine crushers at a constant rate. The loading rate can be as high as 4,000 to 5,300 tph. Under the above two systems, the train has to move under the bin/silo at a slow pace, requiring both pre-loading and post-loading railway lines for the rake to get loaded in one go. A bulb-type arrangement facilitating forward movement of the train is the most ideal layout for such loading systems. Importantly, for in-motion loading, the locomotive has to be ideally equipped with automatic creep control system to enable the maintenance of a constant creep speed despite varying load conditions. The creep speed depends on the length and payload of the wagons and loading rate of the load out.

Static loading system

Figure 3: Silo load out



Some load outs have been developed using high capacity overhead ribbon bunkers which are capable of loading 5-6 wagons simultaneously, but with the rake kept static. The rake has to be moved by the locomotive after each set of 5/6 wagons has been loaded. In this case, load out rates of about 1500 tph are feasible. Another variant of the static load out system is the movable wagon loader. Here, the rake remains static whereas the wagon loader moves over the entire length of the train. Such an arrangement is in vogue in SAIL’s iron ore loading points in Kiriburu and Megahataburu. The major advantage of this system is that no post-loading tracks are required, though the loading rate is much lower than the in-motion load out system. However, the most commonly used static bulk loading system on IR pertains to loading through payloaders, where the loading output can be varied and controlled, depending on the number of payloaders deployed.

Thus, systems requiring loading of 8-10 mtpa, the choice is between the silo or surge bin load outs. But if space is a constraint, as in the case of most of the iron ore loading points in India because of the hilly terrain, a couple of movable wagon loaders working in tandem can be the solution.

Tipplers vs. track hoppers

Similar to rapid loading systems, rapid unloading systems are also essential for better terminal and rolling stock management. In fact, there is a direct correlation between the unloading system and the type of wagons used. If BOXN and gondola type wagons (BOY) are used, the unloading system will necessarily have tipplers, but for side/bottom discharge wagons, track hoppers are a must. The performance of tipplers in the Indian context is much tardy with the tippling cycle of 5/6 hours per rake, because of the fixed couplers of the wagons warranting uncoupling of each wagon and spotting it on the tippler. In contrast, unloading of a rake of hopper wagons on the track hopper is much faster at 1½ to 2 hours, as it does not involve any 'uncoupling' and lots of 10/15 wagons can be unloaded at a time, depending on the length of the track hopper. There is a potential to reduce the unloading time further if the automatic door opening mechanisms of the wagons are operated from the locomotive instead of using external compressor as is the case in almost all such extant unloading terminals. Another problem area is the absence of Solenoid Valves in the wagon fleet which could activate the door opening mechanism of such wagons.

Figure 4: Moveable wagon loader in operation at Megahataburu

In order to overcome the deficiencies in the conventional tippler systems, the heavy-haul rail operators in Australia like BHP Billiton and Pilbara Railway have resorted to gondola type ore cars equipped with rotary couplers to improve the dumping cycle and reduce the damage to wagons. Large tipplers knows as 'Dumpers' have been installed at the gateway ports which can handle two wagons in tandem with a dumping cycle ranging between 80 and 85 seconds. The tippler can unload a full rake of 230 wagons carrying a net tonnage of 24,000 tonnes in barely 3 hours time. In Pilbara Railway, under the Dampier Port upgrade plans, tipplers with faster dumping cycles of 55 seconds for two wagons have been planned which will reduce the unloading time of a rake of 230 wagons to below 2 hours. Even with fixed coupler wagons, it may be possible to develop technology for tipplers capable of handling two or more wagons at a time, thereby improving the tippling cycle considerably.

Choice of wagons

As discussed above, there is indeed a symbiotic relationship between the unloading system and the wagons. Selection of the right type of wagons is crucial to terminal efficiency, particularly in respect of unloading terminals like steel plants, ports, power plants and cement dumps. Though it has been amply demonstrated that the hopper wagons are much superior to BOXN/BOY type wagons in terms of the release time, major disadvantages of these stocks are the adverse payload to tare ratio, higher cost and, more importantly, their inability for universal usage compared to BOXN type of wagons. But, if at least the first two deficiencies of these wagons can be properly addressed, they will be the ideal wagons for bulk movement of iron ore and coal, particularly in a close circuit operation.

Figure 5: Rotary coupler ore cars on the dumper in Pilbara Railway, Australia

The door opening mechanism of BOBRN (with 6 doors) wagon makes it heavier by nearly 3 tonnes with an adverse tare to payload ratio. The existing design has six door opening across the track which restricts adding to the volumetric capacity. If wagon is redesigned with four doors opening parallel to the track and a tub type design with maximum possible side skirting throughout the length of the wagon, its loadability can be increased considerably, improving its payload to tare ratio. This may also reduce the cost. As most of the iron ore circuits on IR are short lead close circuits, with inevitability of one-way empty running, induction of such rolling stock with suitable modification can yield an optimal turnround and throughput. Thus, instead of taking an omnibus policy decision that all new steel plants should plan for carriage of iron ore in BOXN type of wagons, it should be plant-specific, dependent on the lead and close circuit nature of operation. Because of the performance efficiency of the side discharge wagons (BOBS type) which is time-tested over a long period of time in iron ore circuits, the air brake variant of BOBS is an ideal wagon from the customers' perspective. Alternatively, a gondola-type wagon fitted with rotary coupler can be an optimal rolling stock for iron ore circuits of all steel plants and ports.

A suitable variant of bottom discharge wagon with better payload to tare ratio or doorless gondola-type wagons fitted with rotary couplers can also be an optimal wagon for close circuit and short lead movement of coal for the mega power plants of the future. Even for power plants having capacity in excess of 2,000/3,000 mw, located far away from the pithead, the enormity of volume of coal traffic to be moved daily (somewhere between 10-15 mtpa), makes it imperative to go in for BOX type wagons fitted with rotary couplers. In the cement sector, to derive maximum benefits of bulk transportation, both in terms of higher throughput and better turnround of rolling stock, it is imperative that a larger share of the cement traffic is brought under the fold of bulk transportation by providing incentives to the cement industry for developing commensurate terminal handling facilities. The 'Wagon Investment Scheme' should also provide adequate compensation and incentives to the cement manufacturers to invest in high axle load customized wagons suitable for bulk transportation in short and medium lead close circuit operation where one-way empty running is inescapable. Customization of wagons to suit the requirement of finished steel loading to ensure optimum loadability and doing away with the stringent packing conditions is another area warranting attention.

Rationalization and automation of maintenance for better terminal functioning

Rationalization of carriage and wagon examination and use of appropriate technology in improving maintenance practices of rolling stock are important measures not only for improving safety but also for reducing the detention to rolling stock. Introduction of intensive pattern of maintenance of rolling stock and permitting extended runs has reduced detention to wagons at terminals for many close circuit operations. There is now a need to expand its application and rationalize the system to progressively eliminate intermittent maintenance of wagons. Use of automation and technology by way of providing wayside equipment for automatic detection of defects in rolling stock in motion in the heavy haul railway systems have not only done away with equipment failure and resultant accidents, but have also contributed to considerable saving in time for maintenance. Installation of asset protection and monitoring equipment like hot box detector, bearing acoustic detector, hanging part detector, etc on the high density freight routes of IR can indeed be useful for improving the maintenance standards and for universalizing the concept of extended runs of rolling stock.

Electrification of terminals

By the end of the 10th Plan, about 17,500 route km of IR was electrified and, during the Eleventh Plan, electrification of another 3,500 km will be taken up. With progressive electrification of the high-density network of IR, there is an urgent need to install flexible overhead equipment (OHE) at loading and unloading terminals to facilitate direct placement and despatch of trains to and from the terminal without change of traction and, at the same time, carry out the handling operation under the wire. Though OHE does not interfere in the unloading operations on track hoppers, in all other mechanized loading/unloading operations, presence of OHE is a major constraint at terminals located in the electrified territory. It is understood that a silo loading system to facilitate loading of coal under the wire has been successfully implemented in Rajrappa Washery on South Eastern Railway. There are several installations, the world over, which permit top loading in electrified sidings. While the detailed design is site-specific, the arrangement generally involves erecting a rigid conductor over such top-loading system, which may either be manually operated or motorized in case the loading length is considerable. Depending on the design needs, OHE can be moved in the horizontal plane or in the vertical plane. A control panel with suitable interlocking ensures complete safety before the OHE is cleared of the wagons being loaded.

In case of motorized operation, the operation of moving the top conductor away and back in position is completely automated and takes only about 1-2 minutes for the entire operation. Normal design of flexible OHE arrangement as used in IR can be easily interfaced with the design for a seamless working. In case of loading by movable wagon loaders, there will be a necessity to have flexible swivelling type OHE over the entire length of the loading line which can be slewed immediately after entry of the train on the loading line so that the movable loader moves over the wagons without any infringement.

It is high time that such arrangements are put in place at all the existing bulk terminals and those planned for the future in electrified territory to ensure seamless operation and adoption of EOL system.

Moving toward heavy haul

Figure 6: Load out in an electrified siding

In the competitive world of logistics, a transport organization needs to continuously improvise to reduce the unit cost of transportation. It is indeed the rationale of "economies of scale" which has spurred all the major players in the transport world to acquire larger carriers, be it newer generation vessels in the shipping industry, large aircrafts in the aviation sector or heavy haul trains in the railway sector. In short, optimization is the very essence of bulk transportation. Today, IR is on the threshold of a transition to heavy haul operation, particularly in the area of bulk transportation. With increasing axle load, creation of dedicated freight corridors, emergence of mega bulk freight terminals, time is ripe for heavy haul operations on IR. It is through heavy haul operation, that the twin goals of economies of scale and optimal utilization of line capacity as well as terminal capacity can be achieved.

However, for heavy haul to be successful, it is imperative that the corridor should be dedicated for heavy haul operation alone. Construction of the dedicated freight corridors connecting the golden quadrilaterals and diagonals will usher a new era in freight transportation by way of providing the necessary wherewithal for heavy haul operation. In the interim period, heavy haul operation can be tried out on close circuit bulk movement corridors, particularly on the existing and emerging iron ore routes on South Eastern, South Western, South East Central and East Coast Railways. Terminal design and planning of the greenfield mega steel plants should take into account the requirements of heavy haul trains in terms of in-plant rail layout and the handling systems. As many greenfield steel plants are projected to come up in clusters in Orissa, West Bengal, Jharkhand and Chhattisgarh, possibility of developing a common user dumping facility with conveyor systems to feed the same cluster can also be explored.

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FREIGHT TERMINAL DEVELOPMENT SINE QUA NON OF LOGISTICS DEVELOPMENT

Sankalp Shukla*

Current trends and future demand

Indian economy has witnessed rapid growth over the last decade, making India an emerging manufacturing hub and a preferred investment destination for multinational corporations. This, in turn, has resulted in increased demand for world-class logistics and warehousing services in India, leading to the growth and transformation of this sector. The robust growth of Indian economy, in general, and Indian industry, in particular, has a direct impact on derived demand for logistics and transportation. The logistics sector has been growing at an impressive rate of 8 to 10 percent per annum since 2002 to touch revenues of $100 billion in 2007-08.

The Indian logistics industry is at an inflection point and is expected to grow annually at the rate of 25 to 30 percent, reaching revenues of approximately US$ 385 billion by 2015. The World Bank's 2007 *Global Logistics Report* ranks India 39th amongst 150 countries in terms of logistics performance. While the Indian logistics sector has a great potential, it presently forms a small portion, approximately 2 percent of the estimated US$ 5,000 billion global logistics industry.

Although, India until lately has been witnessing high growth rate in the band of 7-9 percent per annum, however, to a large extent, a major part of its growth story is driven by domestic consumption. There are serious concerns for the global slowdown, but India has the potential to sustain its rate of growth. Indian economy has shown enormous resilience in an increasingly integrated and competitive global economy. Macroeconomic forecasts for India reveal that it would witness GDP growth of 8 percent until 2020, which is an encouraging outlook for the logistics sector.

Significantly, the investment rate in the economy has touched a high of 36 percent of the GDP. Further, the government has planned to raise infrastructure investment to the level of 8 percent of GDP, resulting in the projected investment of US$ 500 billion during the 11th Plan period. In the transport sector, despite slowdown, Indian Railways has continued with the growth story, and in the last four years there have been accelerated investments in the area of infrastructure development through public-private partnerships. Construction of two DFCs (dedicated freight corridors) will witness demand for more logistics parks, terminals, ports and transport hubs. Factors like the

* *Managing Director, INLOGISTCS, New Delhi.*

changing tax regime, increasing trade, and the emergence of organized retail will lead to accelerated growth in the logistics sector. Infrastructure projects like IR's dedicated freight corridors, road development schemes and modernization of some 37 operational airports will increase traffic handling capacities, thereby enhancing logistics performance.

The port container traffic grew at a promising rate of over 14 percent during the last decade; the CAGR posted by JNPT terminals was over 23 percent. The ports on the west coast are likely to maintain this growth rate for the next decade as well. This implies that the port-based logistics sector too would require facilities to cater to such high demand of traffic. The role played by CFSs and ICDs would undergo a major change: the future would be of logistics hubs, which would supplement the ports traffic in a seamless way.

Development and evolution of logistics

For most domestic players, logistics has for long been restricted to the basic transportation of goods. Traditionally, warehousing – which is an important constituent of the logistics sector – has been dominated by small players with low capacities and poor handling, stacking and monitoring technologies. India's archaic warehousing system has been detrimental to the growth of almost all sectors, especially sectors like food and food-processing that require modern warehouses and investments in cold chains and allied machinery.

With increasing demand (from both MNCs and Indian companies) and growing requirements, the Indian logistics industry has expanded its bouquet of services to now include warehouse-related activities as well. Interestingly, the role of a warehouse too has transformed – from a traditional storehouse to a place where the inventory is efficiently managed, with greater emphasis being laid on value-added services, such as packaging, labelling, bar coding and reverse logistics.

All these factors have led to the rapid growth of the organised warehousing industry in India. Growing at the rate of 35 to 40 percent per annum, the warehousing industry is capturing the imagination of various logistics players, both domestic as well as international. Warehousing activities account for about 20 percent of the total Indian logistics industry and offer further growth potential. This market segment is estimated to grow from US$ 20 billion in 2007-08 to about US$ 55 billion by 2010-11. Over the next five years, approximately 110 logistics parks and 45 million square feet of warehousing space are expected to be developed across the country.

The logistics sector in India is fraught with much inefficiency. Logistics cost in India is indeed high – at around 13 percent of GDP, which is much higher than that in USA (9 percent), Europe (10 percent) and Japan (11 percent). According to a recent report by FICCI-Ernst & Young (E&Y), the average time taken to clear import and export cargo at ports is about 19 days in India, against three to four days in Singapore. Further, as compared to the European countries, rail transportation in India is almost 3.5 times more expensive and the average transit time by road is three times higher. The inefficiencies of the Indian logistics industry can be largely attributed to factors such as fragmented market structure and inadequate infrastructure.

