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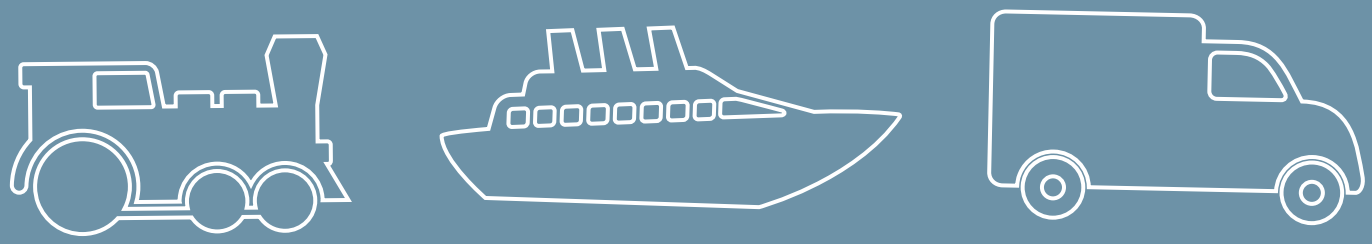

Building India

Transforming the nation's logistics infrastructure

Contents

Preface

Infrastructure development is a critical enabler to economic growth. Logistics infrastructure, covering the road, rail, waterways and air network of a country, is the backbone on which the nation marches ahead. Although the urgency to develop India's logistics infrastructure has been realised in the past decade, the task at hand is daunting. India's logistics infrastructure is insufficient, ill-equipped and ill-designed to support the expected growth rates of 7 to 8 per cent over the next decade. This expected 2.5-fold growth in freight traffic will further increase the pressure on India's infrastructure.

India has the opportunity to address this issue. Over two-thirds of the infrastructure network capacity of the future has not yet been built. Learning from the past and adopting global best practices, India should pursue a logistics infrastructure strategy that minimises investment, maximises cost efficiency, reduces losses for users and is energy efficient. This will need India to build its freight infrastructure in a manner that creates an integrated network across modes and prioritises high-return programmes.

This report, "Building India—Transforming the Nation's Logistics Infrastructure"[1] provides a perspective on how India's logistics network should evolve to meet future freight needs in 2020 and beyond. It discusses how India's current logistics infrastructure is inadequate to meet its growth aspirations and estimates the current and future concentration of freight traffic flows in the country in order to define logistics requirements and financial implications. It proposes a balanced modal strategy as the best way forward and lays out the elements of a National Integrated Logistics Policy to move from strategy to implementation. It argues that the time is right for all stakeholders—policy makers, regulators, public and private providers, resource holders, equipment providers, financiers and end users—to act in concert to build the country's future.

We hope this report will contribute to the ongoing discussions and policy developments related to the development of India's logistics infrastructure—an imperative for economic development.

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1 McKinsey & Company has conducted proprietary research in the areas of infrastructure financing, infrastructure implementation and logistics infrastructure strategy. This report is part of the Building India series of reports that attempt to provide a comprehensive perspective on infrastructure development in the country.

Acknowledgements

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This study has benefited enormously from the valuable inputs provided by key stakeholders, policy makers and government officials in various ministries in the central government and several others across state governments, including Coal India Limited, CONCOR, DFCCIL, DG Shipping, Indian Railways, NHAI, The Planning Commission, and the PMO. We are grateful to all of them for sharing with us their experiences and insights. In addition, perspectives and comments received from various industry leaders and practitioners across the logistics infrastructure value chain have enriched this effort.

This effort would not have been possible without the commitment and efforts of the working team comprising Achint Setia, Ankit Misra, Sanjeev Sujan, Pallavi Sharma, Khushboo Vaish, Anubhav Kaul and Ravi Shah. We would like to specially thank our project manager—Hemang Mehta for leading this effort. The working team benefited from the help provided by colleagues in the McKinsey Knowledge Centre and Research and Information services. We are thankful to them for their efforts.

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Executive Summary

Logistics infrastructure is a critical enabler of India's economic development. Recognising this pivotal role, logistics infrastructure spend has been tripled from around USD 10 billion in 2003 to a planned amount of around USD 30 billion in 2010. Despite this increase, the country's network of roads, rail and waterways will be insufficient as freight movement increases about 3 fold in the coming decade. This shortfall in logistics infrastructure will put India's growth at risk.

Since a large part of India's future logistics network is still to be built, the country has a chance to build infrastructure optimally, to meet the growing demand. Doing so requires an integrated and coordinated approach in which the development of each mode—railways, waterways and roads—is matched to the needs and existing assets are better utilised.

In particular, India needs to increase its use of rail, and realise the potential of its waterways. For example, in the normal course, India's rail share in freight would decline to 25 per cent from the current 36 per cent. This is relative to almost 50 per cent rail share in China and the US, similar continental sized nations. The concerted approach suggested in this report can increase India's rail share to 46 per cent.

If India fails to achieve this, waste caused by poor logistics infrastructure will increase from the current USD 45 billion[1] equivalent to 4.3 per cent of today's GDP, to USD 140 billion or more than 5 per cent of the GDP in 2020. If tackled in an integrated and coordinated manner, this can be reduced by half and India's transport fuel requirement reduced by 15 to 20 per cent.

Achieving this will require four major shifts:

- **Building the right network and ensuring flows on the right mode,** comprising an integrated mesh of seven high-density long-distance corridors (rail and coastal waterways), 150 medium-distance rail and road connectors and about 700 last mile links
- **Creating enablers to maximise the efficient use of the network,** which includes developing 15 to 20 logistics parks, providing standards for containers and pallets and upgrading the skilled workforce
- **Extracting more from existing assets,** for example, by increasing the share of toll plazas with electronic tolling, using stainless steel wagons with higher load carrying capacity, and increasing spend on maintenance of roads
- **Allocating more investment to rail and reallocating within roads and rail,** Based on current trends, USD 500 billion is estimated to be spent on logistics infrastructure in the next decade, with roads accounting for more than 50 per cent of the spend and rail for 40 per cent. However, this investment will need to be re-apportioned to support the changes required. The allocation to railways, for instance, needs to increase to more than 50 per cent with large sums spent on building high-density traffic corridors, connectors and last mile links

1 Losses are estimated by benchmarking costs against countries with more efficient logistics networks such as the US. See Appendix B for details.

If these shifts are implemented, India's waste in logistics in 2020 at about USD 100 billion would be almost one-third lower. This amount can be reduced further to about USD 70 billion (3 per cent of expected GDP) if the investment can be increased to about USD 700 billion. Further India's commercial energy consumption would reduce by ~1%.

To implement these four major shifts, India will require a National Integrated Logistics Policy (NILP). Such a policy should target a greater share of rail, reduce economic waste and improve energy efficiency. The policy will need to establish and implement 10 targeted national programmes including for dedicated rail freight corridors, coastal freight corridors, national expressways, last-mile roads, last-mile rail, multi-modal logistics parks, road maintenance, technology adoption, skills development and equipment and service standards.

Implementing a new logistics infrastructure strategy is a complex task given the multiple stakeholders within the central and the state governments. An empowered cross-ministerial group will be needed to drive this effort, define programmes, allocate budgets, monitor implementation, and ensure continual coordination across ministries. The high level National Transport Policy Development Committee recently set up by the government to develop policy recommendations is the first step in this direction.

This report expands on these perspectives and is organised in the following three sections:

- India's current logistics infrastructure: Inadequate to meet growth aspirations
- Required logistics infrastructure strategy going forward: Shift to a balanced modal network
- Moving from strategy to implementation: National Integrated Logistics Policy (NILP).

INDIA'S CURRENT LOGISTICS INFRASTRUCTURE PLAN: INADEQUATE TO MEET GROWTH ASPIRATIONS

The country's road, rail and waterways network is a legacy of colonial rule, historically developed to transport troops, agricultural products and raw materials. As a result, India's logistics infrastructure is not adequately equipped to meet rapidly rising freight traffic, changing consumption patterns and increasing numbers of production centres. Over the last 60 years, limited planning and investments in freight transport have resulted in numerous inefficiencies. Further, India's economic growth will only put greater pressure on an already stretched network. The four aspects outlined below characterise India's logistics network.

The logistics flows are highly concentrated

Three components of India's logistics network account for over two-thirds of total freight traffic flow in the country (Exhibit 1).

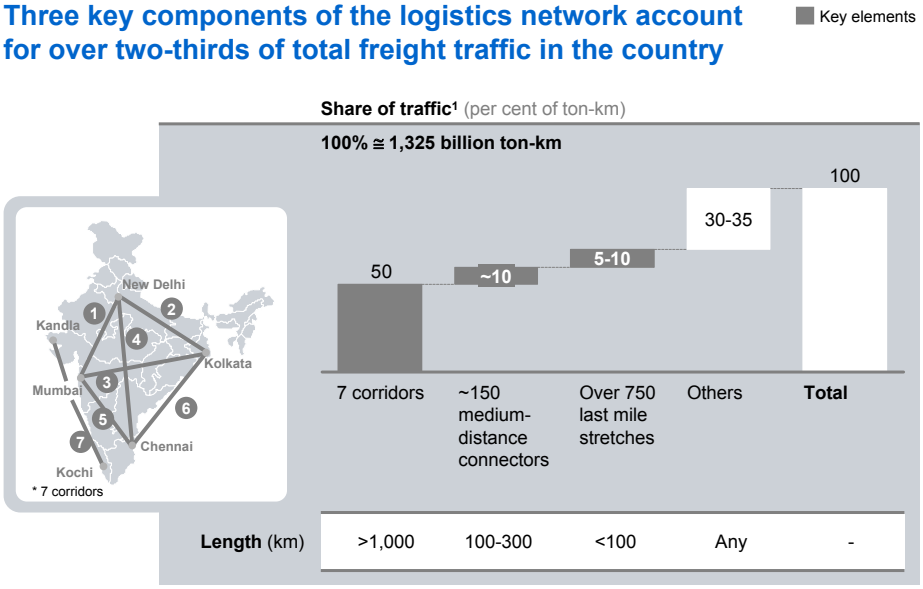
Component 1 – Seven long-haul corridors[2] that connect 15 high-growth clusters form the backbone of India's logistics network

The seven corridors account for about half of the total freight traffic in 2007. Consequently, freight routes through these corridors witness the highest traffic volumes in the country

2 These corridors are the Delhi-Mumbai, Delhi-Kolkata, Mumbai-Kolkata, Delhi-Chennai, Mumbai-Chennai, Kolkata-Chennai, Kandla-Kochi.

Exhibit 1

Three key components of the logistics network account for over two-thirds of total freight traffic in the country



1 Share estimated for 2007

SOURCE: McKinsey

and will continue to do so.[3] National highways along these corridors handle 40 per cent of road freight traffic even though they are less than 0.5 per cent of the Indian road network. Similarly, rail links on the corridors account for 27 per cent of the Indian rail network but handle over 50 per cent of rail freight traffic in the country.

Component 2 – Over 150 medium-distance connectors that link the corridors are key for India's logistics network

They are 100 to 300 km in length, typically branch out from the corridors, and carry 10 per cent of freight in ton-km.[4] More importantly, close to 30 per cent of freight volumes pass through these connectors at some point. These connectors include rail links and state and national highways—as well as major district roads that account for a disproportionate share of intra-state traffic.

Component 3 – Over 750 last mile links[5] of up to 100 km form a critical component of India's logistics network

These links connect key production, consumption and transit points such as ports, mines and industry clusters to the corridors and connectors. They have not typically been the focus of efforts to build the country's logistics infrastructure. Nevertheless, the poor quality

3 Traffic estimates are based on a bottom-up assessment of freight flows along key highways, rail links and coastal corridors (along the East and West coast) and have been adjusted for future changes in freight flows of key commodities such as coal. See Appendix A for details.

4 Freight flows and critical connectors are estimated through a bottom-up analysis of 8 major states and extrapolated to the rest of the country. Freight flows on connectors are estimated on the basis of the GDP of the districts they connect. See Appendix A for details.

5 Last mile links are estimated based on a bottom-up study of over close to 400 industry clusters, 200 ports (including major and non-major) and 200 mines and their proximity to national and state highway networks. See Appendix A for details.

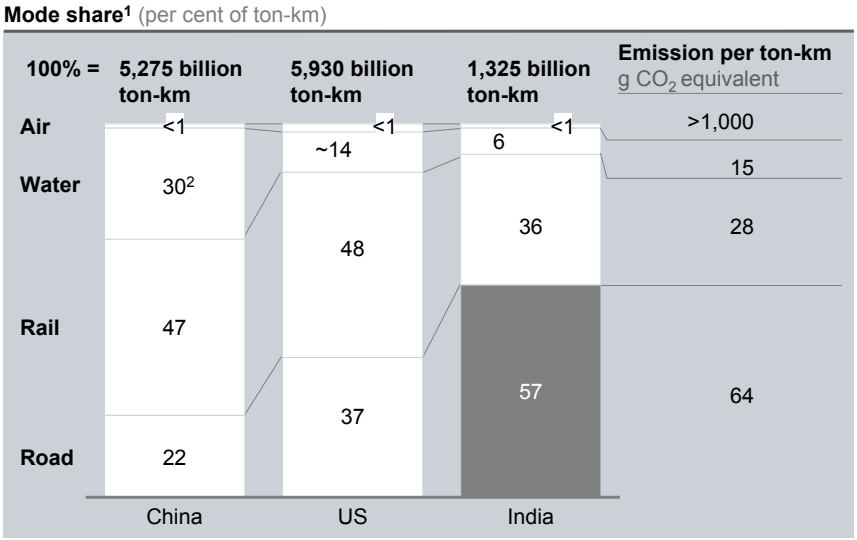
of these links or their absence altogether is often the cause of bottlenecks and poor service levels.

India's freight transport relies excessively on roads

India's roads account for a higher share of freight traffic compared to other continental sized countries like the US and China (Exhibit 2). India's reliance on roads is more than three times that of China.[6] This is despite the fact that a large part of India's freight traffic comprises bulk material and moves over long distances that can be more economically served by rail and waterways.[7]

Exhibit 2

Freight transport in India is dominated by roads



1 Share estimated for 2007, excluding pipelines
2 Two-thirds of this is from coastal shipping and one-third of this is on inland waterways mainly the Yangtze river

SOURCE: World Economic Forum; China Statistic Yearbook; Planning Commission India; NHAI; Indian Railways; DG Shipping; Bureau of Transportation Statistics US; McKinsey

Further, the higher dependence on road transport is adverse for the environment as emissions from road transport are higher than emissions from rail and waterways. Road transport emits 84g of CO^2 equivalent per ton-km compared to 28g for railways and 15g for waterways. Yet, India continues to transport a majority of its goods via roads including bulk materials like steel, cement and coal. A moderate shift from road to rail can help India save close to 0.7 per cent of its total commercial energy consumption.

6 The low share of roads in China's freight flows can be attributed to the greater utilisation of waterways along the East Coast and the Yangtze river system and use of railways for long-distance movements across the hinterland.

7 Around 80 per cent of freight movements (in ton-km) are over 400 km.

Around USD 45 billion is lost each year due to inefficiencies in India's logistics network[8]

While in absolute terms, industry spend on logistics in India is low—the relative spend is high. India spends 13 per cent of GDP on logistics which is more than what the US (9.5 per cent) and Germany (8 per cent) spend.

The purchasing power parity (PPP) adjusted benchmark of transportation costs by mode with the US demonstrates that India's logistics infrastructure is inefficient. For instance, rail and coastal shipping costs in India are approximately 70 per cent higher than those in the US. Likewise, road costs in India are higher by about 30 per cent. This not only results in higher prices and lower competitiveness, but also hampers economic growth. Our analysis suggests that poor logistics infrastructure costs the economy an extra USD 45 billion or 4.3 per cent of GDP each year. Two-thirds of these costs are hidden i.e., not generally regarded as logistics costs. These hidden costs include theft and damage, higher inventory holding costs, facilitation and transaction costs.

A 2.5 times increase in freight traffic in the next decade will put further pressure on India's logistics infrastructure

India's current infrastructure is already over-stretched. For example, most of the national highway network and rail links along the Golden Quadrilateral and North-South and East-West corridors are congested. Many large ports are already operating at very high utilisation rates.

Further, even at a conservative annual growth rate of 7.5 per cent, India's freight traffic is likely to more than double from current levels by 2020. Finally, investments in the current network design will only lead to increased inefficiencies and in losses as established earlier.

Recognising these challenges, the Eleventh Five-Year Plan proposed a large increase in logistics infrastructure spend from USD 65 billion or 1.5 per cent of GDP in the Tenth Plan period to USD 160 billion or 2.3 per cent of GDP. This is even more than India plans to spend on power during the same period. Despite the large increase, the planned spend is insufficient. It would at best result in a 15 to 20 per cent increase in road and rail network capacity.[9] The growth in freight traffic will outdo this increased capacity.

The current trajectory suggests that the total investment in logistics infrastructure would be over USD 500 billion by 2020. Despite this increased investment, our analysis suggests that service levels, absolute transit times and transit time variations will only worsen given the growth in freight traffic. As a result, economic losses, which are about USD 45 billion today could rise to around USD 140 billion in 2020.

Inadequacies in India's logistics infrastructure could constrain India's growth by adversely impacting user industries. India's exports for example, could be rendered less competitive on account of higher transit times and lower reliability.

8 Losses have been estimated by conducting a detailed analysis of the flows of three commodities (coal, auto components and agricultural goods) that represent key sectors in India, and have been extrapolated to all sectors of the economy to arrive at total losses. See Appendix B for details

9 Includes 140,000 lane-km of new national highways, state highways and major district roads and 18,400 track-km of additional rail tracks including doubling, gauge conversion and new lines.

SHIFT TO A BALANCED MODAL NETWORK

Based on the profile and quantum of India's freight flows, a systematic and efficient development of logistics infrastructure calls for a major shift along four important dimensions – concentrating flows along the right mode, building enablers, increasing asset efficiency and re-allocating investments (Exhibit 3).

Exhibit 3

An efficient logistics infrastructure strategy requires a shift along four key dimensions by 2020

			SHIFT	
			From current trajectory …	… to balanced modal mix
1 Network structure	Network components and mode	Corridors (rail and water)	~4[1]	7
		Connectors (expressways)	5-7[2]	20-30
		Last mile links (road & rail)	N A[3]	~750
2 Enablers	Illustrative enabler to support network	Logistics parks	N A	15-20
3 Asset efficiency	Illustrative shift	Per cent of toll booths with electronic tolling	<50%[4]	>90%
4 Invest-ment allocation	Share of spend (per cent[5])	Water	~10	~10
		Rail	~40	50
		Road	50	~40

1 No focused last mile programme in current plans
2 Expressways only
3 Two rail Dedicated Freight Corridors (DFCs) planned, plus coastal corridors
4 Assuming all current manual toll booths not upgraded, whereas all new toll booths created have electronic tolling lanes
5 100% = ~USD 500 billion over the next decade

SOURCE: McKinsey

The shifts towards a balanced network design could enable the railways to recapture a share of more than 45 per cent of freight traffic by 2020, relative to the current trajectory, under which its share will reduce to 25 per cent (Exhibit 4). This balanced network will also reduce losses to 4 per cent of the GDP, in comparison to an increase to over 5 per cent of the GDP if the current trajectory is pursued. Finally, if investments in logistics infrastructure are increased to USD 700 billion from the current level of USD 500 billion, losses could further decrease to under 3 per cent of the GDP.

Building the right network and ensuring flows along the right mode

Road has become the dominant mode of transport for India's freight traffic. Current plans earmark half of the planned investment for roads even as capacity on rail and waterways (including last-mile connections) remains inadequate. However, to meet the demands of growing freight traffic, a shift to more economically as well as environmentally suitable modes i.e., waterways and rail is vital. In addition to a greater emphasis on rail and waterways, the right mode of transport has to be used. Ideally, rail and waterways should be prioritised for long distances,[10] rail for medium distances[11] and roads including expressways, for shorter stretches. Such a balanced modal approach would lower transportation costs, achieve greater efficiency and be more environment-friendly.

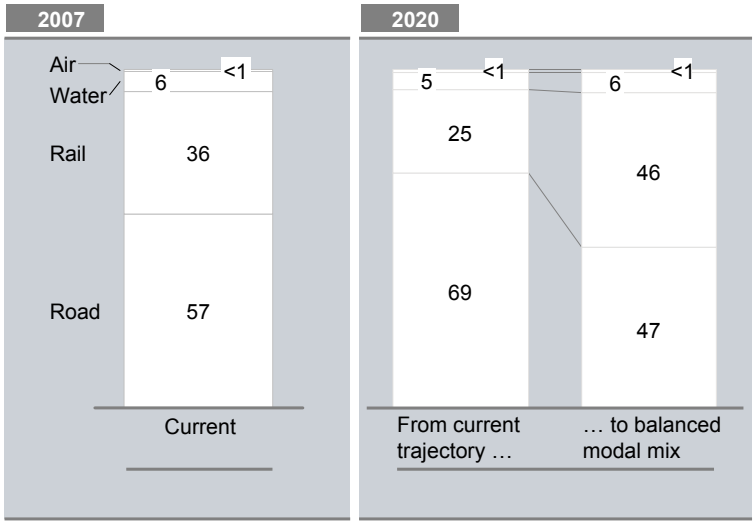
10 Distances over 700 kilometres.

