

4.

# INTEGRATED TRANSPORT: STRATEGY AND LOGISTICS



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# 4. INTEGRATED TRANSPORT: STRATEGY AND LOGISTICS

The Committee aims to design a transport system—a network of networks—that permits the greatest choice at the lowest resource cost; one that is safe, efficient, effective, and is reflective of the net economic, social and environmental costs of service provision.

How do we get there? How does India deliver on a transportation system that meets the national purpose? What sets of strategies must be deployed? In this chapter, the Committee proposes an integrated approach to devising strategy for investment in transport infrastructure and service delivery. The approach is motivated by the view that transport—especially of a freighted good—is firmly integrated within the value proposition of the good; the contemporary supply chains and those of the future render them inseparable from any other production input. The perspective taken in this chapter is that it is modern transport practices that create and shape the market for many goods in today's globalised and integrated world. Consequently, this integrated approach to transport planning advocates considerations that go beyond ensuring the availability of a variety of transport modes and beyond accommodating easy intermodal transfers of passengers and freight, though these are important in their own right.

Instead, the integrated philosophy is about more than the simpler choices over intermodal transport that it is sometimes confused with. Choices within each transport mode—intra-modal or trans-modal

choices—are also brought to the forefront of the planning exercise. The argument over the allocation of funds to road and rail is not limited to road and rail, but also includes deliberation on the minute detail of freight and passenger rail transport, to the economics of commercial and passenger vehicles on the roads, to the resource cost of freight transported via dedicated tractor-trailers versus generic bulk cargo trucks, to desired substitution from these modes to air and marine shipping, and to how all of these fit together. In short, the integrated approach to transport strategy considers the universe of transport modes, and in setting out choices between the modes, also considers choices to be made within the modes, and choices over the complementarity of modes. The philosophy emphasises both bottom-up as well as top-down thinking on transport to arrive at a desired complete and internally consistent strategy, and one that is best suited to deliver the holistic transport network described in Chapter 2, Volume II.

This chapter is divided into two halves. The remainder of this section sets out the theoretical foundations of the integrated approach, together with some India-specific observations. The second half then provides an extended look at transport logistics in

Longer-term intergenerational transport infrastructure planning seeks to identify the deep secular, or structural, influences on the local and global economies in the early stages of their development, and tailor comprehensive development plans consistent with the resultant and desired traffic patterns.

India, and the benefit that this sector could draw from integrated transport planning. The purpose is both to consider the state of the industry domestically and around the world (an important topic for this Committee in its own right), and also to provide an illustration of the benefits that modern integrated transport strategy can bestow on the sector. The bulk of this second section is a discussion on the practical methods for planning efficient intermodal transport. Though the working example in this chapter is limited to the freight-carriage and logistics industries, there is no reason that similar thinking cannot be brought to bear on planning for all users of transport services.

## THREE APPROACHES TO TRANSPORT STRATEGY

### THE BOTTOM-UP APPROACH

For some politicians, policymakers, planners and administrators, identifying suitable transport investments will be motivated by an attempt to concentrate their spending focus over a defined period. For example, a civic agency or local government might reasonably proclaim 'bus rapid transit' (BRT) or 'rural connectivity' as their infrastructure development theme over the 12<sup>th</sup> Five Year Plan. Equally, political exigencies could favour the development of National Highways as the masthead road-building theme for one plan, and rural roads for another.

These 'bottom-up' investment themes certainly serve their purpose as short-term spending foci or as tools for communicating strategy, but they leave much to be desired in helping decide on the strategy itself. What are the macroscopic reasons for choosing one investment plan over another? What makes the various elements of an investment plan fit, such that, taken as a whole, the desired outcomes will be achieved? In effect, these bottom-up themes reflect project-centric, rather than network-centric, thinking. These projects are decision outputs, rather than the required inputs into the infrastructure investment decision framework. And even as outputs, they are not quite useful as they distract attention from what is really important: the outcomes. Will the transport system cater to projected traffic demand?

1. Chapter 8, Volume II on Transportation of Energy Commodities.

What systematic reforms will be required to contribute to accessibility, mobility and connectedness? Will people and goods be able to move seamlessly from one transport mode to another? Will the system account for and be robust to structural, social, demographic, economic and environmental factors? In short, bottom-up, project-based thinking does not begin to answer the strategic questions on transport networks that governments and investment planners are really interested in.

However, the bottom-up approach is nonetheless the tool that is commonly used at present for determining many of the key ingredients that the strategy will ultimately rest on. As discussed later, these include traffic flows, projected demands for transport services and cost structures of alternative service delivery mechanisms for a given transport mode.

### THE TOP-DOWN APPROACH

Other agencies and ministries might prefer a more top-down approach beginning with the identification of the important economic, geographic, demographic or industrial elements of the Indian or global socio-economic environment and the resultant impact on transport demand and supply. For example, an inescapable conclusion of the desired growth path for the Indian economy over the next 20 years is the requirement for more coal-fired thermal power plants<sup>1</sup>. This argues strongly in favour of improvements in the carrying capacity of railways for bulk coal and investment in ship-to-train connectivity to allow better movement of imported coal. This top-down perspective is considerably more macroscopic than the bottom-up view. However, even this 'bigger picture' is not quite big enough. The major shortcoming of this approach is that the successful identification of a macroscopic theme to motivate infrastructure development can be undone by shoddy project selection; or worse, by incomplete project selection. To continue the example above: suppose that the 'coal' motivator for a certain transport strategy is taken to hold support only for projects that boost rail capacity. Improvements in the intermodal connectivity at ports, which would be essential for efficient distribution of imported coal, are then neglected.

### THE THIRD PERSPECTIVE: THE DRIVER OF INTEGRATED TRANSPORT PLANNING

The bottom-up and top-down approaches are better suited to planning for the short- and medium-terms. For long-term, intergenerational planning for transport infrastructure, a longer-term view on the local and global environment is necessary. In this worldview, strategies determined by booming economic sectors, modish financial ideas, latest technological developments, or 'hot' geographic regions are largely redundant. This perspective argues not so much for

the picking of fair winds in one economic sector or transport mode, but for preparedness for wholesale changes to the national climate along all dimensions: demographic, social, economic, technological and environmental. In short, it seeks to identify the deep secular, or structural, influences on the local and global economies in the early stages of their development, and to then tailor comprehensive infrastructure development plans consistent with the resultant and desired traffic patterns.

Returning to the example, this third perspective turns the concept of the drivers of transport strategy on its head. Coal, or even thermal power, is not the theme. Rather, the secular trends are the industrialisation and urbanisation of the Indian economy over the coming decades, and investment for the transport of coal to generate power is only one infrastructure idea that stems from these. Industrialisation and urbanisation have such far-reaching effects that a more expansive and crucially, internally consistent infrastructure investment plan is called for. The urbanisation driver will certainly provide justification for boosting investment in the rail transport of bulk goods such as coal, but it will also support the case for better urban roads and mass rapid transit. It may call for the rebalancing of long-distance rail services away from passenger services towards freight services<sup>2</sup>. Similarly, an explicit acknowledgment of the role that transport must play in the government's distribution and development policies a theme likely to persist in India for some time can prove more fruitful than an ad hoc 'system' of opaquely redistributive taxes and subsidies that distort the transportation markets.

Thinking about these long-term influences on the transport market also helps in devising much-needed prioritisation frameworks for transport investment. Together, these individual infrastructure ideas that are each grounded in urbanisation or distribution or another theme will provide complete investment plans—i.e., integrated strategies—that address the goal noted at the start of this chapter: infrastructure that supports the desired pace of India's socio-economic transition at the lowest resource cost.

The defining attributes of these 'third'-perspective themes which will guide integrated transport planning are their long-term and largely irreversible nature; their far-reaching, game-changing effects on the economy; their indifference to business cycles; and their relative immunity to financial and economic shocks. Note that these are characteristics of the driving forces that underpin the strategy, and not of the components of the resulting investment plans.

Picking overarching future trends is as much art as science, based on divining relationships in patchy data, and extrapolating from that scant information, with fingers firmly crossed.

The challenges to using these long-term themes to motivate and shape infrastructure investment plans are several and severe. To define a fundamental driver requires the accurate and timely identification of structural trends that will persist for a substantial period. History is littered with bold predictions that never came to pass or were measurably less bold than their sponsors had anticipated. This is not unreasonable. Picking overarching new trends for the future is as much art as science, based as it is on divining relationships in patchy data, extrapolating from the same scant information set, and making assumptions about the future states of the world, all with fingers firmly crossed.

To repeat a point made elsewhere in this report, there is important endogeneity in devising long-term plans and the resulting infrastructure. Trends are vulnerable to the response they inspire. For example, the suburbanisation (as opposed to the urbanisation) of American cities was a major long-term trend observed in the post-war years, with important implications for transport infrastructure and policy. The policy response was to make it easier for people to commute from suburban homes to downtown city centres by building more and better roads, and pricing fuel below social costs. However, the resulting environmental pollution, sub-optimal landuse, increased commuting times, thinning of group social capital, and general urban degradation has meant that the factors supporting the suburbanisation theme have reversed, and many American cities have seen a rebirth in the vitality of the downtown. Against these challenges are indisputable benefits. Infrastructure development plans that are the outcome of integrated strategies are more likely to be complete, consistent and robust, as the next sub-section shows.

## THE THEORY OF THE INTEGRATED APPROACH

The Committee has adopted the classical view that the demand for transport services is derived from the demand for other goods and services. This is to say that without the existence of goods that are produced and consumed in different locations, there is no requirement for transport<sup>3</sup>. There must be both functional complementarity in that viable demand

2. Note that the emphasis is on rebalancing away from passenger services and towards freight services; growth in passenger services can still be commensurate with the fundamental drivers of demand. The integrated approach yields this kind of useful prioritisation.

3. It is most convenient to frame this discussion in the context of the movement of freightable goods. Logically isomorphic constructions can be made for the movement of passengers, but at the cost of substantial linguistic calisthenics. For example, one may argue that services rendered by the employees of a firm are 'produced' at their residences, but 'consumed' at their workplaces, thereby giving rise to the necessity for the daily commute. To avoid these awkward constructions, and in keeping with logistics as the focal example in this chapter, the remainder of this discussion proceeds by considering the movement of goods only.

4. Rodrigue (2006).

and supply relationships exist, as well as spatial complementarity in that the demand and supply must originate at different geographical locations<sup>4</sup>. For example, raw materials must be sourced from location A, manufacture takes place at B, packaging at C, distribution at D, consumption at E, and waste disposal at F. In this manner, transportation services supply the missing link that allow the match of the demand for and supply of a good.

The derived demands for transportation can be further decomposed into those that are direct and indirect, with the former referring to those for the

There must be both functional complementarity in that viable demand-supply relationships exist, as well as spatial complementarity in that demand and supply originate at different geographical locations. Transportation services supply the missing link that allow the match of the demand for and supply of a good.

transportation services themselves. However, the supply of transportation also generates the demand for other goods, such as for fuels that must be moved to the point of consumption, and for warehousing along various intermediate and terminal points of the supply chain. These second-order demands are the indirect consequences of the demand for the actual utility-providing good.

This classically obvious understanding of transport demand underpins much development of strategy and investment plans,

and is fit-for-purpose. However, an alternative view that subsumes transportation into the supply-demand nexus—by rendering it an integral part of the manufacturing and consumption processes—provides useful theoretical basis for an integrated strategy for planning transport. This alternative view can be justified on the following grounds, and is especially pertinent when considering topics in logistics and freight movement<sup>5</sup>.

The first argument reverses the link between the demand for a good and its transport. Under the traditional view, as noted earlier, the demand for a good gives rise to the demand for transport services. As scale expands, as more goods of a particular type and of several different types are transported, natural high-volume transit corridors develop between pairs of geographic nodes. Further, these nodes serve as hubs distributing to spokes, as warehousing junctions, and as interchanges allowing for the selec-

tion of the most efficient transport mode and gauge for each leg of the journey. As the transport system achieves scale economies and becomes more sophisticated, a definitive topography begins to take shape. Transport modes and processes are standardised—containerisation is a classic example—expanding supply chain capacities. In turn, these standardisations and efficiencies reduce costs, thereby making it feasible to transport other goods for which the freight was hitherto prohibitive. The net result is that it is the sophisticated freight and logistics network itself that creates the market for other goods, an upending of the traditional view.

The derived-demand perspective on transport essentially concludes that transportation costs are exogenous to manufacturing and consumption. A second argument against this view is that contemporary transport processes de-emphasise the costly maintenance of inventory in favour of tighter supply chains that synchronise raw material collection, manufacture, packaging, bundling and unbundling, distribution, and retail. Transportation thus becomes an intrinsic part of this modern system for supplying a market<sup>6</sup>. Specifically, this transportation is specialised enough to be called logistics, a term that has its origins in the military as the careful management of supply routes to a battlefield and associated processes. Firms that specialise in logistics are also beginning to blur the lines between transporter, transport arranger, and even manufacturer. These so-called third- and fourth-party logistics providers assume responsibility for the supply chain for a particular product to varying degrees. Fourth-party providers also then provide a host of auxiliary services that become an essential part of the product offering<sup>7</sup>. In this manner, transport is no longer an exogenous cost, and is no longer a service derived from the demand for another good, but is an embedded part of both that good's supply chain and its value proposition.

The third argument stems from the observation that an increasing number of logistics services are provided by integrated providers. Previously, separate agencies and enterprises would have been responsible for customs clearances, quarantine inspections, freight forwarding, trucking, shipping and final delivery, with delays and costs imposed by administrative and intermodal considerations. Industry consolidation, more flexible regulation, and technology have each combined to yield entities that anticipate and regulate the flows of freight. These integrators do not plan activities in response to a derived demand, but with respect to shaping and being shaped by customers' supply chain<sup>8</sup>.

5. Rodrigue (2006) and Rodrigue (2011). This alternative view that argues against considering transportation as a derived demand is more difficult to motivate for passenger transport.  
 6. The advantages of such a demand-driven system are 'higher inventory turnovers, better customer service, as well as increased labour productivity and capacity utilisation which should transcribe in higher incomes, returns and lower operating expenses'. Rodrigue (2006, 2011: 1455), citing Lee (2003).  
 7. For example, UPS, the second-largest parcel carrier in the United States, not only delivers Toshiba laptops throughout the country, but is also responsible for after-sales customer service, for collection of faulty product, and for its eventual return and repair.  
 8. Rodrigue (2006).

## Box 4.1 Integrated Transport Networks

Historically, the coastal regions have benefited the most from economic growth and prosperity. The development levels invariably decline in areas further away from the coastline. Inadequate connections often make inland locations less competitive. Development of integrated transport networks would provide improved access to inland areas and spread the benefits of economic growth.

Development of growth centres away from the coastal areas is equally essential. Establishing dry ports in inland locations can stimulate this process. These ports would create the opportunity for the same economic stimulus seen at seaports. They would allow shippers to undertake consolidation and distribution activities as well as complete export/import procedures at inland locations that are at relatively short distances from farms and factories.

Source: Asian Institute of Transport Development: Regional Seminar on Intermodal Logistics, 2007.

Fourth, just as the industry has consolidated, so has the infrastructure it requires. Massive logistics parks are modern-day marvels of technology and efficiency. Huge quantities of freight seamlessly interchange from plane to truck, or from ship to rail, or any combination of these. The seamless interchanges rely on efficient tracking, common or mutually intelligible software systems across the modes, and on standardised equipment such as the shipping container. The logistics parks are hubs of administrative services like customs and quarantine, and of purpose-built inventory control facilities. They also become home to businesses that require efficient access to a variety of transport modes, and to the staff and ancillary services that are required to support these. Once built, it is not necessarily the case that the throughput of these parks, a measure of the demand for transport, is determined solely by the demand for final goods, as would be the case if transport services were derived from these demands. For example, the industrial plants, new townships and logistics parks that are being built on the backbone of revitalised modern road and rail transport facilities, and known collectively as the Delhi-Mumbai Industrial Corridor are integrated demand-engines in their own right. The logistics parks and the transport links provide the scaffolding on which the entire set of other facilities rests.

The fifth and final argument against the transport-as-derived-demand view is perhaps the most pertinent and immediate. It is often noted that our world is shrinking and that transport has made it so. However, more nuanced conclusions can be drawn from this tautology. At one level, transport has ceased to matter because modern logistics has ensured that the focus can remain on identifying the most effi-

cient supply chains<sup>9</sup>. 'When transport costs are high, manufacturers' main concern is to locate near their customers, even if this requires undesirably small plants or high operating costs. As transportation costs decline relative to other costs, manufacturers can relocate first domestically, and then internationally, to reduce other costs, which come to loom larger'<sup>10</sup>. In these most efficient supply chains, inventory costs are driven down by ensuring that parts and products are delivered to wherever they need to be at a guaranteed time: too early is almost as problematic as too late<sup>11</sup>. This is relevant for low- as well as high-value products<sup>12</sup>. In this regard, transportation systems are synonymous with inventory management systems, and are hence integrated within the manufacturing process, and especially in the management of production time and time-to-market. For many goods, it is no longer possible to separate out transportation from any other manufacturing input.

The five arguments noted above make a strong case for considering the demand for transport to be integrated with the demand for any other good. There are substantial endogeneities and feedback effects that challenge the derived-demand hypothesis. This has both positive and negative conclusions for transport planning. On the plus side, this implies that transport planning has more power to engineer and channel economic growth in a manner that is in the national interest than might appear at first glance. On the other hand, it places substantial onus and technical demands on the decision-making authorities to devise and deliver on plans. Whether the net repercussions are positive or negative, the major conclusion to be drawn from these observations is that transport planning must be necessarily integrated within and across modes.

9. 'It is better to assume that moving goods is essentially costless than to assume that moving goods is an important component of the production process.' Edward Glaeser and Janet Kohlase, cited in Levinson (2007: 8).

10. *Ibid.*: 14.

11. Alternatively, the certainty of delivery at a definitive time is almost as important as compressing the delivery time.

12. Zara, a brand of the Spanish company, Inditex, has grown to be the world's highest-grossing clothing retail chain on the back of its sophisticated logistics. The label is widely acknowledged to get a new item of fashion from conception to shopfloor within two weeks, against an industry average of six months. Besides its skilled staff and choice of manufacturing locations that are close to its largest markets, the biggest contributory cited in Zara's success is the sophistication of its supply chain.

## Box 4.2

### Management Structure and Pricing of Services

All human endeavour involves choices and nowhere is this more true than in commercial activity. Transport is an integral part of economic and commercial activity. As such, it also requires choices to be made between different modes of transport, such as rail and road. However, the sum of individual choices, even while maximising the welfare of an individual or a firm, may not maximise social welfare.

Despite the comparative advantage of rail over road in terms of social costs, its share in both passenger and freight traffic has been declining over the years. The reasons for this decline can be broadly categorised into pricing policies and non-pricing attributes related to rail and road modes.