Logistics cost across major markets

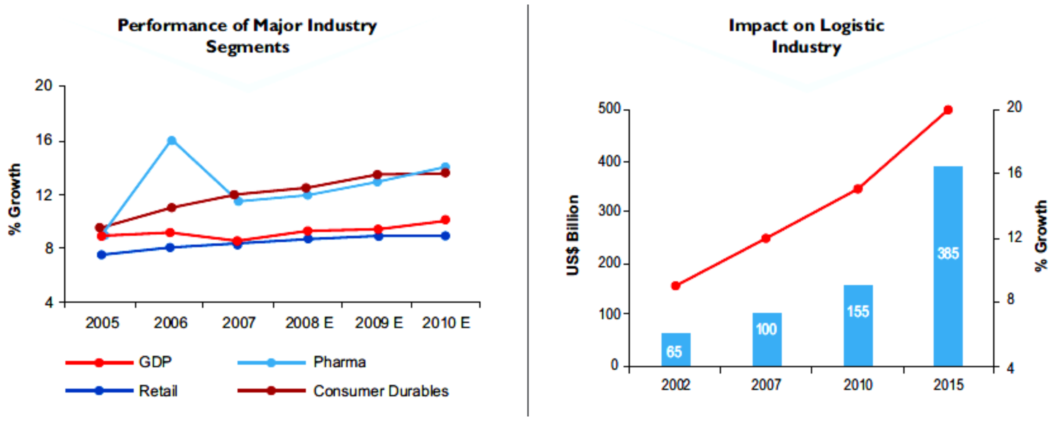
Country	Logistics Cost as % of GDP	% of logistics activity by organised sector
USA	9%	57%
Europe	10%	30-40%
Japan	11%	80%
India	13%	Less than 6%
China	18%	10%

Source: Accenture Study

Key growth drivers

Let us examine the key growth drivers for India's logistics sector – such as, increase in foreign trade, outsourcing of manufacturing activities and the emergence of organised retail – that are necessitating the growth of warehousing, supply chain management, cold storage and transportation. Several factors have favourably impacted the growth of the country's logistics industry, like rationalization of tax regime, growth across major industry segments such as automobile, pharmaceutical, fast-moving consumer goods (FMCG) and the emergence of organised retail. With escalating competition and cost pressures, companies are increasingly focusing on their core competencies by outsourcing their logistics requirements to third party logistics (3PL) players.

Sustained performance by major industry segments and emergence of organized retail will lead to growth of Indian logistics industry



Source: Cushman & Wakefield Research

Key factors governing the future of Indian logistics and warehousing industry

(a) Burgeoning domestic demand

Emergence of organized retail: Globally, retail has been a key driver for the growth of logistics industry and India is no exception to this phenomenon. Organized retail in India has been growing at over 30 percent per annum. The total retail industry is expected to grow from US$ 320 billion in 2006 to US$ 421 billion by 2010. The growth of organized retail has created demand for specialized logistics services, wherein every retailer relies on strong logistics and warehousing infrastructure for the success of his business. This sort of changing business environment should give further impetus to the logistics sector by generating increased demand for high quality and efficient logistics and warehousing services.

Increase in foreign trade: In 2007, the Indian economy witnessed a growth of 13 percent in exports and 17 percent in imports. India's current share in global trade is around 0.8 percent which is expected to increase to 1.6 percent by 2012. Robust growth in foreign trade will increase the demand for good quality and timely logistics and warehousing services.

India becoming a manufacturing hub: The world over, India is being recognised as a destination for outsourcing of custom-based, high-technology manufacturing activities. According to the Confederation of Indian Industry (CII), India will emerge as one of the global 'manufactured product' outsourcing hubs and will reach revenues of approximately US$ 50 billion by 2015. In order to remain cost-competitive, contract manufacturers will be required to provide integrated logistics solutions that will bolster the cost saving potential of the outsourcing initiative. The increasing trend of outsourcing will, in turn, generate strong demand for logistics solutions in the country.

(b) Reducing logistics costs

India's multi-layered tax regime, infrastructure bottlenecks and other inefficiencies have been the primary reasons for keeping its logistics costs high. Under the existing tax structure, 2 percent Central Sales Tax (CST) is levied on interstate sales. As a result, companies have had to maintain small warehouses and depots in every state in order to avoid paying CST on interstate sales. These multiple warehouses have resulted in high inventory costs, increased working capital and other overheads.

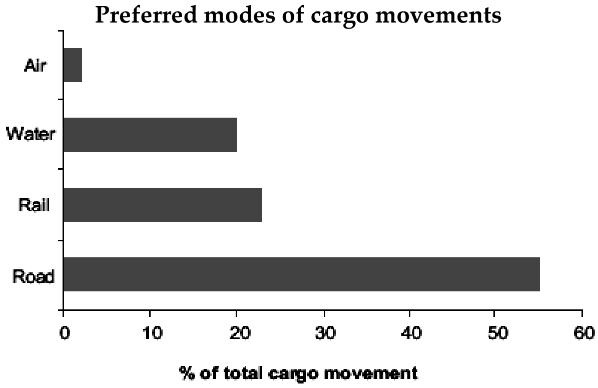
A simplified tax regime will help logistics players service multiple markets and offer end-to-end solutions far more efficiently and at much lower costs. As per the World Bank's report on the Logistics Performance Index, a 0.5 percent decrease in logistics cost leads to 2 percent growth in trade and a 40 percent increase in the range of products that get exported out of the country.

From multiple taxes to a simplified tax regime: Union Budget 2008-09 proposed the phasing out of Central Sales Tax (CST) by 2010-11. Once implemented, this measure will promote outsourcing of logistics operations and encourage the creation of large warehouses at strategic locations that would operate on the 'hub-and-spoke' model. The implementation of Value-Added Tax (VAT) in 2006 has played a role in reducing logistics costs. The proposed implementation of Goods and Service Tax (GST) could lower the logistics costs further. According to the Confederation of Indian Industry (CII), improvement of logistics and warehousing industry could make Indian industries more cost-competitive, thereby enabling a GDP growth of 11 to 12 percent, from the existing 7 to 8 percent.

(c) Improvement in infrastructure

Transportation in India accounts for nearly 40 percent of the total cost of production. One of the major barriers faced by the Indian logistics industry has been the lack of quality physical infrastructure. However, India's core sectors are witnessing a significant change. The country is expected to increase its expenditure on infrastructure development from 4.7 percent of GDP in 2007 to 8 percent of GDP by 2012. This increase will help boost the logistics industry. Better connectivity to small towns and cities is another area that the planners need to work upon.

Preferred modes of cargo movements



Source: Confederation of Indian Industry

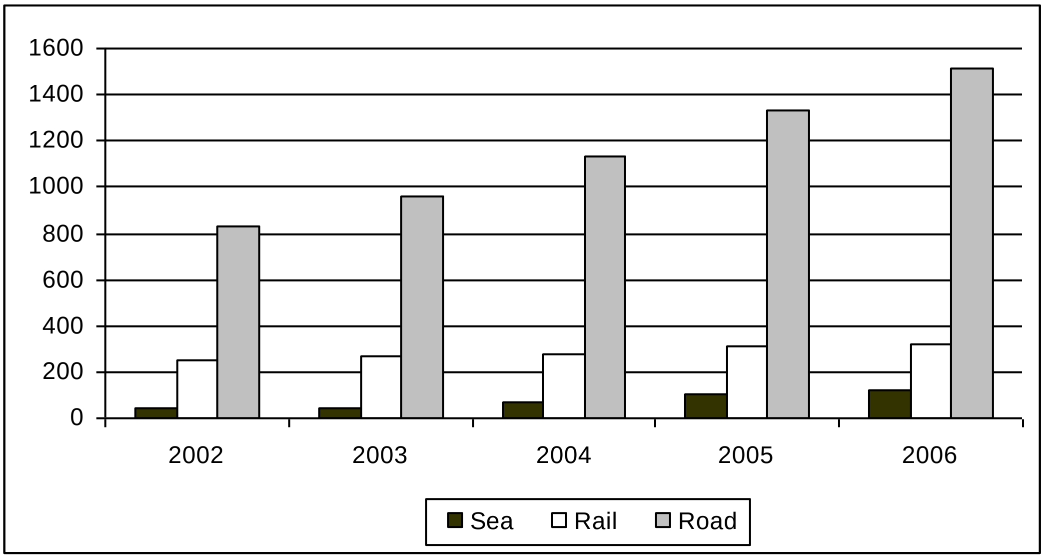
Road transport is currently the most dominant form of transportation with more than half of the goods in the country being moved by road. The railways, which were a popular mode for freight transportation (especially the movement of bulk goods), have been loosing ground to road transportation due to limited access to smaller towns, capacity constraints and unfavourable freight rates. Air, on the other hand, is a costly mode and its use is restricted to high value low volume shipments.

Emerging trends in logistics industry

A fragmented market

India's logistics sector shows little or no integration between different modes of transport (principally road, rail and sea). International comparisons suggest that this integration is a fundamental component of an increasingly sophisticated and mature industry. Although all segments of the industry are growing, road transport continues to outpace the rest – showing four-year CAGR of 16 percent versus 7 percent for railways.

Market share by mode of transport (Rs. billion)



Growth of the organised sector

The logistics and warehousing sector in India, till now, has been highly fragmented and characterized by the presence of numerous unorganized players. A large number of players have been providing services in individual segments like transportation, warehousing, packaging, etc. In 2007, organized players accounted for only 6 percent of the total US$ 100 billion Indian logistics industry.

The changing business dynamics and the entry of global third-party logistics players (3PL) has led to the remodelling of the logistics services in India. From a mere combination of transportation and storage services, logistics is fast emerging as a strategic function which involves end-to-end solutions that improve efficiencies. Logistics players that provided limited logistics services are also planning to broaden their areas of operation. Besides expansion of distribution network by both national and regional players, the sector is also witnessing considerable M&A (merger & acquisition) activity. For instance, DHL acquired Blue Dart, TNT acquired Speedage Express Cargo Service and FedEx bought over Pafex. Consolidation within the industry will lead to economies of scale for the existing organized players, thereby lowering costs and improving efficiencies.

Global logistics companies – like Gazeley Broekmen (Wal-Mart's logistics partner), CH Robinson and Kerry logistics – have also forayed into the Indian market in order to capitalize on the vast emerging opportunities within this industry. Many of them are planning to develop their own logistics parks across the country. Another trend witnessed over the last few years has been the entry of several large Indian corporate houses – such as, the Bharti group, Tatas and Reliance Industries Limited – into the logistics sector. The Indian conglomerates foresee huge potential for specialized logistics and warehousing facilities, particularly in industries like retail. Companies like Bharti, Tata Realty and Infrastructure, GE Equipment Services and Reliance Logistics cater to the logistics needs of their own group companies as well as provide services to other companies.

The growth of the organized sector would enable the logistics industry to provide cost-effective and integrated logistics solutions in order to meet the ever-increasing demand. As per estimates, the market share of organized logistics players is expected to double from 6 percent in 2007 to approximately 12 percent by 2015.

Rapid growth of the warehousing sector

The role of a warehouse has also transformed from a conventional storehouse to an inventory management set-up with greater emphasis on value-added services. Warehouses now provide additional services like consolidation and breaking up of cargo, packaging, labelling, bar coding, reverse logistics, etc. It has emerged as a critical growth driver, leading to large investments by logistics companies for the development of warehouses and logistics parks with rail connectivity. As stated earlier, warehousing and related activities currently account for about 20 percent of the total logistics industry. However, it is estimated that by 2010, this proportion would increase to approximately 35 percent.

The traditional concept of establishing warehouses in the proximity of manufacturing facilities and raw material sourcing centres is also undergoing a transformation. Today, there is an increasing trend of relocating warehouses near consumer markets.

Currently, the organized warehousing industry in India has a capacity of approximately 80 million tonnes and is growing at the rate of 35 to 40 percent per annum. An investment of approximately US$ 500 million is being planned by various logistics companies for the development of about 45 million square feet of warehouse space by 2012.

Logistics parks – one-stop shop for meeting logistics needs

A logistics park is a notified area that facilitates domestic and foreign trade by providing services like warehousing, cold storage, multimodal transport facility, container freight stations, etc. The park also acts as a place where a company can unload cargo for distribution, redistribution, packaging and repackaging. Majority of these logistics parks will be developed in the proximity of established and emerging industrial hubs in the country in order to tap their logistics needs.

By 2012, around 110 logistics parks, spread over approximately 3,500 acres, are expected to come up across India at an estimated cost of US$ 1 billion. Availability of large land parcels at relatively low cost, connectivity to multiple markets across states and proximity to industrial clusters has led to the emergence of some tier-2 and tier-3 cities as favoured destinations for the development of logistics parks and warehouses.

Key functions of logistics parks

Inventory management

One of the key aspects of modern terminals is inventory management which is essential in terms of optimal utilization of resources and time. This could be achieved by paying attention to the following, apart from ensuring visibility and control of all cargo – at the gate, in the yard, the container stacks as well as on vessels or rail wagons.

– Real-time inventory management.

– Rapid deployment plus optimized material flow solutions.

– Secure, flexible and open IT platform with best-in-class look, feel and functionality.

– Dynamic management information and decision support systems.

– Seamless integration with enterprise resource planning (ERP) and legacy systems.

There should be dynamic, networked control means for the shorter container lift and vessel turnround times. Besides, there should be enhancement in cargo processing, high container throughput, improvement in productivity and the proper use of available space. There has to be requisite support for the operational needs of business and also the provision of comprehensive and flexible reporting structure in real-time for peerless decision-support.

Indian logistics industry – emerging geographical locations

Industrial clusters in India can be broadly divided into four economic zones, based on the concentration of key industries like pharmaceuticals, auto and auto-components, textiles, machinery and electronic goods. The presence of these industries is likely to favourably impact the development of the logistics industries in these locations. Major states that fall in these four economic zones are:

North: Haryana, Himachal Pradesh, Delhi and Punjab

West: Maharashtra, Gujarat and Rajasthan

South: Andhra Pradesh, Tamil Nadu and Karnataka

East: Orissa and West Bengal

Western India (Maharashtra, Gujarat and Rajasthan) has emerged as the most prominent destination for the logistics industry. Upsurge in the retail sector along with these states having several industrial clusters of textile, pharmaceutical, engineering and automobile industries will favourably impact the logistics sector in this region. Likewise, with increased emphasis being given to the stepping up of trade with China, West Bengal (which is also the gateway to northeastern states) is strategically poised to become a major logistics hub within the eastern zone.

These hubs offer excellent road, rail and seaport connectivity and are also witnessing significant investments in infrastructure. High penetration of organized retail, presence of industrial clusters and upcoming industrial projects and SEZs in and around these areas make these 'established' hubs all the more attractive. Major ports and existing logistical hubs – like Mumbai, Kolkata and Chennai – fall under this category.

Mumbai has emerged as the most-favoured location for the development of logistics parks. An investment of approximately US$200 million has been planned towards the development of seven to eight logistics parks on approximately 600 acres of land around Mumbai.

Emerging hubs

Gurgaon, Vizag, Nagpur and Indore fall under this category since these hubs have a high potential, but lack the supporting infrastructure, as of now. These hubs, however, have major infrastructure projects underway which are scheduled to be completed within the next three to five years. Infrastructural developments will make these hubs develop into attractive opportunities for logistics activities.

These 'emerging' logistics hubs are also characterized by high growth industries, connectivity with multiple markets and availability of large land parcels at relatively lower rates (as compared to the established hubs). They have also witnessed in the recent past significant land transactions, involving logistics and warehousing projects.

Promising hubs

Promising hubs comprise of areas, such as Jamshedpur, Alwar, Ahmedabad, Bangalore and Ambala, which have considerable prospect of being developed into logistics hubs. Increase in manufacturing activities is bringing about a change in these areas and opening up opportunities for the logistics players. At present, these hubs have moderate presence of organised retail and an absence of multiple industries, though this scenario has begun to change. Infrastructure in these hubs is still a challenge and needs to be developed in order to attract logistics players. These hubs are known for industries like oil and gas exploration, textile, oil and information technology.

Nascent hubs

Nascent hubs are marked by untapped market potential and limited infrastructure. The potential of these hubs is restrained by factors, such as limited penetration of retail, lack of connectivity to multiple markets and absence of multiple industries. Hubs like Kochi, an important tourist destination, fall under this category. Kochi has immense potential for growth due to the presence of an international airport and a port.

