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Infrastructure Deficit in Land Transport Infrastructure in India



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INFRASTRUCTURE DEFICIT IN LAND TRANSPORT INFRASTRUCTURE IN INDIA

Over the past 75 years since Independence, India has made consistent strides in infrastructure development across various sectors such as transportation, housing, commercial development, telecom, and sanitation. Recognising infrastructure as a key driver of socioeconomic progress, the government has invested significantly in what is termed as 'social overhead capital', aiming to extend development to even the remotest corners of the nation. This strategic approach has involved dedicated budget allocations, cross-subsidisation of revenue-generating infrastructure, and focused program delivery, resulting in expanded physical transportation networks, enhanced connectivity, localised service provision, and increased digital penetration.

However, despite these efforts, India faces a considerable infrastructure deficit, ranking as the second largest in the world after Brazil. This deficit signifies that the country's current infrastructure falls short of meeting the demands posed by its burgeoning economy and population. An infrastructure deficit arises when the existing physical structures and networks crucial for a functioning society and a thriving economy are inadequate to support the nation's needs.

India's Infrastructure push

The dedicated programs for road connectivity (Bharatmala), port infrastructure (Sagarmala), electrification, railways upgradation, and operationalising new airports/ air routes (UDAN) have significantly improved the physical infrastructure in the last few years (Economic Survey 2022-23). With the National Infrastructure Pipeline (NIP) in 2019 and the National Monetization Pipeline in 2021, a strong baseline for infrastructure creation and development has been put in place, providing a multitude of opportunities for foreign investment and engagement. The NIP was launched with 6,835 infrastructure projects with a projected infrastructure investment of ₹111 lakh crore. This has expanded to over 9,000 projects across 35 sub-sectors and covers economic and social infrastructure projects jointly funded by the Central Government, State Governments, and the private sector. With its strong forward and backward linkages, physical infrastructure will enhance the economy's productivity in the medium term.

	BE FY23	April- Nov 2022	April- Nov 2021	YoY growth
			₹ lakh crore	(Per cent)
Road Transport and Highways	1.88	1.49	0.74	102.1
Railways	1.37	1.15	0.65	76.65

Defence Services (capital outlay)	1.52	0.73	0.73	0.88
Transfer to States	1.12	0.43	0.08	438.54
Telecommunications	0.54	0.25	0.03	692.43
Housing and Urban Affairs	0.27	0.11	0.17	-32.47
Atomic Energy	0.14	0.09	0.06	47.5
Defence (Civil)	0.08	0.05	0.04	22.13
Police	0.11	0.05	0.03	53.22
Space	0.07	0.02	0.04	-48.74
Health and Family Welfare	0.06	0.01	0.02	-16.33
Source: Economic Survey 2022-23				

What is infrastructure?

In the most rudimentary sense, the term “infrastructure” is derived from “infra” in Latin, which loosely means “below the structure” and can be taken to express “foundation”. The term also has French roots. It first appeared in the 19th century in railroad planning. Presently, the vast extant literature has in common that infrastructure is essentially a system of basic public goods serving a community and is to be supplied by the state. However, what infrastructure consists of is rarely explored, and its attributes and composition are largely left to be defined in an ad hoc fashion.

In economics, Nobel Laureate Tinbergen (1962) first introduced the distinction between infrastructure (for example, roads and education) and superstructure (comprising manufacturing, agricultural, and mining activities). Jochimsen (1966) was the first one to define infrastructure as the “sum of material, institutional and personal facilities and data which are available to the economic agents and which contribute to realising the equalisation of the remuneration of comparable inputs in the case of a suitable allocation of resources, that is complete integration and maximum level of economic activities.” It follows that infrastructure can be classified into material, institutional and personal.

Zipao (2020) asserts that “Infrastructure entails connectivity, circulation of goods, and movement of people. It establishes ideas, crosses socio-cultural boundaries, maintains and expands social intersections and deepens community relations.”

Impacts of Infrastructure Deficit

The importance of "infrastructure," also known as "economic and social overhead capital," in national and regional development has been highlighted in the substantial literature on economic growth and development (Rosenstein-Rodan, 1943; Nurske, 1953; Nadiri, 1970). According to

this literature, a nation benefits twofold from the provision of social overhead capital. First, the provision of better health care, and education immediately improves the welfare of people through increased skills, less absenteeism, etc. Second, the availability of utilities, roads, and airports boosts the productivity of consumer capital, such as homes and buildings, and productive capital, such as machinery, equipment, and animals. Lakshmanan (1989) thus posits that over time, the development of infrastructure will have an impact that significantly alters the relative costs of both inputs and finished goods. The expectation is that, over time, a new general equilibrium of costs and prices will emerge (Lakshmanan, 1989).