11 Distances between 400 and 700 kilometres.

Exhibit 4

The proposed shift will lead to a very different modal mix

Per cent



SOURCE: McKinsey

An efficient network will have five rail dedicated freight corridors (DFCs) namely, Delhi-Mumbai, Delhi-Kolkata, Mumbai-Chennai, Delhi-Chennai, Mumbai-Kolkata and two coastal corridors namely, Kandla-Kochi and Kolkata-Chennai. These corridors will need to be supported by 20 to 30 expressways, road and rail links across the 150 connectors and 700 last mile links.

In effect, a considered network design is vital to develop effective and efficient logistics infrastructure, particularly if the funds are limited and freight flows are concentrated. Investments need to be targeted and initiatives focused in connecting growth clusters.

Creating enablers to maximise network efficiency

This shift predominantly refers to improving interfaces. It includes constructing last-mile links and 15 to 20 logistics parks to ensure interconnection between modes. Additional initiatives include standardising equipment, containers and pallets and upgrading skills.

Extracting more from existing assets

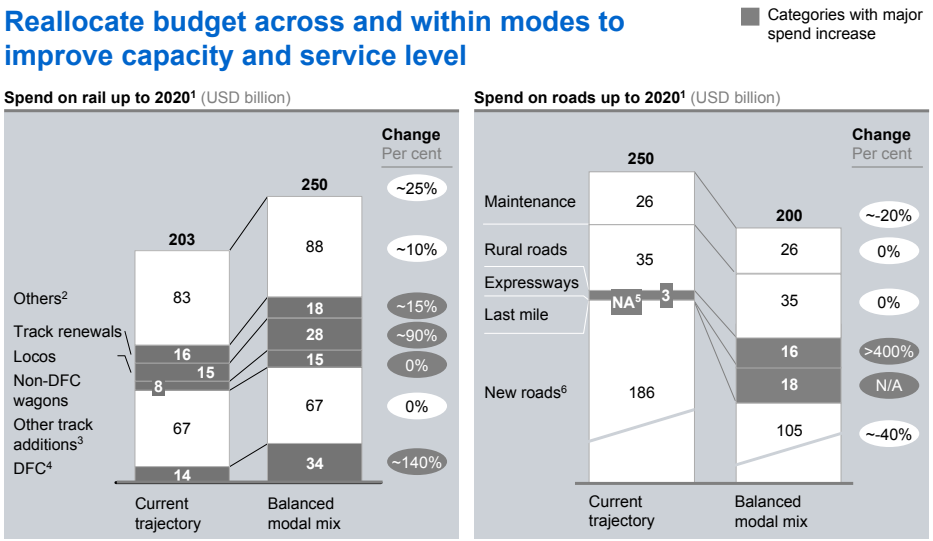
Our work posits that India needs to use its existing logistics infrastructure and equipment better. Measures to this effect include better maintenance of roads, rail tracks and rolling stock; unlocking the capacity of the rail network by accelerating the implementation of automatic block signalling, moving to lower tare load wagons,[12] improving the efficiency of scheduled rake maintenance operations; and enhancing road efficiency through electronic tolling systems on highways. These measures could unlock 5 to 10 per cent of freight capacity with much lower investments than is needed for new infrastructure creation.

12 Lighter wagons, capable of carrying higher loads.

Allocating more investment to rail and reallocating within road and rail

According to the current trajectory, over USD 500 billion is likely to be spent on developing logistics infrastructure in the next decade. Current trends suggest that about half of this will be spent on roads, around 40 per cent on rail and the rest on waterways, mainly for ports to facilitate trade. To support the changes described earlier, two simultaneous actions are required for India to build economical and environment-friendly logistics infrastructure. First, more funds need to apportioned to rail. Second, funds within rail and road need to be spent differently (Exhibit 5).

Exhibit 5



1 Spend between 2008 and 2020
2 E.g., coaches, locomotives, signalling, electrification, track renewals, bridge works, computerisation, passenger and other user amenities, workshops and production units
3 New tracks (excluding DFCs), rail doubling and gauge conversion. Over half of this spend is for developmental reasons, not the most economically viable locations. Change for the economically viable locations is more significant
4 Including wagons
5 No focused programme for last mile
6 Includes state highways/major district roads, excludes expressways and roads built as a part of focused last mile programme

SOURCE: McKinsey

- **Reallocate spend within railways:** The increased investment in railways needs to be used to create rail capacity on high-density corridors and to support the movement of a greater volume of traffic on existing track infrastructure. This means more spend on DFCs, rolling stock and other additions such as new tracks, rail line doubling and gauge conversions. While current plans are to complete two DFCs by 2020, five are needed.[13] To fulfill this aspiration, spend on DFCs in the overall allocation to railways should be doubled from around 7 per cent to close to 15 per cent.[14] This increase in investment, needs to be supplemented with the development of logistics parks and last-mile road and rail links which can facilitate better integration across modes.

- **Redirect investments within roads:** Targeted deployment of the USD 200 billion investment in roads on the high-density traffic stretches could increase the road length of national highways by 60 per cent, and state and major district roads including expressways by 15 per cent by 2020. In particular, there are two areas in which higher spends are recommended. One, an increase in the number of planned expressways from about six to about 30 by 2020 will improve service quality and fuel efficiency.

13 Mumbai, Mumbai-Chennai, Delhi-Kolkata, Mumbai-Kolkata, and Delhi-Chennai.

14 This includes the investment in wagons used for plying on the DFC network.

This will require an increase in spend from USD 3 billion to USD 16 billion by 2020. Second, the spend on last mile stretches should be increased substantially to around 10 per cent of the total spend on roads. At present, there is no focused programme and measurement of last-mile links. As an unfortunate consequence of this reallocation, a smaller proportion of the spend within roads will be on national and state highways that do not fall along corridors, connectors and last-mile stretches.

In addition to re-allocating investment to the extent possible, an increase in funds available to the logistics infrastructure sector would be beneficial. Our analysis suggests that if investments are increased from USD 500 billion to around USD 700 billion by 2020, the losses in the system would decline from over 4 per cent to under 3 per cent of GDP in 2020.

MOVING FROM STRATEGY TO IMPLEMENTATION: THE NATIONAL INTEGRATED LOGISTICS POLICY

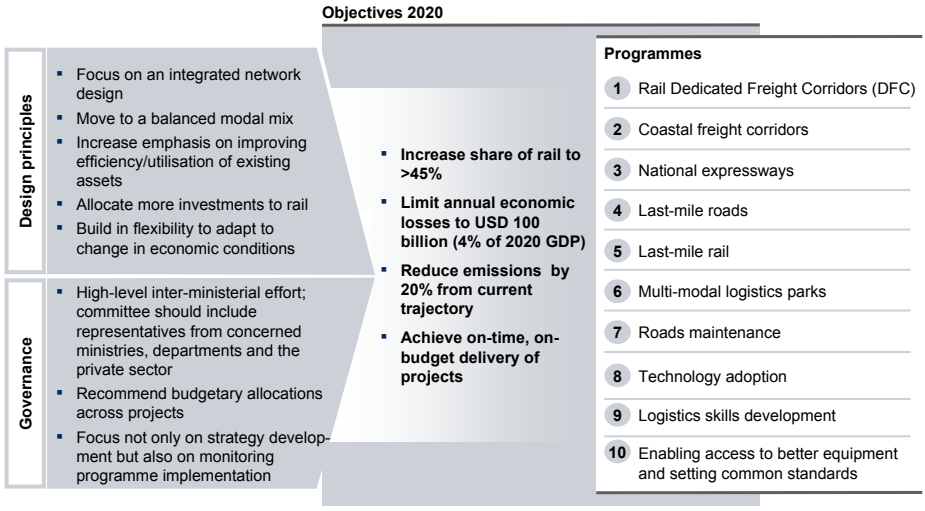
Achieving the four major shifts outlined above will require a concerted effort by multiple stakeholders and pose many challenges. An integrated policy defining a new vision, launching 10 priority programmes and governance that spans across ministries will improve India's ability to achieve its economic growth aspirations, while reducing energy consumption.

National Integrated Logistics Policy – a new vision for India's logistics infrastructure

A National Integrated Logistics Policy (NILP) that shapes a vision for India's logistics infrastructure in 2020 and beyond would be a critical enabler for such efforts (Exhibit 6). The NILP could help the government reduce recurring losses to the economy and improve capital efficiency in the following three ways. First, it could define the blueprint for the most effective and efficient logistics infrastructure to support a balanced modal mix, based on the anticipated increase in freight flows by 2020. Second, it can ensure better coordination

Exhibit 6

National Integrated Logistics Policy (NILP) is needed to move from strategy to implementation



SOURCE: McKinsey

between multiple national and state-level bodies responsible for developing logistics infrastructure. Third, it can facilitate easier access to and optimal allocation of scarce resources such as investments, equipment and people.

Such a policy should: 1) have tangible objectives to build logistics infrastructure that keeps pace with India's economic growth, 2) define a set of programmes that can help realise these goals; and 3) ensure a governance structure that enables efficient and timely execution.

The NILP objectives could include:

- Implementing a balanced modal mix by increasing the share of rail in freight carriage to more than 45 per cent
- Limiting the economic losses attributed to logistics to less than 4 per cent of GDP (USD 100 billion)
- Reducing energy consumption by 10 MTOE in 2020 (around 1 per cent of total commercial energy consumption) and hence freight related greenhouse gas emissions by around 20 per cent from expected levels under the current trajectory[15]
- Achieving on-time and on-budget delivery of infrastructure projects, which requires an improvement in project implementation relative to current performance.[16]

The NILP should also set clear long-term targets based on rigorous analysis of future flows of freight traffic. These can then be cascaded into near-term targets for the various bodies involved in building India's logistics infrastructure.

Ten targeted programmes should be the bedrock of the National Integrated Logistics Policy

The NILP should propose and result in the launch of 10 targeted programmes outlined below which would ensure that the objectives are met:

- **Rail dedicated freight corridors:** This programme should have a dual focus. First, accelerating the special purpose vehicles (SPVs) for the two planned DFCs—Delhi-Kolkata, Delhi-Mumbai—and simultaneously incorporating SPVs for three additional DFCs. These are on the Kolkata-Mumbai, Delhi-Chennai, Mumbai-Chennai corridors.
- **Coastal freight corridors:** The objective of this programme must be to strengthen the West i.e., Kandla to Kochi and East i.e., Kolkata to Chennai coastal freight corridors through integrated projects that include last-mile rail and road programmes, trans-shipment hubs, proactive marketing and accelerated port development.
- **National expressways:** This includes constructing expressways of 100 to 300 km stretches that factor in expected increases in traffic by 2020. While currently 5 to 7 expressways are likely to be built by 2020, ideally, the number of expressways should be increased to over 20 by 2020. Expressways should include high-traffic routes such as Nasik-Shirpur and Ghaziabad-Bareilly.

15 From around 180 million tons of CO2 equivalent in 2020 under the current trajectory to around 150 million.

16 Current project implementation track record shows on average a cost and time overrun of 20 to 25 per cent for infrastructure projects. For details see McKinsey report on "*Building India: Accelerating Infrastructure Projects*"

- **Last-mile roads:** Creating a dedicated last mile programme with over 750 last-mile links to connect in particular port and railway terminals to production and distribution centres.

- **Last-mile rail:** This should ensure last mile rail infrastructure in many of the last 750 mile links. It will include developing track and rail head infrastructure to support 8 to 10 critical coal corridors in mineral rich states such as Jharkhand, Chattisgarh and Orissa.

- **Multi-modal logistics parks:** This programme will predominantly focus on demarcating land for logistics parks at 15 to 20 key points where different modes overlap, near major cities, or along proposed DFC routes. Designed as concessions, these should be equipped with the necessary infrastructure to ensure the seamless movement of freight across modes.

- **Roads maintenance:** This comprises creating long (e.g. 10 years) annuity-based maintenance contracts for 400 km to 500 km stretches. The current practice has been to issue contracts for shorter distances of 50 km to 100 km. Clear commitment to maintenance could also encourage the participation of more private providers. Extending both the duration of contracts and increasing the road stretches to be maintained could act as an incentive to providers to achieve scale and invest in better technology, thereby reducing costs.

- **Technology adoption like national electronic tolling:** This entails standardising technology for nationwide electronic toll collection (ETC) in future contracts and establishing a nationwide clearing house with set norms and service standards to facilitate transactions, thereby reducing waiting time and improving service levels.

- **Logistics skills development:** Adopting a balanced modal approach will increase demand for requisite skills. In particular, demand for four types of personnel will grow—warehouse managers, logistics managers, coastal seafarers and truck drivers. This in turn will require upgrading the training infrastructure and collaborating with institutes of technology, engineering colleges, marine training institutes and driver training institutes to help meet growing demand.

- **Enabling access to better equipment and setting common standards:** This refers to acquiring access to better equipment such as larger trucks and higher tare load railway wagons and developing common standards to aid inter-modal transport that ensures consistency in containers, pallets and cranes. Further, supporting research institutions like Road Research Institute could help develop better quality road construction material to bolster construction while simultaneously reducing costs.

Governance changes needed at the highest levels to develop the policy and ensure implementation

Developing and implementing various initiatives as part of the balanced modal approach will require an integrated approach across multiple stakeholders at the central and state level. The level of coordination required is monumental, as developing India's logistics infrastructure is the responsibility of a number of state and central government units and infrastructure development agencies.

The policy itself can be developed in a manner similar to the Integrated Energy Policy i.e., through an appropriate committee. Such a committee should include representatives from the concerned ministries and departments (e.g., NHAI, Indian Railways, Waterways Authority), stakeholders across ministries (e.g., Ministry of Roads, Ports, Railways, Finance, Aviation) and from the private sector (e.g., user industries, developers and

logistics providers). The government has recently set up the High Level National Transport Development Policy Committee that could fulfil this role.

Adopting and implementing an integrated logistics policy will need an empowered Group of Ministers, the Cabinet Committee on Infrastructure, the Prime Minister's Office or an equivalent central body at the highest level to take charge. While the policy execution will be carried out by ministries in the centre and states, such a body should ensure an integrated, coordinated, timely and flexible approach to infrastructure development.

Separately, to ensure speedy implementation, well-functioning infrastructure implementation "war rooms" should be set up for high-priority projects at various levels to provide common information, debottleneck and accelerate implementation of projects, under nodal and executing agencies like NHAI, as well as at the centre with the Cabinet Committee on Infrastructure.

PRIVATE SECTOR OPPORTUNITIES

Building logistics infrastructure capable of handling rising freight traffic more efficiently and in an environmental-friendly manner will open up large new opportunities for industry.

First and foremost, user industries will need to rethink their logistics strategy under two scenarios: a scenario where the logistics situation worsens as well as in a scenario that a new more efficient balanced modal logistics network gets created that opens up new opportunities. Companies that rethink their strategy for modal mix, use of containers, network planning and so on will benefit the most.

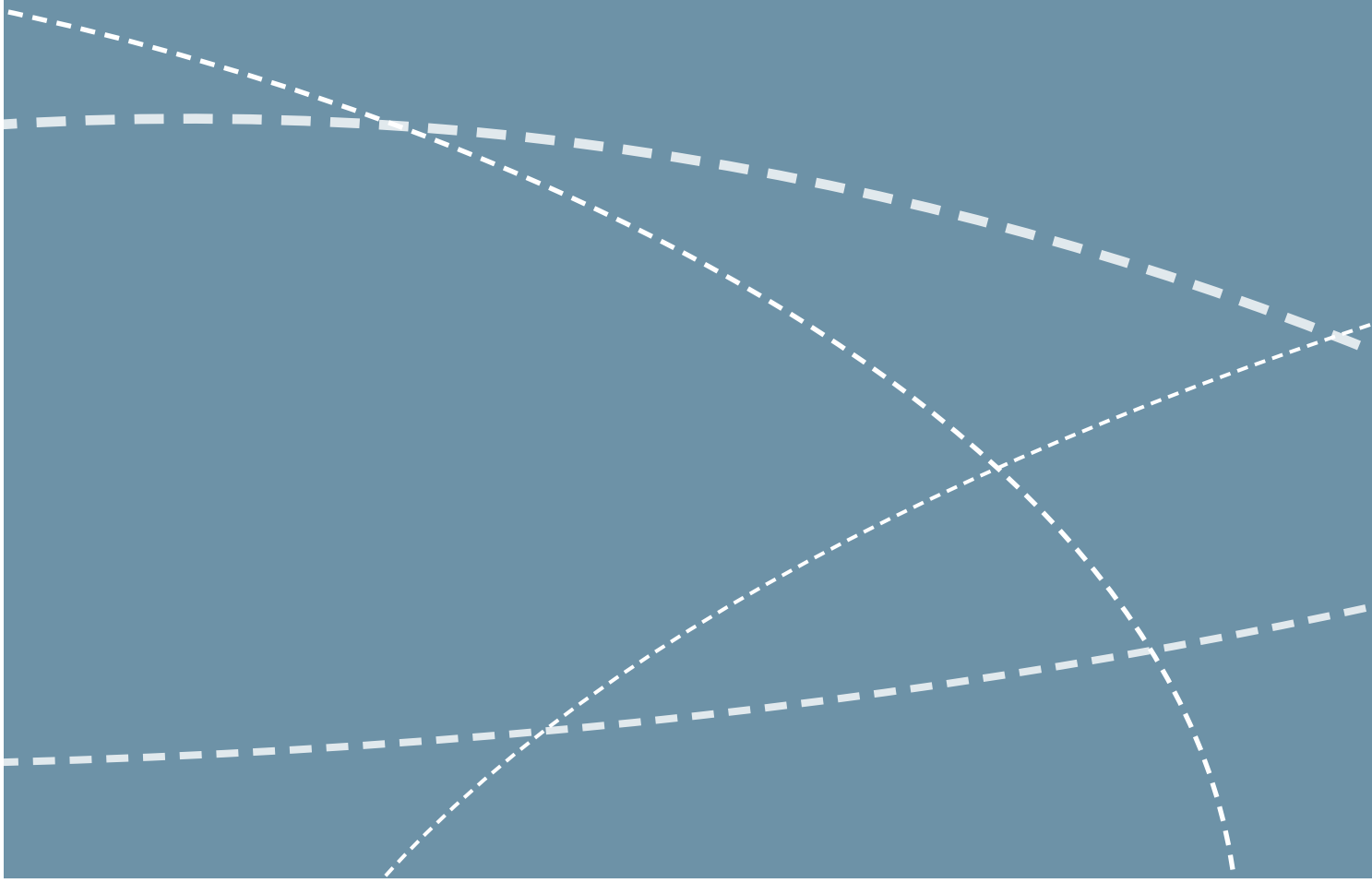
New opportunities will also surface for infrastructure developers and construction companies, technology and equipment providers. The size and scale of opportunities will increase. For example, capital and operational expenditure spending on road development till 2020 could be as much as USD 200 billion. Similarly, expenditure on rail tracks including DFCs could be close to USD 90 billion. The investment in ports could be as much as USD 50 billion. Increased demand for rail wagons will benefit equipment providers. Technology providers would also benefit through greater demand for warehouse management software and a common ETC platform across tolling centres.

Simultaneously, logistics providers also stand to benefit on multiple fronts with the implementation of the new vision for India's infrastructure. Benefits include greater demand for Third-Party Logistics (3PL services) such as warehouse management, end-to-end transportation management; and more opportunities for coastal operators to create charter and liner services in commodity bulk materials like coal, cement, iron ore, transport, and increasingly, in container transport.

□ □ □

India stands to gain economically and environmentally from implementing an effective and efficient balanced modal logistics infrastructure system. Economic gains encompass capital savings and reduced waste, both in the freight system and in the user industries. Environmental gains like reduction in emissions and reduced energy consumption are also likely. Implementing this is imperative but by no means easy. It calls for strong leadership to facilitate political alignment across the centre and states, rigorous implementation and programme management.

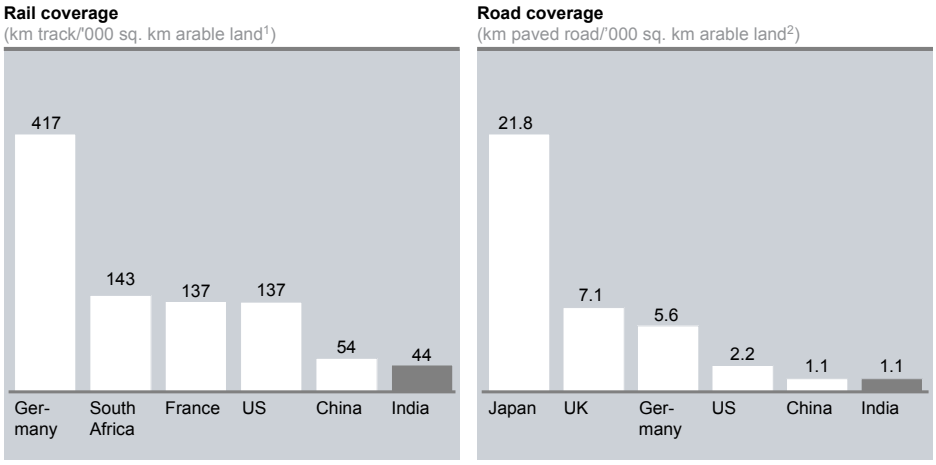
India’s current logistics infrastructure: Inadequate to meet growth aspirations



Logistics infrastructure is a key enabler of economic growth. Recognising its importance to India's development, the government has increased its spend on logistics infrastructure in the last decade. Several major projects like the Golden Quadrilateral have been initiated, two dedicated freight corridors (DFCs) have been conceptualised and port capacity doubled. Nevertheless, much of the country's network built before independence is plagued by insufficient planning and investments (Box A). This has resulted in the shortfalls we see today. For example, India logistics infrastructure delivery is characterised by high costs and low service levels compared to other countries. Furthermore, the installed infrastructure capacity lags behind global peers (Exhibit 1.1).