Key locations for the logistics sector

Kolkata: Kolkata is amongst the oldest port cities in the country and accounts for about 6 percent of the total container traffic in India. Situated on the Golden Quadrilateral, it is well connected to other major cities of India by road and rail. It is also the gateway to the northeast Indian markets and a key location for trade with China. Proximity to textile and auto-component industry clusters and other manufacturing units has made Kolkata a major economic centre. Ten special economic zones (SEZs) in the proximity of Kolkata have received in-principle approval. This will result in major demand for logistics in this region. As a result, centres like Haldia, Falta, 24 Parganas, Dhankuni, Kharagpur, Bantala and Durgapur are expected to witness substantial logistics activities in the near future.

Mumbai: Mumbai, the commercial capital of India, has for long been an established logistics hub. Two major ports near Mumbai account for approximately 60 percent of the container trade in the country. Mumbai also has the busiest airport in India in terms of cargo traffic. Several manufacturing clusters, focusing on machine tools, FMCGs, drugs and pharmaceuticals, are present in the proximity of Mumbai. Bhiwandi is the largest warehousing location on the outskirts of Mumbai, while Panvel is fast emerging as a warehousing cluster due to its proximity to the Jawaharlal Nehru Port Trust (JNPT) and the availability of large land parcels. Demand for warehouse and logistics services is expected to accelerate further due to the scarcity of quality warehouses, increase in foreign trade and the upcoming Maha Mumbai Special Economic Zone.

Hyderabad: Hyderabad as a logistical hub provides excellent connectivity to large markets in southern and western India. In addition to having established clusters of textile and engineering firms, Hyderabad is also an important centre for the pharmaceutical industry. A large number of upcoming SEZs have necessitated the development of logistics for the domestic market as well as for global trade. Jedimetla, Suraram and Sanat Nagar are existing warehouse hubs, while Medchal Road along NH7, Patancheru to Sangareddy along NH9, Hyatt Nagar (near Ramoji City) and the outskirts of Shamshabad are upcoming locations for the logistics sector around Hyderabad.

Chennai: Chennai is the second largest port in terms of container cargo traffic. Its status as an emerging passenger car export hub has increased the importance of having a good logistics network in this region.Various manufacturing clusters focusing on textiles, engineering goods and automobile components are also present in proximity to Chennai.With over 28 international cargo flights operating per week, Chennai is the best connected destination in southern India. The prominent logistics hubs in Chennai are Madavaram, Poonamalle and Thiruvottiyur.They offer good connectivity to industrial locations, highways and seaports.

Nagpur: Nagpur is an ideal location for a 'hub-and- spoke' distribution model in the country. A major location along the North-South road corridor of the country, Nagpur is well-connected to many state capitals by road and rail. Steps such as the gradual dissolution of taxes (and more specifically the Central Sales Tax) and the ongoing infrastructure development will help Nagpur become the multimodal logistics hub of the country. With the development of the Multimodal International Hub Airport at Nagpur (MIHAN), a multi-product SEZ, Nagpur will witness increased industrial and commercial activity in the future, leading to increased demand for logistics services.

Gurgaon: Gurgaon is ideally situated to cater to the logistics needs of the NCR and facilitates import- export traffic in the industrial areas of Haryana, north-Rajasthan and Punjab. Several auto components manufacturers, electronics and general manufacturing clusters ate situated in close proximity to Sonepat, which is strategically located on NH 1 and offers connectivity to NH 71, NH 24 and NH 58. The 135-km Kundli- Manesar-Palwal expressway under construction will connect major national highways and provide connectivity to Uttar Pradesh and Rajasthan. Gurgaon has the advantage of being situated on the Golden Quadrilateral with easy access to the dedicated freight corridor giving it a clear advantage of developing a logistics hub. Further, 17 upcoming SEZs in locations around Gurgaon like Sonepat, Badli and Delhi, will strengthen Gurgaon's position as a prime logistics hub.

Bangalore: Bangalore (Bengaluru) lies on the Golden Quadrilateral and has excellent road, rail and airport infrastructure. Accessibility to the ports of Chennai and Cochin has led to the emergence of Bangalore as an attractive hub for exports. In addition to the established manufacturing clusters of garments and textiles, booming retail sector and an emerging biotechnology industry have increased the potential of logistics and warehousing sector in Bangalore.

Notified SEZs catering to an emerging biotechnology industry at neighbouring Hassan district are likely to further stimulate logistics and warehousing demand in Bangalore. Existing prominent warehouse locations in Bangalore include Hoskote, Whitefield, Peenya, Doddaballapur, Hosur Road and Devanahali.

Indore: Located in central India, Indore is connected to other parts of the country through NH 59 and NH 3. Indore is a prominent hub for automobile products, pharmaceuticals, textiles, food processing and heavy engineering. Indore which already has a planned 2,500 acre multi-product SEZ is also the likely location for an additional 2,490 hectares of industrial cluster proposed by the Madhya Pradesh Audyogik Kendra Vikas Nigam Ltd. (MPAKVN).

Kochi: Kochi is one of the principal ports of India strategically located on one of the busiest maritime routes. It is well connected to all major cities in southern India. It is also well connected to the hinterland by NH47, NH49 and NH17 and various rail links. The Kochi Port Trust has initiated several projects like an international bunkering terminal and a port-based SEZ that will necessitate the development of logistics services in Kochi.

The Kerala State Industrial Development Corporation (KSIDC) has acquired approximately 750 acres of land for the development of SEZs. Districts of Kannur, Kozhikode and Malappuram have been short-listed for SEZ development, catering to the textile, healthcare and rubber product industries, all of which require efficient logistics support. These SEZs would benefit from the good accessibility provided by the Kochi port. Formal approvals have been received for the development of 950-acre port-based SEZs in Vallarpadam and Puthuvypeen. Several other infrastructural developments also make Vallarpadam and Puthuvypeen ideal locations for the development of logistics parks and warehouses.

Steps to streamline the logistics industry

Setting up logistics parks in SEZs can improve India's competitiveness

Around 70 to 80 non-IT/ITeS SEZs have been notified in the country in order to cater to various sectors. These notified SEZs along with emerging economic corridors and industrial parks require efficient transportation and supply chain support, connectivity with various markets and other value-added services. Therefore, in order to ensure that SEZs operate successfully and improve India's competitiveness, logistics parks catering to an entire range of logistics infrastructure should be developed in emerging economic corridors and industrial parks.

A national logistics strategy can improve efficiency and lower costs

In order to achieve high customer service at low cost, India needs to formulate a national logistics strategy that encourages competition and facilitates participation by the private sector players. Such a strategy should aim at aligning diverse state and central government policies, set targets for the growth of this sector, chalk out roles for the public and the private sectors, focus on infrastructure development and facilitate the entry of new players in the logistics industry.

Regulating the sector to bring about uniform service standards

Today, a wide gap exists in the services being offered and the pricing of various industry players. A regulatory authority that specifies minimum service standards and benchmarks pricing can be instrumental in establishing a uniform service standard in India's logistics and warehousing industry.

Granting industry status to logistics can address inefficiencies

Several inherent inefficiencies can be addressed by granting industry status to the logistics and warehousing sector. This may also encourage public-private partnership and increase the government's focus on this sector. Such a step will also help in the consolidation of this industry and provide it better access to finance.

Conclusion

Amidst a growing economy and a surge in demand for logistics and warehousing activities, many logistics companies reinvent themselves and target larger roles. With bottomlines strengthening, the sector attracts both public as well as private equity. This should help enhance the service offerings of the sector as well as help existing players diversify into new business areas.

Traditional Indian logistics players are now organizing themselves in order to become more scalable, both nationally and internationally. Analysts attributed this change to the expansion of retail activity in the country that would create huge business opportunities, with the added advantage of being exposed to the latest technology in the field of logistics. The entry of global firms has made domestic players more competitive and quality-conscious.

Over the next five years, 3,500 acres of land is expected to be developed as logistics parks and warehouses and rail-connected freight terminals. Therefore, real estate decisions will play a crucial role in developing the competitive strength and enhancing the effectiveness of logistics players. Historically, warehouses have been located in close proximity to primary markets. However, the abolition of CST and an improvement in infrastructure would enable companies to realign their supply chain and move closer to consumer markets. The changing business dynamics and evolving regulatory framework has given rise to new emerging locations. As a result, demand for real estate will no longer be restricted to only the existing primary logistics hubs in the country. Since almost one-third of the total realty development in the sector is expected to take place in emerging locations, many tier-2 and tier-3 cities that offer good connectivity to multiple markets will witness increased activity from logistics players, providing a thrust to the real estate market.

While we are witnessing rapid growth of the logistics and warehousing industry with rail connectivity terminals, a number of bottlenecks continue to restrain the development of this sector. India's transport network growth, for instance, has not been able to keep pace with the country's economy. While several initiatives like rationalization of taxes and investment in infrastructure have been undertaken, a lot remains to be done as far as organizing and modernizing this sector is concerned. Granting an industry status to logistics and warehousing sector, efficient implementation of infrastructure projects, and simplification of the regulatory structure and availability of skilled manpower are critical to the growth of the Indian logistics industry.

Development of modern freight terminals

The need for modern freight terminals with rail connectivity is very much essential to meet the robust growth in logistics industry as this will not only enhance the efficiency levels, cut transit time, save damages and pilferages, but will also be helping the industry in cutting costs on logistics which is as high as 13 percent of GDP in India today.

Modern freight terminals can only be successful if they are backed by a robust logistics infrastructure. Similarly, India's dream of becoming a manufacturing hub to the world may well remain a dream if the logistics infrastructure does not keep pace with the growth in other sectors in order to enhance the country's existing cost arbitrage. In short, the growth of several industries and their cost-competitiveness rests squarely on the growth and development of the logistics and warehousing industry. An increased focus on this sector by both the government and the private players will go a long way in strengthening the 'India advantage', helping the country achieve the coveted position of a superpower.

Modern freight terminal: activities and services

Domestic rail-linked terminal/ICD/CFS or road linked ICD/CFS

Activities:

- Handling – Unloading/loading of railway/container rakes. Handling can be either manual through labour or by machines, i.e., lift-on/lift-off of containers by reach stackers.
- Warehousing of cargo in the closed areas as bonded/non-bonded.
- Stacking yards for empty or loaded containers.
- Secondary transportation to destinations, if required.

Services:

- An easily accessible bimodal (road/rail) or tri-modal (road/rail/air/ship) platform.
- An uncomplicated environment that imposes few constraints.
- Multi-modal transportation, warehousing, supply chain and inventory management.
- Quality services for companies and their staff:
  - (a) Business services: meeting rooms, vehicle maintenance, shared space management, green space maintenance
  - (b) Employee services: stores, bank services
  - (c) Secured park: guards, dedicated fire protection system
  - (d) High speed and very high speed networks

Industrial and commercial powerhouse

- In addition to conventional industry that is capable of innovation (textiles, engineering, metallurgy, construction), a number of new industrial and service activities have emerged
- Logistics, packaging, specialty textiles, food processing, agribusiness, medical and pharmaceutical industries, paper, etc.
- Economic diversification is supported by local authorities and benefits from the development of higher education, research, new technologies and the tertiary sector in general. It can also count on a qualified labour force capable of handling co-packing and co-manufacturing activities efficiently.

A pool of logistics skills

(a) Specific training courses

(b) Special research centre

- Using integrated logistics services and public services.
- Complementary activities – packaging and call centres with the strength of networks.
- Land leasing to transport operators/warehouse and office leases/sale of warehouses and offices.
- Provision of bonded and non-bonded operations under the same roof so that multiple customers can benefit.

Comprehensive multimodal land transportation model

(a) Carload (b) Intermodal/ Automotive, (c) Transload.

Differentiated service offerings

(a) Fastest rail routes between key markets (b) Expeditious and premium service levels

Customs and banking infrastructure

Intermodal terminals

Cost and operational efficiencies:

(a) Concentrate and improve service points, (b) Reduce redundancies and reshape network

Business issues

(a) A network is essential for developing domestic business

(b) Network should be planned on a hub-spoke model

- 4-5 Hub points
- 25-30 Rail-based feeder terminals
- 200-300 Road-based collection and delivery depots

(c) Concerns

- Cost/availability of land
- IR land and terminal use policy
- Lead time for development

Case study: Kalamboli freight terminal

A state-of-the-art modern freight terminal is being developed by INLOGISTICS at Kalamboli along with Central Warehousing Corporation at an existing CFS facility. This is the perfect module on lines of a modern freight terminal required in India. Association with CWC is based on developing and improvising a normal CFS facility to a modern freight terminal on PPP basis.

The facility was catering to EXIM trade serving the volume of 3,000 to 4,000 TEUs per month – the entire traffic handled by road. With the development of various CFS facilities near JN port area, the Kalamboli terminal though ideally located on NH-4 having various industrial clusters within close proximity of less then 100 to 200 kms, lost considerable volumes and hence was forced to earn revenue by converting many of the warehouses into Customs bonded facility. The terminal was facilitating the trade through the Customs bonded warehouse and around 1,000 TEUs of EXIM were being serviced.

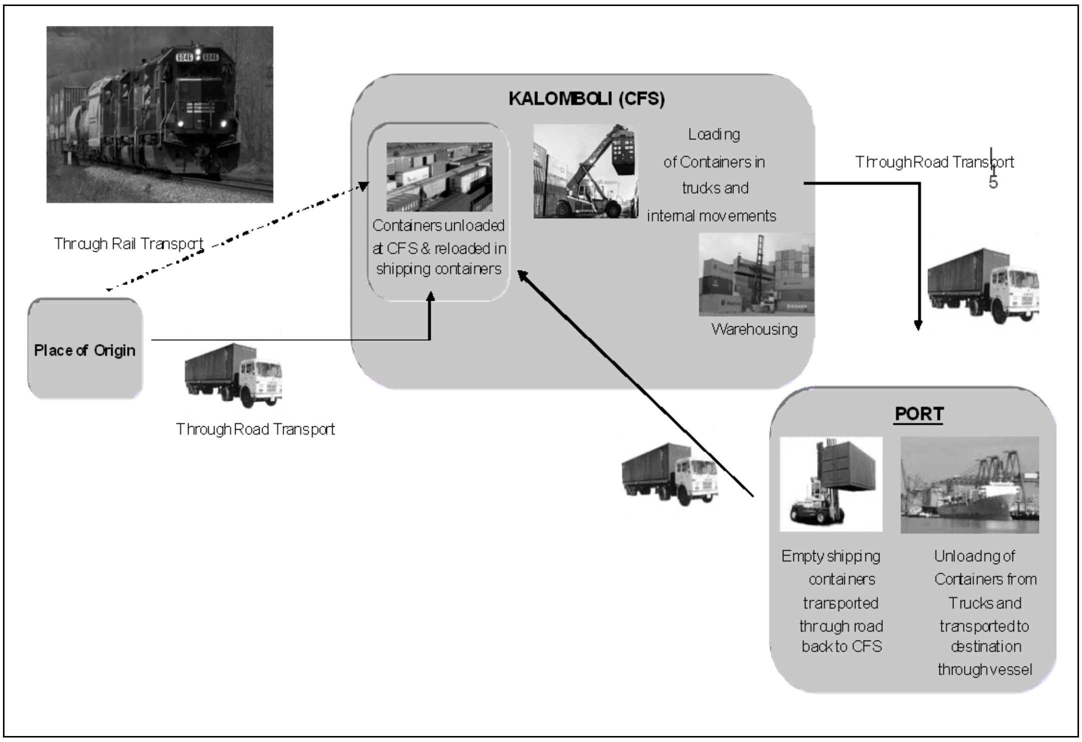
INLOGISTICS provides one-stop solution to establish multimodal handling facilities through rail-linked CFS at Kalamboli: (a) handling of BCN rakes for agro-commodity; (b) handling of EXIM container trains; (c) handling of domestic container trains; and (d) handling via road import/export.