According to Star and Rudleder (1996), the concept of infrastructure is relational. When it comes to organised processes, it becomes infrastructure (Star & Rudleder, 1996). For instance, a road only qualifies as infrastructure if it is built, maintained, and suitable for traffic. A list of the constituent dimensions of infrastructure was also provided; these included embeddedness, transparency, and reach/scope; they also included conventions of practice and standards that have an installed basis and become apparent upon collapse.

The consequences of the infrastructure deficit, thus, are far-reaching. In India, for example, an unreliable power supply leads to frequent blackouts, hindering manufacturing and causing production losses. Poor road networks increase transportation costs, making goods less competitive and contributing to inflation. Beyond economic constraints, infrastructure deficits severely diminish the quality of life.

Lack of access to clean water and sanitation creates major health risks, particularly for vulnerable populations like children and the elderly. Unreliable healthcare infrastructure limits access to essential medical services, leading to poorer health outcomes. Poor transport links isolate communities, restricting access to education, employment opportunities, and basic social services. This cumulative effect drastically erodes the well-being of individuals and hampers overall societal progress

Scope of the paper

This paper provides a national-level/macroeconomic perspective on the infrastructure deficit present in Land Transport Infrastructure (LTI) in India. While acknowledging the vast spectrum of infrastructure development encompassing various domains, the scope of our analysis is necessarily confined due to several key considerations. We have excluded civil aviation, waterways, and urban transport infrastructure (including metros, buses, EVs) from our analysis due to certain limitations.

While inland waterways consisting of canals, rivers, backwaters and creeks undoubtedly play an indispensable role in the infrastructure landscape of local economies, their share in the navigable length, a mere 20,236 km⁸, is currently quite small and underutilised in the total landmass of India, and is present in only 23 states and union territories. Thus, we have streamlined the focus of this paper to modes of infrastructure that facilitate larger-scale, pan-India connectivity. Including a less extensive network like inland canals within the scope of this study could potentially skew the overall analysis and divert focus from the sectors with the most significant impact on national infrastructure.

The role played by the Government of India in infrastructure development also presents a reason for our specific focus. The Ministry of Civil Aviation in India is primarily responsible for policy formulation and regulation. While railways are a natural monopoly controlled solely by its Ministry, and roadways and highways, despite having a contribution of its road network development attributable to Public Private Partnerships (PPPs), the same is not the case with the Ministry of Civil Aviation. The latter is highly privatised in India, with six major airports entirely private. The Indian civil aviation sector is predominantly driven by private entities and what they do for the maintenance and upkeep of the fleet, and the prices are driven by market forces. Airlines are private businesses that make independent investment decisions based on market forces, whereas government investment in airports directly impacts national connectivity. This paper prioritises sectors with the highest level of government involvement in infrastructure development through public expenditure. For this reason, aviation does not fall under the purview of our analysis. Railways and roadways consistently receive the largest portion of the government's infrastructure budget. Focusing on these sectors allows for a more in-depth analysis of areas where the state plays the most critical role in fostering national connectivity and addressing infrastructure gaps.

The urban transport infrastructure comprises of buses, metro, EVs, etc. One significant factor influencing their exclusion is the recent emergence of electric vehicles (EVs). Since EV infrastructure is a rapidly evolving field, established data on deficit levels within this sector remains scarce. Attempting to analyse a deficit in such a nascent stage wouldn't provide a comprehensive picture, as the landscape is constantly shifting and reliable benchmarks haven't yet been established. Similarly, several government policies aimed at infrastructure development, across various sectors, are still in their early stages of implementation. Assessing the impact of these policies on deficit reduction would necessitate more time to gather concrete evidence on their effectiveness. Finally, metro development is primarily governed by individual states and functions largely as an independent business entity within each city. This fragmented structure and focus on urban centres make it challenging to integrate metro systems into a national-level analysis of infrastructure deficit.

Land Transport Infrastructure

Transport infrastructure plays a critical role in facilitating trade and economic growth. Improved infrastructure demonstrably exerts a positive influence on trade performance by reducing various costs associated with transactions, minimising loss and damage to goods during transport, and ensuring timely delivery. Brooks (2016) highlights these factors, alongside others, that contribute to a robust and efficient trade environment. Furthermore, sound transportation infrastructure acts as a catalyst for productive capacity. By bridging connectivity gaps between previously isolated regions, it facilitates the flow of goods, services, and people. This improved connectivity translates into reduced distribution and trade costs, minimising the financial burden of moving goods from production centres to markets. Moreover, efficient infrastructure networks promote economic inclusion by enabling poorer communities to participate more effectively in trade and economic activity. These benefits underscore the importance of infrastructure investment in promoting broad-based economic growth and development (Ma, 2017)

Land Transport Infrastructure (LTI) is described as a complex transportation system that hauls passengers and goods via roads and tracks. Road and railway together form the cornerstone of India. Roadways dominate the transportation sector in modern India, carrying 85% of the

country's passenger traffic and more than 60% of its freight⁴. India carried 1,050,738 million passenger-kilometre in 2020 alone⁵ and about 1.4 billion tonnes of freight⁶. An analysis of the Union Budget reveals that the disbursement to both roadways and railways combined as a share of total transport constitutes about 94.69% and 99.79% of the revenue and capital accounts, respectively. The economy and society hinge upon the physical capability of its members to transport individuals, raw materials, and manufactured products. This extensive network of transportation forms the very foundation of modern society, enabling access to essential services and directly linking manufacturers to final consumers.