Exhibit 1.1

India's logistics infrastructure lags behind global peers as well as other developing countries



1 Estimated as of 2006
2 Estimated as of 2007

SOURCE: CIA World Fact Book 2007; Transport Corporation of India; Planning Commission; Government of India; Ministry of Surface Transport Government of India; McKinsey

Recognising these challenges, the government has increased the spend on logistics since 2003 (Exhibit 1.2). In the Eleventh Five-Year Plan, spend on logistics infrastructure at around USD 160 billion is higher than spend allocated to power at USD 150 billion.[17]

Yet, India's logistics network is not equipped to manage a two and a half fold increase in freight traffic expected by 2020. A fundamentally different approach will be needed to build India's logistics infrastructure. This approach should be developed on a fact-based understanding of the country's current freight flow profile, the degree of inefficiency in the logistics system, future growth, and development of both regions and products.

17 Includes road, rail and ports. Excludes airports and storage.

Box A: India's current freight infrastructure is a result of transportation networks built before independence

Rail: India's rail network is a vestige of British rule. Over 80 per cent of the current network was built before the country's independence in 1947. India therefore has a network developed by over 40 different railway entities. Further, many independent kingdoms had their own railway networks. Soon after partition, around 40 per cent of the network became a part of Bangladesh (most of the Bengal-Assam railway lines) and Pakistan (the North-Western railway lines). The remaining tracks were amalgamated into the Indian Railways. While traffic on rail has grown more than 10-fold between 1951 and 2007, rail track length has only grown 1.4 times in the same period. Despite the overcapacity in 1950 and the efficiency improvements like gauge conversion and electrification since then this stark gap between traffic and infrastructure growth has resulted in capacity constraints on key portions of the network with high traffic. Furthermore, traffic growth will continue at high rates, requiring a step increase in the rate of network build-up.

Road: Similar to the railways, investments in India's roads have not kept up with growth in traffic since independence. Passenger and freight traffic have grown close to 200-fold since 1951. However, in the same period, road length has increased only 8-fold from 0.4 million km in 1951 to over 3.3 million km in 2007. Further, India's roads are not only old but also in poor condition with over 30 per cent of the National Highway network constructed before independence. While the road network of over 3.3 million km seems extensive, only 15 per cent of these roads are highways and only 0.5 per cent of roads are two- or four-lane roads. India's paved-road density is 940 km per 1,000 sq km of arable area much lower than 21,000 km in Japan and 7,050 km in the UK.* Further, a significant proportion of highways are structurally inadequate to support the 10.2 tons of load per axle that trucks are allowed to carry.

Waterways: Growth in waterways has been hampered by limited investments and the loss of key routes following partition. Prior to the Fifth Five-Year Plan, developing inland waterways was accorded low priority with a cumulative investment of under INR 35 crore. This was partly due to the prioritisation of irrigation, and limited viability of inland waterways owing to deforestation and silting. Further, the partition of the country rendered several routes unviable. For example, the Karachi-Rangoon stretch via Colombo was a key coastal route but following partition, this stretch was significantly shortened, resulting in lower traffic. Similarly, the Karnafuli and Kolodyne river routes connecting the north-eastern states to Bangladesh and Burma are not used as extensively as before independence.

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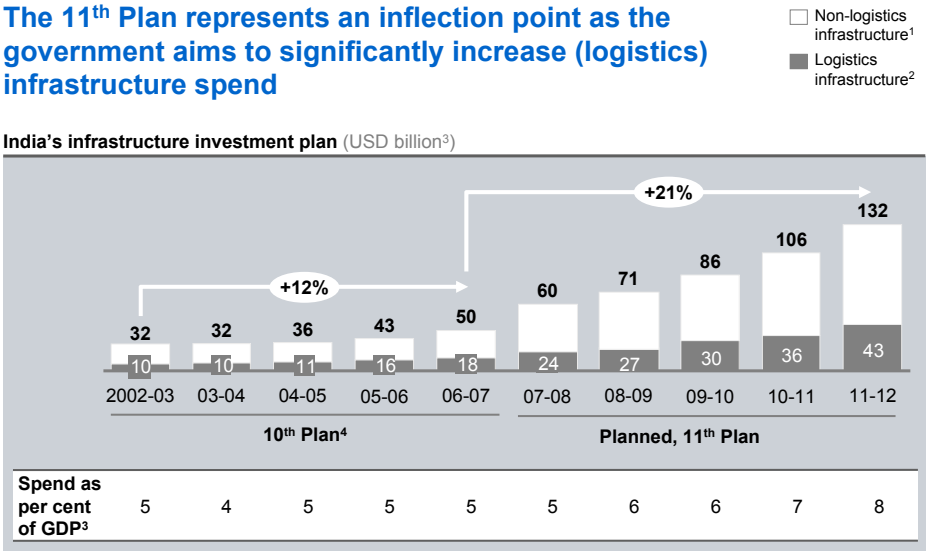
* Source: CIA World Factbook data; McKinsey.

Exhibit 1.2

The 11th Plan represents an inflection point as the government aims to significantly increase (logistics) infrastructure spend



1 Non-logistics infrastructure includes power, irrigation, telecom, water supply and sanitation, and gas
2 Logistics infrastructure includes road, rail, ports, airports and storage
3 At USD 1 = INR 45
4 Actual for 2002-03 to 2004-05, estimates for 2005-06 and 2006-07

SOURCE: "Projects of Investment in Infrastructure during the11th Plan", Planning Commission, Aug 2008; McKinsey

This chapter highlights the fact that

- The logistics network is highly concentrated
- Freight transport relies excessively on roads
- Around USD 45 billion is lost each year due to inefficiencies in India's logistics
- An over 2.5 times increase in freight traffic in the next decade will further pressurise the existing logistics infrastructure.

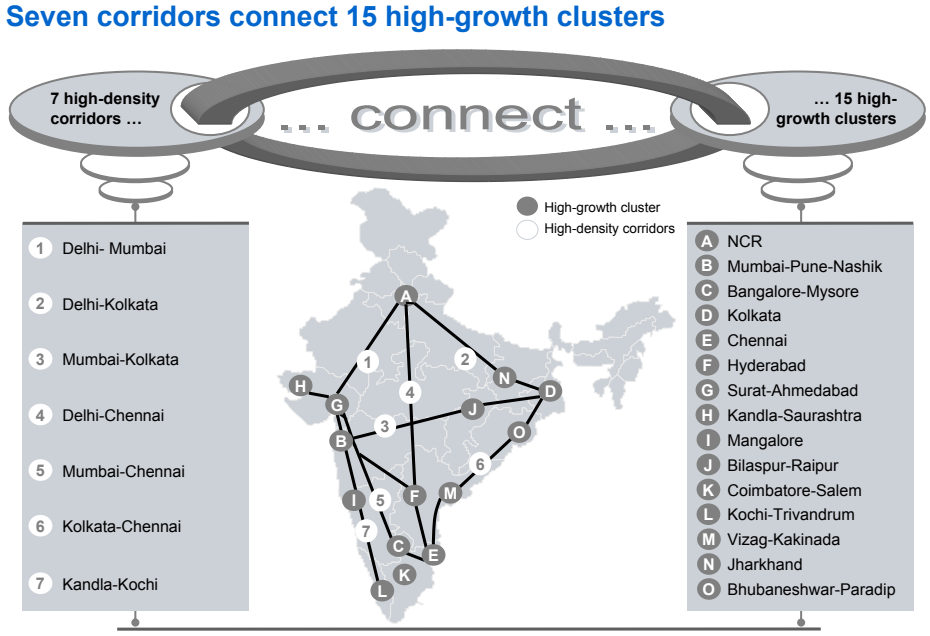
THE LOGISTICS FLOWS ARE HIGHLY CONCENTRATED

A detailed bottom-up analysis of India's current and future traffic flows across various modes has been conducted (detailed in Appendix A). This analysis leads to the conclusion that India's freight network is highly concentrated and three key components of the network account for two-thirds of total freight traffic in the country.

Component 1 – Seven long-haul corridors that connect 15 high-growth clusters form the backbone of India's logistics network

Fifteen high-growth production consumption clusters, growing at 1 to 2 per cent higher than the country's GDP are expected to account for about 60 per cent of the increase in GDP in the next 10 years. Consequently, freight routes through these areas will witness the highest traffic volumes in the country. This current concentration will only increase in future.

Exhibit 1.3



SOURCE: McKinsey

Seven corridors connect these major clusters (Exhibit 1.3) and accounted for around 50 per cent of the total freight traffic in 2007 in ton-km.[18] Looking ahead, they are likely to account for 60 per cent of the growth.[19] Within this geographic concentration:

- National highways (NH) along the selected routes account for less than 25 per cent of the total NH length (i.e., less than 0.5 per cent of the Indian road network) but handle over 40 per cent of road freight traffic
- Rail links comprise 27 per cent of the Indian rail network but handle over 50 per cent of rail freight traffic in the country
- Two corridors along the East and West coasts have a significant share of coastal traffic, which can be increased even further.

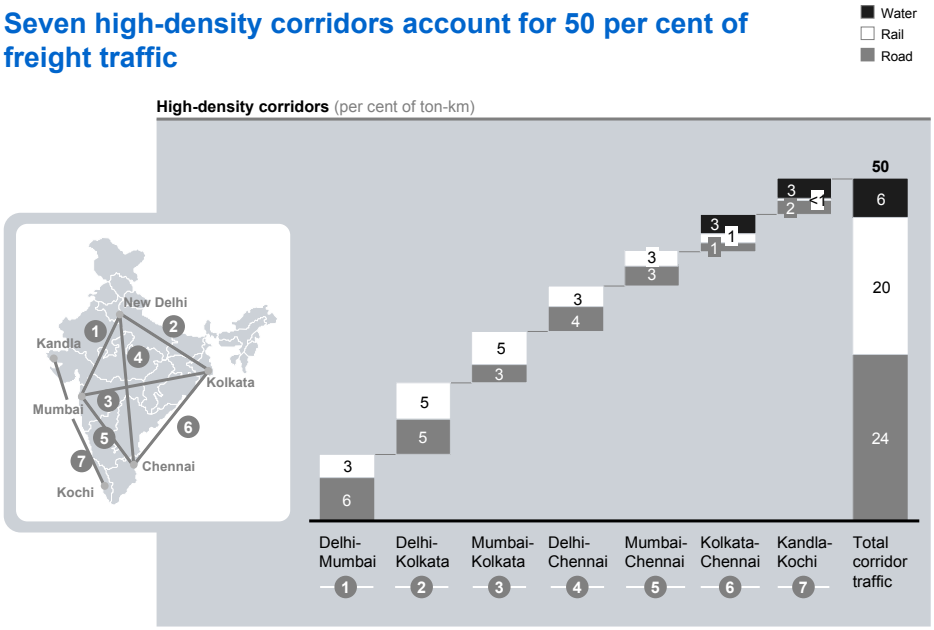
Exhibit 1.4 outlines the concentration of freight traffic along the corridors.

18 This traffic estimate is based on a bottom-up assessment of freight flows along key highways, rail links and coastal corridors.

19 Appendix A details the methodology for projecting freight traffic based on the estimated growth of the selected clusters, adjusted for other changes in freight flows. For example, this includes coal that is expected to witness a slower growth in freight flows (in ton-km), at 6.5 per cent compared to 8 per cent for all other goods in 2020. The lower growth rate of coal is attributed to the development of new power plants located either at the pit-head or along the coast, thereby reducing the need for transportation.

Exhibit 1.4

Seven high-density corridors account for 50 per cent of freight traffic



SOURCE: McKinsey

Component 2 – Over 150 medium-distance connectors that connect the corridors are key for India's logistics network

In addition to the seven corridors, over 150 medium-distance connectors[20] i.e., 100 km to 300 km long stretches, are critical links in the overall network. The connectors include mainly rail links and state roads/national highways that link major state district headquarters to the corridors, and account for around 10 per cent of freight traffic in ton-km. More importantly, while the connectors comprise a small share of the network (e.g., merely 1 per cent[21] of the road network), around 30 per cent of India's freight volumes[22] pass through these routes at some point of time. A case in point that highlights such concentration is Maharashtra. Around 1 per cent of the state road network that links the high-growth clusters handles over 60 per cent of intra-state road freight traffic.

Component 3 – Over 750 last mile links[23] of up to 100 km form a critical component of India's logistics network

While the corridors and connectors handle a large share of freight traffic, they do not cover many of the cargo source, transit and termination points. These include ports, mines and industry clusters, whose transport needs are met through a number of last mile links—a core component of the logistics infrastructure. A careful study of these locations suggests that more than 30 per cent of them are not currently on national or state highway routes.

20 Appendix A describes the approach to estimating traffic on these connectors. Freight flows and the number of critical links are estimated through a bottom-up analysis of eight major states and extrapolated to the rest of the country. Freight flows on connectors has been estimated based on the district GDP of clusters they connect.

21 Medium-distance connectors account for 30,000 km to 40,000 km of India's 3.3 million km road network.

22 Measured in tons.

23 Last mile links are estimated based on a bottom-up study of over close to 400 industry clusters, 200 ports (including major and non-major) and 200 mines and their proximity to national and state highway networks. See Appendix A for details.

For instance, mines such as Tensa (iron ore) and industry clusters such as Rajganjpur and Wynad require better last-mile links to the nearest national highways/state highways along the corridors or connectors, for the smooth movement of cargo.

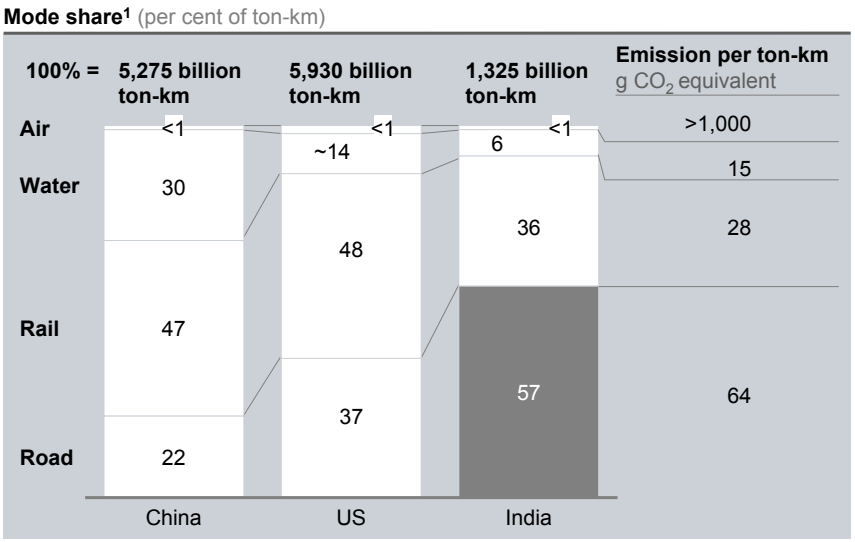
Last-mile connectivity has not typically received much attention in infrastructure development or transportation policies. This has created critical challenges. First, existing links are of poor quality, and second, there is a shortage of such lifelines that connect production and consumption centres with connectors and corridors. Our analysis suggests the current network alone requires over 750 last mile links[24] to effectively meet current requirements.

INDIA'S FREIGHT TRANSPORT RELIES EXCESSIVELY ON ROADS

In addition to the structure of the network, the mode of transportation is a key characteristic of a country's logistics infrastructure and freight flows. India transports a much higher proportion of its freight via roads relative to other continental sized countries (Exhibit 1.5).

Exhibit 1.5

Freight transport in India is dominated by roads



1 Share estimated for 2007, excluding pipelines

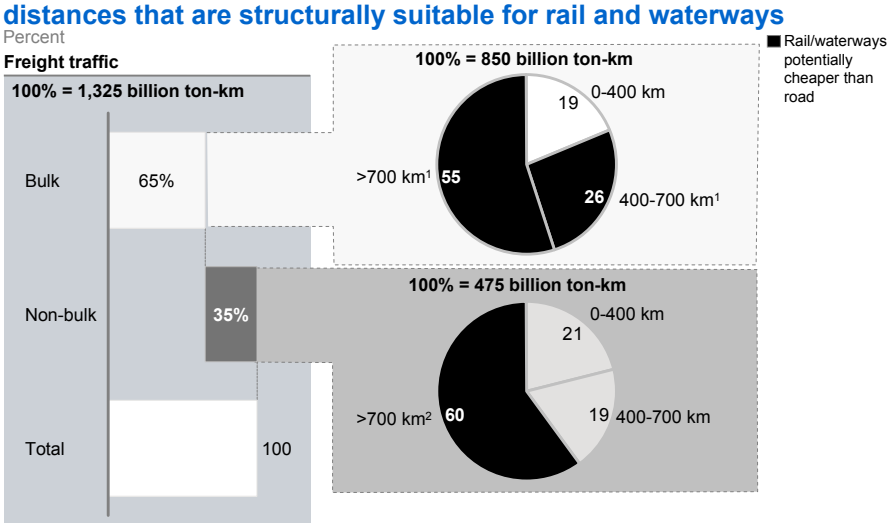
SOURCE: World Economic Forum; McKinsey; China Statistic Yearbook; Planning Commission India; NHAI; Indian Railways; DG Shipping; Bureau of Transportation Statistics US; McKinsey

This is despite the fact that much of India's freight comprises bulk commodities and moves across long distances that can be more economically served by rail and waterways. Close to 65 per cent is bulk and over 75 per cent is transported (in ton-km) over distances of more than 400 km (Exhibit 1.6). Such excessive reliance on roads results in high costs, increases energy consumption and negatively impacts the environment.

24 Appendix A describes in detail our analysis which assessed more than 400 industry clusters, more than 200 ports (including major and minor ports) and close to 200 mines to arrive at the number of last-mile links needed.

Exhibit 1.6

Two-thirds of India's freight travels over long and medium distances that are structurally suitable for rail and waterways



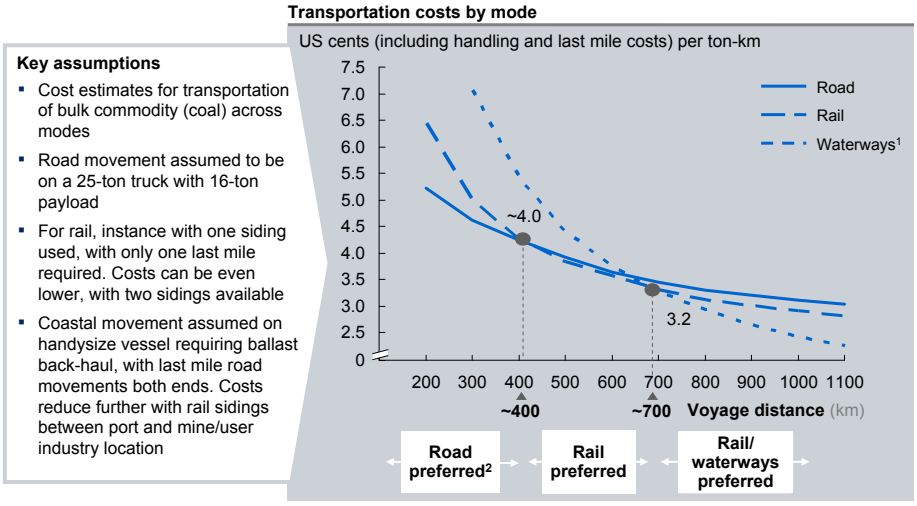
1 Assuming rail siding available at origin, a short last mile move required on road of under 50 km to final destination
2 At 700 km distance, true for heavy cargo such as tiles/stones/pig iron (28 tons in a container); assuming no rail siding available but short last mile moves on trucks of less than 50 km between rail terminals and points of origin/destination

SOURCE: Indian Railways; McKinsey

While road is the least expensive form of transport for distances up to 400 km, as distance increases rail and waterways become cheaper (Exhibit 1.7). Flows where rail is structurally cheaper than roads account for around two-thirds of the total traffic. While costs by mode and distance breakpoints could vary by route, type of commodity, fronthaul or backhaul etc., the breakeven distances are directionally correct.

Exhibit 1.7

Transportation costs on rail and waterways are lower than on roads for longer distances



1 Refers to coastal shipping
2 For large-volume movements (e.g., coal to power plants, it makes sense to use rail with two sidings for even shorter distance movements for reasons of truck availability)

SOURCE: Indian Railways; interviews; McKinsey

In addition to cost effectiveness, the development of rail and waterways can help energy conservation and in turn lead to environmental benefits. This is because emissions from rail and waterways at 15 g and 28 g CO_2 equivalent per ton-km are much lower than emissions from road transport at 84 g CO_2 equivalent per ton-km. Despite these obvious benefits, India continues to transport most of its goods via roads, including steel, cement and even on occasion bulk material such as coal over distances greater than 700 km.