Facilities:

–	Total area	:	1,20,000 sq mtrs (30 acre)
–	Paved & unpaved area	:	50,000 sq mtrs (between rail and boundary on W/H side) and 32,000 sq mtrs (other side)
–	Rail siding	:	7,500 sq mtrs
–	Warehouses	:	10,625 sq mtrs
–	Gates	:	2
–	Office complex	:	1,000 sq mtrs
–	Other structures	:	1,000 sq mtrs
–	Balance unusable area	:	18,000 sq mtrs

INLOGISTICS have successfully bid for developing a modern freight terminal with rail connectivity at the said facility to cater to domestic/agro-commodities/container movement to connect Mumbai region and JN port on pan-India basis. The said terminal will provide services by rail/road for both domestic and EXIM trade and will be using its full potential by servicing approximately 80,000 to 100,000 TEUs per annum in addition to approximately 120,000 tonne of loose cargo per month. This facility will also be providing Customs bonded warehousing in an adjacent facility.

Inbound operations (Kalamboli)



Core services planned at Kalamboli

- Rail bound activity for BCN and container trains
- Cargo by road
- Warehouse back-up
- Reefer plug points with power back-up
- Option of handling domestic traffic
- Option of handling container trains of private players
- Consolidation of cargo for domestic and local traffic
- Covered storage facility for goods
- Bonded and non-bonded warehousing facility

Principal commodities

Export commodities: Sugar, Rice, Maize (corn), Cotton bales (raw cotton), Soybean extraction (de-oil-cake) and Rapeseed meal.

Import commodities: Pulses, Steel (plates/coils/pipes) and Paper.

Business proposal

- CWC, Kalamboli has a potential to handle over 7,000 TEUs per month arriving by wagons
- 1,000 TEUs per month cargo by road
- Agro-commodity in bulk arriving from various stations across the country can be redefined using this as main core for complete logistics solution
- Handling of domestic and EXIM container trains of different private players
- Reefer power plug facility of over 50 FEUs
- Import empty containers can be utilized for export
- Establish supply chain management
- Maximize space for placement of containers
- Efficient storage facility
- Adequate skilled labourer
- First class infrastructure
- Centralized for execution of EXIM traffic

Conclusion

The Kalamoboli modern freight terminal has been functional from the 01st of August 2008, INLOGISTICS intends to come up with more such facilities on pan-India basis with PPP module in mind to minimize the infrastructure cost but, giving the best logistics services needed to meet global standards. We would like to be associated with public sector companies like CWC, Railways and other similar agencies to develop their unexploited potential for the benefit of the country and trade and commerce.

MULTIMODAL HUBS FOR STEEL TRANSPORTATION AND LOGISTICS

Juergen Albersmann*

Introduction

Transport hubs as building blocks of distributional logistics

The elementary role of a mode of transport is carriage of goods. In the simplest case, the transporter is merely given the source and the destination of the goods to be transported. The ways in which the goods are to be transported are not described by the consignor and left to the decision of the transporter. The goods are loaded and transported to the destination with the help of a suitable vehicle and unloaded on the ramp of the receiver. Finally, the vehicle returns to the point of origin.

Generally, the consignor concentrates more on the production of goods and less on their transport. A forwarder is assigned for the transport of goods and to customize it within a network, for which the respective resources are kept ready. Apart from the owned or leased transport capacity, there is need for a physical network of terminals, which serve as consolidation points for the respective destinations or routes. Consolidation means that the consignments of different customers are collected in a small transport vehicle (typically having a maximum payload of 7.5 tonnes, the so-called 'collection and distribution trucks') and kept ready for transport on the respective route.

Since all customers do not deliver all their packages for a common destination, individual packages are sorted out according to their place of delivery and loaded on semi-trailers or swap trailers. These are then transferred to heavy transport vehicles on the main routes to be taken to what are called hubs. The major difference between a terminal and a hub is that only heavy transport vehicles arrive at a hub where no distribution of goods takes place. The hub is linked to all the terminals through sectional traffic. In a production network, the inbound and outbound traffic moves across spokes (Figure 1).

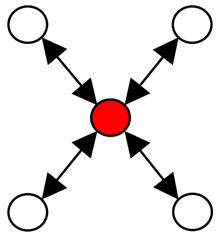
As in a bicycle, the central point surrounded by spokes is the main point of focus in the network. Moving on from this rather simplified comparison, one can think of big and complex networks, such as the one of DB Schenker in European land transport, which is made up of more than one hub. Production networks constructed in such a manner has

* *Vice President Business Development, DB Schenker Rail, DB Mobility Logistics AG.*

numerous advantages. To begin with, the traffic in the network works to such high capacity that it has a positive contribution on efficiency. Even small and middle scale companies can ensure the functioning of their distributional logistics across whole continents without having to maintain cost-intensive networks themselves.

Multimodal hubs and multimodal transports

Figure 1: Schematic depiction of a 'hub and spoke' system



In the previous paragraph we examined the building blocks of a mode of transport which is carried out with the help of heavy transport vehicles. Vehicles can also be described as modes of transport. If transport is carried out with the help of only one mode, then it is called through unimodal transport. If it is carried out through many modes of transport, then it is referred to as multimodal transport. If the consignment is delivered through many modes of transport to the hubs, the hubs should provide for the necessary handling and dispatch systems which include adequate infrastructure like quay walls for (inland) ships and railway lines for rail transport. In the case of steel logistics, rail transport plays an important role apart from heavy transport vehicles and inland shipping, because the usual handling facilities like forklift or manual pallet jack do not suffice owing to the enormous weights of the consignments. A complete transport system made up of several modes of transport is described as multimodal transport.

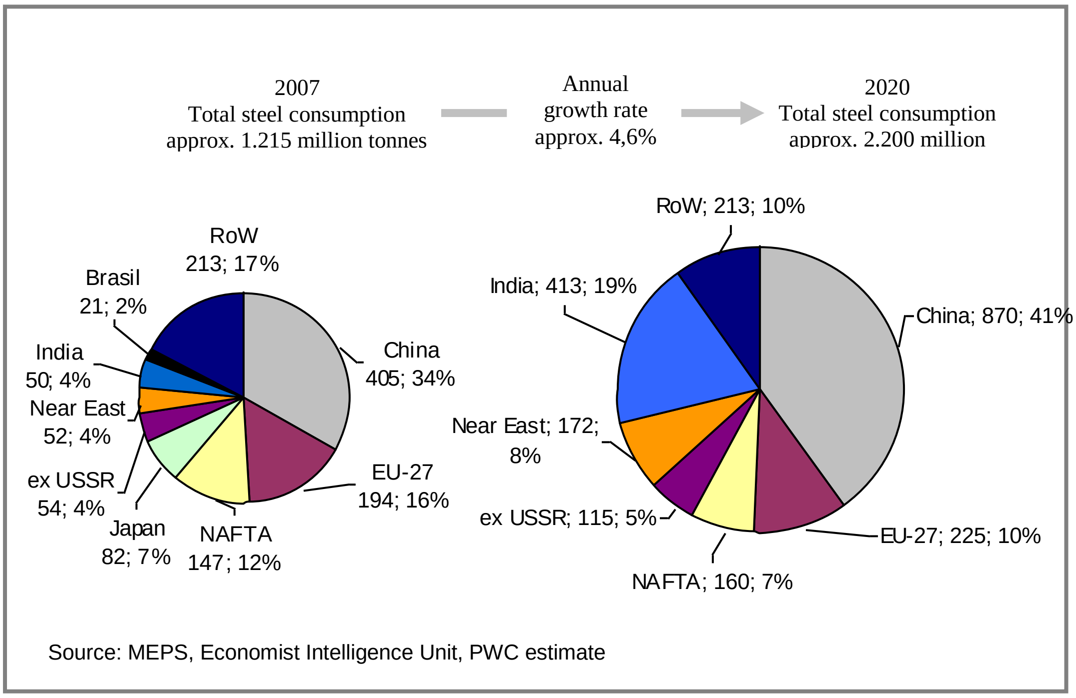
Steel logistics as a link between supply and demand

The steel sector has been booming for a long time: the world steel production grew by 1.35 billion tonnes in the year 2007. This development is expected to continue without much interruption in the coming decade. According to the predictions, the global steel production will reach 2.3 billion tonnes in the year 2020 with an average yearly growth of 4.3 percent. At the same time, the increased crude steel production will show many regional diversities. According to the predictions, the so-called BRIC countries (Brazil, Russia, India and China) will have the highest growth. The growth in these countries will account for more than 10 percent, while in Western Europe and North America, no significant increase in production can be expected. With an annual growth of 4.6 percent, the global demand for steel will outgrow the global steel supply.

The biggest consumers of steel products in the projected period would be China, India and the Middle East. European and North American steel markets are losing their importance. The share of the European Union (27) will decrease from 16 to 10 percent. The NAFTA with a global market share of 7 percent will be pushed back to the fourth position by the Middle East. The biggest markets worldwide for steel in the year 2020

(Figure 2) would be China (41 percent), EU27 (10 percent), the Middle East (8 percent), NAFTA (7 percent) and India (19 percent).

Figure 2: Chart depicting steel consumption



From the logistical point of view, China, the Middle East and India face the biggest challenges. Steel as an important raw material is indispensable to the development of infrastructure and mobility. At the same time, one needs transport infrastructure for transport and storage of steel, which is appropriate for handling of large and heavy bulk goods. The new steel markets are up against two challenges: in addition to increasing their production capacities, they also need to develop an appropriate steel logistics system to be able to serve their markets.

Traditionally, rail transport has been very closely involved in the transport requirements of the steel industry. The system of wheel/rail makes possible the efficient transport of heavy goods over long distances by rail like no other mode of transport. Railway is the first choice as a mode of transport in a country like India in which nearly all raw materials needed for steel production can be acquired regionally and almost the entire sale remains in the Indian subcontinent. In India, for every tonne of crude steel production, 4.5 tonnes of bulk goods are being transported. In Europe, one observes a ratio of one to three. With an estimated 150 million tonnes of crude steel consumption in India in the year 2020, there would be an annual transport demand of approximately 675 tonnes on rail. This fact clearly establishes the continued need for co-existence of steel and rail industries.

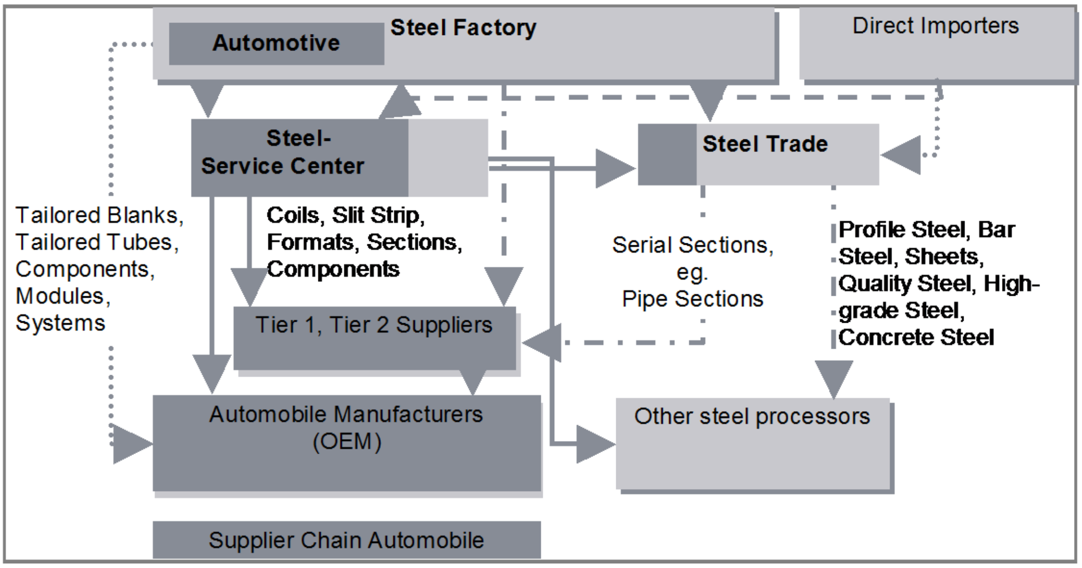
Multimodal transport can take place with regard to rail transport required for steel industry as well as in the area of procurement and distributional logistics. For example, imported coal is transported to the receiving port on bulk carriers and subsequently transported by rail to the steel factories. The multimodal logistics services should also be adopted for the distribution of semi-finished and finished products.

Steel distribution in Europe

The classical market models

Steel distribution takes place mainly in two ways. It can be a direct sale between the producer and the consumer or indirect distribution, in which case a steel trader or service provider is involved (Figure 3). The latter category acts as a marketing agent or assumes a value-adding function, in that they supply to small customers who are quite often unknown to the producers. They customize or in many cases refine the original product according to its further use. Transport and logistics are necessary in both these distributional methods. However, indirect distribution poses greater challenge to the logistical system. Within the German steel market, 30 percent of steel sale is carried out through direct distribution between the producer and the consumer (majority of the automobile industry). The bigger part (in this case, approximately 70 percent) is carried out indirectly through the steel service centres and steel traders. Moreover, two-thirds of the so brokered steel deliveries are stocked and sent later.

Figure 3: Depiction of steel distribution



If this business model could be carried out in India, it would generate an annual storage capacity of up to 70 million tonnes within the steel distribution chain. Further, steel service centres can be set up which could undertake tailoring steel blanks apart from cutting, surface conditioning. Specialized logistics service providers are presently already offering these services and replacing the self-service centres set up by the respective producers.

Consolidation of the steel market and different production networks

Although there are heavy investments in the expansion of crude steel production capacities in India and China, the global steel market is still affected by a large number of participants in the market. Even the merger of Arcelor and Mittal on the one hand and Tata and Corus on the other could not change this. With a production capacity of over 120 million tonnes, Arcelor Mittal is the biggest steel producer in the world. Today, the five biggest global steel producers account for not more than 18 percent of the total global steel production. The multitude of national, regional and multinational steel producers are up against the three major corporate groups providing raw materials, and who contribute up to 80 percent of the global iron ore supply. In order to face the market stronghold of the raw material suppliers, the steel industry will consolidate even further and create its own access to iron ore and coal deposits. In pursuit of this strategy, the expansion of crude steel production will rapidly be relocated to raw material-rich regions. India and Brazil are bound to benefit from this development.

Large producers of steel pose new challenges to the logistics service providers. Steel distribution was predominantly regional for the last few years; the top producers in the meantime diversified their production networks across transactional locations. Thereby, the liquid phase 'upstream' is often separated from the further processed solid phase 'downstream'. Production and further processing capacities are being globally optimized and dedicated. These production networks are thus to be globally supplied and provided with raw materials, semi-finished and finished goods at the appropriate time for the next stage in the value-added chain.

Logistics service providers must, therefore, react distinctly quicker to the demands of the producers and take over the important function of link and buffer. The production of steel with the optimization of raw materials, manpower and energy costs leads to prolongation of order times affecting the delivery schedules. Flat-bar steel for automobile production has an order time of 6 to 8 weeks and an average on-time delivery of less than 40 percent, whereas the automobile industry expects an order cycle of maximum 2 weeks. The high on-time delivery is resulting from the well-known techniques of owing to the known mechanisms of assembly line production (Just in Time/Just in Sequence), and to avoid excess inventories without increase in risk of shortfalls. A balance between both interests and can be worked out with the help of efficient storage and transport logistics.

The multimodal transport concepts, including those of steel storage, comply with this logistics function. Large production batch sizes can leave the production site of the steel manufacturer in block train having capacities of up to 3000 tonnes. At this point, a firm final customer consignment sale is not necessary and hence does not hinder the flow of production. The sale, and with it the determination of the material, can be done later at the time of transport or storage. However, the logistics service provider must process according to the customer specifications and deliver the ordered quantity to the final customer within the agreed timeframe. For this second part of transport, a truck is often chosen because of its high flexibility and distinctly small capacity. The storage and commissioning takes place ideally at the transition point between the two modes of transport, namely, railways and roadways, hence at the multimodal hub.