Of the two modes, rail is a state-owned monopoly subject to price regulation, while the road transport market is privatised and competitive for freight traffic. The prices of freight transport service by trucking are determined by free market forces. However, for passenger road transport, both public sector undertakings and private operators supply the service under a regime of price regulation.

The pricing systems prevailing in the two modes are totally different. Rail transport, in its pricing, covers all costs, including that of the fixed infrastructure, whereas road pricing does not reflect the full normative cost of ground infrastructure and its maintenance. Besides, the road and fuel taxes have little or no relation with the true resource cost of various inputs.

In road transport, the freight and passenger segments operate as independent entities, while in rail, there is no such distinction. This difference in structural characteristics has critical implications in pricing of the products in the two modes. In road transport, there is no element of cross-subsidisation between the two products, while railways indulge in it with great profligacy.

Source: Asian Institute of Transport Development (2002).

### INTERMODAL TRANSPORT SYSTEMS

Intermodal transport is the combination of at least two modes of transport in a single transport chain, ideally without a change of container for goods. With the multiplicity of modes, the cooperation and participation of several agents is required. On the demand side, owners, shippers, forwarders, shipping lines and logistics service providers each fulfil a particular set of service provisions, with terminal, rail, inland navigation, short-sea, road and intermodal transport operators involved in supplying the actual services. Terminal operators at ports, logistics parks, airports and other transshipment junctions are at heart of the intermodal system by transferring intermodal units between mainline transport networks and undertaking drayage.

The extra handling required of intermodal shipments adds to overall costs. However, these costs whether direct or indirect in the form of economic externalities, are usually a small proportion of the gains to be made by transporting goods on modes to which they are best suited for particular segments of the journey. Intermodal transport systems demand flexibility, reliability, cost-effectiveness and extensive collection and dissemination of

information. Against this, they offer cost savings, reduced congestion, air pollution, noise and fewer accidents through the use of dedicated and finely tuned systems.

It is important to note that, in itself, the intermodal principle is not about advocating a particular modal mix. Within the context of a regional or national economic environment and the prevailing social and financial circumstances, different modal mixes are likely to prove apposite. Thus, the principle petitions for the discovery of the optimal mix, with a view that the various components can be integrated into an origin-to-destination supply chain that improves overall efficiencies of the transport system. By improving the connections between all modes of transport and integrating them into a single system, intermodality allows better use to be made of rail, inland water transport and coastal shipping which, by themselves, are not readily amenable to origin-to-destination supply chains but are excellent for certain segments therein<sup>13</sup>.

The inefficiencies of a transport system are manifested in higher prices, longer journeys, reduced reliability, lower availability of quality services, type restrictions, higher risks of damage or pilferage and more complex administrative procedures.

13. Intermodality is, therefore, complementary to other transport policies such as liberalisation of transport markets, developing of national networks for a single mode, and the promotion of fair and efficient pricing. EC (2001).

Table 4.1  
**Break-Even Distances, Rail and Road**

COMMODITY	BREAK-EVEN DISTANCE (KM)	COMMODITY	BREAK-EVEN DISTANCE (KM)
Food Grain	222	Cement	160
Fruit & Vegetables	313	Livestock	162
Coal & Other Minerals	188	Iron & Steel	173
Fertilisers	167	Containers	307
Sugar	372	Other	307
Petroleum	126		

Source: RITES (2007-08)

Though multimodal systems seek to eliminate or dampen some of these outcomes through better modal mixes and efficient intermodal transfers, the good functioning of the system is determined by several critical enablers.

First, missing stretches of infrastructure within one mode or missing links between modes, however small they might be, can prevent seamless intermodal chains. They impose additional transfer and friction costs on operators. Inadequate access by rail, road or waterborne transport to existing transfer points can hamper the integration of these modes and transfer between modes.

Second, because the various component modes of an intermodal system are financed and managed separately, the responsibility for strengthening the links between them is unclear. Moreover, the existence of different forms of ownership and charges for the use of infrastructure and terminals does not enable transparent and coordinated infrastructure planning at local and regional levels. Intermodal transport is only as strong as the weakest link in the transport chain, a point made more forcefully in Chapter 2, Volume II, this report. The lack of standardisation and interoperability within and between modes poses significant problems. The wide variation of loading unit dimensions across modes, and the incompatibility of the transport equipment for road, rail, coastal and inland waterway traffic raises transfer and handling costs and necessitates cumbersome transshipment techniques. Simple standardisation technologies like pallets and shipping containers allow vehicles, vessels and wagons to be designed with complete agnosticism on the cargo carried. Further, the standardised handling equipment and the automation of handling procedures permit both easier and faster transshipment.

Unequal levels of performance and service quality mark the various component modes of an intermod-

al system. It is not much good if a coastal shipping system can deliver, and the road system remove, a certain defined quantity of cargo from a port, but the port's handling equipment can only process a small fraction of the required throughput. The differences arise from variations in the cost structures, but also from the industrial organisation, competition and liberalisation of a particular mode. Modes where operators are confronted with a high threshold for access to their infrastructure tend to generate monopolistic behaviour, resulting in a lack of customer-oriented operations and sub-optimal use of capacity. Next, because operators own their own fleets or even infrastructure, they often tend to subscribe to and promote only one mode of transport and disregard better options which may exist on other modes.

A final barrier to the efficient use of intermodal systems is the allocation of responsibility and liability. If the final receipt of an intermodal supply chain with many service providers is a damaged product, what is the appropriate measure for registering insurances and claims? The competitiveness of intermodal transport is also hampered by unequal administrative treatment and impermeable information. For example, transport documents are to a large extent still based on paper and differ according to specific modes—maritime, rail, road or air transport.

## **INTEGRATED TRANSPORT PLANNING IN PRACTICE: AN INDIAN PERSPECTIVE**

As noted earlier, it is essential that an integrated transport strategy does not develop in mode-specific silos, and is tied to the agenda for national socio-economic development in an organised and sensible manner. The following discussion sequentially identifies the major steps in an integrated planning exercise, before focussing on general implementation

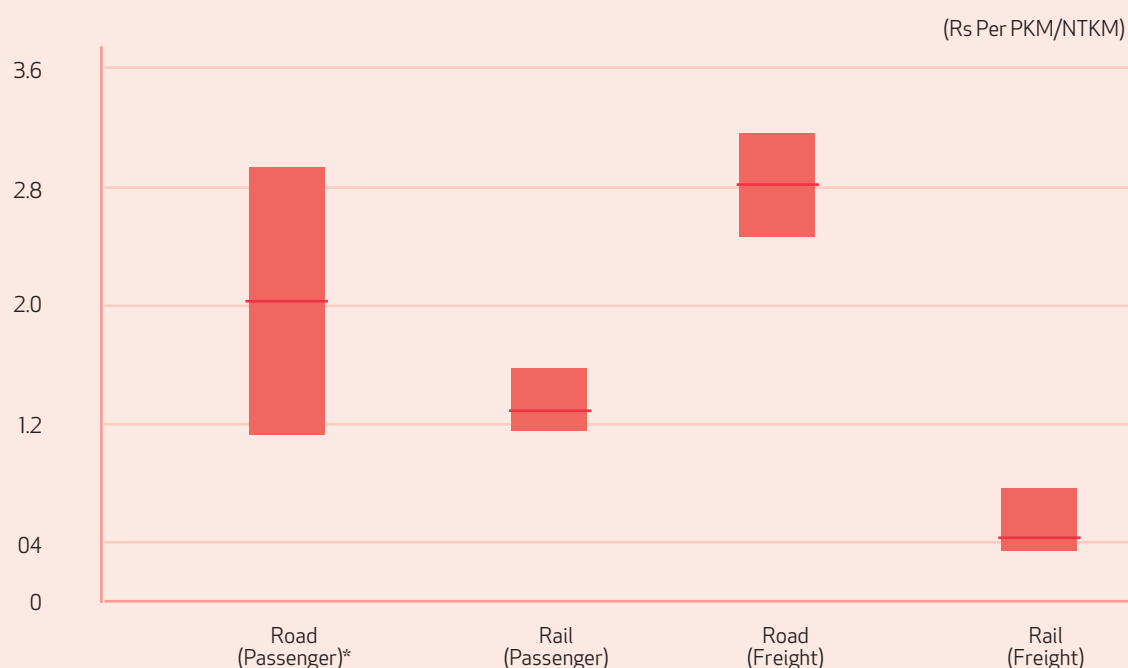
## Box 4.3 Comparative Study of Rail and Road Modes

The use of transportation is not wholly a benign activity. It causes strain on nature by consuming scarce resources, emitting harmful pollutants and generating undesirable wastes. Different modes of transport cause varying levels of stress and consequent damage. Hence, there is growing recognition that the transport systems and modal choices should factor in the cost of environmental degradation and social damage, as it would promote both overall sustainability and sustainable transport.

It was in this context that the Asian Institute of Transport Development (AITD) undertook an empirical comparative study of rail and road modes with a focus on social sustainability. The empirical model simulates effects of intermodal substitution. It estimates all inclusive costs—financial, environmental and health damage caused by line-haul operations and related development of ground infrastructure. The results of the study are graphically depicted below:

### SOCIAL COSTS OF ROAD AND RAIL

- \* In terms of social costs, railways have a huge cost advantage over road transport. The advantage is greater in freight traffic than in passenger traffic.
- \* Policy changes can induce shift of modal choice in favour of rail and in favour of public road transport over personalised transport.



\* The option of 'bus only' is considered for road passenger transports.

Source: Asian Institute of Transport Development (2002).

issues and common pitfalls. As is true for this entire chapter, the focal example is the generalised movement of freighted goods and logistics.

### TRAFFIC AND COSTS STUDIES

The first step is to identify past and expected changes in the pattern of traffic demand for various modes of transport<sup>14</sup>. These changes mainly occur due to

two factors: the types of commodities that are moved through the system (themselves a function of the country's changing economic profile), and the costs at which the various modes of transport can accommodate the changing traffic patterns and volumes. The cost structures analysed should be resource costs, which are the sum total of the financial outlays by user and operator together with any external or shadow costs that are borne by society.

14. Puri (2012).

These studies on expected traffic flows and cost structures support the taking of a long-term view, which is especially important as transport infrastructure takes time to develop, and is also expected to be serviceable over long periods<sup>15</sup>. These detailed studies should be kept current so that the resulting investment plans are always validated in the face of the changing growth and cost environment. As noted by Puri, traffic flows and costs studies must be carried out with respect to major commodities, type of route, length of haul and keeping in view alternative technologies.

It is critically important to use identical methodologies for estimating unit transportation costs to ensure fair comparison and allocative efficiencies in earmarking financial resources. To do this requires the development and availability of suitable accounting systems at the constituent units and agencies engaged in the development and operation of transport infrastructure and services.

These traffic flows and cost studies within and across modes make possible optimal decisions on mode-specific investment. The Planning Commission has sponsored several such studies in the past, but these have not been carried out at regular intervals<sup>16</sup>. An important outcome of this research on traffic flows and resource costs has been to build granular knowledge of the break-even distances for the efficient cartage of various commodities by different modes of transport, and especially by road and rail. The break-even distances can then be used in identifying optimal investment plans. For example, the latest available data for India suggest that road is superior to rail for hauling foodgrain from origin to destination at leads of about 220 km. At larger distances, rail is the preferred mode for mainline haulage despite any delays at intermodal nodes where the grain must be transferred from or to trucks for initial lading or final delivery. (See Table 4. 1 for break-even distances for other commodities.)

In 2007-08, RITES carried out the latest attempt at determining traffic flows and unit resource costs for rail, road, airways and coastal shipping. It generated analyses on commodity-wise freight and passenger transport across the entire country, estimating both financial as well as economic costs<sup>17</sup>. The traffic data was used to estimate the actual modal mix, and the costs data to establish the optimal modal mix based on break-even distances<sup>18</sup>. The several thousand

pages of detailed analysis of individual segments of track and road and waterway can be distilled, somewhat baldly, into the following observations:

- Though there is a growing preponderance of freight carried between geographic regions, intra-regional freight volumes are perhaps twice as large and inadequately catered for<sup>19</sup>.
- The result of these traffic increases is severe congestion on key rail and road corridors, and the creation of bottlenecks on the network pertaining to a particular mode and at junctions where freight is transferred between modes.
- There is a discernible gap between the actual and optimal modal mixes. According to RITES, a switch from the actual to the optimal modal mix will result in a 3 per cent increase in freight throughput at a cost saving of around Rs 380 billion or 16 per cent of the total cost expended on transport in that year.
- Beyond the general observation that there are substantial efficiencies to be gained in a switch from road to rail, the study identifies that these switching benefits are largest for the following commodities: Miscellaneous (78 per cent)<sup>20</sup>; Iron and Steel (61 per cent); POL (61 per cent); Fruit and Vegetables (53 per cent) and Cement (36 per cent).
- Technical advances and solutions to achieving the optimal modal mix are readily available in the form of technologies such as higher-powered locomotives, high-speed coaches and wagons, and multi-axle road vehicles, besides many innovations in logistics management and operations software. However, these are patchily and inconsistently deployed.
- The operation and management of different modes of transport is characterised by a varying mix of institutional frameworks, acting independently of each other. As such, the various modes have been developed as isolated entities seeking to further idiosyncratic modal interests.
- A lack of data, and especially for traffic on the highways, is a major limiting factor in the development of good transport policy.

Before proceeding to a summary of the recommendations of the RITES study, it is crucially important to note that RITES determines the desired modal mix on the basis of break-even costs based on resource costs. Consequently, the 'optimal' modal mix is theoretical insofar as it is not reflective of the government's development priorities or other allocative and distributive

15. The study has previously also noted that infrastructure decisions are difficult to reverse in general, and even more so at short notice.

16. The Committee on Transport Policy and Co-ordination carried out the first study in the mid-1960s. This was followed by three studies by RITES in 1976-77, 1986-87 and 2007-08. Ibid.: 16.6.

17. The nine commodities considered were coal, foodgrain, iron and steel, iron ore, POL products in liquid form, limestone and dolomite, cement, fertilisers and miscellaneous/others. Together, these nine commodities comprise 63 per cent of the total volume of 2,387 million tonnes carried by all four modes across the entire universe of 52 commodities.

18. A break-even distance refers to the point of indifference between two mode choices, such that the prospective user of a transport service is indifferent between them.

19. The study noted that freight traffic increased threefold on the railways, by a factor of seven on the roads and by 10 times on coastal ships. Combined with an increase in the distances transported, overall freight increased four times.

20. RITES studied 52 commodity groups and the final miscellaneous category includes parcels and comprised about 3 per cent of the total volume of traffic carried across all modes in 2007-08.

## Box 4.4

### The National Transport Policy Committee [1980]

The findings contained in the report of the National Transport Policy Committee of 1980 have naturally dated with respect to prices and technologies and the socio-economic agenda. Some recommendations, however, remain pertinent and perhaps more urgent than they were 33 years ago. This box summarises the thoughts of the Committee with respect to planning intermodal transport, and it is worthwhile beginning with the very last one:

*For achieving the best intermodal mix, we suggest that appropriate investment decisions and use of pricing mechanism should have preference over regulatory measures and administrative controls.*

The NTPC of 1980 was cognizant of the need to devise an investment strategy that was concomitant with the nation's development agenda of the day. In the late 1970s, the twin pillars of the agenda that the Committee focussed on were the employment potential and the energy intensity of the various modes of transport. To that end, the Committee studied the direct and indirect employment potential of different modes in substantial detail, before ultimately rejecting this as a basis for making decisions on intermodal transport. 'We hold the view that whatever importance employment generation may have in programmes of development, it has no role to play in determination of the intermodal mix in the transport system of the country. (Instead,) our policy aim should be to develop technologically as efficient a transport system as possible, so that production and hence employment generation programmes of other sectors are not jeopardised due to transport bottlenecks.'

The Committee placed heavier stock on the second pillar, arguing that the prevailing energy crisis in the country meant 'energy conservation should be given overriding consideration in determining the intermodal mix for the transport system'. They recommended achieving this by promoting modes that are more energy efficient and by selecting a modal mix that was compatible with India's energy resource endowment (i.e., coal, which favours rail).

Within the context of this development agenda, the Committee established the view that the central issue of transport policy is to allocate rationally and at minimum resource cost, the total available resources for investment between the various modes of transport. This is a view endorsed by the NTDPC.

The NTPC made a comparison of the costs of transporting units of freight traffic via road and rail to assess the relative advantages of these modes. The cost data and break-even points of 11 commodities were assessed, and for most of these, road proved more economical at distances below 300-350 km. The Committee also concluded that any increase in oil prices would only bias this break-even distance downward, and in favour of rail. Further, it was of the view that neither coastal shipping nor inland waterway transport had any important role to play in determining the optimal modal mix.

goals. Further work will be required to first, continually update the RITES results, and then to synthesise them with other goals of government policy in a non-distortionary fashion. On the basis of these observations, the authors of the RITES study recommend the following measures:

- An urgent increase in capacity is required for all modes, and especially in that of the railways. For freight, an equal focus to last-mile connectivity with ports and logistical parks as to dedicated freight corridors is essential.
- The development of domestic container traffic should be encouraged.
- The transport of several commodities can immediately shift to the more efficient mode

(predominantly, rail) for the lion's share of the lead distance if multi-modal logistics parks aid intermodal transfer.

- The siting, profile and capacities of the multi-modal parks should be made conditional on a careful analysis of the patterns of traffic in the movement of commodities in the serviced hinterland.
- Recognising the important role that road transport will continue to play in the future, the study recommends further exploration of roll-on roll-off operations that deliver road-rail complementarity.
- Advanced research in mode-specific and mode-agnostic technology improvements is essential.

## Box 4.5

### Ikea's Coffee Mugs and Tea-Lights

The Swedish firm Ikea has now become the world's largest furniture retailer. It also carries an extensive range of goods for the modern household, and its minimalist Scandinavian design sensibilities have become a de facto standard for interior design in many countries. Ikea is known for its focus on product design and on finely managing its supply chain with a relentless focus on cutting costs. It is the company that pioneered flat-pack designs for furniture. Every piece of furniture it sells is designed to be packed flat into the smallest space possible for shipping, lowering its distribution costs. (Separately, it has perhaps done more to promote Swedish cuisine than any other person or institution.)