The National Infrastructure Pipeline analysis sheds light on the government's ambitious goals regarding Aspirational service standards, particularly in terms of Long-Term Infrastructure (LTI). The government aims to achieve:

- Enhanced road connectivity to remote areas, supported by widespread charging infrastructure and on-road traction facilities for electric vehicles.
- Establishing world-class stations and developing a fully integrated rail network, prioritising connectivity to remote regions while emphasising safety measures.

RAILWAY INFRASTRUCTURE

Established in 1832, Indian Railways has evolved into the backbone of the nation's transportation system.⁴ It is administered by the Ministry of Railways and guided by the policy directives of the Railway Board (PRS Legislative, 2023) and holds the distinction of being the world's second-largest railway network under single management. Initially conceived as an experimental line in the Madras Presidency, Indian Railways rapidly expanded, witnessing the inauguration of the first passenger service in North India between Allahabad and Kanpur in 1859. By 2014, the network had achieved a remarkable capacity, transporting a staggering 8.397 billion passengers and exceeding 106 million tonnes of freight annually¹. This vast infrastructure spans 28 states and eight union territories, fostering connectivity not only within India but also extending its reach to neighbouring countries like Pakistan, Nepal, and Bangladesh. Indian Railways plays a pivotal role in integrating the nation's social and economic landscape. While the majority of the network falls under the Ministry of Railways' purview, a small number of private railways also operate, catering to specific industrial requirements in sectors such as sugar production, port operations, mining, and plantations⁵.

The majority of the nation's rail transportation is owned and run by Indian Railways, which is a state-owned railroad company in India. The Indian Government's Ministry of Railways is in charge of it. As one of the infrastructure's pillars, India's industry and economy are inextricably linked with the Indian Railways. "The movement to and from the major ports, as well as the transportation of people, depend heavily on the movement of coal, iron ore, and other raw materials for the manufacturing industry, fertilisers, cement, and steel products" (White Paper on Indian Railways, 2009). Since transportation is a derived need, economic expansion increases demand for it. In the context of a liberalised economy and an increasingly competitive global milieu, the transportation sector is compelled to heighten its competitive edge, encompassing both cost efficiency and service quality. Given India's vast landmass and the inland concentration of its activities, the pivotal role of Indian Railways in furnishing such competitive services emerges as an imperative facet of the resolution to India's infrastructural needs (Mohan, Infrastructure Development in India: Emerging Challenges, 2004).

During the 1990s, the Indian Railways encountered huge financial problems which impeded its expansion and exposed concerns regarding its capacity to furnish competitive transportation services in forthcoming periods. These problems arose due to large investments in overly ambitious and unprofitable projects that hurt the Indian Railways' finances even two decades later (Mohan, Infrastructure Development in India: Emerging Challenges, 2004).

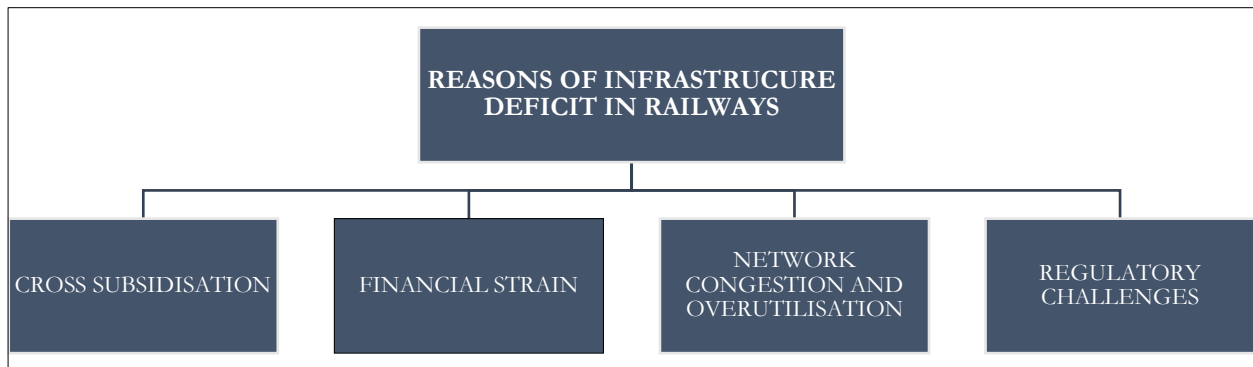
The National Infrastructure Pipeline (NIP) outlines strategic goals that serve as a benchmark for identifying the infrastructure deficit in Indian Railways. These goals highlight areas where the current state of Indian Railways falls short and require significant improvement (NIP, 2020). By analysing the NIP's strategic goals in relation to the current state of Indian Railways, we can identify a comprehensive picture of the infrastructure deficit. Addressing these deficits and aligning them with the NIP's vision is crucial for achieving a robust and efficient railway system in India.