The renaissance of the rail transport carrier in Europe

A look at the development of the modal split of the railways in the freight transport sector shows a slightly increasing tendency in Germany and Europe towards a definite growth in the goods transport market in the last few years. A number of factors have played an important role in this case. With the ever-progressing internationalization of production and sales markets, more raw materials and semi-finished and finished goods are being transported between the different value-added levels than ever before. In addition, the expansion of the European Union and consequent simplification of transport of goods and services across Europe has been an important factor. After the initial recovery process, production in the economic area of south and southeast Europe is growing. The growth in the transport market and as a consequence thereof of increase in transport services has led to maximum utilization of the infrastructural capacity, which is reflected in the limited availability of wagons and dense truck traffic on the state and national highways.

While in the past, the railways were always considered for bulk goods, trucks were and are a universally preferred mode of transport for short, middle and long distances for all kinds of goods. Owing to the permanent optimization of rail production systems and also owing to the positive signals resulting from the liberalization of the rail freight transport, the railways have made themselves attractive in the last few years. Another important factor favouring railways is increase in energy prices and increasing awareness of sustainability and 'green' products. Railways are definitely superior to trucks when it comes to energy efficiency.

European single wagon carrier as a substitute for heavy goods vehicles

The supply of iron ore, coke and limestone to a steel production plant takes place with the help of railways and inland shipping. However, railway is in direct competition mainly with trucks when it comes to the transportation of products. Thus, the modal share of steel products transported by the railways amounts to approximately 35 percent in Germany and 24 percent in Europe, whereas the share of products transported by trucks amounts to 52 percent and 54 percent respectively. In Germany, approximately two-thirds of the railways are engaged in single wagon traffic. The steel production in Europe almost matches the total demand in the region. However, in Germany, the high-grade steel is produced domestically whereas simpler products such as steel slabs and construction steel are mainly imported from abroad. Owing to the high share of special steel, a small part of the production is transported by air.

A look at the network capacity of railways and roadways in the steel industry (Figures 4 and 5) shows that the region south of the ARA ports (Antwerp, Rotterdam and Amsterdam) and the Rhine-Ruhr region can be designated as the new centre for the European steel transportation. North Italy is an important region of operation for trucks. Transportation of steel slabs, sheets and coils, because of their weight of up to 30 tonnes for one piece, is problematic and tied up with a number of special requirements. Usually, a truck with a maximum payload of approximately 25 tonnes can load only one coil. As such, road transport is uneconomical for middle and long distance stretches. The railways in this case enjoy a distinct advantage. In this age of ever-increasing fuel costs, one can assume that the share of rail transport in the steel industry will go on increasing. The European state railways have a large fleet of special trains for transporting steel at their disposal. DB Schenker offers an alternative to road transport in the form of its single wagon system with its several multimodal freight terminals. Northern Italy especially has become an important destination for cross-docking transportation between rail (transit via the Alps) and the final distribution in the northern Italian industry centres. This is one reason for the success of multimodal logistics park (MMLP) in northern Italy.

Product-oriented wagon technology for efficient loading and unloading of steel products

To compensate for the high flexibility, adequate availability and lower transport price of trucks in Europe, the railways have adjusted their freight wagons to the product specific demands of the industry. Thereby, factors like swift loading and unloading, loading to capacity, and safe handling of material as well as high transport security relevant to the product characteristics have assumed importance. DB Schenker acquired the biggest fleet of covered coil wagons with automatic tie-down. Such a wagon can be loaded with 5 to 7 steel coils within a few minutes and, as such, an additional tie-down is no longer necessary. For tracking and tracing of shipments, information on each goods wagon is provided through a GPS transmitter.

Figure 4: 'Steel' transport through railways goods carrier

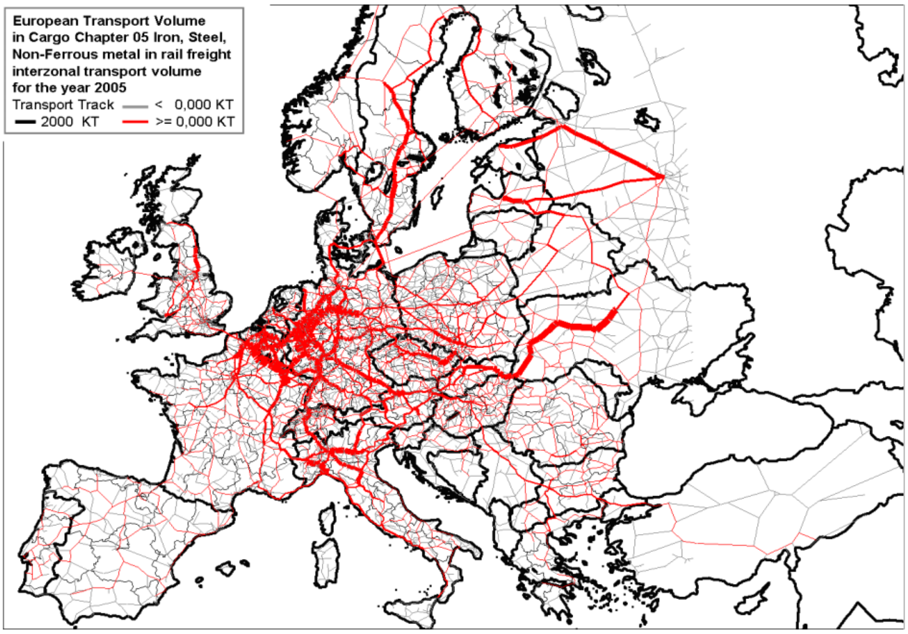


Figure 5: Advent of 'steel' transport on roads goods traffic

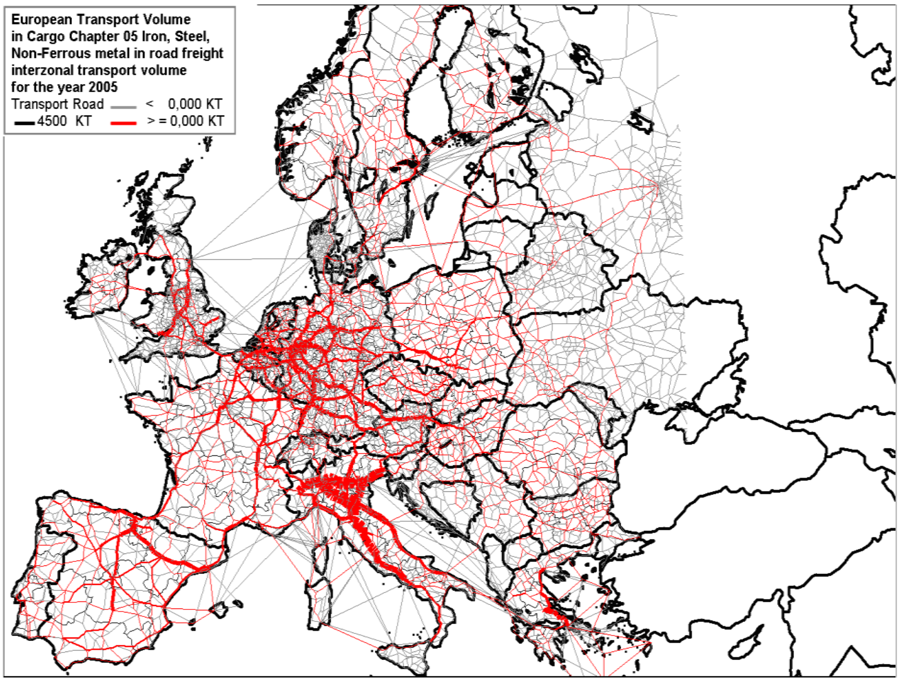


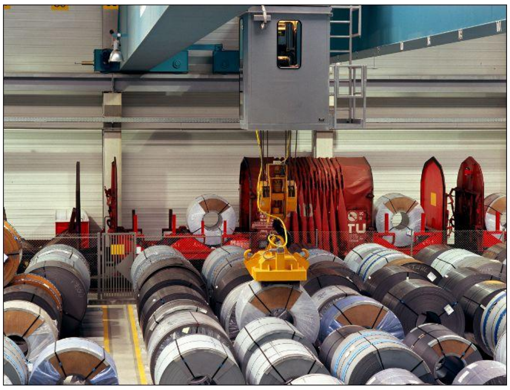
Figure 6: Different customized freight wagons

Similar solutions have been developed for the transport of cut sheet metal boards (Figure 6) known as 'Tailored Blanks', long products such as steel pipes, and very big sheets for the production of parts of ships or large pipes.

Product-oriented storage technology for flat-bar steel products

Today, the flat-bar steel is distributed mostly in the form of coils. It is differentiated between the semi-finished product, the hot rolled coil (HRC), and the finished product, i.e. the cold rolled coil (CRC). Both types of coils are transported and stored in Europe almost exclusively with horizontal coil axles. This conserves the respective outer edges of the steel sheet, although it requires additional safety measures during storage. In addition, cold rolled steel is susceptible to moisture. As such, its handling as well as storage requires protection against inclement weather. To avoid accumulation of condensed water on the steel coils, it is necessary to channel and regulate the air humidity at the storage site. The figure 7 below shows a multimodal steel distribution storage facility from DB Schenker in Hagen, Germany.

Figure 7: Specialized steel storage



Within the storage facility, wagon groups of up to 13 rail cars can be loaded and unloaded simultaneously. A direct transfer between rail and roadways is also possible owing to the overarching crane towers.

This storage facility serves European steel producers as a storage site for deliveries to approximately 100 customers in the radius of about 100 km around the facility. The customers can call up to a batch size of 1 coil of their daily steel demand. A delivery within 24 hours can be guaranteed because of the storage facility's proximity to the consumers. Additional storage of steel coils by the customer is thus no longer necessary. Up to 4 block trains can be loaded and unloaded with steel coils at the storage facility. The facility has distributional performance of up to 90,000 tonnes in a month, which is the equivalent of approximately 4000 outbound truck deliveries.

European multimodal freight terminal concept as a link between rail and road

In these days, transport and logistics services operate on behalf of industrial companies nationally and internationally, in order to make use of existing value added potential. This is largely reflected in trade agreements and consequent reduction or abolition of trade restraints, which have further enabled access to favourable resources of production. As a result, many companies today believe in the division of labour and are internationally oriented.

Development of multimodal freight terminal concept in Europe

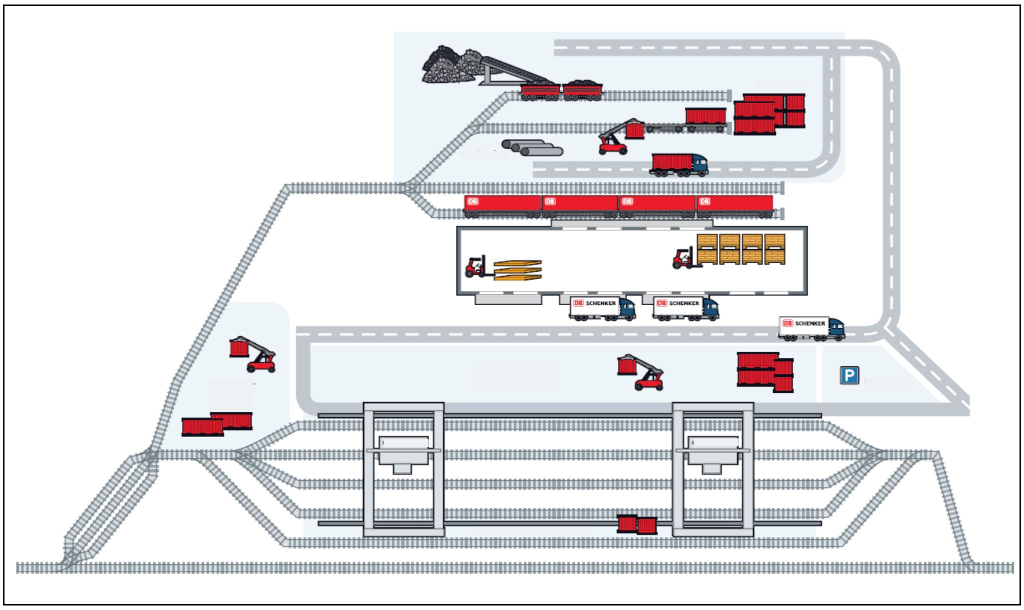
The rising development of the multimodal freight terminal is not the least due to the logistics sector recording a very positive growth worldwide. Growing transport volumes in addition to the increasing transport distances are clear indicators of a value-added process being carried out beyond national boundaries. To add to this development, many European transport and logistics companies are critically involved in this increasingly networked world economy carried forward by global transport channels. However, the competitiveness of the European logistics companies is currently being affected in Europe's domestic market due to increasing toll charges, restrictive driving period regulations, shortage of drivers, ascending fuel costs, traffic jams, as well as by environmental zones, which, in turn, reduce the flexibility and productivity of truck-based transport chains. Furthermore, rising transport costs can be due to the increasing price of mineral oil and insufficient (quantitative and qualitative) infrastructure outside of Europe.

In order to ensure sustainable and sensible division of labour between the European and international level companies needs increasingly efficient and intelligent transport systems which can, to a certain extent, function despite the generally increasing costs. The term "Intelligent Transport System", sums up the various operations and the eventual combination of different transport carriers. True to the motto, "the whole is greater than the sum of the parts", the question to be posed is, whether the bringing together of diverse and until now self-sufficient transport carriers would create a synergy, which will, in turn, be able to adequately compensate for the increasing costs in the transport and logistics sectors.

Salient features of the multimodal freight terminal concept

The DB Schenker multimodal freight terminal concept puts forth an approach to reduce the above-mentioned challenges to the logistics sector and also to facilitate better use of the strengths of the transport carrier. With the inclusion of the rail transport carrier, the concept is able to optimize the existing supply and distribution systems as well as the intermediate factory logistics and the regional storage systems.

Figure 8: Typical configuration of a multimodal freight terminal plant



Multimodal freight terminals are multifunctional logistics centres with good connectivity to rail and road networks, which, in addition to rail/road, storage as well as trucks loading/unloading, when adjusted to the needs of the customer, can provide a multitude of logistical services. Due to the flexible local infrastructure, multimodal freight terminals are constructed to handle different kinds of goods, whether packed or unpacked, solid or liquid, in pallets or loose. For this purpose, appropriate equipment is made available for use according to the respective requirements ranging from reach stackers, forklifts to conveyer belts, earthmovers up to portal cranes for the handling of containers and heavy duty components.

Due to their efficient connectivity to rail and roadways, multimodal freight terminals combine the advantages of railways (mass efficiency), trucks (flexibility) and regional storages (buffering). The multimodal freight terminal concept thus enables prospective customers, with or without their own private sidings, to replace their existing transport services, carried out predominantly/solely through trucks, by logistical concepts, which to a large extent use the environment-friendly railways. In this way, rail and roadways can be combined intelligently and economically to bring about better use of transport capacities.

Multimodal freight terminal as a logistics hub

From the above, it is clear that the multimodal freight terminal acts as a flexible infrastructural interface between the transport carriers – railways and roadways – and, if necessary, waterways. A multimodal freight terminal is always a bimodal or a multimodal hub, which can bundle up mass flows, and buffer and allocate them according to the demand. In this way, one can consolidate large volumes and high frequency truck transport and deliver according to the wishes of the customers, which, in turn, brings about a reduction in the truck traffic and thus has a positive effect on the road infrastructure and on the people living in the vicinity.

Generally, there are the following three ways to integrate multimodal freight terminals with multimodal transport chains:

(i) Use of a connecting rail line according to the shipment. For example, using a big loader as well as a grouping of wagons for a leading share on rail, turnaround of goods at the multimodal freight terminal and distribution of goods according to the consignee through truck follow-up particularly appropriate for the distributional logistics.