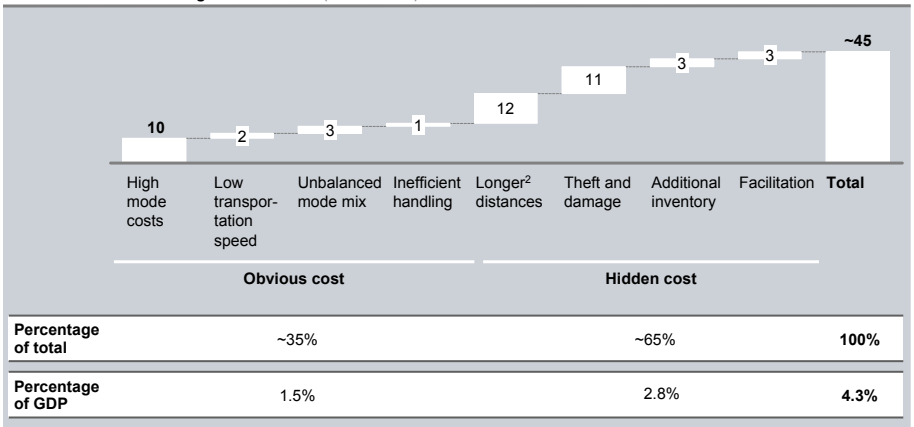
AROUND USD 45 BILLION IS LOST EACH YEAR DUE TO INEFFICIENCIES IN INDIA'S LOGISTICS

India's logistics network is plagued by inefficiencies resulting from the lack of infrastructure and equipment, high handling costs, theft and damage. Costs to users are therefore higher than those in other countries with equivalent logistics infrastructure. Our analysis suggests losses from inefficiencies amount to around USD 45 billion in 2007[25] (Exhibit 1.8).

Exhibit 1.8

Logistics users in India spent ~USD 45 billion more than required due to inefficiencies in the logistics system

Inefficiencies in India's logistics network[1] (USD billions)



Percentage of total	~35%	~65%	**100%**
Percentage of GDP	1.5%	2.8%	**4.3%**

1 Extra spend vis-à-vis best-in-class. Estimated for 2007
2 Based on longer average distances travelled relative to other large countries e.g., average distance travelled by coal in India is close to 500 km versus around 400 km in China

SOURCE: Industry reports; Global Insight; McKinsey

India's spend as a percentage of GDP is 13 per cent, higher than that of the US, Japan and Germany. However, high cost as a percentage of GDP is not a sufficient indicator of an inefficient network. This is because the spend on logistics depends on a range of other factors than just the efficiency of the infrastructure including the share of manufacturing and agriculture in GDP, the size of the country, geographic characteristics and so on. For instance, China's higher logistics spend as a percentage of GDP can be attributed to a number of factors (see Box B).

25 Losses have been estimated by conducting a detailed analysis of the flows of three commodities (coal, auto components and agricultural goods) that represent key sectors in India, and have been extrapolated to all sectors of the economy to arrive at total losses. This approach is further detailed in Appendix B.

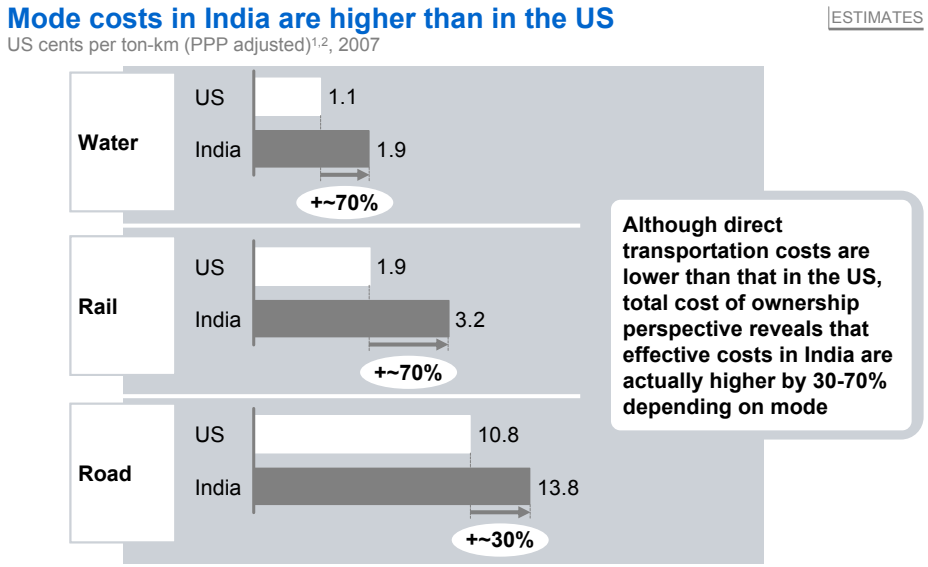
Box B: China's spend on logistics as a percentage of GDP is high

Logistics spend as a percentage of GDP is not in itself a sufficient indicator of the condition of a country's logistics network. Against China's higher spend of 17 per cent of GDP, it might appear that India is doing reasonably well. However, China's high spends can be explained by a few factors:

- **Lower share of services sector relative to India:** China has a higher non-service share of GDP as compared to India (60 per cent in China versus 45 per cent in India). However, the costs are on par after adjusting for the share of services (about 30 per cent of non-service GDP). Considering the next two factors resulting in structural disadvantage for China, the similar logistics costs as a per cent of GDP imply that the state of physical infrastructure in China is better than that in India, as is commonly known.
- **Terrain:** Two-thirds of China's territory is either mountains or deserts, increasing transport costs.
- **Imbalanced flows:** There is higher flow towards the East, given that most development has happened along the East coast. Further, East-bound flows comprise bulk commodities such as coal whereas West-bound flows are typically consumer goods, both requiring different trucks. Consequently, the share of empty backhauls is high.

A Purchasing Power Parity[26]-adjusted total cost of ownership analysis of the three main modes of transportation—road, rail and waterways—is a much better indicator of the inefficiency of India's logistics infrastructure (Exhibit 1.9). This analysis reveals that road transportation is 30 per cent more expensive in India than in the US; whereas rail and waterways are 70 per cent more expensive.

Exhibit 1.9



1 PPP adjustment refers to adjustment for Purchasing Power Parity by industry sector. This is as per World Bank publication on Global Purchasing Power Parities and real expenditures, which takes into account share of labour in different industries over and above the country PPP
2 Includes handling costs, as well as indirect costs (e.g., higher inventory, theft, damage, transaction costs). Direct transportation costs based on representative sample of movements in India and comparable movements in US

SOURCE: Industry interviews; DG Shipping; Indian Railways; Bureau of Transportation Statistics US; McKinsey

26 Purchasing Power Parity is a factor adjustment taking into account the impact of the share in the key inputs (e.g., labour) cost structure of the industry.

In addition to mode costs, transit times across modes in India are longer and vary widely compared to developed countries. This can be partially attributed to low average speeds. For example, the average speed of a truck is 35 km per hour on India's highways as compared to over 75 km per hour in the US. Similarly, the average speed of freight trains is 25 km per hour in India while it is close to 45 km per hour in the US. Low average speeds are accentuated by a variety of factors: uncertainty in waiting times at toll stations, freeze in truck traffic during the day, high turnaround times at ports, low priority accorded to freight trains on Indian railways, low-quality track infrastructure and outmoded trucks susceptible to frequent breakdowns, resulting in long transit times. These challenges significantly increase the management complexity for users of India's logistics network.

Beyond the challenges of long and uncertain transit times, India's logistics network is also hampered by poor transportation equipment. Trucks are smaller, relatively unreliable and the railways use higher tare load wagons with lower axle loading (21 to 22.9 tons versus over 25 tons in the US and China) coupled with inadequate loading and unloading infrastructure. Inefficiencies are further compounded by the absence of electronic tolling systems; limited use of information technology (e.g., in tracking and routing wagons) results in higher end-to-end transportation costs, higher administration costs and also increases the costs from damage et al. But around 65 per cent of the inefficiencies are hidden i.e., they are currently not directly attributed to logistics.

A 2.5 TIMES INCREASE IN FREIGHT TRAFFIC IN THE NEXT DECADE WILL PUT FURTHER PRESSURE ON INDIA'S LOGISTICS INFRASTRUCTURE

Despite greater attention and investments, India's current logistics infrastructure is weak and significant portions of it are over-utilised. For example, most of the national highway network and rail links along the Golden Quadrilateral and North-South and East-West corridors are heavily congested. Further, India's freight traffic is expected to grow over 2.5 times in the next 10 years or at around 7.5 per cent CAGR (Exhibit 1.10). While investments in logistics infrastructure will increase, the inability of the sector to keep pace with growing traffic will increase inefficiencies and losses to the economy will continue to rise.

Current trajectory will result in an investment of USD 500 billion on logistics infrastructure

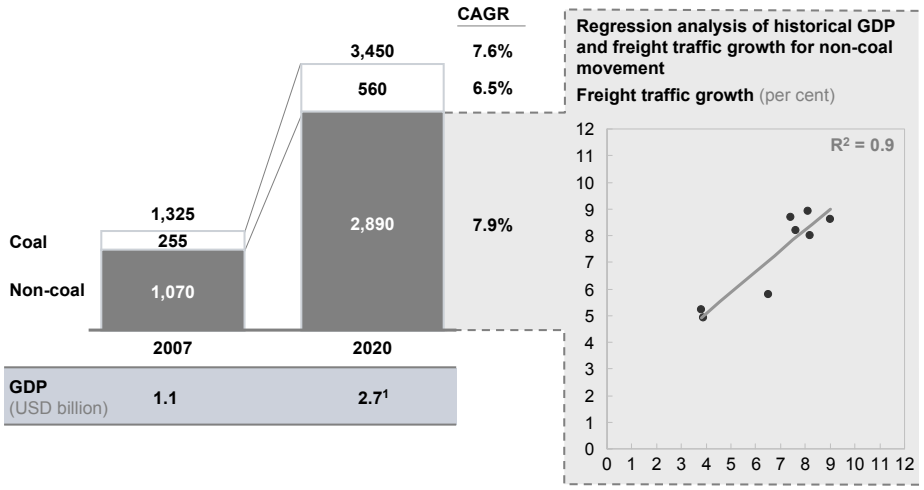
Recognising the urgent need to rapidly scale up investments to meet rising demand in the sector, the Eleventh Five-Year Plan has allocated close to USD 160 billion towards developing roads, rail and waterways. 48 per cent of this spend is apportioned to roads, 41 per cent to rail and 11 per cent to waterways including ports. Further, the Planning Commission has indicated a possible increase in spend on infrastructure as a per cent of GDP from 5.3 per cent in 2008 to 10.3 per cent in 2017.[27] Based on planned and expected investments in the 11th Plan, as well as estimates for future plans to clarify GDP growth at 7.5 per cent per annum over the next decade, investment in logistics infrastructure is estimated to be about USD 500 billion by 2020 (Exhibit 1.11).

27 Planning Commission, Government of India, 2007.

Exhibit 1.10

Freight traffic is expected to grow over 2.5 times over the next decade

Billion ton-km

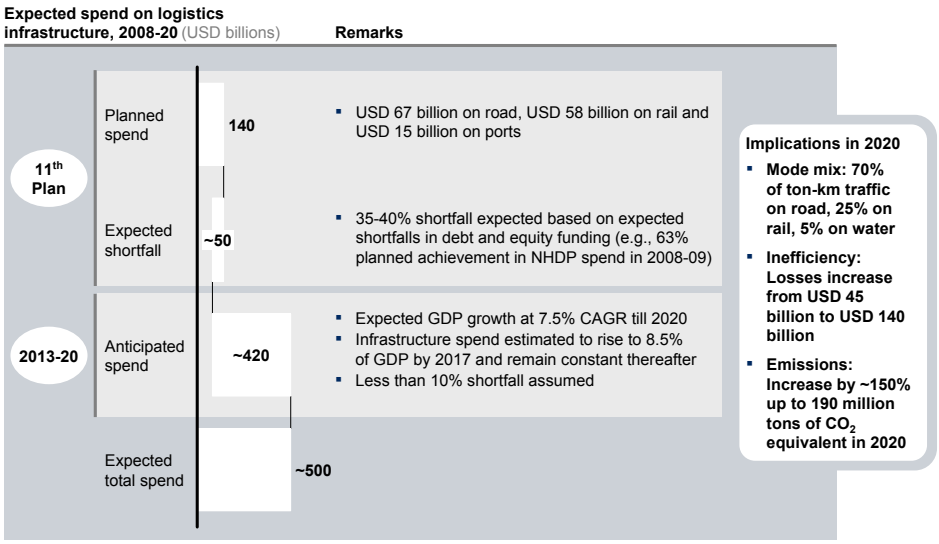


1 Estimate based on 7.5% annual GDP growth

SOURCE: Global Insight; Planning Commission; McKinsey

Exhibit 1.11

Despite over USD 500 billion investments by 2020, user industries will most likely face even bigger challenges than today



SOURCE: Planning Commission; McKinsey

We recognise that current plans address several important capacity requirements through to 2020:

- The NHDP targets an additional 72,000 lane-km of national highways by 2015. Beyond the NHDP, an additional 65,000 lane-km of national highways are expected to be built by 2020, in line with the increase in annual spend on national highways. This suggests a doubling of capacity on the national highway network by 2020. Similarly, over 220,000 lane-km of state highways are likely to be built by 2020, implying a 30 per cent increase in the state highway network.

- In the rail network, two DFCs are expected to be completed by 2020. Further, close to 40,000 km of tracks (including new lines, doubling and gauge conversion) are expected to augment the current network of 63,000 km. Also a large part of the network is expected to improve technology including electrification and superior signalling including Automatic Block Signalling (ABS).[28]

- Over 1,500 million tons of port capacity is expected to be added during this time.

Economic losses will rise despite capacity addition

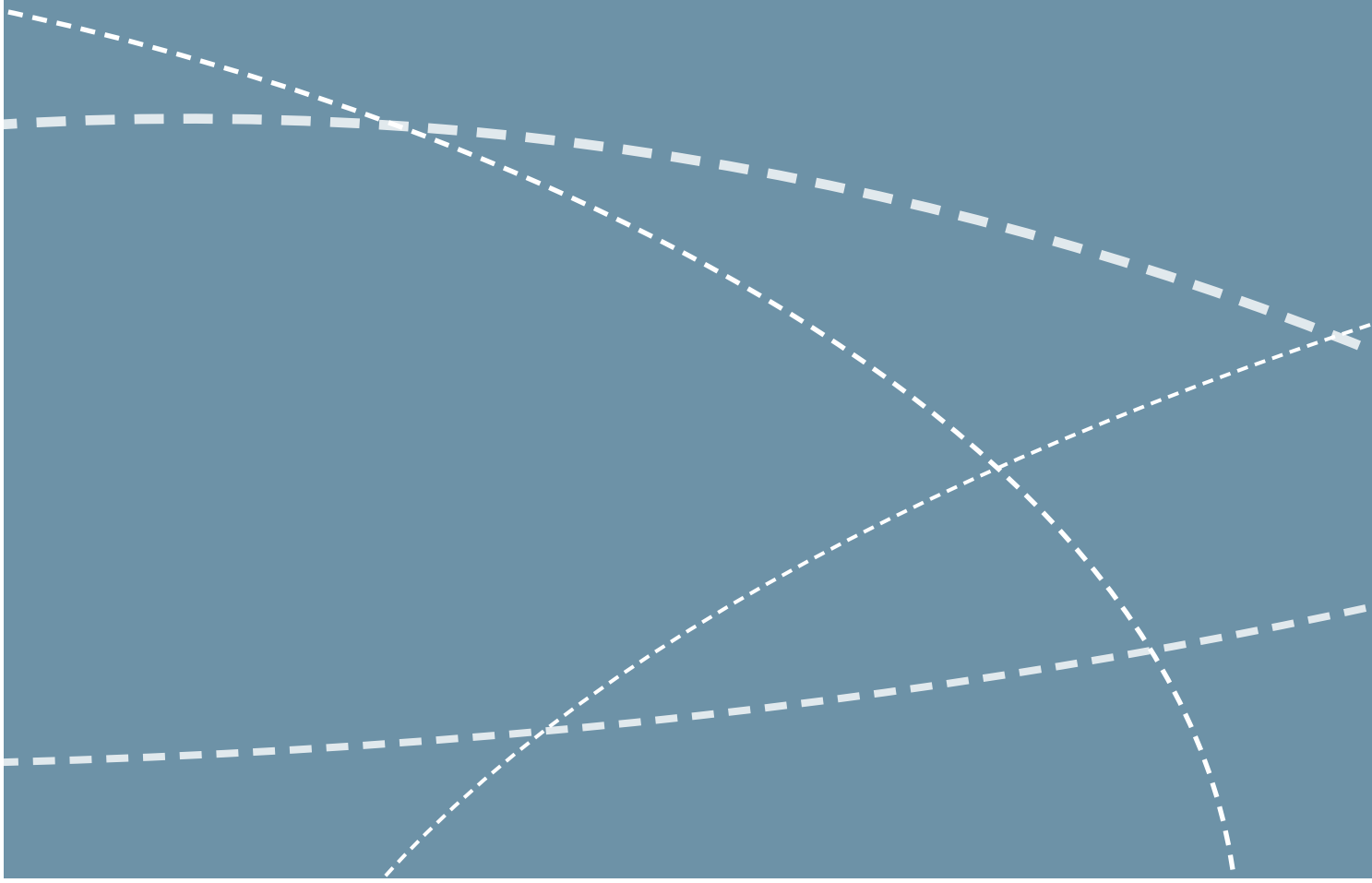
The government's current investment trajectory will result in an even higher share of freight travelling on roads in the absence of sufficient capacity on rail and waterways. In fact, 70 per cent of freight will travel on road, 25 per cent on rail and 5 per cent on waterways. Consequently, the loss to GDP from inefficient infrastructure is estimated to increase from around USD 45 billion to USD 140 billion over the next decade due to more congested roads, higher working capital requirements (a result of inventory in transit), increased road costs (fixed costs will be distributed over a smaller distance covered every day) and increased possibilities of theft and waste. In addition, more traffic on roads will impact the average speeds of trucks, increase transit times, lower reliability and subsequently negatively impact service levels.

□ □ □

Rising freight traffic, an unbalanced modal mix, substantial inefficiencies and losses demand an urgent response. A systematic and integrated logistics infrastructure development strategy is needed to ensure the country's growth aspirations are not derailed. The next chapter outlines the contours of such a strategy.

28 Automatic Block Signal, or ABS, systems consist of a series of signals that govern blocks of track between the signals. The signals are automatically activated by the conditions of the block beyond the signal. These signals can enable 6 to 8 trains between two stations as against current systems at most places which allow only one train between two stations.

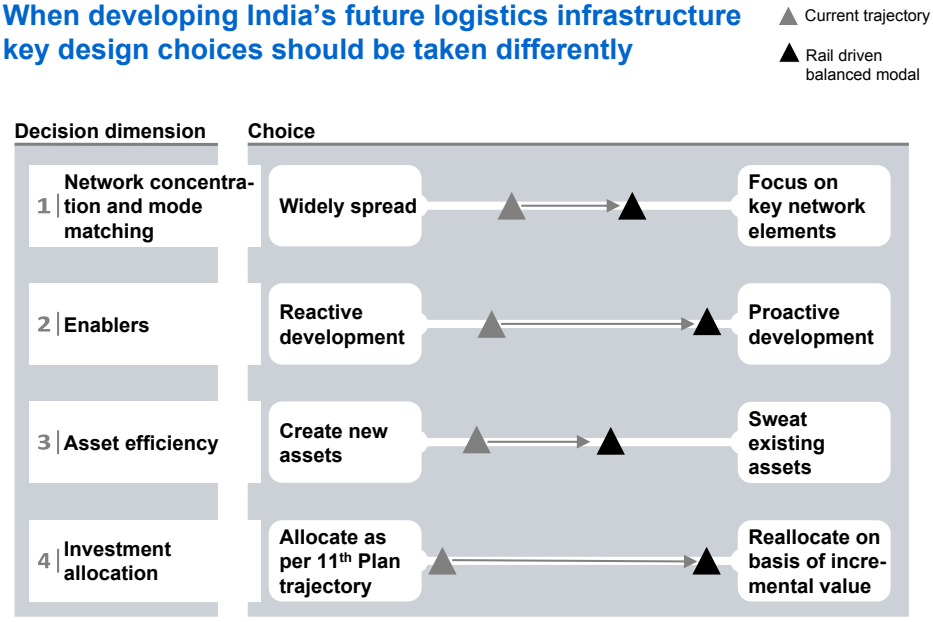
Required logistics infrastructure strategy going forward: Shift to a balanced modal network



As outlined previously, India's logistics infrastructure faces significant challenges in meeting the needs of a growing economy. Freight flows are highly concentrated, rely excessively on roads and are characterised by severe inefficiencies. Keeping in mind the profile and quantum of India's freight flows, systematic and efficient development of the logistics infrastructure will require critical choices and a major shift along the four key dimensions outlined below (Exhibit 2.1).