One of the more prosaic products sold in its stores is the 50-cent coffee mug. The selling price of the 'Bang' mug is its great draw card, resulting in over 25 million mugs sold each year. However, it must still conform with Ikea's corporate policy on offering appealing product design and quality. Further, it should be profitable in its own right, rather than a loss-leader for the sales of other goods. The Bang mug has been re-designed three times with a view at making it more profitable. The first version fit 864 mugs on a standard shipping pallet. The subsequent redesign added a small lip to the mug making it sturdier and allowing around 1,200 to be packed onto a pallet. The third redesign shortened the mug making it stouter while adding a slightly different handle. The net result was the ability to pack an astonishing 2,204 mugs onto a standard pallet, the same space that had originally accommodated only 864 mugs. In a classic vindication of Ikea's 'Don't Ship Air' policy, overall shipping costs for the mug have reduced by 60 per cent, allowing Ikea to continue to profitably offer the mug at the same price for well over two decades. (It is perhaps relevant to add that while Ikea gets the supply chain right, by many accounts it fails to do the same on the distribution side. Tales of missed and delayed deliveries are legion.)

Another example of Ikea's decisions to avoid shipping 'air' can be seen in the overhaul of its logistics practices for transporting tea-light candles. Earlier, these candles were simply bundled randomly into a plastic bag, with bags being packed into cartons and cartons onto pallets. Efforts to re-arrange the candles with more care within the plastic bag yielded immediate payoffs with the volume of each bag reducing dramatically. This meant that about 40 per cent more candles could be transported within a standard shipping container. Perversely, this now yielded a container that was too heavy to comply with weight limitations on European flatbed trucks. Ikea solved this problem by deploying 'cluster supply' methods. Instead of the candles being directly shipped from manufacturer to Ikea warehouses, the firms were now encouraged to ship to suppliers of other Ikea products with lower weight-to-volume ratios, such as furniture. In effect, the furniture suppliers also became the receivers, packers and shippers of candle products by combining these with their own deliveries of (flat-pack) beds and couches.

Source: Material adapted from Chase et al. (2008) and EIA (2010).

- The study presents a strong case for a Central Transport Co-ordinating Agency, responsible for planning, monitoring and selective regulation of policies related to the development of the integrated transport system.

#### RECOGNITION OF MODE-SPECIFIC CHARACTERISTICS

Marginal unit costs for transport on the various modes will reflect several mode-specific characteristics. Acknowledgment and exploitation of these characteristics ensures that each commodity is transported on the most suited mode at every stage of the journey. For example, fixed costs are higher in the railways and so exhibit more dramatic increasing returns to throughput. Road transport proves

nimblest at carrying small loads over short distances to easily accessible as well as remote destinations at relatively low total costs.

Costs at constant speeds—discounting for required accelerations and decelerations, are lower for shipping than for other means of transport. Together with the absence of corridor congestion—coastal shipping capacities are only constrained by the availability of ships and the efficiency of ports—this implies that shipping can be more efficient than even rail along coastal routes, and especially for time-insensitive cargo, especially if the costs of transshipment at the ports are minimal.

To fully exploit a transport mode, its weaknesses must be accommodated. Rail and shipping both ben-

## Box 4.6

### The Criticality of Logistics Costs

Transport and logistics costs most often pose a barrier at least as large, and frequently larger, than tariffs. In fact, trade is affected more by the cost of transport than by the tariffs. A 2008 WTO report, *Trade in a Globalising World*, explains that spending on shipping for world imports in 2004 was three times higher than spending on tariffs.

The logistics costs in India are estimated to account for 12-13 per cent of GDP. In the United States, these costs vary between 8.5-9 per cent of GDP. A reduction in logistics costs by one per cent would yield an annual saving of \$5 billion for Indian economy.

If the logistics costs are brought down to the levels that prevail in the United States, this would result in about 4 per cent reduction in prices of Indian goods making them more competitive globally. At the same time, this reduction in costs would mean large reduction in inventories, and consequently in working capital.

Source: Asian Institute of Transport Development: Regional Seminar on Intermodal Logistics, 2007

## Box 4.7

### Indicators of Performance of Logistics Services

The performance of logistics services can be gauged by the following indicators, that are somewhat specialised to the use of international maritime shipping for mainline transport. Analogous indicators can be easily drawn up for rail or road as the main transport mode in an intermodal chain.

#### 1. Timeliness

- Total time for trade-related procedures
- Customs inspection clearance time
- Technical control clearance time
- Time for trade document procedures
- Inland transport time
- Verification of container security
- Vessel turnaround times
- Vessel waiting times to obtain berths
- Time to resolve customs appeals

#### 2. Cost

- Total cost for trade-related procedures
- Port- and terminal-related charges
- Total cost for trade document procedures
- Border control costs
- Inland transport costs
- Additional costs to verify container security

#### 3. Complexity and risk

- Total number of documents per trade transaction
- Criteria for customs inspection
- Percentage of containers inspected
- Level of customs inspected
- Damage or pilferage as percentage of values of container
- Shutdown of port due to natural disaster and labour dispute (days)
- Whether the port is a signatory to customer security initiative
- Percentage of containers electronically scanned
- Percentage of containers physically inspected
- Speed of inland transport

Source: World Bank (2005) and Planning Commission (2010)

enefit from a more flexible and extensive road network that ensures last-mile and intermediate connectivity. The obvious limitation is that transfers between these modes must be efficient.

Finally, consideration of mode-specific characteristics must also reflect their differential environmental impacts, energy intensities and lifecycle costs<sup>21</sup>. The energy intensity of different transport modes is influenced by the terrain traversed, choice of locomotive power, efficiency of deployed engines and the care with which they are maintained, amongst many others. This important element of the decision process for deciding on the optimal modal mix thus needs to be carefully pieced together, again in the context of actual and planned traffic movements by commodity. Further, given the scarcity of energy, there is cause to weight this criterion more heavily in the decision-making exercise.

## IDENTIFYING DISTORTIONS AND THE ROLE OF PRICE AS A RESTORATIVE MEASURE

The unit costs of freight transport are not indicative of the true marginal costs of transport, given the common observation that the transport sector in India is rife with market failures. As elsewhere, these market failures are the result of positive and negative externalities of transport demand and supply, of the networked nature of transport infrastructure which necessitates high upfront costs and so promotes monopolies, and due to characteristics that render transport at least a partial public good in the strict economic sense<sup>22</sup>. However, government policies have either not adequately addressed these market failures, or have presented solutions that have exacerbated the problems. Several examples of these distortions are discussed in the last section of Chapter 2, Volume II, of this report, and we only summarise these here:

- New capital works have generally been favoured over proper maintenance and repair. This has resulted in a mismatch between the actual and rated capacities of the mode.
- Network enhancements have been alltoofrequently driven by political rather than business or even social welfare considerations, resulting in haphazard and inefficient route expansion.
- Improved accessibility and transport links to remote or uneconomic locations have been based on decisions clouded by popular demand for a particular transport mode rather than by sound economics.
- Differing tax regimes across the states exacerbate inter-state border formalities and inefficient geographical arbitrage in production and distribution locations.

To fully exploit a transport mode, its weaknesses must be accommodated. Rail and shipping both benefit from a more flexible and extensive road network that ensures last-mile and intermediate connectivity. And transfers between these modes must be efficient.

Finally, a complex web of subsidies, tariffs and taxation policies applies to transport in India<sup>23</sup>. Adjusting the pricing of transportation is a standard tool for redistribution policy. These highly managed prices are not informative for making market decisions and for influencing modechoice. Examples of the deleterious impact of these policies abound:

- More vehicle-kilometres are driven than they would be if motor fuels were priced at market
- Demand has skyrocketed for diesel vehicles, with severe environmental implications, given the generally high-sulphur diesel fuel available in India
- Freight tariffs cross-subsidise rail passenger fares, distorting both markets
- Taxes on aviation fuel and services are only loosely tied to economic fundamentals or any market characteristics that they are intended to correct

In short, prices are rarely indicative of the full marginal social costs incurred, thereby creating a role for the State to play a decisive role in determining the prices and the quantity and quality of transport infrastructure and services through appropriate policy measures. These policies and the resulting prices influence the selection of choice of mode of transport and the particular technologies deployed within a mode. However, this is not to say that the sound economic prescription is for the state to determine prices independently of the fundamentals that drive the transportation market. Instead, the main objective of transport policy may be restated as the creation of the appropriate technical and economic conditions so that each mode of transport is employed and priced within the system in a manner determined by its resource cost advantage.

## OTHER POLICIES TO AID INTEGRATED TRANSPORT STRATEGY

India's transport network is best viewed as a 'network of networks' that can be classified based on (a) network standards and technology, (b) geographical hierarchy, and (c) mode choice. Each of these classifications yields useful insight into what makes a good network, and the policies required to support this.

21. Lifecycle costs are considered more fully in Chapter 7, Volume II.

22. Transport networks exhibit increasing returns to scale and cost structures comprising massively front-loaded construction expenditures and near-zero marginal costs, implying that natural monopolies are the most efficient market structures. (Air and maritime ports function as standalone nodes and, depending on market structure, may not always be best characterised by natural monopolies.)

23. See Chapter on Fiscal Issues (Chapter 9) in this volume.

Table 4.2  
**The World's Top Trade Lanes**

A: TOP TRADE LANES IN TERMS OF VALUE OF GOODS CARRIED, \$ BILLION (AIR AND OCEAN) 2009			B: TOP TRADE LANES IN TERMS OF VALUE OF GOODS CARRIED, \$ BILLION (AIR AND OCEAN) 2030		
1	China-USA	291	1	China-USA	594
2	China-Japan	208	2	China-Japan	337
3	Japan-USA	147	3	China-Korea	281
4	China-Korea	141	4	China-India	264
5	Germany-USA	119	5	China-Germany	201
6	Germany-UK	113	6	Japan-USA	190
7	China-Germany	102	7	China-Singapore	178
8	UK-USA	98	8	China-Indonesia	170
9	Japan-Korea	70	9	Germany-USA	167
10	UK-Netherlands	68	10	China-Malaysia	162
11	Korea-USA	66	11	China-West Africa	151
12	UK-France	63	12	Germany-UK	144
13	Hong Kong-USA	58	13	UK-USA	144
14	China-Singapore	56	14	China-Thailand	141
15	France-USA	55	15	China-Brazil	136
16	China-Australia	54	16	India-USA	125
17	Netherlands-USA	52	17	China-UK	121
18	Japan-Hong Kong	46	18	China-UAE	120
19	China-Netherlands	44	19	India-Netherlands	119
20	UK-Belgium	43	20	India-Singapore	116

Source: Calculations by DHL based on data from Roland Berger Consulting, and estimates of growth of bilateral trade.

Transport network standards apply in a physical sense, e.g., narrow, metre or broad gauge railway; and also as a matter of policy, e.g., trucking permits for carriage of freight in a state. Differential standards along various parts of a network must walk a fine line between being fit for the purpose at hand and supporting overall network functionality. For example, it is not feasible for all roads to be of a single uniform width. But equally, the standards that apply to rural roads, and State and National Highways, must agree for the smooth performance of the overall road network. Clear and stable network standards reduce operational uncertainty and transaction costs, and so raise the productive efficiencies of transport services that are deployed on the network. Transport standards can also include the use of new technologies such as common databases to track and trace shipments, or containers that aggregate and standardise the movement of diverse objects. Networks that span various geographies local, regional, national and international should be mutually coherent in terms of the specifications and standards employed.

Next, issues related to intermodal connectivity reign supreme and comprise a theme that is developed in

much detail in the next section of this chapter. Each type of transport network and mode has strengths and weaknesses. Weaknesses are minimised and the usefulness of each transport mode maximised when it is possible to switch between modes seamlessly and at low cost. To note useful examples in the Indian context: rail efficiency and usefulness increases when coal can be transported via truck on good roads from pithead to railhead, and thence on a standardised gauge track to a power plant. Logistics on the best highway network can fall prey to interstate border formalities and idiosyncratic permit and tolling protocols that prevail on different parts of the network.

### SUMMARY

To summarise, the prescription for achieving an integrated transport strategy as defined earlier proceeds as follows: (a) establish traffic flows and unit transportation costs across the various modes for the various commodities; (b) identify existing distortions in the market for transport; (c) identify other government development and distribution priorities and the role of transport in these matters; (d) use these facts to arrive at the desired optimal

modal mix; (e) install sufficient capacity and maintain both old and new infrastructure to ensure that no mismatch between actual and rated capacities; (f) use economically sensible pricing policies that are determined either by the market or by independent tariff-setting authorities to encourage a mode-choice driven by efficient markets; (g) install nodal infrastructure and promote technologies that reduce the costs of mode- and gauge-transfer.

## LOGISTICS AND INTEGRATED TRANSPORT

Given a list of cities and the distances between these cities, what is the shortest route between them that would visit each city exactly once, before returning to the origin? This simple question, known as the ‘travelling salesman’ problem, is difficult enough to have withstood the combined assault of mathematicians and computers for the better part of a century. It is one of the six remaining ‘Millennium Problems’ with the solution carrying a prize of \$1 million. It is also the fundamental problem that the modern logistics industry attempts to solve everyday: how does one ensure that the hundreds of components in a supply chain are exactly where they need to be at a specified time at the lowest possible cost? And though proof of the shortest route that the salesman must take remains a mathematical quandary in the general case, operations research has done exceptionally well in identifying heuristics and writing software to develop practical solutions to this fundamental problem of logistics.

These solutions have been so successful that the past three decades have seen massive overhauls in supply chains and business practices. As a rough approximation of the contemporary business standard, firms no longer give exceptional thought to locating their factories near customers or suppliers to simplify transport requirements and minimise costs. Instead, they seek to partner with desired suppliers and logistics providers the world over to manage product assembly, product quality, inventory and distribution. Modern logistics has redrawn the transport map of the world in favour of extremely high-volume land and sea transport corridors, and built enormous interchange complexes catering to varied transport modes and providing complex warehousing facilities for many industries and commodities.

The term ‘logistics’ is somewhat slippery to pin down exactly. Its origins lie in the French military practices of organising troop movements and maintaining supply links with deployed battalions. In modern

Logistics differs from transport insofar as the former is an elemental part of the production process, while the latter is merely a matter of distribution of material or finished product.

business practice, a leading industry body defines logistics as ‘that part of the supply chain management that plans, implements, and controls the effective forward and reverse flow and storage of goods, services and related information between the point of origin and the point of consumption in order to meet customers’ requirements’. Various other textbook definitions tinker with this at the margin, but the broad agreement is that logistics deals with the careful management in time and space of the movement of components and resources with respect to a larger business agenda.

The six operational objectives of a logistics system have been described as (a) rapid response based on anticipated need, and supported by flexible and robust technology and transport systems; (b) minimum variance to ensure certainty of delivery in time and space; (c) minimised inventory to reduce storage costs; (d) movement consolidation to reduce transport costs; (e) product quality; and (f) support for life-cycle activities such as returns, repairs and disposal.

As such, in the context of the movement of goods, logistics differs from transport insofar as the former is an elemental part of the production process, while the latter is ‘merely’ a matter of the distribution of raw material or finished product. In short, effective logistics can make a ‘better’ product, whether measured by quality or cost. Meanwhile, effective transport can only ensure that said raw material or product is actually made available at a desired location.

Logistics costs to the economy are variously estimated at around 9 per cent of GDP for the United States through to approximately 11 per cent for Japan, 12 per cent for France and Korea, and 18 per cent for China<sup>24</sup>. Cost estimates for India do not appear to be as robustly calculated, and various studies have provided a range of 12 to 15 per cent of GDP<sup>25</sup>. The high level of coordination required between the many fragmented and specialised participants in the logistics industry in India is sometimes cited as a cause for the relatively high proportion of logistics expenditure in GDP. In one panel study, it is noted that a 0.5 per cent decrease in logistics costs (relative to GDP) leads to a 2 per cent increase in trade and a 40 per cent increase in the range of products that are exported out of a country<sup>26</sup>.

24. International Transport Forum (2012) and Sanyal (2006). China’s relatively high share of logistics spend in GDP can be explained by the facts that (a) the share of the service sector in the economy is lower relative to India’s (b) a large expanse of terrain is dominated by deserts and mountains; and (c) with the bulk of the population centres and growth centres located on the East Coast or in Eastern China, the nature of West to East flows (mainly bulk goods) is very different from that of East to West flows (mainly consumer goods). This requires the use of different trucking technologies and also results in many containers returning to their origins unladen. See Gupta et al. (2010).

25. Essential questions on whether firms choose to outsource logistics functions and warehousing will affect the accounting of logistics costs.

26. World Bank (2007).

Table 4.3  
**Logistics Performance Index**  
 [Top Ranked Countries]

THE TOP 10 PERFORMERS ON THE 2012 LPI						
COUNTRY	2012		2010		2007	
	LPI RANK	LPI SCORE	LPI RANK	LPI SCORE	LPI RANK	LPI SCORE
Singapore	1	4.13	2	4.09	1	4.19
Hong Kong, China	2	4.12	13	3.88	8	4.00
Finland	3	4.05	12	3.89	15	3.82
Germany	4	4.03	1	4.11	3	4.10
Netherlands	5	4.02	4	4.07	2	4.18
Denmark	6	4.02	16	3.85	13	3.86
Belgium	7	3.98	9	3.94	12	3.89
Japan	8	3.93	7	3.97	6	4.02
United States	9	3.93	15	3.86	14	3.84
United Kingdom	10	3.90	8	3.95	9	3.99

Source: Logistics Performance Index Results (2012).

That said, it should be noted that measuring logistics costs is fraught with difficulty and that international comparisons may not be entirely robust. Broadly, however, studies on logistics costs focus on the following areas: (a) customer service including parts and service support and the handling of returns; (b) transport costs and warehousing including storage and site selection; (c) inventory management including packaging and reverse logistics; (d) lot-quantity costs including materials handling and procurement; (e) order processing costs and (f) information systems costs including those related to communication, forecasting and planning<sup>27</sup>. These cost headlines also provide an excellent summary of the scale and scope of the modern logistics industry in shaping business practices.

The remainder of this section looks at the state of the logistics sectors in India and internationally. Briefly, these sections show that relative to international counterparts the Indian logistics sector demonstrates a lack of scale, scope, flexibility and dynamism, and exhibits a yawning urban-rural divide. The performance of the sector is hampered by restrictive regulation, poor mainline infrastructure, inefficient inter-modal transfers of freight, fragmented industrial organisation, and skill shortages amongst several other factors. The application of an integrated strategy for transport infrastructure development should ameliorate many of these defi-

ciencies by creating a dynamic intermodal transport system. The final sub-section of the report identifies the components of this strategy and their expected effects.

## THE INTERNATIONAL LOGISTICS LANDSCAPE

### HIGHLIGHTS FROM THE STATE OF THE ART

The city of Louisville (population c. 750,000) in the state of Kentucky in the United States has two disproportionate claims to fame. It is home to the Kentucky Derby, country's most famous horse race, and perhaps its most watched two minutes of sporting activity each year. Its airport is also home to the WorldPort, the centralised sorting facility of the United Parcel Service of America (or UPS) that is the second largest provider of logistics services in the United States. Together with Federal Express's (FedEx) global sorting facility at Memphis, Tennessee, called the SuperHub, these two logistics giants deliver over seven billion packages every year, more than one for every person on the planet, for combined net revenues of around \$100bn.