(ii) Turnaround of goods according to the shipment on a truck and truck foreruns to the multimodal freight terminal; turnaround of the goods in the multimodal freight terminal as well as setting up of a train; handling from the receiver with railway sidings (particularly appropriate for the supply logistics).

(ii) Combination of (i) and (ii): Twofold forked transport with truck foreruns and follow-ups as well as turnaround of goods in receipt and dispatch multimodal freight terminals, the leading share between the multimodal freight terminals to be of rail.

One thing common to all above three cases is that the main run has to be grouped together and is to be carried out on the railways, whereas the trucks play off their flexibility during foreruns or follow-ups. The multimodal freight terminal itself acts here as a multimodal logistics centre with the function of a hub, since depending on the requirement, one can formulate different relations and they can be carried out by rail or road. In this way, the multimodal freight terminal system demonstrates a close similarity to the 'hub and spoke' system of the piece goods forwarders, because the supply chain between the source (forwarder) and the destination (receiver) is not direct, but regulated from the central bundling point, that is, the multimodal freight terminal.

Possibility to develop efficient customer oriented logistical concepts with the integration of railways

Until now, the advantages of multimodal freight terminals were made clear as regional, efficient bundling points of railway companies connected economically through truck transport to cover wide areas. In addition to that, multimodal freight terminals offer interested customers a number of other possibilities; for example, possibility of outsourcing parts of their own value-added chain.

Due to the possibility of the combination of transport and logistics extended services (so-called value-added services), apart from the transport services, multimodal freight terminals offer the customer an individually contracted logistical solution. Multimodal freight terminals can, in this way, demonstrate themselves in a competitively advantageous position of a unique selling proposition (USP), since some specific services can be offered which can only be copied by the competitors with great difficulty. The palette of offers, which can be developed, can range from supplier management, warehousing with stock-keeping, inventory, customs processing, commissioning to packing until refinement and IT-services. These components can be custom-picked according to the individual needs of the customer and can be incorporated in the multimodal freight terminal complete solutions on the basis of long-term contracts.

The last and important component in a distributional logistics chain is the delivery of the goods 'just-in-time (JIT)', tailored to suit the customer's needs and, if necessary, delivered also in smaller quantities, as part quantities to small scale or medium scale companies. Many customers, forwarders as well as receivers are aware that multimodal freight terminal acts as a regional warehouse and as such they can dispense with their own supply and forwarding warehouses, at least in parts. In such a way, the fixed costs on the customer's side can be reduced to a minimum. Moreover, in this case, it can be demonstrated that the integration of multimodal freight terminals in transport chains is a win-win situation for the transport as well as the logistics sector. It also projects to a prospective customer that transport and production systems can be linked intelligently to exploit the cost potential.

Development of DB Schenker Multimodal Freight Terminals in Italy: A case study

Starting position

An area of growth which was identified by DB Schenker quite early is the management of multimodal transport chains in combination with forwarding and logistical activities. DB Schenker undertook certain steps in this background together with some customers in order to attain volume growth as well as increase in revenue and better performance in goods transport in railway sector. Initially, the Italian transport market came in focus to achieve these objectives. The relative lower capability of the Italian single wagon freight transport in comparison to the road-based transport networks was one of the reasons why Railion – the railway company in the DB Schenker Network – in the year 2004 decided to generate greater quantities of transport inbound and outbound from Italy with the help of independent production structures and across the board functioning transport chains.

The Italian single wagon freight transport does not have the amount of area coverage, which is needed from the forwarding industry locally. It means that a number of industrial customers in Italy do not have or have only a small or insufficient railway siding. Due to these reasons, many German and North European industrial companies make use of trucks merely to procure and distribute goods in Italy.

Development of the multimodal freight terminal concept in Italy

On the basis of this starting situation, the logistical department of Railion decided to take advantage of rail and road transport by combining them together one-to-one as described in the earlier paragraphs. In the case of long stretches, therefore, on the main runs, the transport needs to be carried out with the help of conventional carload (single wagon carrier) on rail. During the follow-up (on the comparatively smaller stretches to reach the end receiver) the transport needs to be carried out with the help of trucks. In this way, it should be possible to gain those quantities which could not be acquired by the railways until now because of the problems of the railway siding on the Italian side of the transport chain. Moreover, the combined transport had not been attractive enough due to some specific reasons, such as sub-optimal terminal infrastructure and absence of block train connections.

Soon after this hurdle was overcome, we came across the next one: it was not easy to convince the customer to change over from a continuous truck transport chain to a so-called one-time switch railway transport chain. In one-time switch, the goods have to be reloaded from the train into the truck. This intermediate reloading which does not occur in the case of truck transport, constitutes a cost factor for DB Schenker and, as such, is a competitive disadvantage against pure road transport. In addition, the customers point out a high risk of damage for the goods which can lead to claims, damage to one's image and eventual loss of customers.

It was thus important to convince some customers, having a basic minimum tonnage per year inbound or outbound from Italy, by giving them a performance catalogue and a marketable offer, that it is possible for Railion to build up an efficient multimodal transport chain on the basis of conventional single wagon transport carriers. It was to be arranged that the customers do not come from the same branch/ industry so that the most diverse unloading, storage and loading technologies would be made necessary. The performance catalogue and the offer to the customer included:

- Ordering the right wagon for the material needed by the respective customer as well as the subsequent transport of wagons with an engine to the nearest yard.
- Calculation of the transport duration in the German single wagon network, in order to get the train from the switching yard nearest to the customer to the one which is in the direction of the multimodal freight terminal.
- Projection of the complete transport time as well as the production process for the transport between the sender and the multimodal freight terminal site in Italy.
- Development of a document of specifications to make a provision for reloading and loading equipment for the storage organization of the multimodal freight terminal, etc. as well as for the establishment of a basic contractual framework with the logistics partners on-site.
- Projection of the total revenue and cost situation with a simultaneous review of the competitor's prices.
- Operative execution of the transactions on-site, including unloading, intermediate storage and loading on to the trucks for delivery.
- Organizing the delivery through trucks to the customer.

Multimodal freight terminal in Castelguelfo

The first trains started running since September 2004 from the new Italian multimodal freight terminal in Castelguelfo near Parma. The trains departed initially thrice a week from Offenburg in Germany and arrived on the following day in Castelguelfo. The trains started in Castelguelfo were made up of single wagon carriers and a set of wagons from different customers from the steel, paper and consumer goods industries. A shuttle connection was started from Offenburg, so that the change, over time, could be brought down to a competitive level. The bottom-line is that through this arrangement, a lasting contribution could be made to the vastly-improved capacity of the Italian single wagon carrier traffic.

The unloading of the received wagons then took place at the Castelguelfo multimodal freight terminal. At this point, one could turn over palleted goods, truck-changing units, and coils as well as numerous other goods – even dumping of goods could be taken care of principally. The delivery of the goods to the customer took place with the help of trucks by road, according to the customer’s wish, either directly after arrival or after being called for, as a whole or in parts. The multimodal freight terminal at Castelguelfo was subsequently used for the northward direction. The reloading of the wagons of the shuttle train on the way back to Germany took place through registration with Railion Italia Services, which, in turn organized the collection of goods from the sender with the help of trucks. The connection of the multimodal freight terminal and shuttle train in Germany was later dissolved and the wagons were embedded into the German single wagon carrier network, through which multimodal freight terminal at Castelguelfo, more or less, got connected to the whole of Germany.

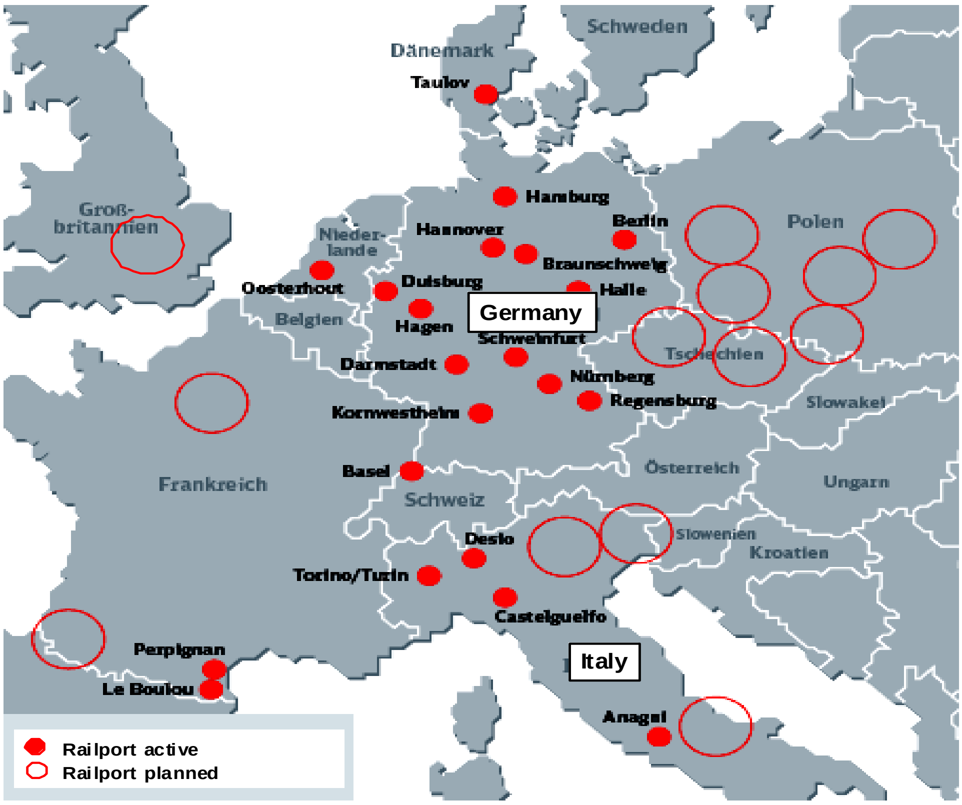
From a very early period, customers used multimodal freight terminal at Castelguelfo as a contracted logistics centre. DB Schenker could solve the following problems for a renowned steel manufacturer: the big coils, the so-called ‘mother coils’ are cut according to the specifications of the customer. The different coil sizes, weights and receivers led to an inefficient use of the goods wagons and a higher loading effort, since customer-specific loading of the wagons was necessary in case of a continuous transport system. With the initial integration of the Castelguelfo multimodal freight terminal into the transport chain, one could simplify the loading process as well as optimize the efficient use of the goods wagons. Now, the loading from the customer took place into wagons, which were loaded with previously sorted out goods directly after production. This reduced the loading effort. Through the mix of heavy and light weight coils for different customers, one could optimize the capacity of the single wagon carrier. The coils were sorted out according to the customer at the Castelguelfo multimodal freight terminal and were subsequently delivered to the end receiver by special trucks.

Growing interest for multimodal freight terminal transport led to a quick demand for an area wide offer in the whole of Europe

The demand for multimodal freight terminal based transport chain became so large within very short time in Italy that DB Schenker was asked to provide for an area-wide multimodal freight terminals. For this reason, two new sites in Italy (Desio and Turin) were integrated into the Europe-wide multimodal freight terminal network in the year 2005. In 2007, the latest multimodal freight terminals were created in Anagni near Rome. In this way, multimodal freight terminals in Italy could acquire new traffic on the railways to the tune of more than 2 million tonnes from customers belonging to the most diverse industrial sectors. It also meant an increase in the shuttle trains running between Germany and Italy from 300 in 2004 to 1,000 in 2007.

Italy in itself is a very great success story. However, a similar picture can be painted for countries in Europe in which DB Schenker multimodal freight terminals were constructed and connected to the German single wagon carrier network (Figure 9).

Figure 9: Medium term expansion options for the DB Schenker multimodal freight terminal network



In this manner, DB Schenker seeks to fulfil the demands and requirements of the international goods flow and its long connected transport ways utilizing appropriate long-range logistical chains and concepts, including infrastructural interfaces between road and rail. The expansion of an area-wide multimodal freight terminal network in Europe is, therefore, a declared goal and will be continuously promoted further.

Outlook: multimodal hubs for steel distribution in India

The Indian domestic demand necessitates new logistical solutions

In the next 12 years, the domestic demand for steel in India will grow to more than 100 million tonnes (IISI Forecast, May 2008) which means that, after China, India will be the second largest growing national steel market globally. The forecasted yearly CAGR is around 10.2 percent. As such, the demand for steel in India in the year 2020 would be 155 million tonnes. The domestic production in the same period would grow to approximately 180 million tonnes. If these scenarios come true, India would be the second largest steel market globally and the demand for transport and logistical services would get tripled. Based on the crude steel production in India in 2020 with a ratio of 1 to 4.5 (production to transport ratio), India would be facing a transport demand of approximately 810 million tonnes within the steel industry (inbound and outbound).

Seventy percent of the demand for steel is concentrated in eastern states steel belt in India, such as Orissa, Jharkhand, Chhattisgarh and West Bengal, while the main steel consumption sector of automobile, construction (infrastructure) and engineering industries will expand towards the commercial centres of NCR, West and South India. As such, steel distribution in India would be posing an enormous challenge. Nearly 120 million tonnes of steel products must be transported from the production region (source) to the consumption sites in Delhi, Pune and Chennai. If the Indian sales market develops similar to the European market models, about 85 million tonnes of steel will be distributed through intermediate service centres, out of which about 55 million tonnes will be actually stored for a period of time, between leaving the factory to final delivery to the end consumer. Presently, less than 20 percent of steel consumers (consignees) possess railway sidings. The steel distribution would therefore have to fulfill the important requirements of transport, storage and handling between the rail and the roadways.

If we achieve an average storage time of about 1 month, this would require a storage capacity of 4.6 million tonnes. The classical storage of flat-bar steel takes place in the so-called coil storages. Here, a capacity of up to 10 tonnes per square meter can be achieved by multi-level storage. This works out to a required stocking area of up to 500,000 m^2, which is equivalent to approximately 90 coil-warehouses of the area of DB Schenker coil distribution warehouse in Hagen (approximately 4,500 m^2 storage space).

Two or more level distribution systems increase the flexibility and service standard for the receiving customer

It has been earlier pointed out that steel production and steel consumption require different production and delivery schedules, which is why a storage facility is necessary to absorb the time gap after the delivery of steel from the manufacturer. Today, such storage function is being carried out almost exclusively by the storage sites of the respective steel producers themselves. This can result in a scenario when Producer A supplies from his storage facility to the sales market, and at the same time producer B holds back his stock. In this way, they represent parallel distribution channels, which depend on the production cycle of the producer (in part, with many steel factories) and therefore cannot be operated at optimized efficiency. On the other hand, shipment quantities from a single source allow for only a single level, and with that relatively small distribution networks which have to often cover greater follow-up distances.

Therefore, logistics service providers and independent steel service centres have taken up both the storage and distribution functions. As independent service providers, these intermediaries provide their services to all steel producers and consumers. In this way, they bring about an increase in the sale quantities and at the same time increase both inbound and outbound quantities. Through the bundling of the storage function with multiple suppliers, construction of storage facilities in low sales regions is also possible, which have to be supplied from the regional central storages according to the demand. In this case, there is a two-level distribution system.

Specialized logistics service providers contribute to increase in efficiency within the logistics system

It seems sensible to construct specialized warehousing facilities for different steel products. Long products require a different loading and unloading technology than what coils and cold rolled steel require (air humidity and cleanliness) or hot-rolled or construction steel may require. Multimodal storage sites with a higher turnover require a different layout from the storage sites for only moving products.

If a steel producer wants to hold every product in every supply region in appropriate storage and with appropriate service, it would lead to increase in storage costs and with that an overall increase in the logistical effort. If it is possible to construct a network of multimodal and producer independent steel logistics facilities in India, with a high-tech know-how, which offer appropriate storage and handling areas for the complete steel industry, it would be possible to increase the percentage of bulk shipments in favour of railways and also to increase the speed and quality of delivery to the final customer. In addition, Indian steel producers could react faster to the changing sales regions while at the same time focusing on their own core competencies of steel production and product development.