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<https://indianrailways.gov.in/railwayboard/uploads/directorate/Heritage/2021/PDF/3%20Presentation%20Shradha%20Arora%20IRICEN%202019.pdf>

⁵ https://swr.indianrailways.gov.in/uploads/files/1587886962549-First_Private_Railway.pdf

Infrastructure Deficit in Railways



Cross Subsidisation

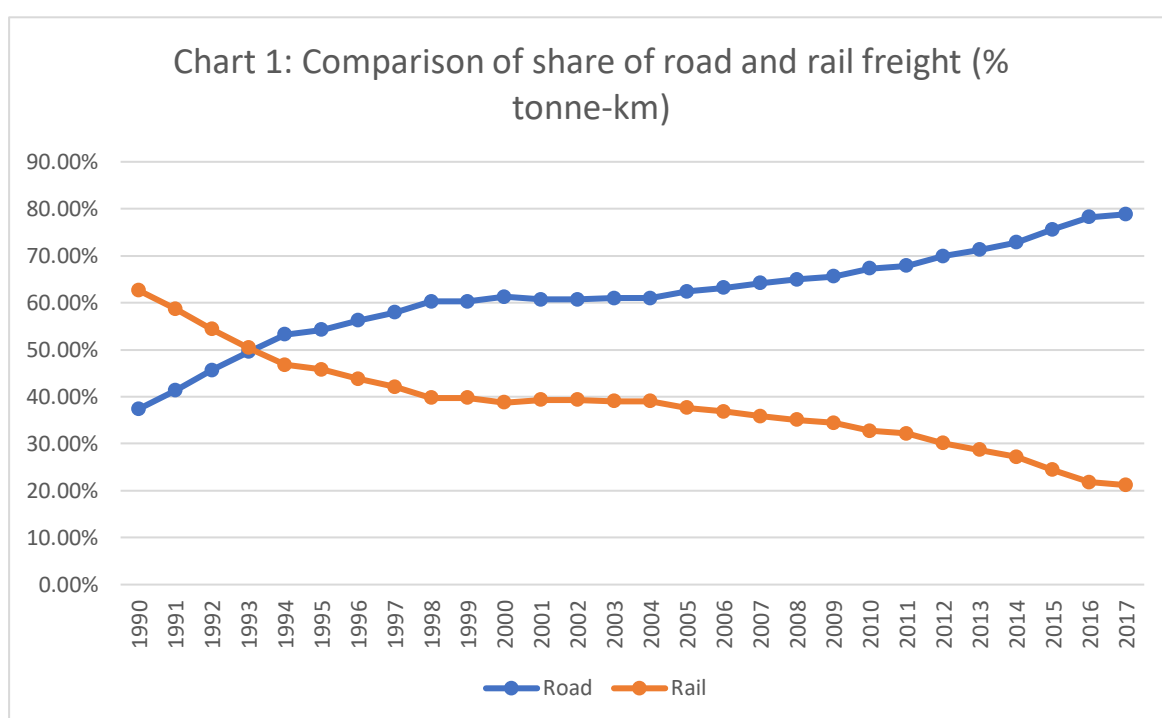
The common perception of railways as one of the primary public services that should be accessible even to everyone has paved way for a system wherein freight users are regarded as capable of bearing higher costs, thus subsidising passenger services, while affluent passengers subsidise fares for others. This model, efficacious within a closed economy, facilitated the passing on of elevated freight charges to consumers, particularly since the primary freight user, the public sector, operated under an administered pricing system. However, this paradigm has become untenable in the context of India's transition to an open economy (Mohan, *Infrastructure Development in India: Emerging Challenges*, 2004). Indian Railways operates on a shared network carrying both passenger and freight trains on the same tracks. As passenger trains frequently have higher priority due to their emphasis on serving the general public, lead times for rail-based freight transport are extended, and reliability is decreased.