Exhibit 2.1

When developing India's future logistics infrastructure key design choices should be taken differently



SOURCE: McKinsey

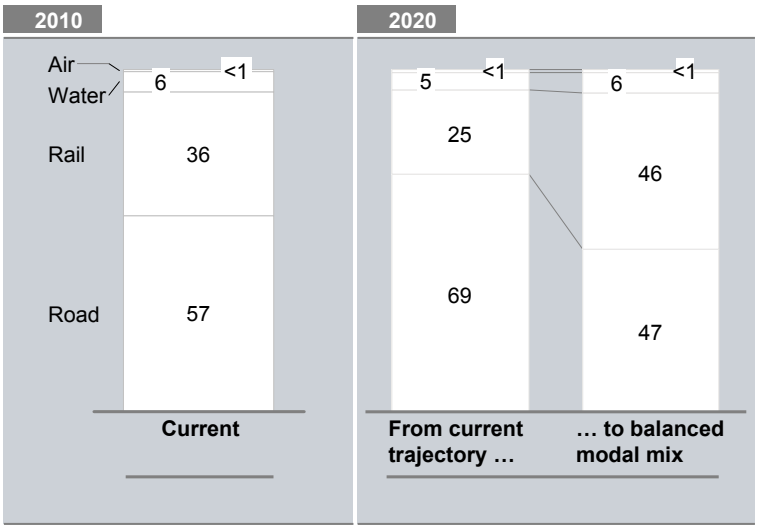
The shifts towards a balanced use of the logistics infrastructure could help the railways transport 46 per cent of freight traffic by 2020, relative to the current trajectory, which will reduce the share of railways to 25 per cent (Exhibit 2.2). This will also reduce losses to 4 per cent of GDP, as against an increase to over 5 per cent of GDP if India pursues its current trajectory. Further, if investments in logistics infrastructure are increased to USD 700 billion from the planned USD 500 billion, losses could drop to below 3 per cent of GDP.

The remainder of this chapter outlines the four key shifts that could facilitate a balanced modal shift.

Exhibit 2.2

The proposed mode shift will lead to a very different modal mix

Per cent



SOURCE: McKinsey

BUILDING THE RIGHT NETWORK AND ENSURING FLOWS ON THE RIGHT MODE

As outlined in the previous chapter, India's freight flows are highly concentrated on a few corridors and medium-distance links. To develop efficient logistics infrastructure, India needs to act on two fronts.

Based on the current network design, the seven main corridors and road links that connect major cities and district headquarters to these corridors will account for close to two-thirds of freight traffic in 2020. Therefore, improving connectivity and service levels on these routes by building the requisite expressways, road and rail capacity on 150 connectors and 700 last mile points will be critical to improve the efficiency of freight flows. However, the emphasis on building roads continues to remain high without adequate focus on other modes. For example, almost 50 per cent of planned investment is earmarked for roads even as capacity on rail and waterways remains inadequate.

In the longer term, a shift to a more structurally suitable mode calls for making a conscious choice about the desired network structure, particularly if funds are limited. McKinsey analysis suggests that rail and waterways need to become primary mode for heavy throughput corridors. Based on the structural cost of transport by different modes over long (more than 700 km), medium (between 400 km and 700 km) and shorter distances (Exhibit 1.6), wherever possible, rail and waterways should be prioritised for long distances, rail for medium distances and roads including expressways only for shorter stretches. As much of India's freight travels over long distances, this prioritisation suggests that India needs to shift its predominant reliance from roads to railways and move towards a more balanced multi-modal approach.

While in the current plans high-density network (HDN) investments are planned for railways, a concerted approach is required for India to build an efficient balanced modal network.

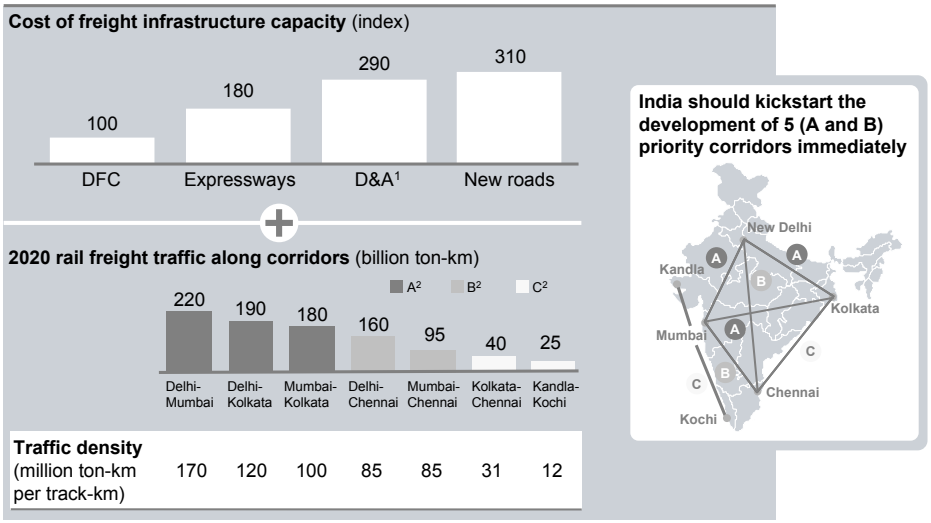
Rail DFCs

Building rail DFCs can facilitate smooth and cost-effective movement of freight along routes of high density. Current plans aim to build two rail DFCs by 2020 (Exhibit 2.3). Nevertheless, there are significant benefits to increasing this number. They include:

- DFCs are the most cost-effective way to add freight traffic capacity. The cost per ton-km of capacity added by a DFC (around USD 25 to 30 million)[29] is lower than investments in other modes. For example, our analysis suggests it is about 45 per cent lower per ton-km than that of an equivalent build-out of expressways and approximately one-third of that for new roads.
- DFCs also enable higher-quality service as compared to other modes. At higher average speeds of 75 km per hour, DFCs can cut down travel time on rail by up to 66 per cent.
- Reducing variability in transit times also significantly reduces inventory requirements. This is because freight trains no longer need to wait for passenger trains, which currently have higher priority on existing tracks. The use of DFCs to transport freight flows will also free up capacity for passenger travel on existing routes.

Exhibit 2.3

India should develop the 5 DFCs with the highest traffic density by 2020



1 Development and augmentation of rail lines
2 A/B/C is the order of priority from high to low

SOURCE: McKinsey

Expressways

While rail DFCs serve as a low-cost and better service option for long-haul traffic on high-density routes, they need to be accompanied by improvements in costs and service quality of short-haul traffic routes. Expressways on 100 km to 300 km long stretches serve as the most efficient connectors in the overall network structure. They are typically

29 This is subject to further cost escalation in DFC cost estimates. This is subject to further cost escalation in DFC cost estimates.

six-lane controlled access highways. While the NHDP currently plans to build 5 to 7 such expressways, increasing the number of expressways to about 20 to 30 and accelerating the completion of projects underway is critical to increase the number of efficient connectors across the network.

Expressways are typically more effective and efficient than regular highways as they allow for higher average speeds of 70 km/hour compared to 50 km/hour on regular highways. Further, expressways ensure lower variations in transit time. Thus, while incremental costs are higher than regular highways, benefits to users both in terms of fuel savings and improved service levels outweigh the incremental costs. Savings on fuel over the life of the highway more than offset the incremental construction costs.

To maximise the benefits outlined above, expressways should be built on all high-congestion routes with utilisation of over 150 per cent i.e., about 11,000 passenger car units (PCU) per day per lane.[30] Some potential routes expected to witness such high-traffic flows by 2020 could include Yewat to Sholapur, Biora to Shivpuri, Nasik to Shirpur, Ghaziabad to Bareilly and Hyderabad to Zahirabad. Some of these could be evaluated as potential stretches for expressways.

Coastal corridors

Waterways have many benefits. They are the cheapest and least-energy intensive mode of transport. The transportation costs (excluding last-mile costs) on waterways is around INR 0.5 per ton-km, well below the INR 0.9 per ton-km for rail and over INR 1.5 per ton-km for road. Further, increasing freight capacity on coastal corridors is easier than adding rail and road capacity.

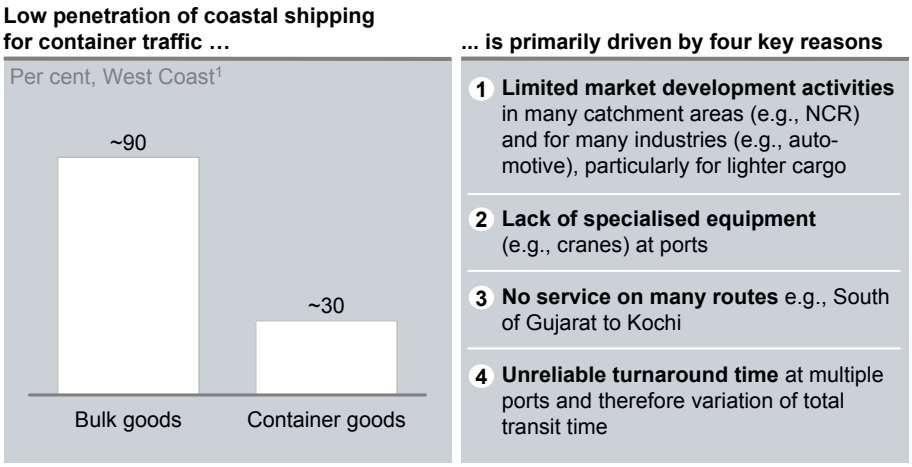
Globally, coastal shipping has been leveraged quite effectively by countries like China, the US and Europe. The share of water-borne transport in domestic freight movements across countries is much higher than India's 6 per cent (Exhibit 1.5). In China, 30 per cent of total domestic freight traffic travels on water (coastal shipping and inland waterways). This can be attributed to China's coastline and connectivity through an extensive inland waterway network through its major rivers. Major commodities such as coal, grain and oil from Northern China are transported through coastal shipping and inland waterways to the southern regions. Further, three major economic clusters (Bohai rim, Yangtze river delta, Pearl river delta) along the coastline from north to south boost the need for coastal shipping in China.

India has the opportunity to increase freight flows on coastal corridors along the West and East coast. Current penetration of coastal shipping is concentrated in favour of bulk goods like petroleum and coal. The low penetration in container traffic can be attributed to multiple factors outlined (Exhibit 2.4) and implies an opportunity to transport container freight at lower costs.

30 According to the *Pocketbook for Highway Engineers*, Indian Roads Congress, for traffic up to 15,000 PCU/day a two-lane road can suffice, beyond which a four-lane road is required.

Exhibit 2.4

Four key gap areas contribute to the currently low penetration of coastal shipping for container traffic



1 Addressable market is defined as that volume for which coastal shipping is currently cheaper than alternate modes

SOURCE: Expert interviews; McKinsey

To capture the opportunity, India will need a complete, integrated network from coastal shipping, to ports to last mile connectivity and will need to dismantle the existing operational challenges: i.e., coastal shipping costs remain high as a result of steep bunker fuel costs (at around USD 600 per ton, this is 2.6 times higher than in the US) and handling charges per ton are also significantly higher. At USD 120 per TEU,[31] container handling costs in India are 2.5 times higher than in China. Smaller vessel sizes, customs duties on spare parts, and low priority from port operators for coastal vessels increase operating costs.

Last-mile links

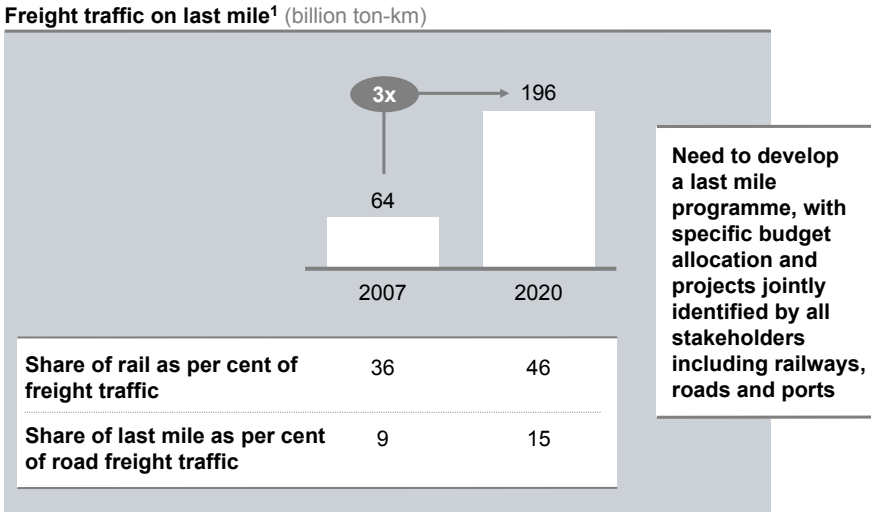
Last-mile interconnects are stretches of up to 100 km that connect key production, consumption and transit points such as ports, mines and industry clusters to the corridors and connectors. Currently, there is limited focus on last-mile interconnects especially across modes, despite the fact that last mile traffic is expected to grow more than 3-fold in the next decade (Exhibit 2.5). Thus, high-quality last-mile roads and rail links will be critical to ensure the smooth flow of freight. The responsibility of building last-mile links typically rests with state and local authorities. However, the main benefits accrue to rail and ports (or private users) that usually do not have direct control over building these links.

An explicit push to develop and improve over 750 last-mile road and rail links that are crucial links in the network is needed. Last-mile links are estimated based on a bottom-up study of over close to 400 industry clusters, 200 ports (including major and non-major) and 200 mines and their proximity to national and state highway networks. In addition, developing last-mile rail connections (track and rail head infrastructure) to support 8 to 10 critical coal corridors in states such as Jharkhand, Chhattisgarh and Orissa is critical.

31 Twenty foot equivalent units is a standard dimension of containers transported.

Exhibit 2.5

Multi-modal approach would lead to strong growth in last-mile traffic ESTIMATES



	2007	2020
Share of rail as per cent of freight traffic	36	46
Share of last mile as per cent of road freight traffic	9	15

1 Up to 100 km stretch of road from rail terminal to key production/consumption center

SOURCE: Indian Railways; Planning Commission; McKinsey

CREATING ENABLERS TO MAXIMISE NETWORK EFFICIENCY

In order to build efficient logistics infrastructure, India needs to put in place several enablers to help maximise the efficiency of its infrastructure. These include building logistics parks, standardising containers and pallets, and developing a talent pool of coastal seafarers, logistics managers and warehouse operators.

Develop 15 to 20 logistics parks as the main network hubs

Logistics parks are network hubs, critical for efficient multi-modal transport as they allow transhipment between modes and consolidation of freight. The use of large warehouses, shared equipment and manpower at these transhipment points can lower operating costs. Transportation costs can also be reduced with improved utilisation of transportation equipment with flow aggregation, as additional distance is typically offset by scale benefits. Logistics parks could be located on the outskirts of high-growth clusters and cities such as Mumbai, Bangalore, Cochin, Hyderabad, Kolkata, NCR, Ahmedabad, Nagpur, Vishakhapatnam and Siliguri, to capture cost advantages in transportation and storage across modes. Land should ideally be identified and earmarked by using specific criteria e.g., selecting locations could be governed by proximity to high local production-consumption volumes, close to DFCs, rail links and ports, et al. so they can support future economic growth.

Standardise containers and pallets

Standardisation can result in higher utilisation of containers and also encourage containerisation which is absolutely critical for efficient multi-modal transport. Such standardisation can significantly reduce handling costs. Further, standard pallets[32] can result in better utilisation of warehouse space as well as container volumes. These

32 A pallet refers to a flat transport structure that supports goods in a stable fashion while being lifted.

measures are also important to ensure that the equipment can move easily across the network. Culverts for example, should be able to accommodate the correct truck heights, while rail track electrification should enable double stack containers of selected standards and so on. Developing compatible standards across modes is no easy task and requires coordinated efforts by the government, industry associations and agencies across modes.

Upgrade skills

While equipment is no doubt a critical component of multi-modal transport, demand for requisite skills will also increase. The number of skilled personnel required to support the smooth functioning of the logistics network is likely to increase from less than 10 million today to over 20 million by 2020. This will include over 100,000 warehouse managers, 5 million truck drivers and 70,000 coastal seafarers.

Currently, acute talent shortage is constraining various industries for example, a large oil company was unable to operate several of its coastal vessels due to a shortage of sailors and was forced to use the rail network, a more expensive mode.

These skills will need to be developed through internal on-the-job training programmes conducted by companies, and bolstered by certification courses that should be developed with the involvement of industry. For example, the existing maritime institutes should increase the focus on coastal shipping courses in their curriculum.

Similarly, training courses for warehouse managers should hone both operational and managerial skills, essential to manage multi-modal logistics parks and warehouses. On the other hand, the curriculum of training programmes targeted at logistics managers should include specific courses on sourcing, contracting, multi-modal operations and tracking (IT-skills), while those designed for truck drivers should not only enhance existing driving, maintenance and freight handling skills, but also provide personnel with an orientation on safety imperatives.

Finally, the government could provide the thrust by adequately providing incentives for training and development, by dismantling barriers to demand for such jobs and by creating appropriate forums for industry collaboration on these areas.

EXTRACTING MORE FROM EXISTING ASSETS

India's infrastructure development programmes have typically focused more on building new infrastructure as opposed to maintaining and extracting better services from existing assets. Although some measures have focused on better utilising existing assets e.g., shifting to stainless steel wagons, the focus continues to remain on building infrastructure as against better utilisation. Our work posits India needs to focus more on optimising existing assets. Six (non-comprehensive) initiatives outlined below can significantly increase the capacity and efficiency of the existing network, if implemented. Over 10 per cent of the existing rail and road network capacity can be unlocked by upgrading existing assets.

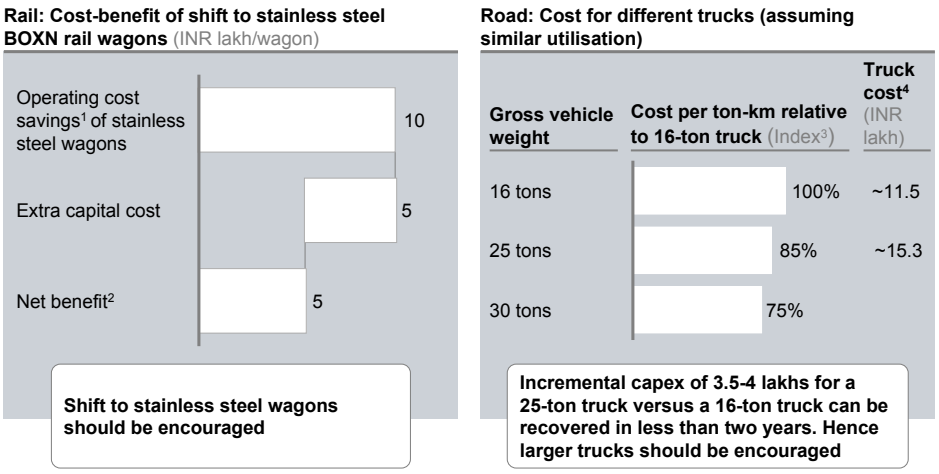
Improve road and rail maintenance

India's roads are in poor shape. Some estimates suggest over 30 per cent of the national highway network needs to be overhauled. Poor road condition leads to economic losses resulting from equipment wear and tear, higher fuel costs and variability in transit times. While the Eleventh Plan has increased the allocation for road maintenance, historically funds for road maintenance have either not been spent, been diverted to other projects or have been spent inefficiently. Current contracts for road maintenance are for short stretches and durations, and bear two challenges. First, they do not attract larger players as the contract sizes are too

Exhibit 2.6

Improving equipment can result in significant value creation

ESTIMATES



1 Present value of operating costs reduction over the life of the wagon
2 Excludes benefits of savings on capex expenditure on tracks, with fewer tracks required to serve same freight volume
3 100% = INR 1.2/ton-km at full load, 100% front-haul and back-haul utilisation in tons
4 Fully loaded truck including cabin and body
5 Typically used as a tractor trailer

SOURCE: Expert interviews; Indian Railways; McKinsey analysis

small. Second, the contractor does not have an incentive to conduct high-quality execution as the duration of the contract is not long enough for it to be economically beneficial.

Upgrade rail wagons and examine axle load

The tare load of existing wagons can be lowered from 6.5 tons per axle to 5 tons per axle by shifting from corten steel wagons to stainless steel wagons. Savings from stainless steel wagons will more than offset the incremental costs. Savings can be of two types: 1) lower fuel costs per ton-km as stainless steel wagons carry higher payload, with the same fuel consumption; and 2) reduced investment requirements for track infrastructure, given that effective capacity of current tracks improves with fewer stainless steel wagons to transport the same volumes.

Indian Railways has already begun using stainless steel BOXN[33] wagons. However, the Railways should explore new designs that can further reduce tare load in the existing BOXN-HL wagons. Similarly, for BCN wagons there is potential to increase payload through use of well wagons. In addition to upgrading wagons, efforts to increase average axle loading from 21.5 tons to 22.9 tons must be made. Current safety norms allow for an average axle load of 21.5 tons on most rail tracks in India, significantly lower than China and the US where trains run at axle loads of over 25 tons. While the lower axle loads can be attributed to the quality of track infrastructure and bridges, there is a need to explore the possibility of increasing axle loads so long as safety is not compromised.