According to a globally carried out study by the Boston Consulting Group, the percentage of services provided by logistics service providers globally, will increase from 40 percent in the year 2000 to 90 percent in 2020. The average growth of the Indian steel market in relation to the Indian road transport business will once more give a fillip to the trend of outsourcing and the search for optimized distributional networks.

The introduction of modern information technology to the administration of storage and value-added service sites enables the producer to have a permanent access to inventory and transport data. As such, the allocation of logistical services to a third-party company does not mean information and control loss. Rather, specific IT-expertise often leads to a higher transparency in cost and quality of the ordering customer and thus provides an impetus for a continuous improvement process. In addition, multimodal steel hubs also comply with all the requirements of an environment and resource optimized transport chain. The use of railways for heavy loads across long stretches brings about a clear overall reduction of emissions as compared to trucks. In this way, steel as a raw material for numerous products can also contribute to an improved ecological balance of the respective finished products.

JAWAHARLAL NEHRU PORT: TERMINAL AND TRANSIT INFRASTRUCTURE – A CASE STUDY

Raghu Dayal*

Nearly 20 percent of Indian Railways' freight traffic equivalent to 145 million tonnes originates from or terminates at the gateway ports located on the country's coastline. This traffic is, therefore, of considerable importance for IR and for the economic development of the country, especially the sprawling hinterland.

The British had structured the colonial commerce from hinterland to ports and back. For this, they relied largely on the railways to transport their export-import cargoes. The railway companies had also oriented their networks to serve this trade. The ports and railways thus forged a symbiotic relationship. Most of the ports set up rail terminal facilities of their own within the port premises, comprising a beehive of rail sidings and sorting lines.

The exchange yards provided the interface between the ports and the railways. This arrangement served well in those days of generally low volume sundry traffic carried in four-wheeler rolling stock. Over the years, the traffic streams have undergone a major change, requiring movement of large volumes of cargo between the ports and the hinterland. *Pari passu*, the trainloads have become heavier and most of the traffic is carried over long distances in rake loads.

The transport technology has also undergone a sea-change during the last three decades. With the container becoming a mainstay of transportation across the world, integrated intermodal transportation has assumed great importance. This has necessitated setting up of container terminals both at the ports and their hinterland. Concurrently, railways have also acquired special type of rolling stock to carry the container traffic.

Container handling 'major' ports in India include Jawaharlal Nehru (JNP), Chennai, Tuticorin, Mumbai, Cochin, Kandla, Haldia and Kolkata. In addition, some 'non-major' ports like Mundra and Pipavav, developed in public-private partnership, are also fast emerging as important gateways in this genre. In 2007-08, ports handled 7.463 million TEUs, registering a CAGR of 15 percent since 1993-94. Out of this, the railways carried 2 million TEUs between the ports and the inland container depots (ICDs) in the hinterland, accounting for a share of 27 percent.

JNP has emerged as the most important container handling port in the country. In 2007-08, it handled 4.06 million TEUs. This amounted to a 61 percent share of the total

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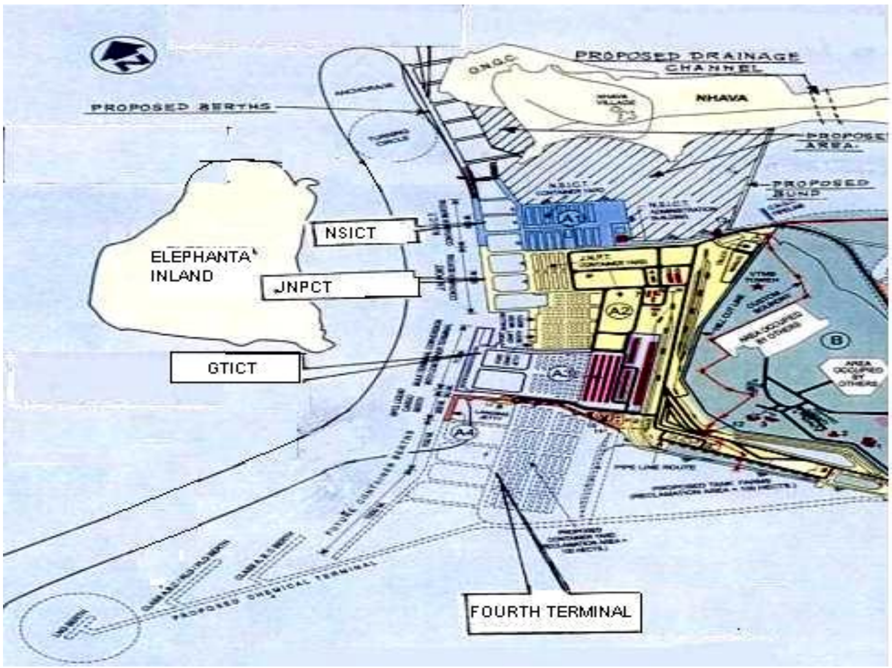
* *Senior Fellow, Asian Institute of Transport Development, New Delhi.*

traffic handled at all the central government-administered ‘major’ ports. Out of this, Indian Railways carried 1.03 million TEUs. This port has, therefore, become an important coastal node for the railways, generating substantial cargo.

Another noticeable feature of JNP is that it is not burdened with its own rail infrastructure inside the port premises unlike the old ports which, as mentioned earlier, developed their captive terminal facility. Indian Railways carries out all rail operations within JNP with their own equipment and staff. As a result, there is no intermediate exchange yard between the port and the railways, thereby making the operations smooth and seamless.

Taking note of the above-mentioned features, a case study of the container handling operations was carried out with a special focus on rail-related terminal and transit facilities at JNP. This was done largely with a view to gleaning lessons for evolving generic applicability guidelines at other existing and upcoming ports of the country. The perspective and the results are presented hereunder.

Figure 1: JNP: Container Terminals



Source: JNPT

JNP has three exclusive container terminals (CTs), namely, Jawaharlal Nehru Port Container Terminal (JNPCT), Nhava Sheva International Container Terminal (NSICT) and Gateway Terminals India Container Terminal (GTICT). A fourth terminal with a much larger capacity is also planned. The table below shows the container-handling infrastructure provided at the existing three container terminals.

Table 1: JNP Container Handling Infrastructure

	JNPCT	NSICT	GTICT
Yard: ha	55	26	29.8
Ground slots: TEU	30,000	6222	5220
Quay length: metre	680	600	712
Quayside gantry	3 x 35.5 t 2 x 50 t	8 x 50 t	8 x 61 t
Rubber-tyred gantry cranes	18 x 40 t	29 x 40 t	29 x 50/61 t
Rail-mounted gantry cranes	1 x 35.5 t 2 x 40 t	3 x 40 t	3 x 61 t
Reach stackers	2 x 45 t	3 x 40 t	4 x 40 t
Top lift trucks	--	2 x 40 t	--
Empty handlers	--	2	2
Tractor-trailers (TT)	98	150	115
Forklifts (small)	10	2	4

Source: Indian Ports Association, JNP Terminals

The following table shows the productivity indices of the three container terminals for the years 2005-06, 2006-07 and 2007-08.

Table 2: JNP: Traffic and Productivity Indices

	2007-08			2006-07			2005-06		
	JNPCT	NSICT	GTICT	JNPCT	NSICT	GTICT	JNPCT	NSICT	GTICT
Import: TEU	618,292	789,930	642,010	643,972	685,914	316,390	653,347	663,519	3,126
Export: TEU	642,631	718,126	648,852	661,097	673,211	317,744	685,635	660,282	794
Total: TEU	1,260,923	1,508,056	1,290,862	1,305,069	1,359,125	634,134	1,338,982	1,323,801	3,920
JNP Overall: TEU	4,059,841			3,298,328			2,666,703		
Berth occupancy: percent	71.61			81.22			90.45		
Berth productivity: moves/hour	54.87			55.16			53.38		
Crane productivity: moves/hour	21.28			20.39			19.27		
Pre-berthing waiting time: hour	11			4.95			6.48		
Average stay at berth: day	0.91			0.89			0.88		
Output: TEU	1,778			1,691			1,609		
Average parcel size: TEU	1,479			1,425			1,301		
ICD TEUs	262,271	445,802	305,259	304,617	367,676	147,021	318,960	362,377	-
ICD TEUs	1,013,332			819,314			681,337		
Trains: No.*	1,908	2,210	2,046	2,081	1,872	952	2,067	2,139	-
Trains JNP overall: No.*	6,164			4,905			4,206		
Share of rail: percent	20.8	29.6	23.6	23.3	27.1	23.2	23.8	27.4	-
Share of rail: JNP overall: percent	24.9			24.8			25.5		

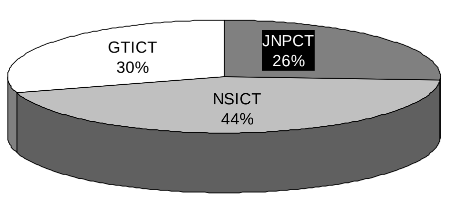
Source: JNPT/ The Link: Special 2008 ** trains in each direction*

It would be noted that there are imbalances in the exports and imports traffic handled at the various terminals. These imbalances get reflected into the composition of the container trains originating from or terminating at numerous inland container depots. The rail share of the port's overall traffic has hovered around 25 percent. Further, the average aggregate load of each rake, for both directions, has varied between 161 and 167 TEUs against the maximum carrying capacity of 180 TEUs.

An anlysis of the terminal-wise container traffic shows that in 2007-08, Nhava Sheva International Container Terminal (NSICT) recorded 44 percent share followed by Gateway Terminals India Container Terminal (GTICT) 30 percent, and Jawaharlal Nehru Port Container Terminal (JNPCT) 26 percent. The table below gives the details, separately for imports and exports traffic.

Table 3: JNP: Rail share of container traffic: 2007-08
Terminal-wise: TEUs: Number

	JNPCT	NSICT	GTICT	Overall
Imports	124,589	263,058	154,053	541,700
Exports	137,824	182,954	147,049	467,827
Total	262,413	446,012	301,102	1,009,527
% Terminal-wise	26%	44%	30%	



Container traffic projections

The national maritime development programme of the Government of India has projected traffic of 20.95 million TEU in the year 2013-14, assuming an annual growth of 18 percent since 2003-04. The share of major ports is expected to be 15.10 million TEU and that of non-major ports 5.85 million TEU. It is worth noting that the non-major ports handled only 0.867 million TEU in 2007-08 (Mundra 0.712 mn TEU, Pipavav 0.155 mn TEU). This shows the growing potential of these ports in the years to come.

Table 4: Container traffic growth

	Traffic in 2003-04	Projected traffic (all ports) 2013-14	Share of 'Major' ports 2013-14
Million tonne	51.00	251.40	181.20
Million TEU	3.90	20.95	15.10

Source: Department of Shipping and Ports

As regards JNP, an integrated capacity assessment model developed by the consultants (KPMG) indicates that the port could achieve a throughput of 10 million TEU in the year 2014-15. The long-term business plan, however, shows a traffic potential of over 25 million TEU in the year 2026-27.

Table 5: Projected traffic potential for JNP

Year	Traffic TEUs: Mn
2007-08	3.77*
2008-09	4.43
2009-10	5.19
2014-15	9.95
2019-20	16.57
2024-25	22.70
2025-26	24.21
2026-27	25.45

Source: KPMG ** Actual: 4.06 mn*

Regarding the rail share of this traffic, a recent study (2007) carried out by RITES of the traffic potential on the dedicated freight corridor (DFC) along the west coast between JNP and Dadri has envisaged JNP to achieve an annual throughput of around 8 million TEU by 2021-22. In view of JNP having already crossed throughput of 4 million TEU in 2007-08, the projections appear to be somewhat conservative. The same study has assumed 35 percent rail share in the port's total container traffic and train composition of 90 TEU each way. Based on these assumptions, a traffic of 48 trains each way per day by 2021-22 has been projected. This number would occasionally increase to 60 trains, taking into account the not-so-unusual factor of seasonal variation. In this regard, it may, however, be noted that with the haulage of double-stack containers, the projected number of trains would get reduced.

Table 6: Estimates of container traffic at JNP: TEUs: '000

	JNPCT	NSICT	GTICT	Terminal-IV (Proposed)	Total
2003-04 (Actuals)	1,038	1,231	-	-	2,269
2006-07	1,308	1,231	400	-	2,939
2011-12	1,801	1,231	1,065	750	4,847
2016-17	2,000	1,231	1,300	2,420	6,951
2021-22	2,000	1,231	1,300	3,500	8,031

Source: RITES (Rail India Technical and Economic Services)

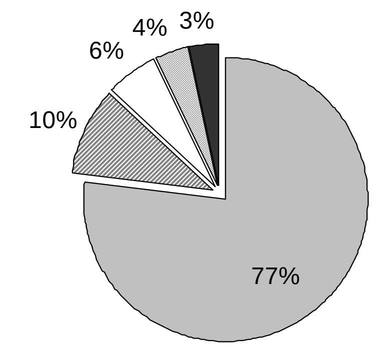
JNP: Losing share of competitive hinterland market

One of the most enduring concepts in transport geography, especially applied to a port, is the hinterland. It refers to the market area of the port, the land areas from which the port draws and distributes traffic. As *The Geography of Transport Systems* (by Jean-Paul Rodrigue, Claude Comtois and Brian Slack) explains, a port sometimes has to reckon with two types of hinterland: (i) "natural or primary hinterland" comprising of the market area for which the port is the closest terminal, and (ii) "competitive hinterland" of the market areas over which the port has to compete with other terminals for business.

In this context, an analysis of the origin-destination (O-D) flows of rail-borne traffic at JNP in 2007-08 shows that this traffic moved on the following four corridors in addition to some of the nodes within the Mumbai area (see Table 7).

Table 7: JNP: Rail share of container traffic: 2007-08
Corridor-wise: TEUs: Number

	Import	Export	Total
Northern corridor	424,169	352,753	776,922
	(78%)	(75%)	(77%)
Northwesten corridor	42,444	59,710	102,154
	(8%)	(13%)	(10%)
Central corridor	27,523	31,049	58,572
	(5%)	(7%)	(6%)
Southcentral corridor	20,002	18,530	38,532
	(4%)	(4%)	(4%)
Mumbai area	27,562	5,785	33,347
	(5%)	(1%)	(3%)



Note: Figures in parentheses indicate percentage share of rail in JNP's total import, export and overall container traffic transportation, respectively (figures rounded).

Northern corridor: J.N. Port-Vasai Road-Pitampur (Indore)-Kota-Tughlakabad-Dadri-Ludhiana (Dhandari Kalan).

North-western corridor: J.N. Port-Vasai Road-Vadodara-Sabarmati (Ahmedabad)-Mehsana-Palanpur-Jodhpur-Jaipur-Rewari.

Central corridor: J.N. Port-Manmad-Aurangabad-Bhusawal-Wardha-Nagpur-Raipur.

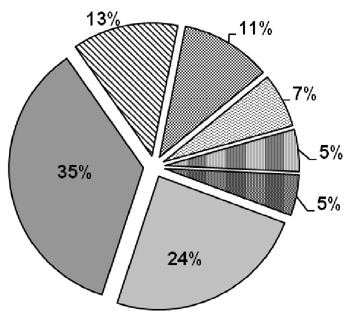
South-central corridor: J.N. Port-Pune-Miraj-Sholapur-Wadi-Hyderabad.