The sorting facilities at Louisville and Memphis are modern-day marvels<sup>28</sup>. Between 11 pm and 4 am every night, the WorldPort and the SuperHub transform into the two busiest airports in the world, with around 200 aircraft movements each. At peak times of the year,

27. Lambert et al. (2006).

28. The location of these processing facilities is not accidental. Both Louisville and Memphis airports are in central United States, about two hours' flying time from most major population centres. There is a ready pool of labour to staff these facilities, and the airports are largely free of adverse weather for much of the year.

Table 4.4  
**Domestic Logistics Performance: Time and Cost**

	EXPORT TIME AND COST						IMPORT TIME AND COST					
	PORT & AIRPORT SUPPLY CHAIN			LAND SUPPLY CHAIN			PORT & AIRPORT SUPPLY CHAIN			LAND SUPPLY CHAIN		
	DISTANCE (KM)	LEAD (DAYS)	COST (\$)	DISTANCE (KM)	LEAD (DAYS)	COST (\$)	DISTANCE (KM)	LEAD (DAYS)	COST (\$)	DISTANCE (KM)	LEAD (DAYS)	COST (\$)
Germany	150	1	1,500	868	5	1,784	150	1	1,500	483	4	1,145
US	206	2	680	346	3	745	126	2	603	273	3	729
South Korea	300	2	572	300	3	500	300	3	707	300	3	500
Brazil	150	2	612	83	3	439	150	2	274	150	5	750
Malaysia	73	3	285	172	2	298	84	2	285	105	2	298
China	162	3	454	215	3	645	133	4	353	171	3	637
South Africa	364	2	1,861	553	3	1,442	320	3	2,000	474	4	1,732
India	626	3	918	197	3	1,043	375	3	1,097	241	4	921

Source: Logistics Performance Index, World Bank (2012).

Table 4.5  
**Domestic Logistics Performance: Procedures**

	PERCENTAGE OF SHIPMENTS MEETING QUALITY CRITERIA	NUMBER OF IMPORT-CLEARANCE AGENCIES	NUMBER OF EXPORT-CLEARANCE AGENCIES	NUMBER OF FORMS: IMPORTS	NUMBER OF FORMS: EXPORTS	CLEARANCE TIME (DAYS) WITHOUT PHYSICAL INSPECTION	CLEARANCE TIME (DAYS) WITH PHYSICAL INSPECTION	PERCENTAGE OF IMPORTS PHYSICALLY INSPECTED	PERCENTAGE OF IMPORTS WITH MULTIPLE PHYSICAL INSPECTIONS
Germany	80	1	1	2	2	0	1	3	2
US	93	3	2	4	2	1	3	7	3
South Korea	97	1	1	2	1	1	1	3	1
Brazil	70	3	3	2	3	2	5	6	2
Malaysia	71	2	3	2	2	1	1	6	3
China	69	3	3	6	5	2	4	17	5
South Africa	89	2	2	2	2	1	2	5	2
India	59	3	3	6	5	2	4	35	16

Source: Logistics Performance Index, World Bank (2012).

airplanes takeoff and land every 45 seconds, each disgorging thousands of parcels containing documents, pharmaceuticals, internet shopping, human hearts, and thoroughbred cars and horses. Arriving planes are offloaded in around 20 to 30 minutes, before being refuelled and laden with cargo for a subsequent destination. The packages that these planes carry are sorted at the rate of around 400,000 per hour before being re-routed on dozens of kilometres of conveyor belts to their onward aircraft. In the time that they enter and leave the facility, any given package will be automatically scanned some 20 times. More than 99 per cent of these are delivered on time, regardless of weather, distance, or the size of package<sup>29</sup>.

As measured by the number of aircraft in its fleet, FedEx may be considered the world's largest airline.

This fleet of 684 jets serves nearly every country on the map almost every day of the week. It employs 290,000 people and maintains a fleet of 75,000 trucks for overland transportation and final delivery. US Customs and border protection agents are based at the SuperHub clearing cargo arriving from other countries.

As impressive as this nocturnal picture of packages, conveyor belts and aircraft that power global trade is, it remains only half the story. Over the past decade, both firms have dedicated increasing resources towards remodelling themselves as fourth-party logistics suppliers. UPS and FedEx will no longer just deliver packages for a firm, but they will also assemble a bespoke order, organise returns and refunds, and provide customer service. For

29. Schactman (2012).

## Box 4.8

### Integration of Logistics Services

One of the major weaknesses of transport infrastructure in our country has been the mismatch at the interfaces of the various modes. As a result, the system, despite upgradation in some segments, continues to operate at sub-optimal levels. For example, while size of the container ships has substantially increased, corresponding facilities for evacuation of the containers from the ports have not kept pace. It is, therefore, essential to plan in an integrated manner across the entire movement chain.

A recent development in the transport sector has been that of extending traditional service boundaries. For example, railways are combining with the port terminals to establish a unified movement chain. Ocean carriers are integrating into ports, inland terminals and landside transport links. At the same time, multimodal operators are increasingly integrating into the reverse of this chain. This vertical integration may lead to emergence of monopolies which are inherently inefficient. A regulatory oversight is therefore called for.

Source: Asian Institute of Transport Development, Regional Seminar on Intermodal Logistics, 2007.

example, all mobile phones imported into the United States by Sprint, a major telecommunications provider, are carried by UPS aircraft from factories in Asia, stored at UPS facilities in Louisville before being assembled by UPS staff into orders for individual stores. Sprint has devolved the management of its supply chain almost completely to UPS, allowing it to focus on the core business of selling mobile phone service.

These massive logistics facilities have attracted other business to the area, businesses that have located nearby solely for immediate access to the most sophisticated logistics in the world. For example, some biotechnology firms market products with an extremely narrow range of tolerance on temperature, moisture and external contamination. The repeated scanning of each package ensures that both manufacturer and end-user are always aware of the integrity of the product and whether it was handled appropriately during transit or is no longer fit for use. Several of these firms have chosen to locate their entire production facilities in the vicinity of the WorldPort and the SuperHub so that they may rely on the bespoke logistics provided by UPS and FedEx. Because of the concentration of biotechnology firms in the region, the US Food and Drug Administration has also chosen to deploy a dedicated team to inspect local facilities. This reduces certification and compliance costs, causing other biotechnology firms to seek to relocate to this area.

Modern technology and operations research have played a similar role in improving efficiencies at the world's largest container ports. The standard shipping pallet and container are themselves humble technological marvels. Ships stacked with as many

as 12,000 containers are offloaded and reloaded by giant automatic overhead cranes. The unloading and loading sequences, often undertaken simultaneously for greater speed, are determined by sophisticated software. The software guides automatic vehicles along routes selected for the greatest efficiency. The vehicles move containers from shipside cranes to another set of cranes which stack them depending upon when and how they are scheduled to be loaded onto trucks and trains for onward carriage. Meanwhile, the shipside cranes reload the ship in stacks seven-high with each placed precisely in a pre-determined location for easier unloading at the destination port. Each of these technologies helps to reduce the amount of time that ships spend in port, shortening the distribution cycle and reducing costs.

As with FedEx and UPS, the largest shipping lines such as AP Moeller-Maersk and CGA CGM are diversifying from merely providing transport services to also playing an active role in working with manufacturing companies in planning their supply chains and distribution networks. Business practices at terminals operated by these firms have resulted in substantially shorter transportation times even as vessel steaming speeds have generally slowed over the past decade to aid greater fuel efficiencies. These shorter—and crucially, more predictable—times have combined with newer technologies to allow goods to be made in regions with the greatest comparative advantages and subsequently permitted more extensive distribution channels.

#### THE STATE AND FUTURE OF THE GLOBAL INDUSTRY<sup>30</sup>

In a reflection of the integration of economies and production systems, global logistics expenditure is expected to near \$2.9 tn by 2015<sup>31</sup>. As

30. A substantial portion of this survey is based on a paper provided by DHL India to the NTDP.

31. Based on calculations by DHL on Datamonitor Global Logistics Industry data and trends in regional logistics expenditure. Does not include spending on bulk carrier and tanker shipments.

## Box 4.9 Load Exchanges

Load exchanges are popular in many countries. For example, in the United Kingdom, the Haulage Exchange allows couriers, truckers and other transporters to post details of available capacity or freight requirements. Details on sizes, dates and the nature of the goods to be shipped are also entered. Software automatically matches available capacities with loads awaiting shipment, alerting both trucker and shipper, and then allowing them to negotiate on the actual terms. The use of such exchanges reduces the incidence of empty return loads, lowers costs and increases revenues, decreases fuel use, and is an environmentally sound practice. The exchanges essentially serve as the marketplace by aggregating and disseminating information. More recently, some exchanges have expanded to include information on runs that are scheduled in advance, allowing firms booking space on the vehicles to better plan their transportation requirements in advance.

The exchanges also serve other functions that help rationalise the industry. By building cross-platform software systems, they make information dissemination easier, and encourage firms to collaborate profitably. The exchanges lower the barriers to entry to the market by making it possible for new firms to seek more customers, and to make runs with smaller loads. The exchange also serves as a de facto quality control over the member firms, which is a useful function in an industry with several new or small-scale participants. In the future, it is inevitable that the software systems for the exchanges will be updated to link with GPS and other tracking information sources, allowing for increased certainty over shipments.

Source: Company websites and EIA (2010).

Table 4.2 illustrates, no bilateral trade route with India featured amongst the world's largest in 2009. By 2030, however, Indian trade routes with the United States, China, Netherlands (reflecting trade with the EU), and Singapore (reflecting trade with ASEAN region) are expected to be amongst the top 20 trade lanes in terms of value of goods shipped by air and ocean freight.

Another important conclusion to draw from Table 4.2 is that by 2030, Asia-related trade lanes are expected to account for almost 75 per cent of the value of goods traded on the top 20 busiest routes. Further, intra-Asian trade is expected to emerge as a major driver of international logistics revenues, accounting for a share 43 per cent of the value of goods shipped in the top 20 trade lanes. This suggests that India's external and internal logistics networks should be especially cognizant of the requirements of trade with other Asian countries in terms of the volumes, values and characteristics of goods traded. Air cargo is becoming increasingly a mode of choice for many exporters and importers, especially in trade routes characterised by geographically diverse supply chains. Global freight movement by air stood at 216 billion route tonne-kilometres (RTKM) in 2011, constituting a doubling over a decade, with a value of around \$10.8 tn<sup>32</sup>. Exports that depend on critical imported intermediate components for their production, and are sensitive to changes in retail market sentiment are especially dependent on air cargo, as

are products that are perishable and require time-sensitive, temperature-controlled environments. Important sectors like high-end textiles, electronics, engineering parts and components, and pharmaceuticals are dependent on air cargo for successful trade. The imported content of manufactures in these sectors is high, and exports too rely on quick access to offshore markets.

The air cargo industry comprises freight forwarders, dedicated cargo airlines, passenger airlines that supplement earnings by carrying belly cargo, and other arrangers of transport services. As compared to the express industry, generalised air cargo goods are delivered at lower speeds and lower prices by taking advantage of flexibility of resources such as by scheduling freight space on passenger aircraft as and when it becomes available. It is considered to be better suited to relatively low-value and high-volume products that must nevertheless be transported by air.

The express air industry on the other hand consists of dedicated providers of end-to-end air logistics services. The aim is to simplify and expedite the process of air transport by organising collections, usually arranging transport on its own aircraft, handling customs clearances as well as the payment of duties and taxes, as required. Value-added express services are also available, such as the ability to track shipments and by offering proof of final delivery. The express industry therefore requires access to airspace

32. Estimated by DHL and based on Boeing World Air Cargo Forecast 2011 estimates of share of air cargo in total freight movement, and world merchandise trade figures available in the World Bank Development Indicators database.

In India, many more clearance forms are required to import a shipment than other countries, and a substantially higher share of all shipments are subject to at least one, and sometimes several, inspections. These bureaucratic hurdles need reduction.

facilities to meet the global standards of speed and reliability for goods that are typically higher-value and more time-sensitive than those shipped by generalised air cargo.

#### **EVALUATING THE LOGISTICS INDUSTRY AROUND THE WORLD AND MAJOR GLOBAL ISSUES**

The World Bank's Logistics Performance Index (LPI) contends that a country's logistics performance is strongly reflected in the reliability of its 'supply chains and the predictability of service delivery available to producers and exporters. Supply chains only as strong as their weakest links are becoming more and more complex, often spanning many countries while remaining critical to national competitiveness.' This publication, issued every two years since 2007, has become the standard tool for measuring the pervasiveness and resilience of these modern supply chains as measured by delivery time, cost, flexibility and reliability. It is intended to be a single indicator that evaluates the contributions that government services, investments and policies make to the extant state of the logistics industry. It measures the efficiency of the border clearance process in terms of its speed, simplicity and predictability; the quality of transport infrastructure; the ease of arranging competitively priced shipments; the competence and quality of logistics services; the ability to track and trace consignments; and the frequency with which shipments reach the consignee within the scheduled or expected delivery time<sup>33</sup>.

India ranked 46<sup>th</sup> in 2012, and the highest amongst a peer group of middle-income countries which include the Philippines, Indonesia and the Ukraine. (See Table 4.3 for the best performers.) Indeed, it ranks higher than Mexico and performs almost as well as Brazil and Thailand, leading the authors to conclude that India is amongst the most over-performing of the non-high-income countries. The LPI's cautions in interpretation, however, would seem to particularly apply to India. Being a large and diverse country it is unlikely that there is uniformly strong logistics performance across the nation. Instead, the results are more likely to be boosted by islands of

excellence with most commerce originating and terminating at the metro cities.

Throughout, whether a country is high-, middle- or low-income, the low LPI score indicates that market participants are dissatisfied with the state of transport infrastructure, and especially with rail infrastructure. Within the South Asian region, however, roads and highways are considered the dominant limiting factor to better logistics performance. Relative to the satisfaction with infrastructure, logistics service providers are generally considered to deliver better performance, no matter which country they operate in.

Table 4.4 presents data on procedural issues such as customs and border control. The LPI notes that time taken in shipment can be especially reduced at the stage when goods are presented for import clearance. Delays at this stage are associated with red tape, excessive and opaque procedural requirements, and physical inspections. As shown in Table 4.5, at least some of India's logistics performance can be explained by the facts that many more clearance forms are required to import a shipment than in other countries, and a substantially higher share of all shipments is subject to at least one, and sometimes several, inspections. Low-income countries' export clearance protocols are long and complex vis-à-vis those for imports, and relative to those in other countries. The resulting long leads reduce the international competitiveness of exports from these countries.

On the whole, the best performing regions in logistics are the OECD countries (though there is marked variation between them), and the export-oriented developing countries of East Asia. The OECD countries exhibit streamlined processes to import and export container and other traffic with much standardisation of information and communications technologies. These standardisations encourage cross-border trust and result in faster processing times. Generally, supporting infrastructure like warehousing and cold storage and intermodal transfer facilities are quickly constructed and considered central to the building of the logistics network. Meanwhile, in fast-growing East Asia the rapid expansion of exports has resulted in huge increases in port and other transport infrastructure capacity. Against this, and as expected in transition economies, the supply and distribution chains in these countries are long with many intermediaries leading to operational inefficiencies, duplication and fragmentation, suggesting further room for improvement.

33. The LPI is constructed by statistically aggregating the opinions of logistics professionals from companies responsible for moving goods around the world. Several countries have demonstrated massively better logistics industry performance over the past three editions of the LPI. For example, Morocco's ranking jumped from 113 in 2007 to 50 in 2012 on the strength of a rapidly implemented strategy that made use of the country's proximity to Europe, and by effectively harnessing private enterprise to focus on improving the procedural elements of intermodal freight transport. Meanwhile, the Index rankings have spurred South Africa, Indonesia and Malaysia into setting out national logistics strategies and reporting on the performances achieved.

Table 4.6  
**Cargo Dwell-Times at Airports Around the World**  
 [Hours]

AIRPORT	EXPORT DWELL TIME	IMPORT DWELL TIME
Singapore	6	4
Incheon	3	5
Dubai	3	4
Hong Kong	4	6
Delhi	36	129
Mumbai	48	96
Bengaluru	36	48

Source: Working Group Report on Air Cargo Logistics in India, Ministry of Civil Aviation.

### THE EVOLUTION OF THE LOGISTICS INDUSTRY

In concluding this section, it is useful to provide a sketch of the evolution of the logistics industry. This is the path that governments, manufacturing firms and service providers in other countries have already beaten down, and a highly plausible one that Indian counterparts will follow as the economy develops and grows. Consequently, the following taxonomy of service provision may be helpful in understanding the extent and continuing evolution of the industry. Traditional logistics services providers arrange for transport and warehousing, with freight forwarders and courier companies being prime exemplars<sup>34</sup>. As experienced arrangers and coordinators of transport services, freight forwarders rationalise and organise the supply of ocean- and air-freight services on behalf of small and medium trading firms. Fragmented trading and transport industries as well as complex customs procedures and non-harmonised regulations mean that there is a continued need for mediation of type provided by freight forwarders, as is the case in India presently.

As transportation industries consolidate and modernise, as physical infrastructure is improved and expanded, and as regulatory processes are streamlined and harmonised to global standards, third-party logistics providers will supplement traditional logistics services in India. This has already happened in the developed economies. Third-party logistics providers (3PL) supplement the basic services with inventory management, packaging and labelling, product return and offer an end-to-end service. Manufacturing firms seek to outsource their logistics needs to these third-party providers

to take advantage of their expertise and networks, or because they do not process sufficiently large volumes to justify dedicated logistics infrastructure, and to reduce the costs associated with arranging transport themselves. 3PL providers offer industry-custom supply chain solutions such as testing, inspection and reverse logistics. The end-to-end control over cargo is critical, and 3PL providers rely heavily on developing efficient processes, such as in backhaul management and route optimisation, and on harnessing technologies such as GPS and RFID<sup>35</sup>.

With a \$165 billion market, Europe is the largest regional market for 3PL, followed closely by Asia at \$158 billion in second place. India is a relatively small market for 3PL, with an estimated size of \$1.5 billion, or just 0.3 per cent of the world market. At around 10 per cent, 3PL penetration in India is far lower than in industrialised economies (Europe at 40 per cent; United States at 55 per cent; Japan at 90 per cent)<sup>36</sup>. At present, Indian firms tend to aggressively outsource domestic transportation and fleet management, given the high levels of asset specificity, and customs brokerage functions due to regulatory complexity. The practices in Indian industry reveal that warehousing, transportation, custom clearing and forwarding are the most frequently outsourced activities<sup>37</sup>.