33 Open top wagons, primarily used for carrying iron ore. Also used for carrying coal and stones.

Encourage use of larger trucks or multi-axle vehicles

Multi-axle vehicles (MAVs)[34] are cheaper to operate as compared to smaller trucks i.e., medium commercial vehicles (MCVs)[35] and light commercial vehicles (LCVs)[36], by over 25 per cent (Exhibit 2.6). The incremental cost of a multi-axle vehicle can be recovered in less than three years. Measures to encourage the use of MAVs could be considered including excise duty reductions for MAVs similar to small and fuel-efficient cars, stringent monitoring of overloaded trucks and enforcing pollution and safety norms, which could result in the retirement of old trucks.

Accelerate implementation of Automatic Block Signalling (ABS) technology

Commonly used signalling technology, Intermediate Block Signalling (IBS) allows only two trains to ply between two stations. ABS, on the other hand, can allow 6 to 8 trains to run between two stations, thereby significantly increasing the network capacity and leading to a potential capacity improvement of 30 per cent in high-density corridors. This makes it a cost-effective way to augment rail capacity[37] as opposed to building new tracks. Nevertheless, it is important to note that the extent of capacity that can be created through implementing ABS is limited. It could account for less than 5 per cent of current rail capacity in 2020. Therefore, other measures such as higher capacity wagons (including lower tare load/ higher-volume wagons depending on commodity carried), track renewals enable higher axle loading on select corridors and new tracks including DFCs are also required.

Introduce electronic toll collections systems (ETC)

Less than 10 per cent of India's 140 toll centres have electronic toll collection systems, significantly fewer in comparison to other countries. For example, in the US 95 per cent of toll centres have electronic tolling systems. Implementing electronic tolling can improve throughput at toll centres by as much as 3 to 4 times over manual toll collection systems. ETC significantly reduces waiting times and consequently reduces fuel requirements. Lastly, toll operators benefit from lower personnel requirements and a drop in leakages.

ALLOCATING MORE INVESTMENT TO RAIL, AND REALLOCATING WITHIN ROAD AND RAIL

As discussed in the previous chapter, approximately USD 500 billion is likely to be invested in the country's logistics infrastructure in the next decade. It is important to allocate these funds optimally and make the right trade-offs to get the highest return on investment. Planned investments across modes and within modes need to be redirected. Also, additional funding to further enhance network capacity will be beneficial.

Increase share of and reallocate investment in railways[38]

The share of railways in total logistics infrastructure should be increased by over 20 per cent from around USD 200 billion to USD 250 billion by 2020 (Exhibit 2.7). Spend on DFCs, rolling stock and other additions such as new tracks, rail line doubling and gauge conversions

34 Trucks with gross tonnage (including weight of truck) of over 16.2 tons.

35 Trucks with gross tonnage (including weight of truck) of 7.5 tons to 16.2 tons.

36 Trucks with gross tonnage (including weight of truck) of under 7.5 tons.

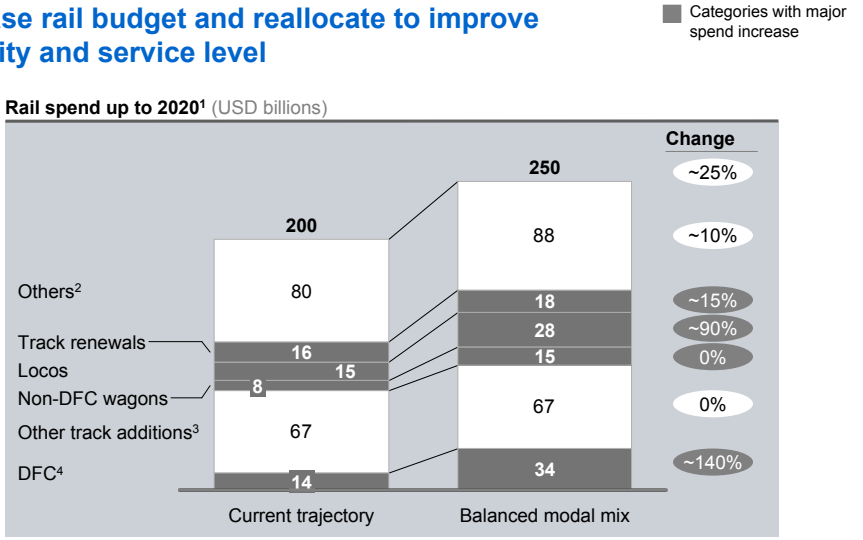
37 Over 60 per cent lower per unit of capacity created.

38 In this analysis, it is assumed that the planned spends for development reasons (e.g., over 30,000 km of rail track addition including gauge conversion and majority of the rail network addition through new lines) is assumed to remain unchanged.

should increase to create rail capacity on high-density corridors at minimal investment and support the movement of a greater volume of traffic. Current plans aspire to complete two DFCs by 2020. However, coping with the massive increase in traffic will require completing DFCs on five high-density corridors, namely Mumbai-Delhi, Mumbai-Chennai, Delhi-Kolkata, Mumbai-Kolkata, and Delhi-Chennai. To fulfil this aspiration, the share of spend on DFCs in the overall allocation to railways should be increased from around 7 per cent to close to 15 per cent by 2020, which is subject to further cost escalations in DFC estimates. Further, additional investment will be required for around 225,000 additional wagons from the 175,000 wagons required in the current trajectory by 2020. This increase in investment needs to be supplemented with the development of logistics parks and last-mile road and rail links that facilitate better integration across modes.

Exhibit 2.7

Increase rail budget and reallocate to improve capacity and service level



1 Spend between 2008 and 2020
2 E.g., coaches, locomotives, signalling, electrification, track renewals, bridge works, computerisation, passenger and other user amenities, workshops and production units
3 New tracks (excluding DFCs), rail doubling and gauge conversion. Over half of this spend is for developmental reasons, not the most economically viable locations. Change for the economically viable locations is more significant
4 Including wagons

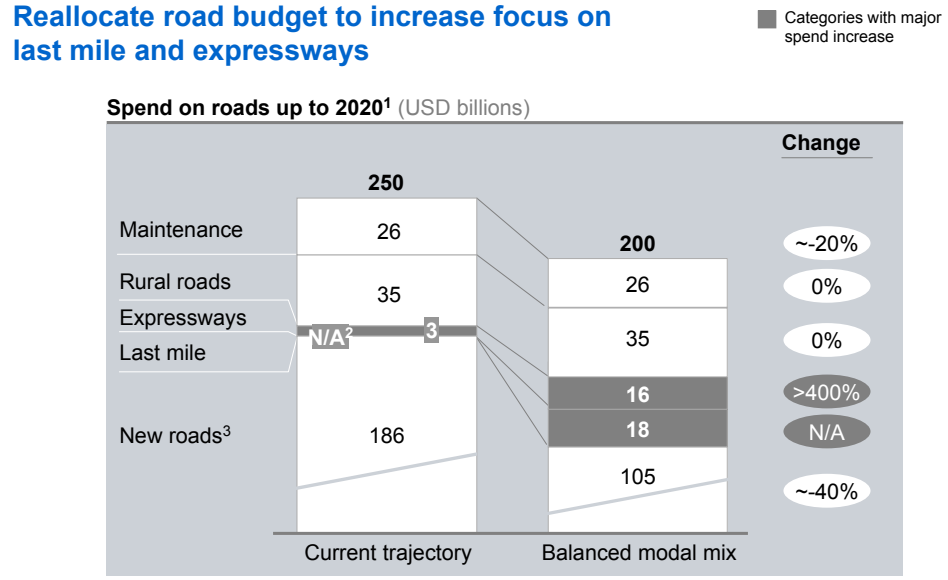
SOURCE: McKinsey

Reallocate investments within roads

USD 200 billion would be available for road development till 2020, if additional funds are channelled to build rail capacity. Targeted deployment of this investment (Exhibit 2.8) on high-density traffic stretches could increase the road length (in lane-km) of national highways by over 50 per cent, and state and major district roads including expressways by around 15 per cent.

Further, it is also important to increase the number of planned expressways from five to seven to twenty to thirty, leading to an increase in spend from USD 3 billion to USD 16 billion till 2020. Finally, the investment earmarked for constructing last-mile stretches should be increased to about 10 per cent of the total investment allocated to roads by 2020. This will be a departure from the present, where a focused programme and measurement of last mile links does not exist.

Exhibit 2.8



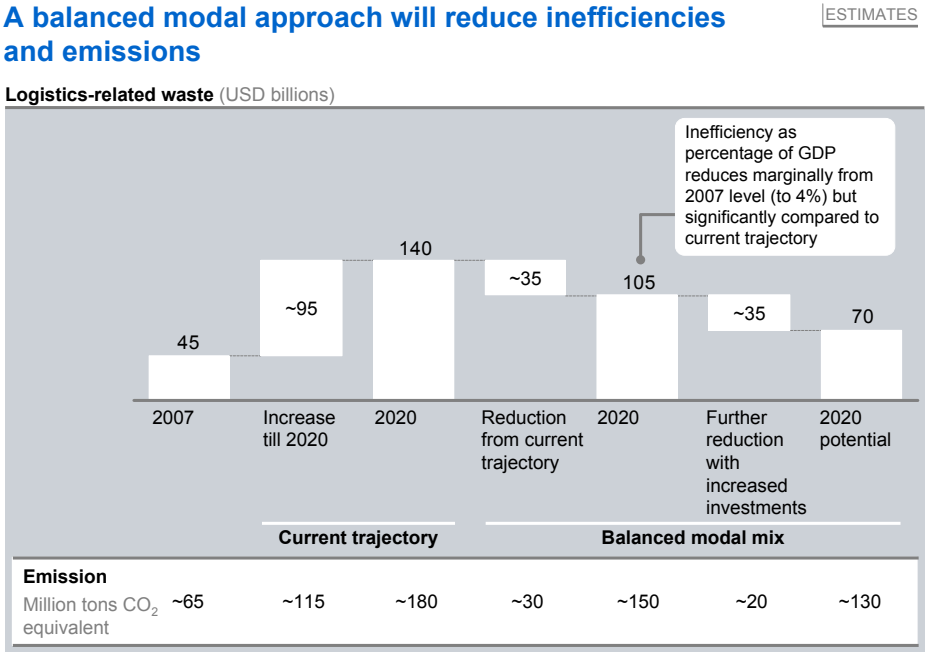
1 Spend between 2008 and 2020
2 No focused programme for last mile
3 Includes state highways/major district roads, excludes expressways and roads built as a part of focused last-mile programme

SOURCE: McKinsey

Increase investment allocation to transport infrastructure by USD 200 billion

In addition to reallocating investment, ideally another USD 200 billion could be made available to the sector. This increase of 45 per cent in investment to a total of USD 700 billion by 2020 could lower logistics-related losses by an additional 30 per cent, or to below 3 per cent of GDP as against over 4 per cent of GDP or USD 105 billion (Exhibit 2.9). The additional USD 200 billion should primarily be used to improve the maintenance of national

Exhibit 2.9



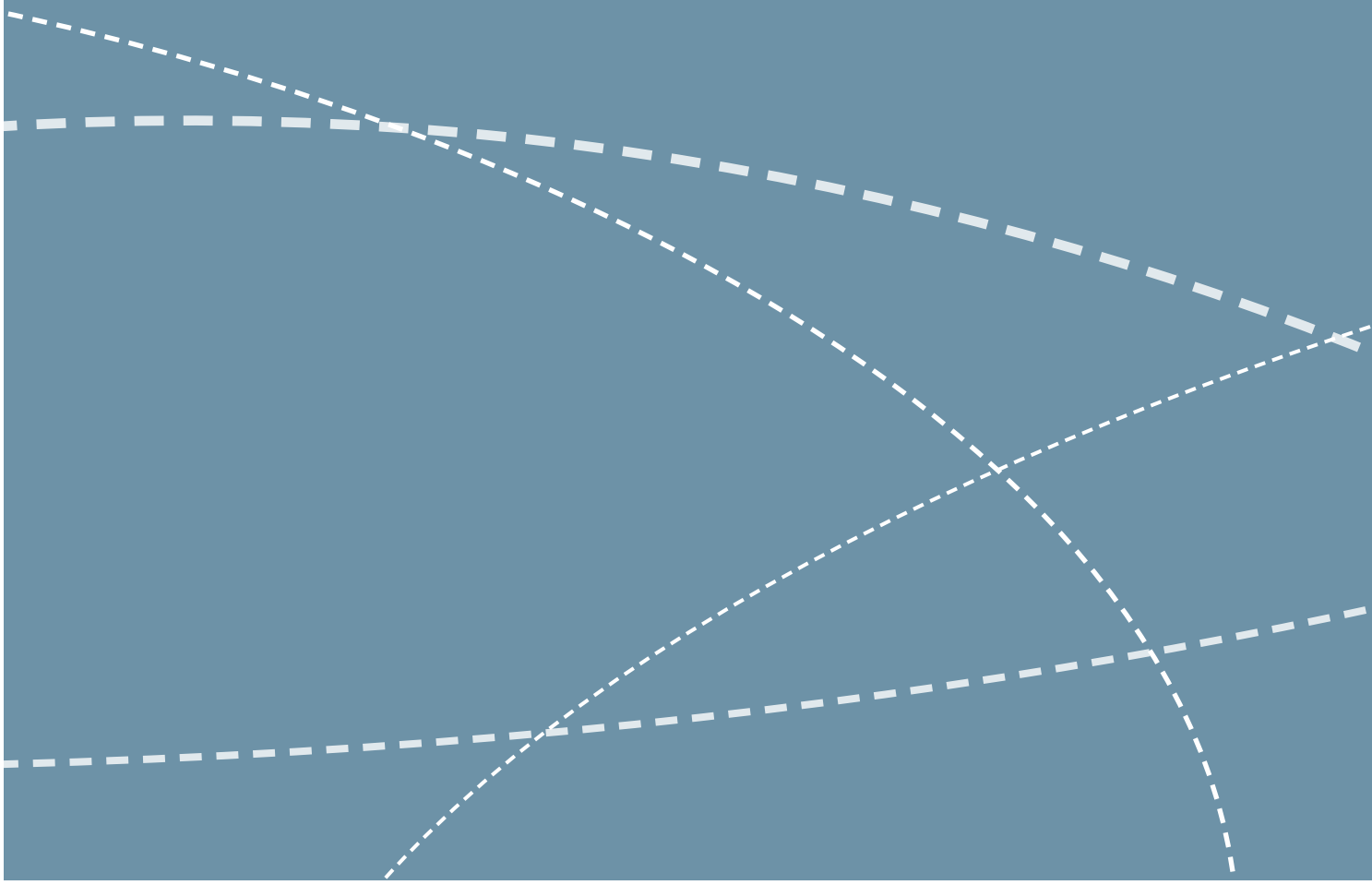
SOURCE: McKinsey

highways and medium-road links, resurface up to 20 per cent of the current road network in poor condition, and increase the investment on new roads to meet international freight traffic service levels.

□ □ □

Building a highly integrated and efficient logistics network capable of meeting India's growth aspirations requires a fundamental shift in the country's current approach to developing logistics infrastructure. The four major shifts discussed in the chapter need to be coordinated across a number of different sectors, government ministries and other stakeholders. The next chapter outlines how this can be accomplished.

Moving from strategy to implementation: National Integrated Logistics Policy



Given the level of coordination required to achieve the four shifts that could guide the development of balanced modal logistics infrastructure, it is critical to develop a National Integrated Logistics Policy (NILP). Such a policy must clearly articulate the design principles and objectives of a new vision for India's logistics infrastructure. An empowered cross-ministerial body will be needed to develop and establish the NILP and also monitor its implementation. Central to the policy will be 10 programmes required to achieve balanced logistics infrastructure development across modes as freight flows continue to rise. The policy will need to be flexible enough to adapt to changes that cannot be foreseen today.

NATIONAL INTEGRATED LOGISTICS POLICY — A NEW VISION FOR INDIA'S LOGISTICS INFRASTRUCTURE

Rapid growth in India's freight traffic, high utilisation of key routes and poor condition of roads, railway, warehouses et al. call for prioritising the development of logistics infrastructure. Further, successfully initiating the four major shifts—concentrating flows on the right mode, building network enablers, enhancing asset efficiency, and reallocating investments will require coordination across many ministries and agencies in the central and state governments. A National Integrated Logistics Policy (NILP) that shapes a vision for India's logistics infrastructure in 2020 and beyond could be a critical enabler for such efforts.

The NILP could help the government reduce recurring losses to the economy and improve capital efficiency in the following three ways: One, it could lay down the blueprint for the most efficient logistics infrastructure to support a balanced modal mix, further economic growth and minimise environmental impact keeping in mind the significant increase anticipated in freight flows by 2020. Two, it can ensure better coordination between multiple national and state-level bodies responsible for developing logistics infrastructure. And finally, it can ensure easier access to and optimal allocation of scarce resources such as investment, equipment and human resources.

Four aspects must constitute the bedrock of such a policy: design principles, tangible objectives, a set of programmes to help realise these goals and a governance structure that enables efficient and timely execution.

Design principles

Our work suggests that the NILP should be crafted bearing in mind the following principles:

- Create an integrated network comprising long-distance corridors, medium-distance connectors and last mile interfaces as opposed to supporting diffused geographic development
- Shift from a road-focused network to a balanced modal network that leverages rail and waterways to transport heavy throughput over long distances
- Increase emphasis on improving asset efficiency, maximise output from existing assets and enhance interfaces between modes

- Review the current allocation of investments between modes and re-allocate as necessary to increase the share of rail

- Build flexibility in policy design and monitoring systems to track progress and to review and course correct based on changing economic conditions and trigger points.

Objectives

NILP should have clear, measurable objectives including reducing economic losses, improving environmental outcomes and enhancing coordination between modes. In order to achieve these objectives, the NILP must set clear long-term targets based on rigorous analysis. These can then be cascaded into near-term targets for the various bodies involved in building India's logistics infrastructure. Objectives and targets are important to ensure improvements are measurable over time.

- **Increasing the share of rail to over 45 per cent of freight traffic by 2020,** from 36 per cent today, instead of allowing it to drop to 25 per cent in 2020. Achieving a balanced modal mix calls for at least maintaining the share of waterways at around 6 per cent in 2020. Separate targets could be included for bulk and container traffic.

- **Limiting annual economic losses to USD 100 billion in 2020.** An integrated logistics network could help India reduce economic losses and has the potential to save over USD 35 billion per annum in 2020. Further, increasing logistics infrastructure spend to USD 700 billion, could reduce losses to around 3 per cent of GDP (Exhibit 2.9). This could result in additional savings of USD 35 billion per annum in 2020. With this objective in mind, the NILP could support the reallocation of funds across modes. This will also increase India's competitiveness, in particular as a potential offshore manufacturing destination that benefits from a low-cost and relatively more reliable supply chain network, stimulating export-led sectors like auto components and textiles.

- **Reducing energy consumption in 2020 by 1 per cent and consequent CO_2 GHG emissions in 2020 by over 20 per cent from current trajectory.** A balanced modal strategy can reduce energy consumption and the consequent environmental impact that comes from increasing transportation. By increasing the share of less-polluting modes of transport in freight traffic, GHG emissions could decline by close to 20 per cent of the current trajectory to 150 million tons of CO_2 equivalent. Energy consumption from freight transport would correspondingly decline by 10 MTOE.[39]

- **Achieve on-time, on-budget delivery of projects.** This is critical to get the maximum impact from the funds invested in logistics infrastructure, and also to improve service levels fast thereby reducing losses. On-time and on-budget delivery of projects will require quality planning, close implementation monitoring and timely de-bottlenecking through policy and other interventions.

- **Improved coordination across modes and timing of initiatives,** ensuring timely development of last-mile road/rail connectivity and interchange points. Building integrated and balanced modal logistics infrastructure creates the daunting task of coordination. This coordination is required on at least two fronts:

  — **Modes:** A balanced strategy involves much more than simply building rail corridors. For example, rail terminals and ports need to be complemented by a network of high-quality last-mile roads in the absence of which, the shift of freight to rail and

39 Million tons of oil equivalent.

waterways may not be adequately efficient. This challenge is evident in the case of a recently developed port, which lacks adequate rail connectivity resulting in the transport of bulk freight via roads. This has adversely impacted economic returns. In addition, coordination between modes will result in systematic investment reallocation choices if resources are scarce.

— **Timing of initiatives:** Building infrastructure across modes requires aligning the timing of build-outs. For example, it is paramount to have last-mile roads built in conjunction with the rail link or port, failing which, the project becomes unviable. Further, phasing different projects within and across states requires scheduling the build-outs in a way that ensures maximum efficiency when the project becomes operational.

TEN TARGETED PROGRAMMES SHOULD BE THE BEDROCK OF THE NATIONAL INTEGRATED LOGISTICS POLICY

The NILP should launch the following ten targeted programmes:

1. **Accelerating the numbers and build-outs of rail Dedicated Freight Corridors (DFCs):** This comprises accelerating the special purpose vehicles (SPVs) being set up for two planned DFCs – Delhi-Kolkata, Delhi-Mumbai and simultaneously establishing SPVs for three additional DFCs, along the Kolkata-Mumbai, Delhi-Chennai, Mumbai-Chennai corridors.