What is of particular interest is that the Northern and Northwestern corridors together accounted for a share of 87 percent. Out of this, the Northern corridor alone had accounted for an overwhelming share of 77 percent. With the steady expansion of Gujarat coast ports and the construction of DFC (W), it is the traffic stream on these two corridors that is expected to appreciably shift away from JNP. JNP will, however, have increasing volumes to handle from the hinterland comprising of the Mumbai area, also along the Central and Southcentral corridors, besides some of the inland nodes on the Northern corridor.

Like a mirror image of the predominant share of Northern and Northwestern corridors in rail-borne container traffic from and to JNP, the following table shows that the six ICDs, all along these two corridors, except the one at Nagpur on the central corridor, account for three-fourths of these traffic streams. In the years to come, as the flow from and to JNP along the DFC(W) would diminish, linkages with ICDs in the hinterland in Central and South-central parts of the country as also in the Mumbai metropolitan areas will be transformed. Some new inland nodes will, in all likelihood, come up and some of the existing ones will need to be expanded.

Table 8: JNP: Rail share of container traffic: 2007-08
Principal ICD-wise

	Total rail-carried: TEUs: number	Share for ICD in total JNP's rail-borne traffic: percentage
Tughlakabad	356,695	35
Dadri	128,972	13
Dhandari Kalan	110,274	11
Sabarmati	66,420	7
Nagpur	51,663	5
Loni	50,140	5
Total of six ICDs	764,164	76
Others	245,363	24



Source: JNP data analyzed

Over the long term, western region is expected to serve as a captive market for JNP due to its proximity. An SEZ planned near JNP will also generate captive traffic for it. It would thus continue to garner a major share of traffic in Maharashtra while its share from adjoining regions, such as Gujarat, gets reduced substantially. The changing potential is shown in Table 9.

New ports such as Pipavav and Mundra in Gujarat, Rewas and Dighi in Maharashtra are likely to wean away a share of the cargo from JNP due to lower cost of rail transportation. Table 10 overleaf gives the comparative data for different destinations.

Table 9: JNP's traffic potential

State	Percent of current traffic of the region coming to JNP	Percent of future traffic of the region coming to JNP
Maharashtra	90	80
Uttar Pradesh	80	40
Uttaranchal	80	40
Delhi	75	40
Punjab	80	40
Andhra Pradesh	10	5
Karnataka	37	5
Gujarat	60	10
Madhya Pradesh	60	40
Others	15.20	15

Source: KPMG

Table 10: Average cost per TEU for using DFC along the Dadri-Ahmedabad-JNP route*

Port	Destination	Average distance (km)	Average cost per TEU
JNP/Mumbai	Tughlakabad/Dadri	1300	Rs. 8,457
JNP/Mumbai	Sabarmati (Ahmedabad)	500	Rs. 2,450
Pipavav/Mundra/Kandla	Delhi region	800	Rs. 5,387
Pipavav/Mundra/Kandla	Sabarmati (Ahmedabad)	200	Rs. 1,462

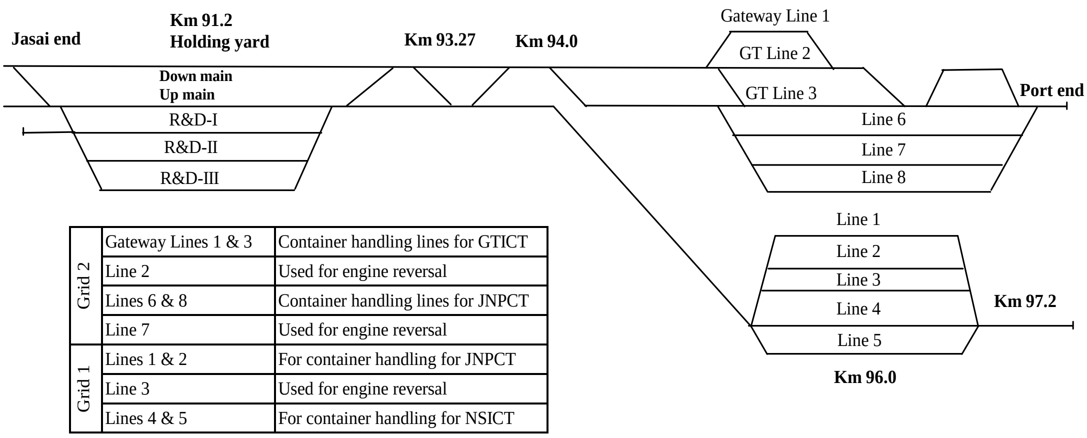
Source: KPMG ** Costs based on apportionment of distance*

Rail connectivity

JN Port is connected to IR's nation-wide network through a lead line connecting the port with its serving station Jasai. Jasai itself is located on the Panvel-Uran branch line section of Mumbai Division, Central Railway, at a distance of 9 km from the port. Panvel, a trijunction at km 68.13, forks out to three directions: (i) Panvel-Jasai-JNP; (ii) Panvel-Karjat-Kalyan or Pune onward; and (iii) Panvel-Roha onward to Konkan Railway. Panvel is thus linked to Roha on Konkan Railway; Diva on Central Railway; and Vasai on Western Railway. There is an intermediate holding yard between Jasai and JNP.

Jasai: The Jasai Chirle marshalling yard is located at km 84 from Mumbai CST (Chhatrapati Shivaji Terminal, earlier known as Victoria Terminal). The take-off point for Jasai lies on the Panvel-Uran freight line. This yard deals with all traffic to and from J.N. Port and the Indian Oil Tankfarm Ltd. Operations in Jasai yard are controlled by two route relay cabins 'A' & 'B'; movement of trains at the Panvel end is controlled by Cabin 'A', and at the JNP end by Cabin 'B', located at km 84.9.

Figure 2: JN Port ICD: Rail infrastructure



Holding Yard: The Holding Yard is located at km 91.75 between Jasai and JNP. It has three lines for common reception and dispatch of trains. The yard is used for holding back and regulating traffic in the event of congestion at JNP or at Jasai. The Holding Yard constitutes a block station and trains between the Holding Yard and Jasai or JNP are worked through line clear arrangements under Absolute Block System.

Rail infrastructure inside JNP: There are a total of 11 full length railway lines serving the three container terminals, viz., JNPCT, NSICT, and GTICT. These terminals share the following rail infrastructure, termed as the *port ICD*. This ICD has two grids. Grid 1 comprises five lines (1 to 5) assigned between JNPCT and NSICT. Grid 2 comprises six lines assigned between GTICT and JNPCT. JNPCT has thus lines assigned in both the grids.

Grid-I

(a) Lines 1 and 2 are assigned to JNPCT

(b) Line 3 serves as engine run-round line.

(c) Lines 4 and 5 are assigned to NSICT.

- Lines 1 and 2 (CSR 700 m) are straddled by rail-mounted gantry cranes (RMGCs) which are unable to perform lift-on and lift-off operations outside their portals for want of extended cantilevers. The span within the crane portals provides a path for road vehicles as well as space for under-the-gantry stacking, to be used for grounding of containers. Under-the-gantry stacking is generally avoided, to minimise the number of crane operations.
- Lines 4 and 5 (CSR 700 m), assigned for the captive use of NSICT are straddled by three RMGCs, which have cantilever extension on either side, enabling them to perform lift-on and lift-off operations outside their portals. Space for four rows of containers stacked under the crane portals and another three rows alongside has been provided, enabling the terminal to hold about 1,500 TEUs.

Grid-II

(a) GT Lines 1 and 3 are assigned to GTICT.

(b) GT Line 2 serves as the engine run-round line.

(c) Lines 6 and 8 are assigned to JNPCT.

(d) Line 7 is used as engine run-round line.

GT Lines 1 and 3 are straddled by three RMGCs, which have cantilever extension on either side, enabling them to perform lift-on and lift-off operations outside their portals. These lines have gantry container stacking facilities.

Similarly, lines 6 and 8 assigned to JNPCT are straddled by three RMGCs, which have cantilever extension on either side, enabling them to perform lift-on and lift-off operations outside their portals. These lines have gantry container stacking facilities.

Train operation

IR provides fixed rail infrastructure of track, motive power and train crew, and operates the trains to and from JNP, maintaining a skeleton complement of staff responsible for ensuring safe receipt/dispatch of container trains at/from the port. The container terminal operator (TO) on whose rail track a train is received unloads its own containers and advises the other terminals to arrange TTs (tractor trailers) to clear theirs.

Need for new initiatives

As the port scales up its annual throughput target to a level of 10 mn TEU, IR will have to streamline operations and provide the necessary facilities in addition to building new capacity. Some of the measures that would help to improve efficiency and productivity are discussed below:

Streamlining change of traction and crew: The section between Jasai and the port is not electrified. Hence, diesel traction has to be used on this territory. The change of traction takes place at Jasai. The diesel crew is, however, based at Panvel. The train examination facilities are available at Jasai. The integration of these two operations thus becomes a critical factor. It is suggested that, in the long-term, the Holding Yard should be developed as the nucleus for container train operations. This would require extension of electrification up to the Holding Yard as also development of ancillary operational facilities.

The preliminary study of the dedicated freight corridor envisages the Holding Yard to be the take-off point, with an independent double-track link, bypassing Jasai, Panvel as well as Diva stations. Thus, the Holding Yard would become an operationally important location for serving JNP traffic. This would involve development of additional lines and related facilities for train operation.

Extending the double track: A double line is used for train operations through Panvel and Jasai up to the port approach at km 93.4, a little beyond the Holding Yard, from where a single line branches off to different port terminals. In order to facilitate simultaneous reception and dispatch of container trains by the different terminals and minimize idling of ICD lines between successive trains, feeder track may be doubled up to the entry point of container terminals with a provision for separate entrance to, and exit from, the port.

Independent entry/exit: In the long run, when the fourth container terminal becomes operational, it would be advisable to build an independent line between the Holding

Yard and the new terminal. This is justified as the number of trains handled at this terminal would be almost equal to that of the three existing terminals put together.

Train fitness examination: The rail-borne containers are carried on flat cars (BLCA) in rake formations. Each rake consists of 45 flat cars and is generally confined to specified circuits. The brake power certificate for such rakes is issued for journeys up to 9000 km. In case the rakes are switched over due to operational exigencies, these are subjected to intensive carriage and wagon examination at Jasai yard on return from the port. Such examination leads to the train being held up for up to 8 hours. Freeing of container trains of their circuit bondage, which is often an operational necessity, will reduce the need for C&W examination at Jasai and the consequent detention.

Doing away with brake van: Without waiting for experimentation of operating trains without brake vans as recommended by the Japanese team for the dedicated freight corridors, IR may well begin with running the container trains without brake vans, in order to reduce time taken for reversing the brake van for trains handled at JNP.

Timely availability of train consist: It is necessary that a full train plan data, with all requisite details, on the lines of the manifest sent to ports by the shipping lines/vessels, is transmitted from the train originating point to its destination for advanced operational planning to be done at the receiving terminal well ahead of its arrival. An integrated EDI network is at any rate an essential operational requirement in modern day trade and logistics transactions worldwide.

Moving boxes directly from quay: Presently, containers unloaded from the vessels are first taken to the container yard, where these are collected for despatch by rail or for haulage by road to container freight stations and inland container depots. The containers, requiring rail transportation, are later moved to rail handling yard for loading on the container flats. The feasibility of direct evacuation of containers from the quay to eliminate intermediate handling needs to be examined by the Customs and other relevant agencies. This would help to reduce the dwell time of the containers as also minimize handling costs.

Improved housekeeping: High dwell time of import containers at the port has been a matter of serious concern. Many vessels in such situations are unable to complete their import discharge cycle within the stipulated time, leaving behind some of the export loadings, thus resulting in shut-outs. The built-up inventory within the port erodes its productivity. Some of the suggestions for mitigation made from time to time include: the empty containers be moved out of the port by the shipping lines; customs may disallow 'not-ready' containers entering the port as they occupy space, awaiting necessary clearances, and thus block other containers from CFSs, which are ready to load, from coming in to the port.

Multiple terminals and train loads: With multiple inland and port container terminals, problem of 'mixed' trains, i.e., a single train carrying containers for different terminals has cropped up. A mixed train received at a terminal carries containers belonging to the other terminals also, which need to be lifted-off and stacked under the gantry, for the owning terminal operator (TO) to remove them at the earliest. Similarly, for loading of a mixed train, the other TOs send the containers after the incoming train's placement.

Table 11: Trains handled by JNPCT and NSICT (2003-04)

Terminal	Dedicated trains	Mixed trains	Total trains	Percent share	
				Dedicated	Mixed
JNPCT	1051 (44.92)	892 (64.87)	1,943	54.09	45.91
NSICT	1289 (55.08)	483 (35.13)	1,772	72.74	27.26
Total	2,340	1,375	3,715	62.99	37.01

Figures in parentheses indicate percentage share in individual category. *Source: RITES*

A study of the container trains handled at JNP for the year 2003-04 showed that 37 percent of the trains carrying containers for JNPCT and NSICT (third container terminal came later) carried mixed traffic. Of these, 65 percent were dealt with by JNPCT and 35 percent by NSICT. Average detention time ranged between 8 and 10 hours per train. In case of non-mixed trains, the detention time was less by as much as 2 hours. The position, with regard to the mixed trains, has, however, since improved. Currently, about 25 percent of incoming trains and 12 percent of trains dispatched from the container terminals are mixed as against 37 percent in 2003-04.

To overcome the problem, the terminal operators have introduced a system of inter-terminal handling of mixed trains. The respective operators deal with the mixed containers and an additional charge is levied for this purpose. This system has its hiccups and the additional charge is resented. The long-term solution, therefore, lies in the deployment of a common operator. This change would also ensure segregation of quayside operations from railside operations.

An often suggested solution to deal with the problem of mixed trains at JNP and such other ports is the development of sorting yards within or outside the port premises. Recent studies carried out in this regard have, however, ruled out this suggestion on techno-economic considerations as well as the non-availability of land. Therefore, as mentioned above, the way out is to go in for a common operator.

Terminal efficiency: The efficiency of a terminal determines the free flow of train movements both inward and outward. It is often seen that limited availability of equipment like tractor trailer slows down the loading and unloading operations. Liberal provision of such equipment would help to boost the operational efficiency through the entire chain. It has to be realized that the terminal infrastructure requires land. Since land is a costly and scarce resource, all efforts need to be made to maximize the output from it.

Conclusion

Though most of the observations made above are specifically related to JNP, the case study has helped to derive some important lessons which lend themselves for generic application to terminal arrangements in the ports in general.

1. The traditional concept of an exchange yard within a port system for handling rail-borne traffic is anachronistic. Trains carrying cargo to and from a gateway port should be operated analogous to the IR's 'engine-on-load' system in which case all operations are carried out by IR with their own equipment and staff.
2. For the development of basic rail infrastructure and further additions and changes in the layout that may become necessary, a long-term perspective plan be kept in view and adequate scope for expansion provided for.
3. In the context of rising volumes of traffic and potential for growth, as exemplified in JNP, the following facilities for efficient operations should be considered/provided:
   - Electrification of tracks right up to the sidings and working areas inside the port so as to let trains roll in within the port premises without change of traction.
   - Sidings and other work areas in a port where loading/unloading operations are conducted, including of containers, tracks may be top-wired or overhead catenary slewed according to requirements and feasibility.
   - For handling large volumes expeditiously and efficiently, entry and exit of trains into, or out of, a port would need to be segregated by providing separate lines for incoming and outgoing trains.
   - Layout may preferably be based on the principle of a loop or balloon for smooth and uninterrupted operations inside the port terminal.
   - Layout of rail lines and different clusters/grids serving specific streams of traffic in the port should provide for intra-grid and inter-cluster operations to be managed without hindering normal operations or conflicting movements.
   - A common operator should be employed to carry out the loading/unloading operations at different container terminals.
   - Smooth and efficient train as well as shunting operations in the port area be facilitated by the installation of a state-of-the-art signalling and communication system.
   - Provision of EDI network with integrated compatible platforms among different operators and stakeholders.