Finally, though a precise distinction is often unclear, some third-party logistics firms have transformed into the so-called fourth-party service providers by working closely with the manufacturing firm to devise integrated supply chain management solutions, providing consulting services to match supply with demand, and assisting with network and cost

34. The size of the freight forwarding industry in India was about \$4 billion in 2006, and has since doubled to about \$8 billion by 2011. It is expected to cross \$13 billion by 2015. (DHL submission to the NTDPCC.)

35. KPMG (2012).

36. Sahay and Mohan (2006).

37. Ibid.

## Box 4.10

### Modern Terminal Facilities

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 amount 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 more and more quantities and volumes of goods. Indeed, in case of mineral traffic, it is figuratively 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. Indeed more often than not, the capacity at the terminals determines the capacity on the transport columns.

All over the world, goods sheds of yesteryears have given way to new facilities often called freight centres, logistics parks, dry ports, etc. These termini are designed to perform multitude of logistics services including even that of consolidation, packaging and distribution of goods. They also act as nodes for multimodal transport and are well endowed with transport connectivity.

These developments imply a need for significant investment in scaling up of facilities and technologies at the existing and new terminals across the movement chain. It is equally necessary to include logistics parks as an essential component of the emerging economic corridors. To give fillip to the related infrastructure, there is a convincing case for granting an industry status to the logistics and warehousing sector.

Source: Asian Institute of Transport Development, Journal of Transport infrastructure, Volume 16, 2009.

optimisation<sup>38</sup>. The firms complete the distribution channel for firms too, by not just delivering products to customers but by also providing installation, assembly and minor repairs.

### GAPS IN THE INDIAN LOGISTICS SECTOR

The current state of the logistics sector in India can be crudely characterised as largely unsophisticated, lacking in organisation, somewhat neglected by policy, and hamstrung by a shortage in skills. This is manifest in the observed inefficiencies of the sector. There are, however, significant pockets of excellence. For example, the automobile manufacturing industry and local service providers have developed transportation, inventory management and warehousing systems to rival those of the international gold standards. On the whole, a blunt appraisal of the sector's future reaches the inevitable conclusions that it is of both enormous potential and of critical importance to the nation's ambitions. This section explores the present structure of the industry as a prelude to the reforms proposed in next subsection. Detailed status reports on physical infrastructure in the form of roads, railways, ports and airports are available in Volume III of this report. Here, the focus is on industry trends, service provision and on gaps in those pieces of physical infrastructure that are dedicated for logistics purposes.

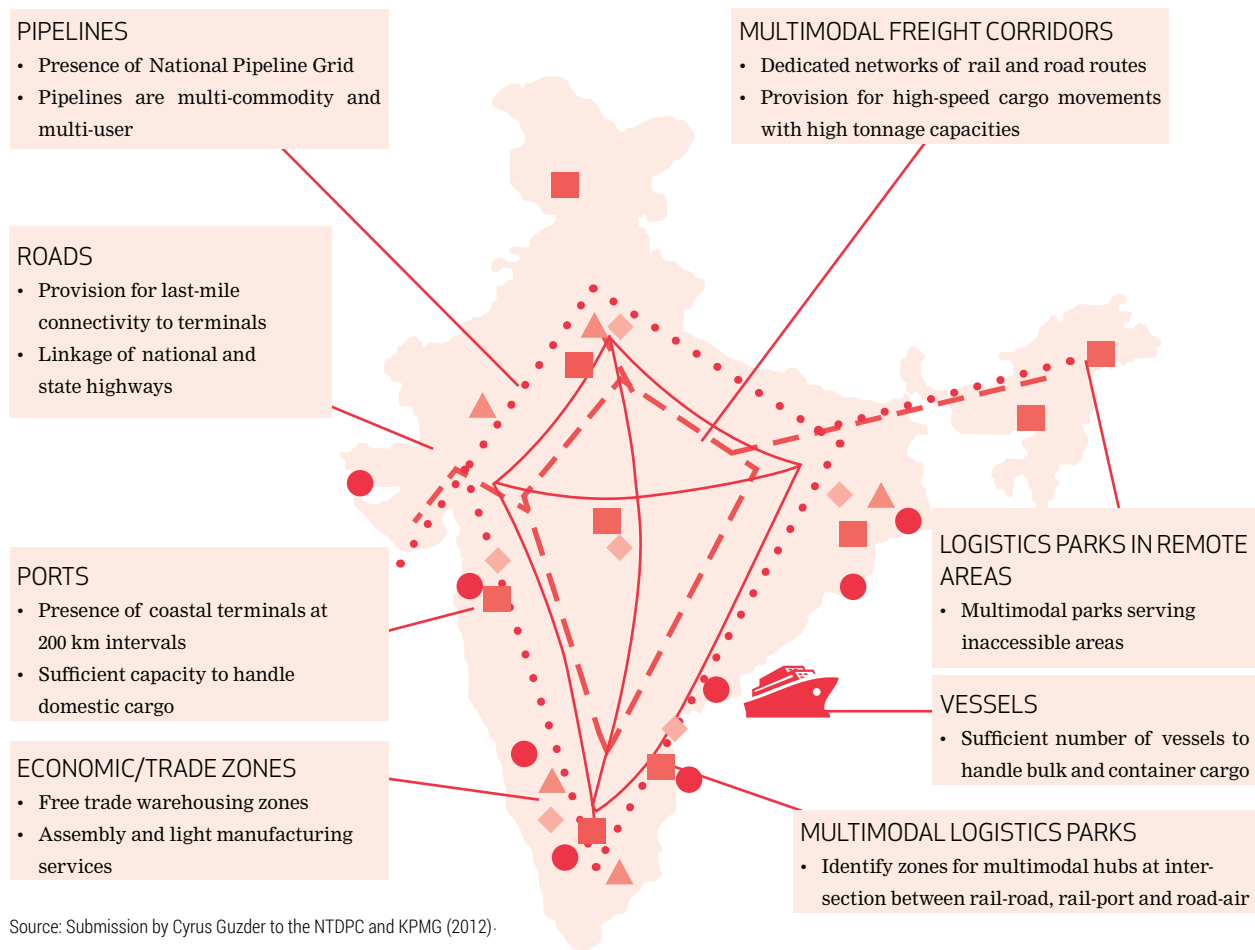
38. KPMG (2012).

39. Gupta et al. (2010).

A common observation to be made of Indian logistics flows is that they are highly concentrated along certain corridors that link the largest metropolitan cities. This leads to the conclusion that transport and logistics infrastructure along these corridors should receive priority funding and development. However, it is tempered by observing that the causality is likely to run in the other direction as well. The infrastructure and availability of services along these corridors is already, though relatively, superior to that connecting with the more minor urban centers. This means that the observed concentration of traffic patterns is likely to be overstated with significant transshipment at the metropolitan cities for distribution into the wider hinterlands. This offers additional impetus for the founding of investment decisions on the basis of detailed origin-destination traffic studies as noted in the previous section.

Another common complaint related to logistics movements is the absence of last-mile links. Ports connect insufficiently well with the rail and road networks. The rail and road networks do not themselves offer efficient points of interchange for each to be harnessed to its best advantages, resulting in sub-optimal energy usages and higher costs as rail's last-mile disadvantages prove debilitating. On the whole, as noted in one study on Indian logistics, the country's exports are rendered less competitive due to higher transit times and reduced reliability, and imports priced higher at the shop front, with the overall burden amounting to 4.3 per cent of GDP every year<sup>39</sup>.

Figure 4.1  
**The Desired State of Indian Logistics Infrastructure**



With logistics services being primarily a private sector undertaking, the government's role is largely restricted to deciding policy and providing infrastructure. Government may choose to provide this infrastructure of its own accord, in partnership with the private sector, or merely by enabling private investment. Meanwhile, as elaborated below, in nearly every sector related to logistics, the prevailing regulations are unclear, overlapping, or stifle needed efficiencies.

As for service provision by the private sector itself, logistics in India has been driven by the objective of reducing transportation costs that have been inordinately high due to regional concentration of manufacturing and warehousing, the geographic diversification of final distribution, as well as inefficiencies in infrastructure and accompanying technology. In turn, the regional concentrations have been motivated by the differential taxation and regulatory regimes of the states. Meanwhile, the reliability of services provided is considered to be low, with long fulfilment times and requiring a high degree of customer engagement, resulting

in concomitant increases in the variable costs of freight transport.

#### THE DECLINING SHARE OF RAIL IN FREIGHT TRANSPORT

The abiding story of freight transport in India has been the steady and unceasing decline in the share of traffic carried by rail versus that transported by road. It is a well-known story (Chapter 2, Volume II). However, given that one of the most important recommendations of this report is the urgency of arresting this decline, the story is one that is worth repeating briefly. In 1951, around 90 per cent of India's freight traffic was carried by rail. Though the first decade of the new republic saw only a modest decline in rail's share, the next 20 years were less forgiving, and the gap had narrowed to a 60-40 split in favour of rail by 1981.

The decline has since accelerated. The liberalisation of the economy, the growth of markets in tier-II and tier-III cities, the expansion of trade, the dramatic increases in investment in the highway network, the subsidies extended to diesel fuel, and the discriminatory pricing of rail freight vis-à-vis passenger

transport have all conspired to now leave rail with a roughly 30 per cent share of freight movement today. Other factors also contribute to the second-class treatment of freighted goods on Indian rails. The prioritisation of passenger traffic over freight means that the latter suffer elongated and uncertain travel times. As noted previously, the certitude of a pre-defined delivery schedule is almost as important in logistics as total transportation cost. Railways' inability to provide these guarantees results in substitution away to the higher cost but time-bound road-based alternatives.

In the absence of more flexible practice, customers usually engage point-to-point trucking services on a full-load basis. Further inefficiencies result when for short- to medium-haul distances, trucks are forced to return to base, empty.

Further, most rail terminals used for loading and unloading of freight are antiquated with limited options for accessing and evacuating cargo. There is reduced flexibility in carrying certain kinds of products<sup>40</sup>. The accommodation of freight on Indian railways has exhibited a marked preference for commodities that generate sufficient traffic to warrant dedicated full rakes. For higher value goods requiring transportation in lower volumes but to a more regimented

schedule, Indian railways' container services have proved less attractive than they might have been.

The economic consequences are that goods are freighted inefficiently by road adding to their total cost, and reducing the competitiveness of exports. This does not include the generalised deleterious effects of distorted markets. The environmental consequences can be measured in terms of greenhouse gas emissions and energy usages that are higher than they need be, congestion and other effects.

#### INDIA'S TRUCKING INDUSTRY AND ROAD FREIGHT

The transportation of large volumes of freight Indian roads are typically done by an unorganised trucking industry. About 75 per cent of trucking firms own small fleets of less than five trucks, with only 11 per cent operating more than 20 trucks<sup>41</sup>. These trucks are usually all-purpose, used for transporting everything from agricultural produce to steel products to higher-value electrical items. Poor maintenance and low-quality spare parts rapidly reduce operational efficiency of trucks. Light trucks and double-axle trucks dominate the Indian trucking industry as narrow and badly maintained roads have traditionally

been forgiving only of smaller and nimbler vehicles, and as regulations prohibiting the overloading of vehicles have been poorly enforced. The small vehicle sizes and rampant overloading mean that Indian trucking costs are amongst the lowest for bulk and heavy goods, but the cost for relatively lighter products—electronics, pharmaceuticals, chemicals, etc.—is substantially higher.

In the absence of more flexible practices, customers usually engage point-to-point trucking services on a full-load basis. Further inefficiencies sometimes result when for short- to medium-haul distances, trucks are forced to return to their base without a load. (See Box 4.9 for examples of how load exchanges can help eliminate empty backhauls.) There is relatively low penetration of tractor-trailer units, of flatbed trucks suitable for container carriage, and of specialised vehicles for refrigerated transport. On the whole, the industry is intensely competitive with low barriers to entry for either operator or driver, a high degree of substitutability, and significant bargaining power vested with the purchasers of trucking services. The capital required to enter the market is small, the licensing regime is not overly strict, and only basic skills and qualifications are requisite<sup>42</sup>. Service quality in terms of keeping to schedule and ensuring safety are not made priorities.

A few hundred logistics firms count amongst the larger fleet operators, offering an extensive network, limited transshipment at their own facilities, and limited value-added services like track-and-trace technologies. To varying degrees, these firms now offer warehousing and container rail transport, cold-chain logistics, and single-window cargo management solutions. Finally, a few industrial sectors, such as automobile manufacturing, have circumvented the limited trucking options available by operating their own fleets of dedicated transport or by working closely with more sophisticated logistics providers to develop their own supply chains and distribution strategies.

Once on the road, the rickety trucks face problems that are not limited to potholed roads or clogged highways which reduce their speeds to about a third of that achieved by developed-world counterparts. On a trans-national journey, they are stopped at multiple checkpoints for inspections, payments of tolls and taxes, octroi and so forth. It is well-acknowledged that many of these payments have no legal founding, and unjustly add to the transportation costs. The 11<sup>th</sup> Five Year Plan notes: 'Vehicles moving on interstate routes remain stationary about 40 per cent of the time in the process of being thus inspected. The World Bank has estimated that truck delays at checkpoints cost the Indian economy anywhere between

40. 'Special wagons are not easily available for carrying specialised products. For example, special types of steel required for automobile production have to be carried by trucks as the existing wagons do not offer the kind of protection that these high value products require. While customers are allowed to request for new wagon designs, the process of getting these wagon designs approved by railways is cumbersome.' Deloitte and ICC (2012).

41. CRISIL (2009).

42. KPMG (2010).

Rs 9 billion to Rs 23 billion<sup>43</sup>. These delays result in Indian trucks being used, on average, for about 60,000 to 100,000 km per year, a figure that is less than a quarter of that in developed countries.

The high degree of competition within the trucking industry places pressures on the prices charged. Margins are then recovered by cutting costs, such as by hiring drivers with suspect licenses, overloading, compromises on maintenance, each of which contributes to a high incidence of accidents and mechanical failure. Regulations on licensing, overloading and vehicle roadworthiness are ineffectually enforced, contributing to rapid deteriorations in road quality, reduced speeds, driver fatigue and accidents<sup>44</sup>.

### PORTS, COASTAL SHIPPING AND INLAND WATERWAYS

Container traffic at India's ports is the second largest but the fastest growing category of freight processed. In 2011-12, the major ports, which handle nearly all of India's container trade, loaded, unloaded or transhipped 120 million tonnes of container cargo<sup>45</sup>. Though container traffic has grown rapidly, the total quantities processed are still well short of international benchmarks. In processing larger quantities of container shipments, ports are hampered by many factors. First, inadequate drafts and port capacities prevent the largest container ships from calling at Indian ports<sup>46</sup>. Second, relatively little transshipment traffic is directed by shipping lines for processing at Indian ports. Third, poor road and rail connectivity to several ports hampers the efficient removal of all freight, but especially of containers. Fourth, the relatively small numbers and extent of inland container depots mean that much of the traffic must be cleared on-site upon landing at coastal ports. Clearance procedures for customs, security and bio-security, are slower and more involved than international standards, with physical inspections often called for, increasing cargo dwell-time at ports and raising costs. Fifth, limited availability and use of material handling equipment and the latest automation technologies at the ports also slows vessel turnaround times, reduces the certainty—and hence the usefulness—of time-bound freight movement, and also increases the time that ships must idle at sea before berths become available. Sixth, charges related to payments for container and port terminal operations, to port authorities, container freight station operators, and a host of other services are a part of the comprehensive cost burden borne by shippers to India. These costs tend to be relatively higher than comparator countries in Asia, especially when put in the context of the quality of services available. Each

The high degree of competition within the trucking industry places pressures on the prices charged. Margins are then recovered by cutting costs, such as by hiring drivers with suspect licenses, overloading, and compromises on maintenance.

of these factors is explored more fully in the chapter on Ports and Shipping (Chapter 4, Volume III). Together with high prices for marine fuel (relative to that used for land-based transport which is subsidised), these factors combine to ensure less-than-desirable use of coastal shipping<sup>47</sup>. Finally, container traffic on inland waterways is negligible with neither barges nor docking facilities available on the major routes<sup>48</sup>.

### FREIGHT MOVEMENTS BY AIR

Indian airports currently handle 2.4 million tonnes of cargo, and are expected to handle about 7 million tonnes by 2020, representing a CAGR of 14.7 per cent<sup>49</sup>. Transshipment of air cargo through Indian airports is expected to become an important business. The transshipment share is assumed to become 5 per cent of total international air cargo volumes handled by Indian airports by 2015-16, and to increase by one percentage point each year thereafter over the next two decades<sup>50</sup>.

Indian airports, including the new airports developed in Delhi, Bengaluru and Hyderabad, have not adopted the best practices for enabling express logistics. These best practices are marked by the availability of dedicated and exclusive handling facilities for express operators, including aircraft parking and transit bays adjacent to on-airport warehouses and the audited delegation of the handling processes to the express air cargo industry. In the absence of these dedicated facilities, the dwell-times for air cargo at Indian airports are substantially higher than in other countries. These high dwell-times are a direct consequence of the following infrastructural deficits: a shortage of landside truck docks, vehicle holding areas and air side operational space; insufficient entry gates; inefficient and insufficient handling equipment and trolleys; the absence of specialised storage and handling facilities for hazardous, radioactive, valuable or perishable cargo; poor quality roads that link airports to cities and the hinterland; an emphasis on physical checks on entry and exit of cargo from bonded areas at the expense of technological solutions; and finally, a lack of on-airport support services such as warehousing and packaging facilities.

43. Planning Commission (2010: 25).

44. Ibid.

45. Chapter on Ports and Shipping in Volume III of this report.

46. Recommendations for major ports in Chapter on Ports and Shipping in Volume III.

47. Present capacity estimates for container shipments along coastal routes are for around 14,000 containers per month, almost all of which is along the West Coast.

48. There is minimal traffic of around 200 containers per day on National Waterway 3 in Kerala. (See chapter on Ports and Shipping in this report.)

49. Ministry of Civil Aviation, Government of India.

50. Working Group Report on Air Cargo Logistics in India, Ministry of Civil Aviation.

## Box 4.11

### Freight Facilities at Hong Kong Airport

Hong Kong International Airport (HKIA) was the world's busiest cargo airport in 2012, just holding off Memphis from the top slot. In 2012, total cargo throughput was in excess of 4 million tonnes carried on 51,000 flights, or about 140 each day. (In comparison, the total international cargo throughput of all Indian airports was around 1.2 million tonnes in 2011-12.) With Hong Kong pressed for usable real estate, it is notable that the entire airport is situated on an island that is largely reclaimed from the sea.

The Asia Airfreight Terminal is designed to handle 1.5 mn tonnes of cargo per year on 8 hectares with a gross floor area of 17,000 square metres. It is equipped with a fully automated cargo handling system with special facilities for dangerous or radioactive cargo together with specially-trained staff, and for perishable goods required cold rooms or freezers. It boasts 97 workstations for build-up and break-down operations, together with transfer vehicles, scissor lifts and cargo hoists.