   The agenda of such a dedicated programme would include prioritising funding with a special emphasis on financial closure. In the event of difficulties in mobilising funds, it could consider suggesting, a part of the funds be sourced from the internal accruals of the Indian Railways. Investment allocation to the DFCs should increase by more than 150 per cent over the next decade from USD 14 billion to USD 35 billion. Second, it is important to encourage private sector participation through Public-Private Partnerships (PPPs). While historically there has been some reluctance to allow private sector participation in high-density freight traffic, PPPs could help secure necessary funding and also allow the sector to draw on a pool of managerial and execution expertise to build the DFCs. Finally, the programme should strengthen the project review mechanism and aid timely execution. Given the strategic importance of the DFC programme, a central monitoring mechanism could be instituted to ensure targets are achieved and express de-bottlenecking measures are at work.

2. **Strengthening coastal freight corridors:** This refers to strengthening the West coast – Kandla to Kochi – and East coast – Kolkata to Chennai – coastal freight corridors. Investing in these corridors will augment scale and improve the economics for coastal shipping, making it an attractive alternative to other modes.

   A coastal freight corridor programme could fulfill three objectives: First, improve last mile road and rail connectivity to and from ports through greater involvement of government agencies responsible for building and managing port infrastructure. Two, increase industry awareness on the viability of coastal shipping for freight by running campaigns that highlight the feasibility of specific routes on both the East and West Coasts for non-bulk and break-bulk goods (e.g., food grains, fertilisers, cement bags, limestone and marble, and cars) and encourage state-owned companies to use coastal shipping. Finally, encourage development of a transhipment hub on the West coast to provide feeder service opportunities along the coast and hence ensure higher utilisation through backhaul freight business.

3. **Constructing national expressways:** Building stretches of expressways, 100 km to 300 km long will be vital to manage the rise in traffic by 2020. While currently 5 to 7 expressways are likely to be built by 2020, ideally, the number of expressways should be increased to over 20 by 2020. High-traffic routes such as Nasik-Shirpur Yewat (Pune)-Solapur could be potential candidates for expressways. The government has already announced the creation of an Expressway Authority of India (EAI) to drive the development of expressways.

   The objectives of an expressway programme could include designing and tendering projects through finalising concession agreements for expressways and by encouraging the participation of large domestic and international players. This should be undertaken after an assessment of the high-congestion routes is conducted and the appropriate configuration of expressways (i.e., enhance existing highways or build parallel expressways) is determined.

4. **Initiating a comprehensive last-mile roads programme:** Implementing a dedicated last-mile programme with over 750 last-mile links to connect all key port and/or railway terminals to production and/or distribution centres along freight corridors is imperative for NILP to achieve its objectives.

   The agenda for such a programme after a systematic assessment of priority links could include: 1) allocating about 10 per cent of the total funds allocated to roads on last mile programmes and incorporating them in the plans of national, state and local bodies tasked with execution; and 2) encouraging states to create SPVs to construct multiple last mile connects across the most critical and high-volume stretches. Doing the latter will help last-mile projects to be perceived as larger programmes and garner the required attention at the conceptualisation and execution stages.

5. **Executing a targeted last-mile rail programme:** This requires provision of track linkage to many of the 750 last mile links, which includes identifying priority links, ensuring adequate projects to enhance capacity of these links and steps to accelerate/ fast-track implementation of select project to ensure timely rail coverage. The last mile links to be covered would include some critical coal corridors covering mines like Jharkhand, Chattisgarh and Orissa as well as key ports (e.g., Paradip, Dhamra, Gangavaram) to ensure smooth rail connectivity for major power, steel and cement plants. This will be important given an over 6.5 per cent per annum growth expected in the transportation of coal over the next decade, as well as a potential requirement to import over 100 MTPA of coal by 2013 in a scenario where domestic supply does not keep up with demand.

   After the necessary identification of last-mile rail stretches is undertaken and project feasibility studies are conducted to identify overall economics and viability gap funding requirements, the programme should aim to proactively create specific projects for each link, convene all relevant stakeholders, drive implementation and regularly monitor execution.

6. **Developing multi-modal logistics parks:** Building logistics parks at 15 to 20 key points where different modes overlap or near major cities or proposed DFC routes will play an important role in the development of an integrated logistics network. Potential locations for logistics parks include the outskirts of Mumbai, Bangalore, Cochin, Hyderabad, Jamshedpur, Kolkata, Delhi/Gurgaon, Ahmedabad, Nagpur, Vishakhapatnam and Siliguri. Designed through appropriate model concession agreements, these logistics parks should be equipped with the necessary infrastructure to ensure the seamless movement of freight across modes.

Such a programme would include identifying and finalising the number of logistics parks and their locations; earmarking land for logistics parks at about 15 to 20 key interchange points around major cities ideally on the proposed rail DFC routes; and providing infrastructure such as power, utilities, road/DFC linkages and rail sidings.

For these parks to become centres of commerce it is imperative to provide amenities required to create a world-class work and recreational environment. This includes building high-quality office space, hotels, restaurants, trade pavilions et al. One way to do this is by creating and bidding out special projects by a dedicated team that designs PPP projects, encourages private sector participation in logistics parks, along with for example, the Indian Railways.

7. **Implementing a systematic roads maintenance programme:** This could significantly improve maintenance of highways to augment efficiency and reduce waste. Our work in this area suggests that this programme must focus on three fronts.

   First, upgrade maintenance contracts for both national and state highways, and major district roads (MDR) maintenance by increasing scale and modifying contracts. This could be achieved by creating annuity toll-based maintenance contracts for 400 to 500 km stretches of national highways for a period of 10 years. This is in contrast to the approach adopted by NHAI which follows the Operate, Maintain and Transfer model for stretches of 200 to 300 km for a shorter duration.

   Furthermore, following the proposed approach is likely to encourage private sector participation. For national and state highways, and MDR contracts there is also need to maintain flexibility to develop new parallel highways across stretches often given out on maintenance contracts. Introducing this aspect along with a specific price clause as needed will allow for future adjustments to infrastructure development plans in light of changes in freight flows in the country.

   Second, the programme should track and ensure maintenance budgets are not redirected towards other efforts. Finally, upgrading road construction technology and materials to minimise periodic maintenance could be a necessity. In some stretches, it may be more appropriate to consider concrete roads instead of bitumen roads that have a longer life and lower maintenance needs, which could be more cost-effective over the life of the road.

8. **Adopting technologies to augment efficiency levels:** Standardising technology for nationwide electronic toll collection (ETC) in future contracts, and establishing a nationwide clearing house with set norms and service standards will help reduce waiting time and improve service levels.

   This programme could have a three-point agenda. First, establish a nationwide electronic toll collection system to ensure inter-operability. Once the technology standard adopted is successfully implemented, it should be adopted for all future projects and retrofitted for existing projects. Two, develop and establish guidelines for a nationwide clearing house. A nationwide clearing house with clear norms and service levels can facilitate easy transactions for both billing to users and payments to the various toll operators, similar to the ATM clearing house system in the banking industry. Three, ensure easy availability and adoption of electronic tags by users. Electronic tags should be widely available, benefits should be communicated clearly and incentives should be provided to encourage early and widespread use.

9. **Developing a suitable talent pool:** The implementation of an integrated logistics strategy will create the need for a range of skills. In particular, demand for four types of

Box C: Opportunities and implications for the private sector

Building a logistics network capable of handling rising freight traffic will create opportunities for the private sector including user industries, infrastructure developers, EPC companies, equipment and technology providers and logistics service providers.

User industries need to manage risk and plan for new opportunities

User industries will need to rethink their logistics strategy under a scenario where the logistics situation worsens i.e., under the current trajectory and plan for opportunities that may open up when an efficient balanced modal logistics network is created.

In the current scenario, logistics costs are likely to increase by 10 to 15 per cent due to lack of network capacity and increasing inefficiency and waste in the system. In some locations, the cost increases could be even higher due to local bottlenecks in network capacity. User industries would need to manage risk by considering the following types of actions—first, they should plan their network and pick locations in such a way as to avoid or reduce the need to transport goods and explicitly consider future available logistics capacity. An example of this shift is a greater number of pit head or coastal power plants to reduce movement of coal, movement of grinding operations in cement closer to end user markets and co-location of ancillary industries like auto-components within the same cluster as the final auto-assembly plants. Second, industries in a cluster should actively collaborate with each other and the government in consortiums to jointly build shared infrastructure like pipelines, roads and rail links, port capacity to ensure sufficient scale and better return on investment. Finally, user industries should try and lock in capacity early through long-term contracts such as rake usage and capacity allocation, through negotiations with the Railways as well as participation in wagon ownership schemes.

If a new balanced modal logistics network is built, user industries need to look for both top line growth through new and increased business opportunities and also margin improvement due to cost reductions. Top line can increase as new logistics networks could open up new markets that were previously inaccessible or unviable. For instance, availability of assured evacuation and inbound capacity on rail can ensure that plants such as cement and power run at full capacity. Cost reduction could occur as user industries shift to cheaper modes like rail and water from road and also factor in improved equipment like larger trucks and wagons. Improved economics and a more reliable logistics network could help India emerge as an even more attractive export destination.

Opportunities for infrastructure developers and EPC companies

The logistics infrastructure sector offers a significant opportunity to developers and EPC companies with a potential spend of USD 200 billion on roads including new roads, network upgradation and maintenance; USD 90 billion for new tracks including five DFCs and USD 50 billion spend expected in ports by 2020.

Four opportunities are likely to emerge: First, there will be an increase in the share of Public-Private Partnerships and Build Operate Transfer (BOT) contracts. This will require greater emphasis on risk assessment, the ability to project increases in traffic that in turn impact overall return on investment, and a greater focus on enhancing capital productivity to ensure on-time and on-budget project execution. Second, there may be greater participation of the private sector in rail. This would require private players to forge partnerships with international players who have prior experience in order to meet pre-qualification criteria. First movers in forming these partnerships will be in an advantageous position. Third, there could be larger and longer duration maintenance contracts especially in the

roads sector. This will create a good opportunity for mid- to large-sized EPC players and will require a fundamental shift in terms of higher Total Cost of Ownership (TCO) orientation and incentive to invest in superior equipment.

Increased business opportunity for equipment and technology providers

Rail equipment providers would benefit with larger volumes and correspondingly higher spends on locomotives, rail wagons and coaches. For instance, over 400,000 wagons, more than 50,000 coaches and greater than 10,000 locomotives will be required by 2020, representing a total spend of over USD 50 billion.

Consequently, three implications emerge for rail equipment providers: First, there is a need to increase manufacturing capacity especially of locomotives and coaches to meet increased demand. Second, there is likely to be an increased demand for specialised equipment like custom-made wagons for industries like automotive, steel and dairy. Third, there will be a need to forge partnerships with international players to gain access to higher quality and next generation designs.

There will be an opportunity for greater application of technologies related to the logistics industry. This includes warehouse management software and tracking solutions including wagons, trucks and containers (e.g., RFID), electronic tolling technology to integrate a common platform across tolling centres on India's roadways, signalling technology including Automatic Block Signalling (ABS) and potentially more advanced satellite-based systems.

Increased business opportunity for logistics service providers

A shift to a balanced modal logistics network that is driven by an increase in rail share from 36 per cent today to 45 per cent in 2020 will lead to an increase in demand for multi-modal services. The role of third-party logistics service providers (3PLs) including container rail operators, coastal shipping operators and warehousing service providers will increase in importance and also result in increased business opportunities.

For example, container rail operators could offer end-to-end services and expand operations to include new routes opened by the five DFCs targeting commodities like sponge iron, pig iron, stone, and tiles. Coastal operators could create charter and liner services expanding support operations in sectors like offshore oil and gas, commodity bulk materials (e.g., coal, cement, iron ore) transport, and increasingly, in container transport. Coastal container operators could, for example target new routes such as Kolkata-Chennai and Mumbai-Kochi and also expand into new product categories of lighter cargo including consumer durables, automotive and FMCG. Warehousing companies can target the many multi-modal logistics parks that are likely to come up at key rail terminals, particularly along the DFCs and at the outskirts of major cities and production and consumption centres.

There are three imperatives for logistics service providers: First, they will need to upgrade their talent pool to address the more complex demands of multi-modal transport and higher service level needs. Second, they will need to work closely with current and new customers to sharpen their service offering, take a TCO view and improve service levels. Finally, they will need to invest in technology and systems like warehouse management and tracking systems.

personnel will increase dramatically – warehouse managers, logistics managers, coastal seafarers and truck drivers. This in turn will require upgrading the training infrastructure and collaborating with institutes of technology, engineering colleges, marine training institutes and driver training institutes to addressing the shift in the demand for talent.

Consequently, a focused programme centred on building the necessary talent pool should undertake the following – undertake an assessment of skills gaps, build training infrastructure, develop certification programmes, encourage private sector involvement in developing and executing training modules.

10. **Enabling better equipment and setting common standards:** Use of superior equipment e.g., larger trucks and higher tare load railway wagons, and common standards to aid inter-modal transport ensures consistency in the types of containers, pallets and cranes used. Further, supporting research institutes such as a Road Research Institute could help develop better quality road construction material and technology to bolster construction while simultaneously reducing costs.

The agenda for such a programme could be focused on two key measures: One, convene all stakeholders and align on common standards for equipment including containers and pallets, as well as standard construction modules. Two, encourage adoption of more efficient equipment like larger trucks and efficient rail wagons by communicating benefits to end users, providing access to financing and encouraging the industry to supply better equipment to logistics users.

The implementation of the above programmes as part of the NILP will have multiple implications and opportunities for the private sector including user industries, infrastructure developers, EPC companies, equipment and technology providers and logistics service providers, as detailed in Box C.

GOVERNANCE CHANGES NEEDED AT THE HIGHEST LEVEL TO DEVELOP THE POLICY AND ENSURE IMPLEMENTATION

Developing and implementing various initiatives as part of the balanced modal approach will require an integrated approach across multiple stakeholders at the central and state level. The level of coordination required is monumental, as developing India's logistics infrastructure is the responsibility of a number of state and central government units and infrastructure development agencies.

The policy itself can be developed in a manner similar to the Integrated Energy Policy i.e., through an appropriate committee. Such a committee should include representatives from the concerned ministries and departments (e.g., NHAI, Indian Railways, Waterways Authority), stakeholders across ministries (e.g., Ministry of Roads, Ports, Railways, Finance, Aviation) and from the private sector (e.g., user industries, developers and logistics providers). The government has recently set up the High Level National Transport Development Policy Committee that could fulfil this role.

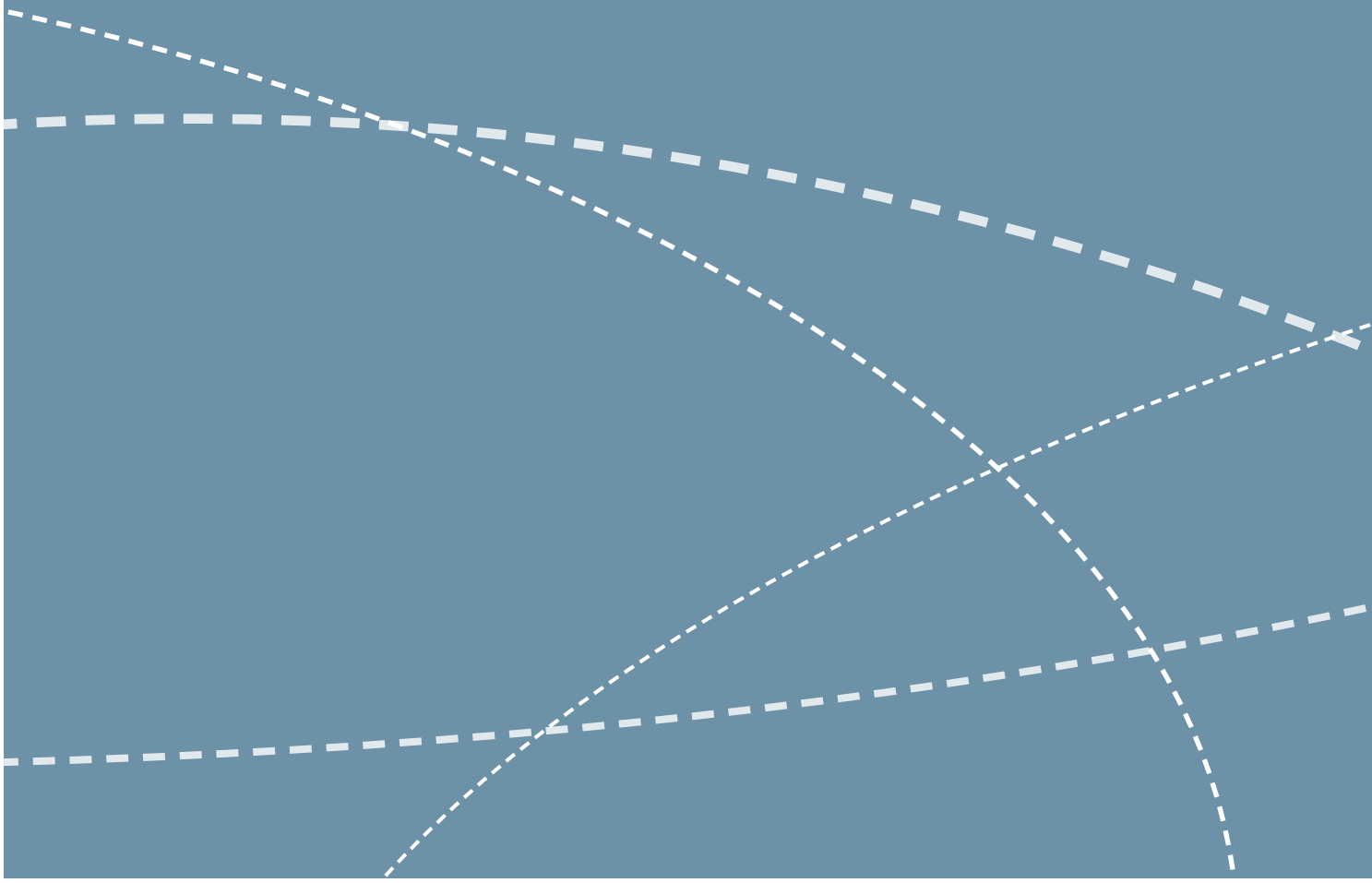
Adopting and implementing an integrated logistics policy will need an empowered Group of Ministers, the Cabinet Committee on Infrastructure, the Prime Minister's Office or an equivalent central body at the highest level to take charge. While the policy execution will be carried out by ministries in the centre and states, such a body should ensure an integrated, coordinated, timely and flexible approach to infrastructure development.

Separately, to ensure speedy implementation, well-functioning infrastructure implementation "war rooms" should be set up for high-priority projects at various levels to provide common information, debottleneck and accelerate implementation of projects, under nodal and executing agencies like NHAI, as well as at the centre with the Cabinet Committee on Infrastructure.

□ □ □

Developing an integrated logistics infrastructure capable of supporting India's growth aspirations requires concerted efforts to develop a new vision for facilitating the most effective flow of freight possible. Much will depend on the ability to develop a coordinated approach to guide the country towards a balanced modal network. It will also require bold governance changes at the highest level.

Appendix A: Approach for identifying key network elements and traffic estimation



This chapter outlines the approach used to identify and estimate the key elements of India's logistics network.

IDENTIFYING CORRIDORS AND ESTIMATING TRAFFIC

The corridor traffic was estimated in three phases:

First, as described in Chapter 1, seven corridors were identified that connect the 15 high-growth clusters in the country, which are expected to account for over 45 per cent of India's GDP growth in the next decade. The 15 high-growth clusters which are expected to drive future consumption and production in the country were identified based on the GDP contribution of the underlying districts and the expected growth rate over the next decade. The GDP and GDP growth rate model has been built in such a way that it is internally consistent at the state and national level for a GDP forecast of between 7 and 8 per cent GDP growth. The seven corridors connect the high-growth clusters identified above and are expected to be the main corridors of traffic growth.

Second, all the key links on each mode—road, rail and coastal waterways—were identified that fall along the seven corridors. For rail, the key links were identified from public data from the Indian Railways. For roads, this is based on published national and major state highways links. For waterways, this represents the freight traffic along the West and East coast's of India.

Third, traffic on each of the three modes on the identified links was estimated based on public data, with some extrapolations for highway sections, for which data was not available. Exhibit A.1 describes the estimated road traffic on all highway stretches that fall along the corridors. This is based on data available on the Department of Roads website, which captures the overall PCUs (Passenger Car Units) of all types of passenger and freight transport vehicles. This was converted into ton-km basis estimated capacity and utilisation of different types of trucks. Exhibit A2 describes the rail links along the seven corridors and the total freight traffic that moves across these corridors. This is based on data from the Indian Railways on the number of freight trains running on these links. Movements along the coastal corridors were estimated using data published by the Indian Ports Association.

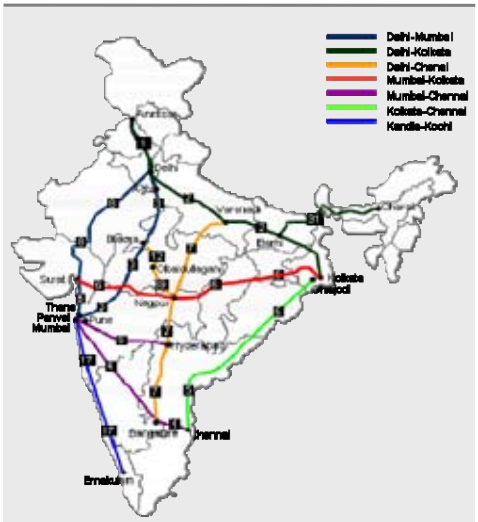
The growth in freight traffic along the corridors was estimated based on the fact that the connecting clusters are estimated to grow at between 1 and 2 per cent points or more of GDP higher than the rest of the country based on the GDP model mentioned above. This was used as a proxy to estimate future freight traffic growth on the corridors.