The Indian Railway's freight policy is also getting out of date. Particularly problematic are these restrictions for smaller-load transporters. Presently, in order to transfer freight, a shipper must hire an entire train. For the purpose of hiring individual or partial wagons, there are no established procedures for aggregating smaller loads. It is for this reason that non-bulk goods like consumer goods, electronics, autos, etc., are delivered by trucks via roads (Mohan, *Infrastructure Development in India: Emerging Challenges*, 2004). The financial sustainability of the Indian Railways is underpinned by a heavy reliance on government budget allocations coupled with inadequate revenue surplus from freight. Indian Railways is a government department and an arm of the Government of India (GoI). However, it is also treated by the government as a business entity, and up until FY 2016, it combined its budget with the overall budget to pay dividends to the GoI, much like any other public sector company. The purpose of Indian Railways is contradictory; the Indian government views it as both a commercial enterprise that must turn a profit and a social organisation intended for public service. Thus, Indian Railways ends up cross-subsidizing passengers by overcharging freight in order to achieve the government's goal of connecting the nation. Around 66 per cent of Indian Railways' overall traffic revenues come from freight. Budgetary support from the government is solely to be used for expansion; Indian Railways is not given any funding for passengers, such as in the form of subsidies. Cross-subsidies of passenger transportation by freight have resulted in some of the highest freight rates in the world.

Although traffic volumes on Indian Railways have increased, rail's market share, particularly of freight transport, has gone down steadily. The figure below (to be recreated) shows that rail's share

of freight transport has been decreasing since 1951 while road transport has gained market share. Its passenger traffic is the largest in the world. However, the proportion of logistics freight carried by rail has decreased from 86 percent in FY 1951 to less than 30 percent in FY 2018.

- a) **Declining Freight Volume:** Although traffic volumes on Indian Railways have increased, rail's market share, particularly in freight transport, has gone down steadily. The figure below (to be recreated) shows that rail's share of freight transport has been decreasing since 1951 while road transport has gained market share. Its passenger traffic is the largest in the world. However, the proportion of logistics freight carried by rail has decreased from 86 per cent in FY 1951 to less than 30 per cent in FY 2018 (Fast Tracking Freight in India, 2020). This diminution is attributed to insufficient rail capacity, particularly on high-density routes. Despite initiatives, such as the private container train operation policy⁶ initiated in 2006 which aimed at enhancing rail's share in container movement, rail's freight transport market share has continued to decline over the years. Additionally, the majority of railway freight is comprised of a limited range of bulk commodities, including coal, iron, and cement⁷. This composition of freight traffic has remained largely unchanged over the past few years. Transportation of coal made up 46.11 per cent of freight earnings (Comptroller and Auditor General of India, 2022). This heavy reliance on a few bulk goods may pose to be a challenge as Indian aims to shift away from coal to renewable energy.



- b) **Persistent Passenger Service Losses:** Approximately 26 per cent of Indian Railways' revenue in 2023-24 is projected to derive from passenger services, with the majority attributed to non-suburban traffic (NITI Aayog, 2016). However, increasing losses in passenger services have outpaced the profitability of freight operations. This trend shows the financial strain imposed by cross-subsidisation, where passenger fares fail to cover costs, necessitating a reassessment of fare structures and social service obligations (NITI

⁶ <https://iritm.indianrailways.gov.in/uploads/files/1366964675894-Container.pdf>

⁷ https://indianrailways.gov.in/railwayboard/uploads/directorate/traffic_comm/rate_inst_11-20-2k3.jsp

Aayog, 2016). The imperative for prudently rationalizing fares, considering competition from alternate modes of transport, has been underscored by stakeholders, alongside a call to revisit the social service obligations of Indian Railways (Standing Committee on Railways, 2020).

This results in problems like differential in speed of freight and passenger trains and a shortage of rolling stock (locomotives, passenger coaches and freight wagons).

Financial Strain

- a) **Operating Inefficiencies:** Expenditures in Indian Railways are primarily financed through internal resources, central government budgetary support (GBS), and extra-budgetary resources (EBR), which encompass borrowings, institutional financing, and public-private partnerships (PRS Legislative, 2023). Internal resources include revenue from passenger and freight traffic, sundry earnings, and other coaching earnings. EBRs include borrowing through the Indian Railway Finance Corporation (IRFC), institutional finance through the Life Insurance Corporation of India, and investment through public-private partnerships (Comptroller and Auditor General of India, 2022). An audit by CAG of India unveiled that there has been a year-on-year increase in EBR and GBS, indicating poor operational efficiency and an inability to generate independent revenue (Comptroller and Auditor General of India, 2022). These operational inefficiencies can be attributed to rising operational costs mainly pensions and salaries, despite a declining workforce (PRS, 2023). The audit report also shows delays in projects that result in cost escalation, which makes it difficult to recover costs and a heightening debt servicing requirement. As of December 2022, a substantial proportion of ongoing projects have witnessed cost overruns and significant delays, posing challenges to budgetary allocations and operational effectiveness (Comptroller and Auditor General of India, 2022).
- b) **Outdated Accounting System:** The accounting framework followed by the Railways, diverging from commercial standards, obscures the true cost of freight and passenger services, hampering financial transparency. The system neither calculates assets nor liabilities, meaning it's not possible to ascertain the cost-benefit of any project. Switching to an accrual-based accounting method would have a business rationale and help managing the internal budget more appropriately.