Several value-added services are available at the terminal including:

- Cargo security screening to ensure compliance of shipment with air carriage security regulations;
- Re-labelling and re-packaging of bulk shipments into smaller ones or vice versa;
- Scheduled release of empty unit load devices such as pallets and containers to allow freight forwarders to better plan logistics;
- Import shipments arranged at truck docks at pre-arranged times;
- Advanced pallet and container handling systems that automatically store and retrieve from nearly 5,000 bulk cargo positions and 1,750 built-up cargo positions;
- Collection and delivery of unit-load devices (such as pallets and containers) from throughout Hong Kong.

On more than 95 per cent of all occasions, the terminal achieves stringent standards on truck queuing time (less than 30 minutes), export cargo reception (less than 15 minutes), import cargo collection (less than 30 minutes), and release of empty containers and pallets (less than 30 minutes). It achieves all of these at a mishandling rate that is about 1 in 20,000 unit-load movements.

The AAT is not the only freight facility at HKIA. The DHL Central Asia hub is capable of processing up to 30,000 packages and 40,000 pieces of mail every hour on a total land area of 3.5 hectares. Hong Kong Air Cargo Terminals with a design capacity of 2.6 mn tonnes of cargo per year, occupy 17 hectares, with direct connections to other urban conurbations in the Pearl River Delta. Further, there are air mail centres run by Hong Kong Post, dedicated cargo terminals run by Cathay Pacific and other airlines, a marine cargo terminal that provides one-stop multimodal service links with 18 ports in the Pearl River Delta.

By 2030, HKIA expects to process nearly 9 million tonnes of cargo, and its latest master plan already argues for the construction of a third runway and expansion of the airport island.

Source: DGCA, Hong Kong Airport and facility websites.

On the procedural front, the following regulatory shortfalls can be identified. The important agencies that regulate trade in food, drugs, chemicals, biological matter and textiles do not have dedicated facilities or laboratories at airports in most cases. Staffing at these agencies has not kept pace with the volumes and varieties of products now traded that must be inspected. Next, operators of cargo terminals must maintain separate licenses for handling areas that process inbound or outbound cargo, and for transshipment cargo. Customs clearances are not available around-the-clock or on demand, and the pricing

model for these services imposes high threshold costs on air cargo operators, discouraging volume efficiencies.

#### WAREHOUSING

Until a decade ago, warehousing in India was synonymous with basic four-walled structures with sub-optimal sizes, inadequate ventilation and lighting, poor hygiene conditions, and marked by the absence of racking, inventory management, or technology solutions<sup>51</sup>. By one estimate, 433 million square feet of warehouse space existed in India in 2009. Of this,

51. KPMG (2010).

only 8 per cent was organised with nearly 30 per cent under direct public administration and 44 per cent under in-house private management.

These warehouses are of poor quality and inadequate for meeting the specialised needs of modern manufactured products and business processes. The large majority of publicly administered warehouses are used for long-term storage of food, and to fulfil shorter-term requirements for public distribution schemes for grain. The absence of cold-storage facilities, and especially ones that are integrated along the food supply chain, together with insufficient protection from pests, thefts and the elements results in an enormous amount of stored grain that is lost or spoiled. With a renewed focus on ensuring food security as the marquee development priority, India can ill-afford this continuing wastage. The absence of scale in the warehousing industry prohibits both the cost-effective adoption of new technologies resulting in lower productivity, and the provision of value-added services like specialised packaging and temperature-controlled environments at competitive prices. Further, the absence of enforceable and enforced quality standards and benchmarks in creating new facilities, hampers efficiency.

Finally, differential retail and consumption tax rates across the states prevent warehouses to be located optimally from a supply-chain perspective; instead, the warehouses often migrate to the lowest-tax jurisdictions. The mandates wielded by various regulatory authorities over warehousing are often in conflict, and the regulations themselves require clarification. For example, the rules related to the storage and handling of pharmaceutical products are governed by Schedule M of the Central Drugs and Cosmetics Act of 1945 (with amendments in 2010), while the norms that define compliance with these regulations are designed by state-level food and drug administrations. In most states, such norms insist on physical separation of inventory, not by product, but by client (i.e., by pharmaceutical producer or distributor), with separate security and personnel for every client. Essentially, this entails the setting up of several separate smaller warehouses within a larger warehouse. In turn, this results in some logically perverse outcomes: the same class of pharmaceuticals requiring the same temperature controls but manufactured by different firms must nevertheless be maintained in distinct storage areas; product-specific skills and management is discouraged and separate personnel must be maintained for the same class of products preventing scale economies from developing.

Differential retail and consumption tax rates across states prevent warehouses to be located optimally from a supply-chain perspective; instead warehouses often migrate to the lowest-tax jurisdiction.

## THE FUTURE OF INDIAN LOGISTICS

India's growth ambitions require supportive logistics policies and service environments as essential enabling factors. In the near term, the driving factors for the anticipated growth in logistics can be found in forecasts of growth in international trade and interstate commerce (Chapters 2 and 3, Volume II). In the more distant future, the expected growth in logistics can be hung on the long-term secular themes defined in the first section of this chapter.

### THE FUNDAMENTAL DRIVERS

Perhaps the most important amongst these is the country's changing demographic profile with the attendant urbanisation, industrialisation, and concentration of industry. It is anticipated that over 60 per cent of India's urban population will be concentrated in 20-25 urban clusters by 2030<sup>52</sup>. Urbanisation and clustering will also lead to the development of specialised industrial agglomerations and satellite cities to serve these clusters. The clusters will need dedicated freight corridors such as the Delhi-Mumbai Industrial Corridor currently under development with high-speed connectivity to key ports and urban centres. These corridors and access routes will help to keep the cost of supplying goods and services to these urban centres low or manageable. In practical terms, establishing the desired logistics strategy to accommodate this urbanisation trend will involve (a) identification of existing, evolving and planned urban centres; (b) identification of sites for a clustering of warehousing and storage facilities to service these hubs; (c) creation of dedicated cargo routes for speedy access of supplies into local wholesale markets and (d) use of intra-city transportation for supply to retailers.

At the same time, the logistics industry and infrastructure will also have to keep pace with the increasing sophistication of manufacturing processes and outputs which will require their own dedicated logistics systems. Existing infrastructure will become obsolete as international standards are introduced in a competitive service-oriented environment. For example, existing, small 'godowns' will need to be replaced by larger, modern warehouses incorporating global standards such as taller designs, modular racking systems, palletisation and the usage of automation and information technology. The growth of specialised industries will necessitate value-added

52. KPMG (2012). The report of the Working Group on Logistics from the Planning Commission suggests the following 15 locations as suitable for situating logistics parks: Ludhiana, Rewari, Mumbai, Kolkata, Chennai, Bengaluru, Kishangarh, Ahmedabad, Hajira, Vadodara, Vapi, Durgapur, Nagpur, Hyderabad, Sriperumbudur.

services, such as cold chain warehousing, packaging and track-and-trace services. In short, the new profile of domestic and international trade will require commodity- and geography-specific storage and transportation assets. The non-availability of such required assets will hinder the investment potential of trade in other parts of the economy.

As noted earlier, India's logistics sector is currently constrained not only by insufficient or inadequate infrastructure, but perhaps even more so by the misuse of transportation modes for the wrong type of commodity and limits on the free use of

The desired 'end state' is an overlay of transport networks, with natural transition nodes where quantities are aggregated and disaggregated for more efficient transport on the best mode for a commodity for a particular stage of the journey

transportation modes in others. At present, raw materials form the bulk of cargo movements in India (around 60 per cent), but have a relatively low value per unit of volume. These need to be moved from point-to-point over long distances. The movement of raw materials entails effective handling at logistics terminals and seamless multi-modal transportation, such as the movement of coal by coastal shipping, rail and road. For these goods, the importance of timely

delivery is superseded by the requirements of ensuring low costs and secure shipments. On the other hand, capital goods and goods used for manufacturing have a moderate value per unit volume, and consumption is often concentrated in and around urban clusters. The goods are shipped over medium distances and transportation priorities are efficient, on-time delivery, together with the possibility of tracking shipments and the use of specialised vehicles or carriers. Finally, consumer goods account for a relatively small proportion of cargo volumes, but have a high value per unit of volume. These need to be moved over short distances and require high degrees of customisation in terms of transportation modes and in terms of storage and transportation assets based on the characteristics of the cargo. The timeliness and reliability of movements take precedence over maximisation of transport asset utilisation.

The volumes for all of these classes of goods will grow, with the transport of bulk goods achieving such critical importance that it is addressed separately in Chapter 8, Volume II. The optimal movement of freight by matching of cargo category with transportation mode will be crucial in a scenario of expanding volumes across categories. Lopsided utilisation of transportation infrastructure such as road and rail, as is the case currently, stresses networks in addition to inflating costs and turnaround times. A

need exists to incentivise optimal selection of modes to reduce congestion and enable smooth movement of cargo. The government also has a normative and prescriptive role to play; for example, by directing that bulk goods only be moved by rail, coastal shipping and inland waterways.

#### THE DESIRED END STATE

The desired 'end state' is an overlay of transportation networks, allowing for the efficient transportation of each commodity type as well as natural transition nodes where quantities are aggregated and disaggregated for more efficient transport on the best mode and gauge for a particular stage of the journey. A brief synopsis of this desired 'end state' is captured in Figure 4.1.

In practical terms, these desired outcomes are a reversal in the mode-share between rail and road, making inland water transport and coastal shipping more attractive, achieving seamless transfer between transport modes and gauges, and hubs for processing, storage, transshipment and onward distribution. Specifically, it is desirable to bring rail's mode-share of freight transport equal to that carried by road (50:50), to increase the share of liquid bulk cargo transported via the pipeline from 55 to 80 per cent (as is the international average), and to substantially increase the mode-share of coastal shipping and inland waterway transport from the currently discouraging share of 6 per cent. This rebalancing from road to rail and the more effective harnessing of the lesser-used transport modes—pipelines and water—can serve to reduce India's transport fuel requirement by 15 to 20 per cent and cut logistics expenditure by 0.5 to 2 per cent of GDP, together with providing non-financial benefits in the form of reduced air pollution and increased energy security.

In summary, the desired state of the logistics infrastructure in India can be encapsulated as follows. First, roads must provide for last-mile connectivity to rail-yards and maritime ports, and there should be good links to the national and state highway networks. Second, dedicated rail freight lines should parallel the corridors of the major movements of goods shipments across the country, and should be worthy of consideration as the premier mode of transport for all but the highest-value commodities above defined break-even distances. These lines should provide for high-speed cargo movements with high tonnage capacities. To support the efficacy of these corridors, roads should link readily with rail, and especially at specialised transshipment junctions or logistics parks. Meanwhile, major ports capable of servicing bulk carrier and container ships with the large beams and drafts that are commonly deployed on international routes should be located relatively evenly along India's coastline. The ports should also possess sufficient capacity to handle domestic cargo.

## THE ROAD (AND RAIL) TO INTEGRATED INTERMODAL TRANSPORT

The first section of this chapter identified the theoretical underpinnings of an integrated logistics policy for freight transport, motivating this by the key observations that logistics are inseparable from the value proposition of a good. To achieve freight transport that is timely, reliable, and cost-effective, a set of policies and practices must be instituted to ensure that the most efficient transport mode is chosen for each commodity or class of product, and at each step of the journey to which it is best suited. This section details the policies and practices that will deliver the desired outcomes. There is natural overlap between the policies and practices that can be recommended to achieve multi-modal efficiencies for the carriage of freight, and those recommended for an individual transport mode. Here, only the former are set out, occasionally in abbreviated form, with the caveat that these must be read in conjunction with the extensive mode-specific documentation in Volume III.

### ROADS AND TRUCKING

For a rebalancing of the multi-modal transport system in India, it is critical that the road sector become more efficient as well as less dominant. The focus should there be on maximising its advantages over other modes that lie in its extensive reach, its last-mile superiority, and its nimbleness and flexibility to deliver smaller volumes at higher frequencies to more destinations. In short, the structure of movement of freight over roads will best serve the country if its performance is maximised over short distances between urban centres, ports, airports, inland container depots and logistics parks, and the surrounding hinterland.

In the future, Indian trucking must become more adept at processing less-than-truckload (LTL) consignments, which are conventionally defined as those weighing-in at less than 10,000 pounds (or 4500 kg). The handling required to provide this service is greater than that needed for full truckload shipments<sup>53</sup>. To maintain the safety and integrity of different shipments, truck carriages will need to feature modern design elements including segregation, compartmentalisation and specialised locking systems. The driver of the vehicle must acquire trucking as well as inventory management skills. With multiple loads being loaded and unloaded at multiple origins and destinations, such trucking services place special demands on the service provider. They must develop route configuration systems as well as devise processes for handling and ensuring compliance for different kinds of shipments. LTL services are likely to prove a boon to small and medium manufacturing enterprises, which may not ship sufficient volumes on certain routes to justify full

For a rebalancing of the multi-modal transport system, it is critical that the road sector become more efficient and less dominant. The structure of movement of freight over roads will best serve the country if its performance is maximised over short distances between urban centres and the surrounding hinterland.

truckload shipments. LTL services will also require substantial consolidation within the industry, as efficient service-provision can only be achieved with an extensive network, with a large and differentiated fleet of vehicles, and substantial investment in back-office management.

Though the government may choose to encourage this consolidation with a standard arsenal of industry tax holidays and other subsidies, it is preferable instead to resolve other regulatory hurdles and market failures such that the required consolidation may eventuate organically. These regulatory hurdles include simplifying the documentation required of truck movements, and reducing unjustifiable excise duties on multi-axle trucks<sup>54</sup>. It should also be noted that multi-axle vehicles cause less damage to roads than two-axle trucks. These vehicles offer cost reduction not merely in terms of lower line-haul costs per tonne-km but in terms of increased loading and unloading efficiency and in maximising transfer of loads between vehicles and modes. Since the benefits in terms of lower road damage do not accrue to the user, lower excise and differential taxation on multi-axle vehicles is justifiable. As noted earlier, prevailing road conditions, lax oversight on overloading, and the constrained liquidity of a fragmented trucking industry have each resulted in a preference for smaller all-purpose trucks, rather than for more sophisticated multi-axle vehicles.

It should also be noted that larger vehicles increase the costs associated with empty backhauls. This lack of demand has perhaps been the largest cause for domestic suppliers shying away from manufacturing this class of trucking vehicle. More recently, however, the situation is changing and some domestic manufacturers have begun to bring the more sophisticated vehicles to market.

Industry consolidation will also help as well as be influenced by another operational measure designed to improve efficiency: the use of the tractor-trailer. These trucks separate the payload from the propulsion mechanism, allowing a single tractor to pull multiple trailers. Fewer engine-units are required, and idling time for these during loading and unloading is reduced. System flexibility improves as a single tractor can be used to haul different types of specialised trailers or containers. Finally, there is better

53. DHL, in submission to NTDPCC.

54. Goods vehicles with three or more axles are subject to a 12 per cent central excise, against a zero excise on smaller trucks.

## Box 4.12

### McKinsey's National Integrated Logistics Infrastructure Policy

McKinsey, the consultancy, have suggested a blueprint for India's national infrastructure policy through to 2020. The aims of this policy are threefold. First, it seeks to ensure an efficient logistics infrastructure that supports a balanced modal mix, furthers economic growth, and minimises environmental impacts. Second, the suggested policy is designed to engender better agency cooperation at the state and central levels, and between these levels. Finally, the policy seeks to provide logical impetus for the allocation and division of spending on infrastructure, skills development, and technologies.

Specifically, the suggested policy sets out the following measurable objectives by 2020:

1. To increase the share of rail in freight traffic to 45 per cent
2. To limit annual economic losses to \$100 bn or to under 4 per cent of GDP
3. To reduce energy consumption by 1 per cent and greenhouse gases by 20 per cent relative to the current levels
4. To achieve on-time and on-budget delivery of projects
5. To achieve intermodal coordination

To these ends, the policy consists of the following 10 elements:

1. Accelerating the number and construction of rail DFCs. McKinsey suggest that the development of the two in-progress DFCs (between Delhi and Mumbai, and Ludhiana and Kolkata) should be expedited, with funding sourced from private enterprise as well as from the rail budget.
2. Strengthening coastal freight corridors. The policy aims to boost coastal shipping along both the East and West coasts by creating transshipment hubs, encouraging state-owned companies to use coastal shipping, and deploying new technologies for processing both bulk and break-bulk cargo.
3. Increase and accelerate the number of expressways of lengths between 100 km to 300 km to support the main NH network along heavily-trafficked routes.
4. Initiate a comprehensive last-mile road building programme to support rail and port infrastructure, and multi-modal logistics parks.
5. Initiate a last-mile rail programme to support mining and industrial activity and agricultural markets.
6. Develop 15 to 20 multimodal logistics parks at intermodal junctions, preferably where DFCs and National Highways intersect near major centres of population. These parks should be provided with land, utilities and facilities to ensure seamless transfer of goods between modes, together with office space, hotels, warehousing, etc.
7. Prioritise systematic investment in road maintenance to achieve the most from the existing asset base.
8. Encourage widespread adoption of automatic tolling by establishing technology standards, and a nationwide clearing house and payments system for operators.
9. Expand human resource capacities and skills-sets, including new colleges, certification standards, and licensing.
10. Enable better equipment, technologies and set common standards.

Source: McKinsey (2010).

operational flexibility in optimising routes, reducing fuel consumption, and reducing transit times, all of which lead to lower fuel and operating costs, reduced wear and tear of roads, as well as a lower carbon footprint per unit of freight carried.

For full deployment of tractor-trailer model, it is desirable that all state regulatory authorities permit the separate registrations of tractor and trailer units, and there does not appear to be any prohibition in the Motor Vehicles Act (2000). There is a need to develop a well-defined law applicable nationwide covering the differential legal obligations of the owners of tractor and trailer units. A national electronic register of trailer ownership, locations, pay-

load and destination will add to the flexibility of the system, by allowing owners of tractor units to plan multiple routes in advance. Further down the line, fleet or load exchanges could be set up to bring transport suppliers and customers together.

The electronic collection of tolls under a single technological standard together with a clearing-house for the various toll operators to reconcile collections and dues will enormously reduce waiting times at toll plazas. The technologies can be readily adapted to collect taxes and fees as well. To incentivise the uptake of this technology, conforming vehicles should be given preferential access and clearance through toll plazas and other checkpoints, a facility

that is only incompletely offered at present. Nationwide recognition of mechanisms for factory-sealed or customs-inspected containers can reduce the need for en-route physical inspections. The rollout of the smart-card based national electronic vehicle registration system (VAHAN) and the national smart-card based commercial driver's license (SARATHI) should be expedited and made compulsory for operators seeking one-time physical inspections of shipments and for operating tractor-trailer units.