The overall freight traffic growth in 2020 for the country which is expected to be over 2.5 times the current freight traffic was estimated top down as shown in Exhibit 1.9. The freight traffic increase has been estimated in two parts—coal traffic and non-coal traffic. Coal traffic has been estimated bottom up given that it constitutes close to 20 per cent of current traffic. The estimate is based on expected future demand in power, cement and other sectors, and factors in the lower average distances travelled with increasing share of pithead and coastal capacity in power. Non-coal-based growth was estimated on the basis of a regression analysis between growth in GDP and growth in non-coal freight traffic in ton-km.

Exhibit A.1

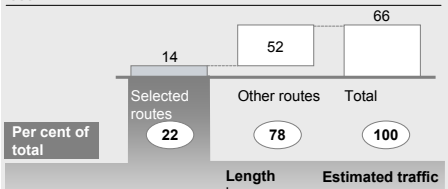
Major national highways in the high-density corridors

National highway links along the selected high-density corridors



Selected routes account for ~22% of total length of national highways

National highway length
'000 km



NH #	Route	Length km	Estimated traffic mn ton-km[1]
1	Delhi-Amritsar	456	7,670
2	Delhi-Kolkata	1,465	38,680
3	Agra-Mumbai	1,161	38,540
4	Thane-Chennai	1,235	30,950
5	Ghiajodi-Chennai	1,533	14,630
6	Surat-Kolkata	1,949	27,160
7	Varanasi-Bangalore	1,717	33,580
8	Delhi-Mumbai	1,375	39,610
9	Pune-Hyderabad	544	15,680
12	Biaora-Obaidullaganj	120	1,170
17	Panvel-Ernakulam	1,269	26,920
31	Barhi-Charali	1,125	13,500
69	Nagpur-Obaidullaganj	350	2,420

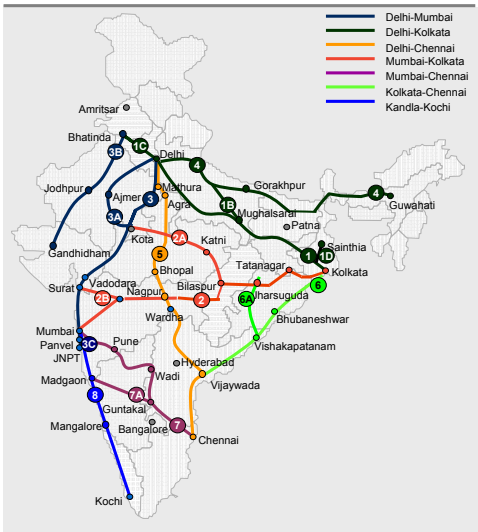
1 Estimated for 2007

SOURCE: Department of Roads and Highways; National Highways Authority of India (NHAI); McKinsey

Exhibit A.2

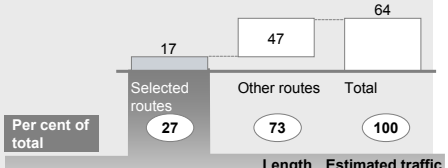
Major rail links in the high-density corridors

Major rail links between high-traffic routes



Rail links along selected routes account for ~27% of total length of Indian Railways

Total rail track length
'000 km



R. No.	Route	Length km	Estimated traffic mn ton-km[1]
1	Delhi-Howrah	1,444	43,500
1B	Ghaziabad-Mugalsarai	735	5,630
1C	Delhi-Bhatinda	284	5,300
1D	Andal-Sainthia	73	550
2	Howrah-Mumbai	1,966	45,650
2A	Bilaspur-Kota	884	15,800
2B	Surat-Jalgaon	311	3,310
3	Delhi-Mumbai	1,371	34,590
3A	Delhi-Chittorgarh	876	4,670
3B	Gandhidham-Bhatinda	1,206	5,440
3C	Panvel-JNPT	50	300
4	Delhi-Guwahati	1,484	14,100
5	Delhi-Chennai	2,045	44,510
6	Howrah-Chennai	1,003	13,780
6A	Jharsuguda-Vizianagaram	494	4,380
7	Mumbai-Chennai	1,223	13,670
7A	Guntakal-Madgaon	407	4,020
8	Mumbai-Kochi	1,107	3,920

1 Estimated for 2007

SOURCE: Indian Railways Web site; McKinsey

The freight traffic in the rest of the country in 2020 was estimated as the overall top-down freight growth in India minus the sum of the freight growth along the seven corridors estimated above.

ESTIMATING CONCENTRATION ON CONNECTORS

Connectors are identified as road stretches that link the district headquarters of the major districts in each state. The top districts that contribute to 60 to 70 per cent of the state GDP were identified for each state to the corridor network. For instance in Maharashtra, seven district groups (Mumbai, Pune, Ahmednagar, Jalgaon, Raigad, Nasik, Solapur) account for 70 per cent of state GDP. The national and state highway/major district roads connecting these districts to the corridor network were identified. Those stretches that do not fall on the corridors are the connectors for that given state.

Estimating the traffic on connectors

It has been established in Exhibit 1.9 that growth in freight traffic is correlated to growth in GDP. This relationship has been used to estimate the share of freight traffic that flows on the connectors within a state. Given that these districts account for 65 per cent of the GDP of the country, this implies that they account for close to 65 per cent of the traffic flow in the country. As the connectors identified are on road, the share of overall freight traffic they represent is 58 per cent. However, not all this traffic passes through the connectors, as some of it directly plys on corridors. Based on an extrapolation of the bottom-up assessment of eight states, between a third and two-thirds of the traffic flows on the connectors. This translates to 130 million ton-km or around 10 per cent of the overall freight traffic in the country travelling on the connectors.

Estimating the number of connectors

A bottom-up assessment was done to estimate the number of connectors in eight states. Table A1 indicates the number of connectors for each of these states and also provides a classification of the state into one of four types: extremely small, small, large with concentrated growth, large with distributed growth. Based on a sample of states in each category, the number of connectors for the categories has been estimated as 0, 3, 10 and 20 respectively. Based on the number of states in each category, the number of connectors across the country is estimated at around 150.

Table A1: Number of connectors for select states

State	Category	Number of connectors
Andhra Pradesh	Large with concentrated growth	9
Gujarat	Large with concentrated growth	9
Karnataka	Large with concentrated growth	12
Maharashtra	Large with concentrated growth	10
Punjab	Small	3
Rajasthan	Large with distributed growth	25
Tamil Nadu	Small	13
West Bengal	Small	6

Estimating the length of connectors

Total connector length has been determined for eight states and extrapolated across the country. For instance, in Maharashtra, the connectors accounted for 826 km of NH roads and 1,779 km of state highways/major district roads (which is just over 1 per cent of the road network in the state). Similarly, in Andhra Pradesh, the connectors accounted for 712 km of national highways and 1,642 km of state highways/major district roads (which is close to 1.5 per cent of the total road network in the state). Based on an analysis of eight states, it has been estimated that the connectors account for less than 2 per cent of the total road network.

ESTIMATING THE NUMBER OF LAST-MILE LINKS

Last miles are defined as less than 100 km road stretches that connect major production and consumption and transit clusters to the corridors or connectors. A detailed bottom-up exercise was carried out to estimate the number of such links in the country.

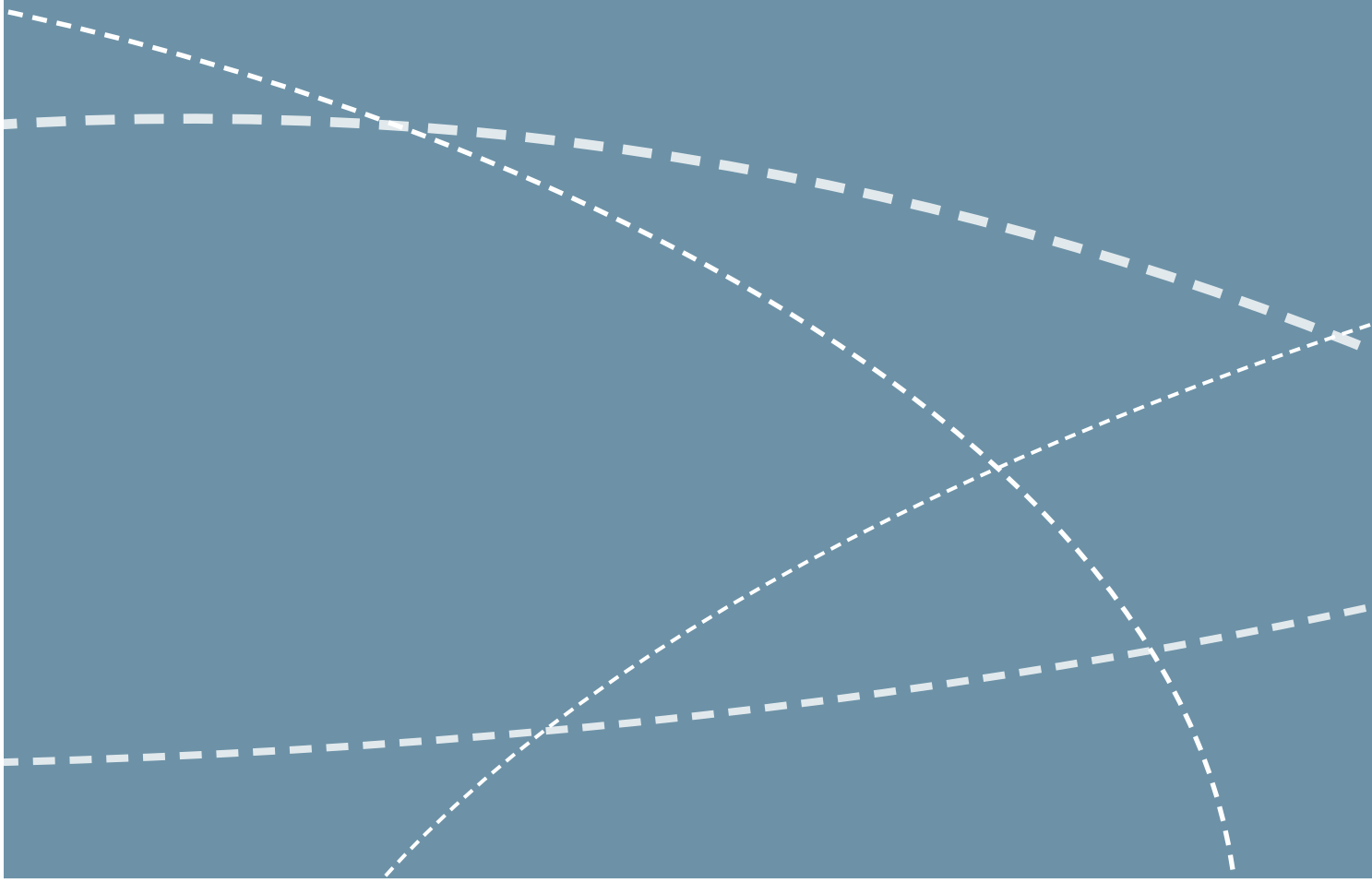
As a first step, nearly 800 freight traffic hubs including over 400 industry clusters, over 200 ports (including major and non-major ports) and close to 200 mines were identified as the major categories of production, consumption and transit centres that would potentially require last-mile connectivity.

Next, the shortest distance road stretches from these hubs to the nearest national or state highway or rail link were identified. All the hubs that did not lie on a national or state highway or rail link and were less than 100 km away from the nearest link require last mile road connectivity.

Overall, each such port not lying on a national/state highway is assumed to require one last-mile stretch to link to the corridor-connector network. On the other hand, an industry cluster or mine is more distributed and requires a larger number of last mile stretches (three assumed).

This reveals the need for over 750 last mile stretches. Some examples of mines requiring last-mile connectivity include bauxite mines at Kachchh and Jamnagar, dolomite mines at West Siang. Similarly, ports such as Valinokkam in Tamil Nadu and Veraval in Gujarat and industry clusters such as Alwar in Rajasthan and Chandrapur in Maharashtra require last-mile stretches to connect them into the core corridor-connector network.

Appendix B: Estimation of losses



Our estimates of the losses from inefficiencies in the logistics network are about USD 45 billion or around 4.3 per cent of the GDP currently.

COMPONENTS OF LOSSES

The value at stake is a combination of losses that are visible (or obvious) as well as hidden in the logistics value chain. Visible losses are due to; 1) unbalanced modal mix; 2) higher transportation costs on a given mode due to multiple factors such as slower speeds and inefficient equipment such as trucks and wagons; and 3) inefficient handling.

Hidden losses are attributed to; 1) longer than optimal distances travelled; 2) higher inventory holding costs; 3) facilitation payments; and 4) theft and/or damage. The amount of losses varies across sectors of the economy and was estimated based on the kind of commodities transported by each sector through the logistics infrastructure.

ESTIMATION OF LOSSES IN 2007

A three-step approach was taken to estimate these losses across the economy:

1. Estimation of losses due to unbalanced modal mix, slower speeds and higher mode costs
2. Estimation of losses due to the other factors (inefficient handling, longer distances, higher inventory holding costs, facilitation payments, theft and/or damage) across three representative commodity flows namely coal, agricultural output and auto components
3. Scaling of the losses under point 2 to all the sectors using logistics adding the losses from point one to arrive at an economy-wide value at stake.

Each of the above steps is outlined below.

Losses due to unbalanced modal mix, slower speeds and higher mode costs

Mode mix is estimated based on the total freight movements in the country. In India, the freight movements are skewed towards the costliest mode i.e., roads. The current modal mix is – roads: 58 per cent, rail: 36 per cent and water: 6 per cent. At the current average mode costs,[1] shifting to the theoretical optimal modal mix for India—road: 48 per cent, rail: 46 per cent and water: 6 per cent[2] would result in savings of USD 2.7 billion in 2007.

Further mode costs across the three modes are higher than optimal. In the case of roads, there is a 20 per cent variation in the mileage offered by well-maintained trucks on good highways versus existing fleet in India on poorly maintained roads. In the case of rail, the wagons in India are able to carry a payload of only 21.5 tons as against 25 tons in many international rail systems including some US class-1 railroads. Further, the tare load of the

1 INR 1.9 per ton-km for road, INR 0.89 per ton-km for rail which includes the effect of cross-subsidisation of passenger traffic and INR 0.55 per ton-km for water.

2 Air has less than 1 per cent share of ton-km.

wagons is about 1 ton lower than ideal, with a further potential to increase the loading on a single wagon. Lastly, the Railways cross-subsidises passenger traffic with freight traffic. In the case of coastal shipping, the long waiting times in ports such as Haldia and Kolkata as well as the smaller draft restricting the maximum size of vessel that can call on many ports result in a longer trip time. Ships can do fewer voyages every month. This is also true for container movements such as Okha and Mangalore, where vessel cranes have to be used as against faster shore cranes. Together, these result in losses of close to USD 8.5 billion.

Truck speeds are slower than optimal, with a truck covering only 300 km per day as against 800 km in the US. Additionally, the speed of freight trains in India is 25 km/hour as against over 45 km/hour in the US and potentially 75 km/hour for the DFC tracks. This requires a higher number of wagons and attendants adding to the costs. Together, these translate into losses of around USD 2.3 billion.

Losses due to other factors across representative commodity flows

Flows of three commodities, namely coal, agriproduce and auto components were studied in detail across the individual value chains. The rationale for choosing these commodities is based on the fact that their flows best represent the bulk, non-bulk and containerised goods flow across India. For each commodity, losses due to longer distances, inefficient handling, higher inventory holding costs, facilitation payments and theft and/or damage were determined. As an illustration, the methodology for estimation of losses in the case of coal is described below.

Actual coal movements in India were studied right from the source (quarry/ports) to the destination (consumption centres e.g., thermal power plants). Three representative flows were analysed (Dhanbad - Varanasi, Haldia - Rourkela and Korba - Roopnagar) and losses due to the above mentioned factors were estimated. These losses were then extrapolated to all the modes of coal transport (road, rail, between ports and roads, between ports and rail and costal shipping). In addition, of the 450 million plus tons of coal transported across the country, the volume distribution and average distance travelled across each of the modes was determined. The losses and freight movement across the modes were aggregated to determine the percentage of losses in country-wide coal movements.

A similar estimation approach was used to determine the losses in flows of agriproduce and auto components.

Scaling of the losses to arrive at an economy-wide value at stake

Six sectors of the economy that use the logistics network were considered for the scaling. These include agriculture, hunting, forestry and fishing; mining and quarrying; manufacturing; electricity, gas and water; construction; and wholesale and retail trade. The three representative commodity flows were mapped to the commodity flows for each of the six sectors. Based on this mapping, the losses across the representative commodity flows were then extrapolated to all the sectors. These sector losses were aggregated to arrive at the economy-wide value at stake of around USD 45 billion in 2007 (Exhibit B1).

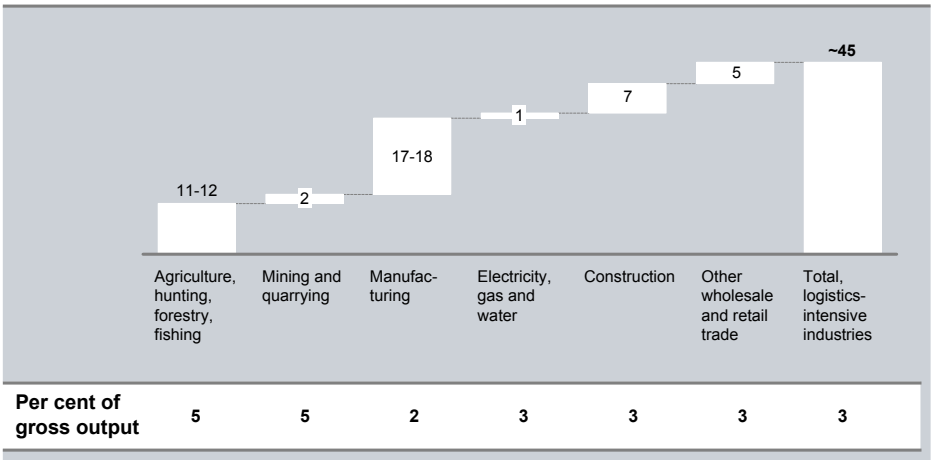
ESTIMATION OF LOSSES IN 2020

Three investment scenarios, namely, 1) current trajectory or as-is; 2) rail driven balanced modal with existing budget but with better allocation across and within modes; and 3) rail driven balanced modal with un-constrained budget allocation were considered to estimate the loss in 2020. Across the three scenarios, the impact on each of the different losses was estimated considering the potential logistics-related initiatives in the respective scenario. This is done jointly for the mode related costs (mode cost, mode mix and speed), and individually for each of the other elements.

Exhibit B.1

Industry-wise[1] breakdown of the USD 45 billion extra costs in 2007

USD billions[2]



	Agriculture, hunting, forestry, fishing	Mining and quarrying	Manufac-turing	Electricity, gas and water	Construction	Other wholesale and retail trade	Total, logistics-intensive industries
Per cent of gross output	**5**	**5**	**2**	**3**	**3**	**3**	**3**

1 Based on ISIC Code classification. Each ISIC Code is estimated as a hybrid of coal, agriculture and auto components, based on closest analogue
2 Estimated for 2007

SOURCE: Industry reports; Global Insight; McKinsey

1. Losses from mode cost, mode mix and speed are estimated top-down for the three scenarios, as a function of eventual mode mix and capacity situation for each mode. In the case of roads, for both the current trajectory and the rail driven balanced modal approach, truck costs are expected to go up by 20 per cent driven by increase in traffic congestion. In case of rail, costs on non-DFC stretches are expected to remain the same, whereas the cost for share of traffic flowing on DFC reduces by around 15 per cent due to improved speed and loadability. Likewise in the case of the capital unconstrained scenario, road costs are expected to go down by 15 per cent from current levels driven by improvement in speed and fuel efficiency. Together, this yields a loss of USD 60 billion in the current trajectory, which drops to USD 40 billion in the rail-driven balanced modal approach and even further to USD 20 billion in the case of a capital unconstrained rail-driven balanced modal approach.

2. For other elements of waste, a ballpark estimate is made in terms of the level of increase/decrease from current levels in terms of per cent of GDP. For instance, theft is assumed to increase by 10 per cent from current levels with increased share of road and greater congestion. Theoretically, this should increase much more, but it is believed that there will be efforts to curb this through other fronts. In the case of rail-driven balanced modal approach, with more containers as well as higher share overall in rail, theft is expected to go down by 25 per cent from current levels. Similar logic is applied for other elements of waste.

If the current investment trajectory is pursued, the loss is estimated to grow to nearly USD 140 billion or over 5 per cent of the GDP in 2020. In case of existing budget but with reallocation, the balanced multi-modal strategy is expected to result in a loss of nearly USD 105 billion or at the existing around 4.3 per cent of GDP in 2020. However, with unconstrained budget allocation, the balanced multi-modal strategy could reduce the loss to USD 70 billion or around 2.5 per cent of GDP in 2020.

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