Network Congestion and Overutilisation

According to a NITI Aayog assessment, only 16 per cent of India's railway route network consisting of seven key routes accounts for 60 per cent of freight traffic (NITI Aayog, 2021). These routes are routinely overused and not built to handle high traffic density, which results in an uneven allocation of capacity. At the same time, while 80 per cent capacity utilisation is optimal, nearly two-thirds of India's railway lines are already operating at or above 100 per cent capacity (NITI Aayog, 2021). Thus, there is a case of overutilisation of present capacity of Indian Railways. From 1.5 per cent of GDP in 1950–51 to 0.2 per cent in 2016–17, Indian Railways received reduced funding for capital projects. (Mishra, 2018). The under-financing of infrastructural needs of Indian Railways also means that freight trains in India carry smaller loads and usually travel at lower speeds than global standards. This increases lead times of goods and reduces capacity of the overall network.

Indian Railways classifies its network into high-density network routes (HDN) and highly-utilized network routes (HUN). The HDN routes account for 16 per cent of the total network and carry 41 per cent of the total traffic, while HUN routes comprise 35 per cent of the network and bear

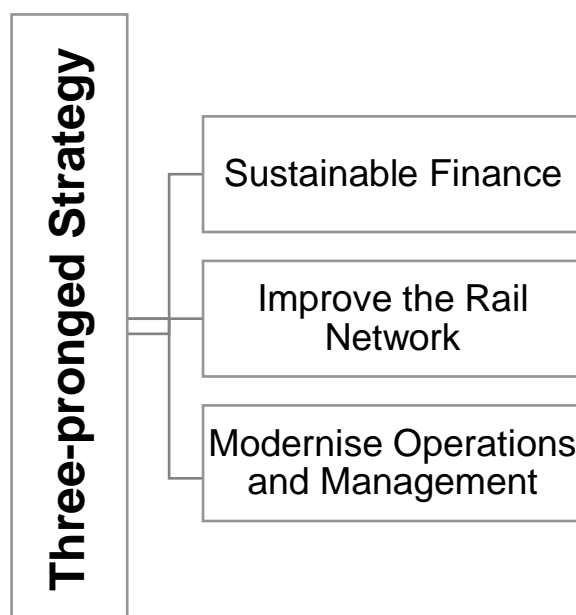
40 per cent of the traffic load (Draft NRP, 2020). This classification underscores the strain on the railway infrastructure, with approximately 80 per cent of HDN routes and 48 per cent of HUN routes experiencing over 100 per cent capacity utilization, leading to significant network congestion. Efforts to enhance freight transportation efficiency, such as the development of dedicated freight corridors and increasing lane capacity, have been impeded by delays, particularly due to challenges in land acquisition and regulatory clearances. Land acquisition challenges have significantly contributed to these delays. Lastly, the absence of decentralized decision-making structures at the zonal level impedes responsiveness to local needs and constraints, hampering operational flexibility and efficiency.

Regulatory Challenges

The Ministry of Railways currently holds the responsibilities of policymaking, regulatory functions, and operations, which hampers operational efficiency and inhibits private sector involvement. This dual role of the Ministry as both player and referee creates conflicts of interest, potentially favouring its own operations over fostering an equitable environment for private participation. Separating these functions would establish an impartial regulatory body, instilling trust and confidence among private investors. A dedicated regulatory body would formulate transparent regulations for private participation, reducing uncertainty and facilitating investor decision-making. By removing direct competition with the dominant Ministry of Railways, a separate regulatory body would promote fair competition and attract diverse private players, fostering a more inclusive and competitive market landscape.

Policy Recommendations

The Indian Railways needs to follow a three-pronged strategy that focuses on sustainable finance, improves the country's rail network and modernise operations and management (Asian Development Bank, 2020).



a) Sustainable Finance

One crucial aspect involves generating revenue to fund its ambitious passenger and freight capacity expansion plans. Here, a shift away from the unsustainable strategy of cross-subsidising passenger fares with freight earnings is essential. The recent success of premium trains like Vande Bharat demonstrates that passengers are willing to pay a higher fare for better amenities and services. Implementing differential pricing based on the type of service and customer segment can lessen the burden on freight revenue and generate funds from the passenger side, too.

Furthermore, Indian Railways must invest in cutting-edge technology to improve operational efficiency and the customer experience. This could involve adopting GPS tracking systems and digital platforms that can optimise existing infrastructure and assets, leading to increased capacity without substantial upfront investment.