## RAIL

There are two initiatives with enormously far-reaching effects that will be most instrumental in reversing the decline of rail's mode-share in the transport of freight. First, the network of dedicated freight corridors (DFC), already commissioned and under construction, must be speedily completed. The corridors will do much to improve the speeds and reliabilities of both freight as well as passenger trains. The focus on freight will also allow the network to service the urban agglomerations and industrial belts where cheaper rail-freight service is most beneficial and most needed. It is critically important that work begins forthwith on the four corridors which have been identified but have yet to receive implementation go-aheads.

Below, this chapter argues for the sustained development of containerised cargo movements. To this end, the freight corridor designs must support efficiency measures such as double-stacking, and terminals and junctions designed for processing containers. The chapter on Railways (Chapter 1, Volume III) discusses the additions in physical capacity and network augmentations required in more detail. Here, we emphasise that mineral and feeder routes connecting mines, power stations, industrial centres and logistics parks to the DFCs will be critical to the success of the dedicated network.

Second, the large-scale cross-subsidisation of passenger services by the exorbitant charges on certain categories of freight is not justifiable as it deflects freight traffic which should be carried by the railways to road thus preventing the railways from carrying types of loads over distances that are in keeping with their comparative advantage. Instead, Indian Railways should set freight tariffs in accordance with market conditions, but subject to independent regulatory oversight in recognition of the monopoly of service. Cost-based commodity-specific pricing regimes may be instituted.

Once the financial viability of the freight network stabilises and upon completion of the DFCs, measures could be taken to increase the participation of private players for owning and moving rolling stock. Under this scenario, private agents own and lease wagons to end-customers, a practice widespread internationally but only incipient in India. The wagons

Indian Railways should set freight tariffs in accordance with market conditions, but subject to independent regulatory oversight. Cost-based commodity-specific pricing regimes should be instituted.

can be specialised for the movement of liquids, auto components or other commodities. The government may wish to introduce or strengthen regulations over service agreements and guarantees on the security of cargo from the service provider to reduce customers' financial risks over rail transport such as those covering delay, non-delivery or damage of goods in-transit.

Beyond these measures, the speed of freight on the network and unit transportation costs can both be improved by the induction of new high-power locomotives capable of hauling longer, heavier, trains and new wagons with higher payloads-to-tare ratios.

## PORTS, COASTAL SHIPPING AND INLAND WATER TRANSPORTATION

Transportation by water is extraordinarily efficient. Fuel consumption for every tonne-km of freight shipped is only 15 per cent of that by road and 54 per cent of that by rail. Emissions, too, are lower as compared to rail or road transport. Coastal shipping is also more suited to handling bulky consignments. With efficient terminal infrastructure, networks, and vessels, coastal and inland carriage of goods by ship can be half as expensive as by rail and up to 80 per cent cheaper than by road.

It is desirable to increase the mode-share of water transport. To do so requires that the availability of sufficient terminal and vessel capacities, improved cargo handling efficiencies at terminals, an increase and regular maintenance of draft in harbours and IWT channels, and more skilled labour to participate in the sector. The required initiatives in physical infrastructure are thus as follows:

- Improved road and rail connectivity with the ports and to inland container depots, dry ports, and logistics parks. The use of shipping is especially vulnerable to poor hinterland connectivity, and natural dependencies exist with rail and road transport networks.
- Smaller new ports at regular intervals on the coast to increase the number of origin-destination pairs, and make coastal shipping more attractive for smaller cargo volumes.
- Increases in the number of vessels transporting bulk and container cargo on Indian coasts, with a range of capacities to suit cargo loads of varying sizes.
- Improved superstructure, through expansion of associated back-up container stack areas, transfer bays, rail transfer facilities for seamless

New airports may be considered, dedicated only to cargo flights. The economic zone around the terminals should facilitate acquisition of space to allow for truck docks, warehouses and temperature-controlled storage facilities, with service roads and entry gates linking the processing area.

rail evacuation, gate terminals for proper road evacuations, operational buildings, modern container handling equipment such as quay-side container handling gantry cranes, yard rubber-tyred gantries, reach stackers, terminal tractors, etc., in the terminal areas<sup>55</sup>.

- Augmenting associated back-up value-add complementary facilities like CFSs, warehouses, assembly and packaging facilities, cargo consolidation areas, processing and distribution centres at off-dock locations to minimise port congestion and for easier inter-modal transfers.
- Dedicated berths for processing container and bulk cargoes, together with modernisation of associated material handling equipment.

On the policy front, the following initiatives should prove advantageous to the use of water transport:

- Co-loading of domestic and international cargo on coastal vessels. Such co-loading is already permissible on Indian-flagged vessels travelling wholly between Indian ports. The facility should be extended to foreign-flagged vessels that often carry considerable spare capacities on coastal routes and to vessels travelling between Indian and foreign ports.
- Centralisation of governance of inland waterway transport under a single agency.
- A standard policy on minimum drafts and regular dredging and maintenance to ensure compliance.
- Mandatory consultations between port authorities, metropolitan and civic agencies, and Indian railways in planning expanded port infrastructure to ensure better rail and road connectivity with the ports. This can be possibly be coordinated through a high-power group, headed by a minister or a secretary along with senior representation from Ministries of Shipping, Roads and Railways (Chapter 4, Volume III on Ports and Shipping).

A common IT platform for message exchange between shipping line, port authority, terminal operator, freight forwarder, and container freight station operator will help communications, planning and scheduling of both, ship arrival as well as clearance and onward despatch once cargo is landed. Inspection

agencies supervising the imports of certain cargoes such as textiles and pharmaceuticals should be supplied with additional staff, with subsequent streamlining of processes to ensure time-definite clearance. Where appropriate, the agencies may choose to accept the clearance documentation issued by regulatory agencies in the country of export or by other credible third parties. Physical inspections should be made on the basis of official judgment and defined criteria in accordance with a formal Risk Management System rather than as a matter of course.

#### AIR CARGO AND FREIGHT

An important task in ensuring better processing of freight at India's airports is the setting up of dedicated terminals or private bonded facilities for air cargo at all metropolitan airports. Alternatively, consideration may be given to new airports that are dedicated only to cargo flights. These hubs are crucial to the development of the generalised logistics and express air service industries. The economic zone around the airport terminals should facilitate the acquisition of space to allow for truck docks, warehouses and temperature-controlled storage facilities and should be zoned as such. Service roads and entry gates linking to the processing area should be designed and constructed with a view towards anticipated volumes of trucks required to remove air cargo.

Delhi in the North; Navi Mumbai, Nagpur and Pune in the West, and Bengaluru and Hyderabad in the South are ideal locations for air cargo hubs given strong intermodal links, and demographic or geographic advantages. The establishment of these hubs will require investment in real estate, buildings, and in material handling equipment with provisions for stacking, palletisation and conveyor movement of containers. Data capture and piece-level control are critical in supply chain management, and bar coding and scanning systems, radio frequency identification tags, etc., are essential for updating track and trace systems.

Space limitations or advantages in intermodal connectivity may merit the situating of bonded facilities at off-airport sites. Procedures and systems should be overhauled such that cargo can be shifted to these bonded areas with customs processing occurring thereafter. These customs-free zones can be set up within the framework of existing laws governing SEZs (Special Economic Zones) by demarcating and recognising warehousing areas within or near airports. These changes will permit the easier movement of cargo to international destinations without customs examination and assessment in India. Further, it ought to reduce airport congestion and cater to increased scale in trade.

Customs clearances should be available at all times at the largest airports with the heaviest traffic volumes. The cost-recovery model used for setting fees

55. Planning Commission (2010).

for customs clearances should be abandoned in favour of a more rationalised fee structure, perhaps funded by a cargo services fee as is the case for passenger screening and clearance. Important regulatory agencies for inspecting shipments of food, pharmaceuticals, textiles and biological matter should have on-airport offices. Private laboratories should be certified and licensed to conduct mandated tests. The regulatory agencies and laboratories should be integrated into a common information technology system shared with customs, airports and cargo service providers. Finally, there does not appear to be a persuasive argument for persisting with a separate license for processing transshipment cargo.

### PIPELINES

Pipelines are an important means of transport, as they do not require the return of 'empties' to the starting point and as such are ideal for unidirectional traffic. They are insensitive to surface conditions such as storms and inclement weather. Besides being environmentally friendly, operating costs are low and inflationary influences have a small impact on transport costs. Pipelines are highly under-used in India today with a mode-share in total cargo transport of less than 5 per cent and in liquid bulk cargo of around 55 per cent. This is lower than in many other countries.

Existing pipeline networks are localised in nature, with limited reach and absence of arrangements for multiple users. This adversely impacts recovery of investments and is reflected in the inadequacy and age of existing pipeline network. Possible initiatives in physical infrastructure are thus as follows:

- A National Pipeline Grid could be established along the lines of the National Electricity Grid. Disparate pipeline networks could be integrated to allow for efficient flow of products across long distances<sup>56</sup>.
- New technologies permit upstream and downstream products to be transported in the same pipeline (such as crude oil, gasoline and naphtha). This can lead to further economies.

With the majority of pipelines under non-governmental ownership and administration, policy plays a bigger role than the provision of infrastructure. The following policies are likely to result in the desired boost for pipeline transport:

- Facilitate the investor in obtaining multiple permissions/clearances that are required for setting up pipelines.
- Fiscal and tax incentives for investing in pipelines could be introduced.

India will require about 25 logistics parks over the next 20 years. These should be situated close to population centres, at junctions of several transport modes, on the grounds of ports or airports, or in their immediate vicinity.

### INTERMODAL TERMINALS AND LOGISTICS PARKS

In this discussion, the terms intermodal terminal, multi-modal transshipment hub, dry port, inland container depot and logistics park are all subsumed into the latter for brevity. However, it is recognised that each of these concepts is somewhat different in terms of the breadth of services provided and connecting infrastructure required. That said, each of these facilities encompasses the following functions in some measure:

1. To serve as a transshipment hub where quantities are aggregated and disaggregated;
2. As a waypoint to manage inventory, store goods and compile economically viable shipments; and
3. As a point of interchange between gauge and mode of transport.

'The use of large warehouses, shared equipment and manpower at these transshipment points lowers operating costs. Transportation costs can also be reduced with improved utilisation of transportation equipment with flow aggregation (over various modes), as additional distance is typically offset by scale benefits'<sup>57</sup>. Together with the ancillary activities and services such as inspections and certification, customs clearances, offices and hotels, logistics parks are enormously important cogs in processing domestic and international trade in a well-functioning economy.

India will require around 25 logistics parks over the next 20 years<sup>58</sup>. These should be situated close to population centres, at the junctions of several transport modes, and serve a large catchment area. A logistics park may be sited on the grounds of a coastal or inland port, or airport, or in the immediate vicinity of these facilities. To minimise the potential for administrative and procedural delays, it is ideal if the former approach is followed where possible. In some instances, it may be worthwhile to set up a new logistics park in conjunction with a new port or cargo airport or rail-freight handling facility. In either case, shorter processing and transshipment times may be expected, and the essential conveniences offered by ready and reliable freight transport are

56. For example, the linking of the Mathura-Jalandhar pipeline in the North with the Kandla-Bhatinda pipeline in the West; and the linking of the Barauni-Kanpur pipeline with that between Kanpur and Allahabad.

57. McKinsey (2010).

58. Essentially every major urban conurbation will require one, and some will require two. For example, the National Capital Region will be well-served by a logistics park that services freight travelling on National Highway 8 and the Western DFC; as well as by another serving freight travelling on National Highway 2 and the Eastern DFC.

The functional agenda and operational remit of every logistics park should be delineated separately. This should then be evaluated independently. Each park should aim to provide efficient and low-cost transshipment and client-oriented value-added services.

likely to encourage many time-sensitive businesses to locate in or near the park.

The guiding principles underpinning investment in logistics parks are the same for all other infrastructure spending as proposed in this report. Here, we only reiterate the important principle of network-centric thinking in planning infrastructure, and the major observations from the Indian experience that have thwarted this principle. As detailed in Chapter 2, Volume II these are (a) network enhancements have been driven by political rather than business or even social welfare considerations; (b) capacity augmentations that have often only resulted in pushing bottlenecks to elsewhere in the network; and (c) a generalised lack of intermodal thinking in planning infrastructure. When deciding on investment in logistics parks, the following 'good' practices may help in ensuring that these observations are not made in the future of parks constructed today.

First, logistics parks should possess sufficient space and be provided with room for future expansion, with the dimensions of the space determined, again, by estimates of traffic flows and patterns. The particular functional agenda and operational remit of each park should be delineated separately. This should then be evaluated independently to determine if sufficient market potential exists, if efficient intermodal terminal operations are possible at the chosen site, and if it links to transport networks that are of sufficient quality. Each park should aim to provide efficient and low-cost transshipment services and client-oriented value-added services. The hub potential of the park should be determined, whether in regional, national or international terms. The legal and operational restrictions on the functioning of the park should be identified in advance, and feasibility studies should pay particular attention to integration with urban master plans, regional development plans, land and building costs, and acceptance by existing users or neighbours of the designated site.

Logistics parks, by their inherent nature and particularly in current context, appear to be ideal candidates to be developed through suitable public private partnership (PPP) formats. The keywords that seem to characterise these parks today is bulky investments, huge land parcels, short project turnaround, efficient operations, tremendous commercial potential and

innovation. These are best addressed and harnessed by the private sector. One of the serious constraints, however, is the availability of land and the fair price of acquisition, which is where the role and support of the public sector shall continue to remain important.

Where space proves to be problematic near urban centres, existing intersections of the highway and railway networks can be expanded by building terminals around the handling areas. These constructions are increasingly seen in Europe (e.g., at Basel/Weil and in Budapest which handle only containers, semi-trailer and swap-body traffic). The size of the terminals should further be determined by the number and length of transshipment tracks, the number and type of handling devices such as cranes and reachstackers, the types of semi-trailer, container and other traffic catered to, the storage required, and the desired opening hours and other preferences of customers.

Land use plans should be mandatory for new parks. A land use plan serves as a guiding document for the development and expansion of intermodal facilities and the lands where these facilities are located. Such plans are required in most developed countries with intermodal freight transportation systems. They should communicate the long-term goals of the operator, regulator and governing agency while strengthening future initiatives. Land use plans can be centralised to include location-specific goals that enable customers, stakeholders, municipalities and government agencies to understand the governing principles that the managing authority uses to manage land and water assets.

In seeking to provide efficient transshipment facilities and value-added services, the terminal building should offer good and safe working conditions for staff, safe drayage, high security against theft and terrorist attacks, and minimisation of environmental effects. The design of the park should be heavily influenced by expected traffic volumes and commodities processed, with consideration to specialised terminals for processing standardised cargo. Provision should be made for the short-term storage of cargo and the long-term storage of empty shipping units or rolling stock if required.

Other design principles that may be followed are as follows. Terminal designs can be modularised and standardised to limit investment costs<sup>59</sup>. All terminals and infrastructure along a particular high-density freight corridor should conform with a set of minimum design rules. The standards should be subject to regular benchmarking and quality certification processes, as well as more formal regulatory review if the standards are enshrined in law. Railway access to transshipment areas should be from both

59. The standardisation of the terminal buildings themselves is at the vanguard of the debate on the design of logistics parks. So far, there has been little progress outside Switzerland and Austria, though the idea is now under the EU's considered attention.

sides to reduce shunting effort and operational costs. Transshipment areas with loading tracks should be compatible with train lengths to reduce shunting requirements further. Terminal management systems for intermodal or railroad-only terminals consist of the following components and modules: train processing; road truck transshipment; regulatory compliance; crane work station and movement optimisation; mobile data captures, tracking and routing; storage and additional services; statistical analysis; and billing. For each of these systems, a single national standard should be decided on and deployed.

On the implementation front, the Working Group on Logistics recommends that the identification of locations for logistics parks should be undertaken by consulting companies such as RITES which should take into account the views of industry collectives<sup>60</sup>. Consortia of companies should be invited to undertake the establishment of the parks on the understanding the Central Government will provide road and rail connectivity and the State Government will assist in the acquisition of land as well as in the supply of utility services.

Planning Commission argues for a new central body with a charter and mandate that is dedicated to the development of the logistics industry, a view that the NTDPC endorses<sup>61</sup>. Pre-emptively called the Central Logistics Development Council (CLDC), its goal will be to serve as an advisory and recommendatory body that seeks to decrease logistics costs through integration of transport services. The Council should consist of representatives from the logistics industry, MoRTH, MoCA, Ministry of Railways, representatives of State governments, CII, financial institutions, insurance companies, and academic bodies. The CLDC will collect and disseminate information, conduct research, advise the government, with funding from the industry. The CLDC will also advise regulatory authorities or create guidelines for self-regulation of some elements of the logistics industry.

The CLDC would spearhead the development of logistics sector. The development process would particularly involve participation of, and coordination among multiple ministries/departments and organisations. It is therefore advisable that a Nodal Ministry be designated for CLDC. Since logistical hubs are already planned as a key ingredient to the ambitious Delhi-Mumbai Industrial Corridor, piggybacking on the high capacity Dedicated Railway Freight Corridor (DFC), the Ministry of Railways could possibly act as the Nodal Ministry. Alternatively, considering the logistics parks as purely trade facilitation and processing centres, the Ministry of Commerce (as in case of China) may be found equally suitable.

The shipping container has become the dominant hold-all for break-bulk cargo. It has allowed new sourcing, manufacturing, and inventory management processes. Managers treat containers as 'warehouses in motion'.

#### UNITISATION OF CARGO: CONTAINERS AND PALLETS

Of all the technologies that have revolutionised the movement of global freight, few have had as much impact as the humble box. Until the arrival of the container, each vessel was laboriously loaded and unloaded by hand, a process that could take weeks. Longshoremen handled on each piece of cargo that went into a ship's hold, stuffing bags and opening crates. The inefficiencies of the system are obvious. Goods are prone to pilferage and spoilage from unprotected storage in the holds. Ship turnaround times go up several times with each article or each non-standard container requiring handling, and the idiosyncrasies hindering mechanisation of the process.

Since first being introduced in coastal shipping along the Eastern coast of the US in 1958, the shipping container has become the dominant hold-all for break-bulk cargo. Container dimensions have been standardised internationally, allowing ships, cranes, trucks, and storage areas to be constructed especially for handling these. Modern ships now carry a total of nearly 1.5 billion tonnes of cargo around the world in 560 million containers<sup>62</sup>. Some vessels boast capacities of 12,000 to 15,000 containers. Modern automated cranes can load and unload nearly 150 containers an hour, each container placed in the exact onboard space and ashore so as to maximise logistical efficiencies. The resulting decline in costs has created new markets for goods, and in a geographic reorganisation of global manufacturing. The decline in shipping times has allowed new sourcing, manufacturing and inventory management processes. Indeed, predictable shipments based on the container have allowed managers to treat containers like 'warehouses in motion. By precisely timing the arrival of components, manufacturers move items from containers directly onto assembly lines or store shelves, bypassing warehouses entirely'<sup>63</sup>.

The containers themselves have been re-engineered to new purposes. Refrigerated containers ('reefers') are used for perishable products and containers lined with bladders are used to transport liquids. The versatility and standardisation of the shipping container—the key to its maritime success—has made it ubiquitous for overland freight transport as well. Flatbed trucks are designed to accommodate

60. Planning Commission (2010).

61. Ibid.

62. Curry (2013).

63. Ibid.

India must rapidly adopt the use of standardised containers and pallets for moving both overland and maritime freight. Associated handling equipment like forklifts, cranes and specialised flatbed rail wagons must become ubiquitous.

one or two containers for last-mile delivery or for longer hauls. Freight trains now increasingly move break-bulk (and some bulk) cargo in containers stacked singly or doubly on dedicated wagons. (The 'humble box' has even found a purpose in retirement as a ready-made low-cost housing solution.)

An equally humble technology that can lay claim to revolutionising freight movement is the pallet, a wooden construction of several planks nailed together. Instead of devising optimal methods for lifting and transporting different objects over short distances, the pallet 'unitises' these operations. Forklifts and warehouse cranes and trolleys can be engineered with the single purpose of moving a pallet, and with complete agnosticism about the characteristics of the payloads actually carried. Some goods never leave their resting place atop a pallet from the moment they exit a factory door until a customer selects them from the same pallet in a retail store. As Box 4.5 notes, companies have redesigned product lines to better suit the standard pallet. In many countries, companies lease pallets to industry, taking on the responsibilities of delivering and retrieving these.

India must rapidly adopt the use of standardised containers and pallets for moving both overland and maritime freight. Associated handling equipment such as forklifts, cranes, scanning and inspection equipment, tractor-trailer units, and specialised flatbed rail wagons must become ubiquitous technologies in use at ports, logistics parks, handling yards, and by road, rail and shipping service providers. The 'unitisation' of freight movement will result in enormous time and cost savings. Financial incentives should be set in place to retire old equipment and inaugurate new technologies. De facto standards for pallets and containers should be officially endorsed and implemented by all state-owned enterprises. It is important that there is no variation between domestic and global standards.

## **HUMAN RESOURCES AND SKILL DEVELOPMENT**

As noted earlier, Indian logistics is slowly but inevitably moving away from the traditional model of transportation services and storage, characterised by small, independent, unorganised providers who focus on a particular transport mode. It is transforming into a new system wherein third-party logistics

providers devise end-to-end transportation solutions for manufacturing firms, arranging transport across all modes, and providing value-added services like packaging and reverse logistics. Further down the road, it is likely that the nascent fourth-party logistics industry will grow further, with firms specialised in supply chain management and in matching supply and demand, further reducing costs and lead times.

The transformation of the industry is, however, dependent on the transformation of the skill sets possessed by the current corps of freight transport professionals, and on a substantial boost in their numbers. By one estimate, the 10-million-strong current corps of drivers, handlers, operators, managers and other freight service professionals will need to double by 2020. This includes a requirement for over five million drivers, 100,000 warehouse managers, and 70,000 coastal seafarers.

### **DRIVERS, HANDLERS AND EQUIPMENT OPERATORS**

The drivers of the future will be required to not just be expert users of their increasingly sophisticated equipment, but to also be au fait with ancillary technologies such as route guidance systems, electronic data entry, and log book management. They will need to be fully aware of any special handling required by a given load of cargo. Further, they will need to fulfil their duties with precision and efficiency to play their role in a supply chain that is intolerant of delay or uncertainty. As such, their driving skills, including defensive driving, will need to be of the first order. They will also need to be trained in vehicle maintenance, freight loading and unloading, and be certified to prevailing safety standards. Their required skill sets will include reading, writing and communication, together with basic technological familiarity, basic knowledge of taxation, permit and license regimes, and the technical nous to manage specialised or hazardous goods in transit.

Truck drivers should be certified to a high, common standard across the country that takes into account these skill requirements. Training institutes should conduct courses in the operation of light and heavy goods vehicles, together with refresher courses and re-certification offerings on handling specialised or hazardous goods.

Meanwhile, a large corps of operators trained in latest material handling equipment technologies will also be required to load, unload and organise cargo. These operators include forklift and crane operators, drivers of haulage trucks at terminals, and so forth.

### **MANAGEMENT**

This chapter has called for heavy investment in multimodal logistics parks. It is intended that these massive facilities will process a large amount of container

and break-bulk cargo. Beginning at the top, park managers with extensive operational and managerial skills will be required. Training programmes for these managers should include specific courses on sourcing, contracting, multi-modal operations and tracking technologies. The managers will also need to be comfortable operating a facility at which many different activities take place, ranging from rail and road transport to customs processing and warehousing to retail and travel. The success of a logistics park will be determined to a large degree by the management team's successes in juggling the competing needs of many different service providers, and in finding efficient synergies wherever possible—these synergies are the charter responsibilities of the logistics park.

Service providers based in the logistics parks may choose to locate some of their senior supply chain management professionals there. Whether based at the parks or elsewhere, the supply chain professionals will need to manage contracts and relationships, select suppliers, understand information, financial and material flows. They will be required to have extensive knowledge on the construction and operation of new facilities such as warehouses and distribution centres. Further technical skills will be required for sophisticated demand and supply planning, and for matching the two to relatively low tolerances.

The major challenge that the industry will face in recruiting these managers will lie in legitimising and publicising the potential of a viable professional career in logistics. At present, 'skills gaps arise from the structure of the industry in India. Small sized entrepreneurs have limited intent or capability to scale and build manpower capabilities. The industry gaps in good management practices are deeply set, as the logistics industry itself has still not emerged as an attractive sector for professionals. [The gaps] in core technical skills arise from the unorganised and fragmented structure in the industry'<sup>64</sup>.

As international borders come to be drawn in ever-lighter shades of grey for the sourcing of components and final assembly, an increasing number of firms will need to become masters at managing their supply chains. To do so, executives at these firms and their logistics advisors and providers must work together to manage flows of material and information while maintaining the integrity of both. They must create and monitor new plants, warehouses and distribution centres and also deal with the links in the supply chains. These supply chain management professionals will be required to have skills in managing information, generalised industry knowledge, customer relationship management, advanced planning and optimisation, and in demand planning.

The major challenge that the logistics industry faces in recruiting managers will lie in legitimising and publicising the potential of a viable career, since it has not emerged as an attractive sector for professionals.

There exist very few formal training institutions or professional certifications for use as credentials of competency. In conjunction with industry, government should design curricula at the master's level for combined training in operations research, supply chain management, cost accounting and planning, each with a focus on logistics. Besides the academic study of these subjects, the goal of the training programmes should be to develop the following practical skills: (a) the coordination and planning of logistics operations in support of business efficiency; (b) planning and management of product supply chains including forecasting skills and inventory management; (c) the acquisition, operation, and maintenance of material handling equipment; (d) facilities management; (e) knowledge of safety, labour, customs and transport documentation and regulations.

## RECOMMENDATIONS

This section collates the major recommendations stemming from the discussion and analysis in this chapter. Again, the focus remains on identifying actionable remedies to existing problems relating to the planning and implementation of integrated transport strategies, with particular emphasis on the movement of freighted goods. Required investments in physical road, rail, aviation and shipping infrastructure are detailed in the respective sectoral chapters.

1. Government must adopt an integrated transport strategy guided by inter-generational drivers of patterns of transport demand. The characteristics of these drivers are their long-term and largely irreversible nature; their far-reaching, game-changing effects on the economy and so on transport; their indifference to business cycles; and their relative immunity to financial and economic shocks. The proposed Office of Transport Strategy should give proper consideration to determining and monitoring these long-term drivers such as urbanisation, demographic change and changes in the mix of industrial activity.
2. The overall aim of the integrated strategy should be to uncover an optimal modal mix.

64. NSDC (2009).

Rules and regulations governing the carriage of goods by road, rail, air, sea or any combination of these should ensure equal administrative treatment. All imports should have the same documentation requirements.

This desired mix should reflect the full resource costs of each transport mode for each type of commodity transported over various distances and terrains. It should also reflect the government's distributive and allocative agenda clearly. To this end, traffic and costs studies must be carried out periodically, with due regard for the specific characteristics of each transport mode and commodity. These studies can be organised and analysed for attendant interventions by the proposed Office of Transport Strategy to guide transport gradually towards a modal mix that is both, efficient and rational.

3. In itself, the intermodal principle is not about advocating a particular modal mix. Instead, it is highly likely that from the optimal modal mix, a persuasive case for intermodal transport will be made. The inefficiencies of an insufficiently intermodal transport system are manifest in higher prices, longer journeys, reduced reliability, lower availability of quality services, type restrictions, higher risks of damage or pilferage, and more complex administrative procedures. The critical enablers to address these inefficiencies and to yield an intermodal transport system are:
    - a. Missing stretches of infrastructure within one mode or missing links between modes should be completed. From its studies on traffic flows, the Office for Transport Strategy should assume the important role of identifying the missing links. It should be provided with the mandate to direct central, state and local authorities responsible for implementing infrastructure to liaise with each other in constructing the missing links.
    - b. With ministries individually responsible for the construction and upkeep of roads, railways, airports, ports and waterways, and other transport infrastructure, the allocation of responsibility for ensuring good intermodal links or for the construction of multi-purpose facilities is not clear. The Office for Transport Strategy should again pay special attention to these important links and facilities, and be provided with powers to direct authorities to attend to their construction.
    - c. With multiple handling and transporting agencies in an intermodal chain, the allocation of liability is not clear. At present, rules governing liability are determined by the Multimodal Transport Act of 1993 (amended 2002), which in keeping with international guidelines maintains that the multimodal service provider has 'presumed fault'. The liability rules could be strengthened on the following fronts: limiting the jurisdiction over disputes to tribunals or courts with special knowledge of transport issues; clarifying the arbitration procedures including the setting up of a defined tribunal and appellate instead of leaving these important details unspecified as at present; and most importantly, by ensuring that the service provider is accountable for loss and compensations regardless of where in the transport chain the loss was deemed to occur.
  - d. Rules and regulations governing the carriage of goods by road, air, sea, rail or any combination of these should be amended to ensure equal administrative treatment. For example, imports arriving by air or by sea should be subject to the same documentation requirements, as should inter-state movements of parcels by road or rail. It is recommended that an inter-ministerial panel examine the various acts governing the carriage of goods by the various modes with a view to harmonising registration and licensing of service providers, processes regulating the handling of goods, and documentation requirements.
  - e. Information is generally impermeable with little interoperability of information and management systems that govern the movement of goods. An inter-ministerial group should agree on a common data standard, in consultation with industry, and provide for immediate collection and dissemination of the data to service provider APIs.
  - f. There is insufficient unitisation of cargo in the form of the use of shipping containers and pallets. The Government should adopt the common standards on these shipping units and then ensure that goods transport on all modes can accommodate these units both on rolling stock as well as on fixed infrastructure.
4. Pricing for transport services and for associated inputs like fuels should be de-politicised and set by market or by independent regulatory authorities. Where prices are set by independent authorities, they should be responsive to changing economic fundamentals in a timely fashion to minimise adjustment costs. Good pricing is simple, clear, prevents market distortions, guides consumption and investment

decisions appropriately, and is sustainable over the long run. Pricing in the transport sector should conform closely to the cost of services and actual resources used in its production, having regard to scarcity values of these inputs.

5. Better attempts must be made at establishing the true nature and extent of transport externalities, the relative incidence of cost and benefit, and how these fit with the government's wider distributive and allocative agenda.
6. Subsidies should be limited to those areas where their retention on societal considerations is overwhelmingly justified. Wherever subsidies are retained, they must be made as explicit as possible so that they are clearly identifiable to ensure transparency. The instruments of pricing, taxation and subsidy should be used to develop an economically rational intermodal mix and to promote operational efficiencies. It is ideal if policies on these are not absorbed into the government's generalised toolkit for fulfilling its distributive and allocative agenda.
7. With respect to the movement of goods on road transport vehicles, the following recommendations are made:
  - a. Growth and consolidation of the industry must be encouraged organically by reducing the documentation, administrative and state-border clearance burden required of truck movements and by reducing excise duties on multi-axle trucks.
  - b. Provisions in the Motor Vehicles Act (1988, as amended) should be effectively implemented. Recommendations made by the Sundar Expert Committee reviewing the Act should be carefully considered. Provisions relating to the overloading of trucks, the unhindered movement of trucks with national permits, and those relating to the registration of tractors and trailers should be uniformly implemented and stringently enforced.
  - c. Tolls should be electronically collected under a single technological standard together with a clearing-house for the various toll operators to reconcile collections and dues.
  - d. Nationwide recognition of mechanisms for factory-sealed or customs-inspected containers will reduce the need for en-route physical inspections.
  - e. Truck drivers should be certified to a high, common standard across the country that takes into account the skills such as reading, writing and communication, together with basic technological familiarity, basic

The speed of freight on the railway network and unit transportation costs can be improved by inducting high-powered engines capable of hauling longer heavier trains, and new wagons with higher payload-to-fare ratios.

knowledge of taxation, permit and license regimes, and the technical nous to manage specialised or hazardous goods in transit. Minimum standards should be formulated at the central level, with all state licensing authorities required to issue licenses in compliance with these.

8. With respect to the movement of goods on rail, the following recommendations are made:
  - a. The network of dedicated freight corridors must be speedily completed.
  - b. Freight corridor designs must support efficiency measures such as double-stacking of containers, and terminals and junctions should be designed to process unitised cargo.
  - c. The participation of private agents in owning and leasing wagons to end-customers and in packing and processing rail freight in unit loads should be encouraged by building rail lines to private facilities and by accommodating rakes originating and terminating at logistics parks (see below).
  - d. The speed of freight on the network and unit transportation costs can both be improved by the induction of new high-power locomotives capable of hauling longer, heavier, trains and new wagons with higher payloads-to-tare ratios.
9. With respect to the movement of goods via sea, the following recommendations are made:
  - a. Ports should provide due emphasis on improving superstructure, by expansions of associated back-up container stack areas, transfer bays, rail transfer facilities for seamless rail evacuation, gate terminals for proper road evacuations, operational buildings, modern container handling equipment such as quay-side container handling gantry cranes, yard rubber-tyred gantries, reach stackers, terminal tractors, etc., in the terminal areas.
  - b. Smaller new ports should be constructed at regular intervals along the coast to increase the number of origin-destination pairs and to increase the attractiveness of coastal shipping.
  - c. Restrictions on foreign-flagged vessels from plying coastal routes as part of their international operations should be relaxed to allow them to carry bulk/general cargo

A National Pipeline Grid can be built along the lines of the National Electricity Grid. Disparate pipeline networks can be integrated to allow efficient flow of products over long distances.

and transhipped exim containers, including empty containers to make use of the considerable spare capacity on these ships. This would enhance domestic mobility for India cargo. Stricter or absolute Cabotage could continue for import and export of crude, critical energy cargoes and defence equipment/parts.

- d. A common IT platform should be developed for message exchange and tracking between the various private agents, marine and landside service providers, ports and government agencies.
  - e. Inspections agencies supervising the imports of certain cargoes should be supplied with additional staff, with subsequent streamlining of clearance processes.
  - f. Physical inspections should be made on the basis of official judgment and defined criteria in accordance with a formal Risk Management System.
10. With respect to the movement of goods via air, the following recommendations are made:
- a. Dedicated terminals or private bonded facilities for air cargo should be set up at all metropolitan airports. Alternatively, consideration may be given to new airports that are dedicated only to cargo flights.
  - b. Customs clearances should be available at all times at the largest airports with the heaviest traffic volumes. Important regulatory agencies for inspecting shipments of food, pharmaceuticals, textiles and biological matter should have on-airport offices. Procedures and systems should be overhauled such that cargo can be shifted to off-airport bonded areas without prior clearance.
  - c. The regulatory agencies and laboratories should be integrated into a common information technology system shared with customs, airports and cargo service providers.
11. With respect to the movement of liquids and gases via pipeline, the following recommendations are made:
- a. A National Pipeline Grid could be established along the lines of the National Electricity Grid. Disparate pipeline networks could be integrated to allow for efficient flow of products across long distances.
  - b. Facilitation in obtaining multiple permissions/clearances those are required for setting up pipelines would be helpful.
  - c. Fiscal and tax incentives for investing in

pipelines could be introduced.

12. In recognition of the importance of warehousing and logistics parks to the logistics sector, the following recommendations are made:
- a. Around 15 to 25 logistics parks should be established. These hubs should be located at major transportation hubs, including at the origin and destination points of DFCs, and at major industrial centres or near major urban conurbations. The parks should have sufficient space to serve as waypoints to manage inventory, provide storage, and should also have excellent links to the road and rail networks, and possibly to airports and ports depending on the local economy and geography.
  - b. The parks should have provision for ancillary activities and services such as inspections and certification, customs clearances, offices, hotels and others.
  - c. Logistics parks should possess sufficient space and be provided with room for future expansion, with the dimensions of the space determined, again, by estimates of traffic flows and patterns.
  - d. The hub potential of the park should be determined, whether in regional, national or international terms. The legal and operational restrictions on the functioning of the park should be identified in advance, and feasibility studies should pay particular attention to integration with urban master plans, regional development plans, land and building costs, and acceptance by existing users or neighbours of the designated site.
  - e. Land use plans should be mandatory for new parks and should communicate the long-term goals of the operator, regulator and sponsoring agency.
  - f. To provide efficient transshipment facilities and value-added services, the terminal building should offer good and safe working conditions for staff, safe drayage, high security against theft and terrorist attacks, and minimisation of environmental effects and impacts.
  - g. All terminals and infrastructure along a particular high-density freight corridor should conform to a set of minimum design rules.
  - h. Railway access to transshipment areas should be from both sides to reduce shunting effort and operational costs.
  - i. Terminal management systems for inter-modal or rail-road only terminals consist of the following components and modules: train processing; road truck transshipment; regulatory compliance; crane work station and movement optimisation; mobile data captures, tracking and routing; storage

and additional services; statistical analysis; and billing. For each of these systems, a single national standard should be decided on and deployed.

13. International standards on unit load devices such as containers and pallets should be adopted and infrastructure adapted to suit. Associated handling equipment such as forklifts, cranes, scanning and inspection equipment, tractor-trailer units, and specialised flatbed rail wagons must become ubiquitous technologies.
14. A new central body, the Central Logistics Development Council comprising of industry members, ministry representatives, and financial and academic institutions should be set up with the mandate of promoting the logistics industry. The body will collect information, advice on required infrastructure and changes to policy and regulation, propose standards on equipment, technology and manpower.

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