Indian Railways could look into public-private partnerships as a way to use the resources and expertise of the private sector to meet the demands of the emerging market. This might entail collaborations with businesses to develop infrastructure, rolling stock, and other services (Debroy, 2015). The National Railway Plan 2030 also pushes for private investment in land and infrastructural development to reduce costs (Ministry of Railways, Government of India, 2022). However, care should be taken in implementing any reform. INDIAN RAILWAYS has been an important part of the everyday life of an ordinary Indian citizen. The push for market intervention should only be incremental. To improve efficiency and accountability, the Debroy Committee recommends reorganising Indian Railways to separate organisations for infrastructure and rolling stock. This can help without rushing into the market in a hasty way in a public sector operation hitherto a monopoly.

The Debroy Committee also recommends restructuring Indian Railways to improve financial accountability. Separating organisations for infrastructure and rolling stock can enhance efficiency without resorting to drastic market interventions.

b) Improving the Rail Network

Upgrading the Indian Rail Network is a critical pillar for its sustainable development. A combination of factors, including insufficient investment in infrastructure, an imbalanced mix of passenger and freight traffic, and project delays that inflate costs, have contributed to the decline of rail's share in freight transportation. To address this, a multi-pronged approach is necessary. Firstly, increased investment is needed to modernize existing infrastructure. This includes upgrading tracks to handle higher axle loads, allowing for heavier freight trains and faster speeds. Additionally, permitting longer trains can significantly increase overall network capacity and operational efficiency.

Secondly, dedicated freight corridors, separate from passenger traffic, represent a strategic solution. The successful completion of the Eastern and Western Dedicated Freight Corridors demonstrates the effectiveness of this approach. These corridors not only enhance network capacity for bulk goods but also improve overall efficiency by reducing congestion on mixed-use tracks.

Intermodal transportation, which combines rail and road transport for containerised goods, offers significant potential. This approach capitalises on the strengths of both modes: rail's efficiency for

long-distance hauls and road's flexibility for last-mile delivery (NITI Aayog, 2021). Identifying and prioritising corridors with high intermodal potential allows for targeted investments in infrastructure upgrades that facilitate the seamless movement of containerized freight. Additionally, enhancing coordination and infrastructure compatibility between rail, road, and water transport is crucial for creating a truly integrated and efficient intermodal transportation system.

By prioritising network capacity enhancement through initiatives like increased axle loads, longer trains, and faster speeds on existing infrastructure, and by strategically expanding the network with dedicated freight corridors, India can significantly improve the competitiveness of its rail sector. The Government of India's ongoing investment in dedicated freight corridors, along with the implementation of the strategies outlined above, will play a critical role in achieving this goal.

c) Modernise Operations and Management

Modernising internal management practices is essential for improving the operational efficiency of Indian Railways. Currently, the highly centralised Railway Board structure concentrates ministerial, commercial, and regulatory powers under one entity (Debroy, 2015). Decentralising power to zonal levels for planning, decision-making, and procurement can streamline operations and improve responsiveness. The Debroy Committee also highlights the importance of separating policymaking, regulation, and operations within the Ministry of Railways. This separation is seen as a critical step towards attracting large-scale private participation, which has been hindered by the current monopolistic structure.

There can be several other solutions to stem the decline of share in freight transport. However, a central pillar needs to be reforming the internal management of Indian Railways. Indian Railways is managed by a Railway Board which is highly centralised in nature. It integrates ministerial, commercial and regulatory powers are vested in a single entity. Although it has proved its worth numerous times in several previous instances, it is high time that some level of decentralisation is introduced in the system. Greater power can be delegated to the zonal level in terms of planning, decision making and procurement. Indian Railways' current zoning system, with 17 zones and 68 divisions, lacks a strategic foundation (Debroy, 2015). Restructuring zones and divisions based on a well-defined plan can enhance efficiency.

Finally, the Committee recommends that Indian Railways focus on its core function of running trains. Diversifying into peripheral activities like running schools and hospitals has proven to be a financial burden. Outsourcing these non-core activities to private entities can free up resources for core operations, leading to a more efficient and financially sustainable Indian Railways (Comptroller and Auditor General of India, 2022). An example cited by the Committee is that of subsidisation of education and medical facilities in alternative schools and hospitals, respectively, including private institutions (Debroy, 2015).

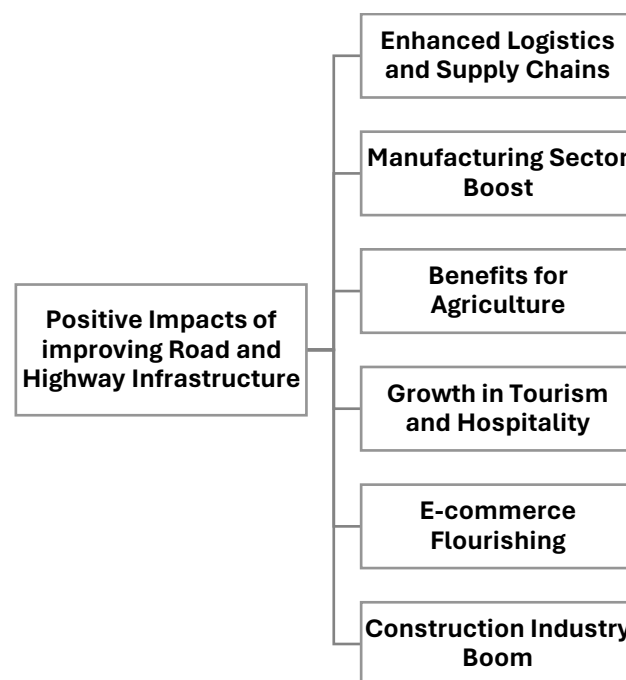
ROAD AND HIGHWAY INFRASTRUCTURE

Road infrastructure, comprising national highways, state highways, district roads, rural roads, and urban roads, serves as a vital transportation and connectivity network for India's diverse populace, including consumers and businesses. Roads play a predominant role in India's transportation landscape, facilitating the movement of goods and passengers while significantly contributing to the national economy. A well-developed road network not only reduces transportation costs in terms of both finances and time but also fosters the integration of various

regions within the country and enhances motor transport connectivity with neighbouring nations on the international front (Transport Research Wing, 2021). Moreover, roads complement other modes of transportation by providing last-mile connectivity to remote areas across the country (Transport Research Wing, 2021). The preference for road transportation persists due to its accessibility, operational flexibility, door-to-door services, and reliability.

Institutional design

The Ministry of Road Transport and Highways (MoRTH) is responsible for devising and overseeing policies concerning road transport and transport research in India. It plays a pivotal role in managing the construction and upkeep of the National Highways (NHs) infrastructure, primarily facilitated by the National Highways Authority of India (NHAI) and the National Highway and Infrastructure Development Corporation Limited (NHIDCL). Additionally, MoRTH plays a crucial role in enforcing regulations outlined in the Motor Vehicles Act of 1988, which covers various aspects of road transport, safety protocols, and vehicle standards. (Transport Research Wing, 2021)



NHs encompass roads crucial for connecting major ports, neighbouring countries, state capitals, and routes of strategic importance. MoRTH holds the responsibility for both constructing and maintaining NHs, with the authority to designate any road as such. The National Transport Development Policy Committee (2013) emphasised the importance of viewing roads as part of an integrated transportation system rather than isolated entities. This approach entails ensuring that the primary road network, represented by NHs, seamlessly links major ports, railway stations, airports, and capital cities. To enhance road network and connectivity, the Ministry endeavours to upgrade state highways to national highways, enhance the construction standards of existing national highways and develop multimodal transportation networks. (Transport Research Wing, 2021; (Asthana & PRS Legislative Research, 2022)

Improving road and highway network

As of 2013, 90% of the passenger traffic and 67% of the freight traffic in the country was carried on the road network (Transport Research Wing, 2021). The Indian network of roads comprises National Highways (NHs), State Highways, District Roads, Rural Roads, Urban Roads and Project Roads. As of March 2019, 71% of all roads were rural roads, while NHs were 2%. District roads formed 10% of all roads, and urban roads 9%. (Asthana & PRS Legislative Research, 2022)

Category of Road	Length in Km	% Share of Total Roads
National Highways (NHs)	1,32,500	2.13
State Highways	1,86,528	3
District Roads	6,32,154	10.17
Rural Roads (including JRY Roads)	45,35,511	72.97
Urban Roads	5,44,683	8.76
Project Roads	3,54,921	5.71
Total	63,86,297	

Source: Road Transport Year Book 2021 (for the years 2017 - 2018 & 2018 - 2019). Ministry of Road Transport & Highways, Government of India

Over time, there has been a notable uptick in the construction of National Highways (NHs) and roads, exemplified by the completion of 10,457 kilometers of roads in FY22, a substantial increase from the 6,061 kilometers constructed in FY16. In FY23, up until October 2022, approximately 4,060 kilometers of NHs and roads were constructed, representing approximately 91 percent of the achievement in the corresponding period of the previous fiscal year. In 2019, the Government of India adopted a forward-thinking programmatic approach to infrastructure development, giving rise to the National Infrastructure Pipeline. This initiative entails a projected investment of approximately ₹111 lakh crore for the period spanning FY20-25, aimed at fostering a comprehensive perspective on infrastructure development nationwide. The initiative also involves close monitoring of progress by the highest levels of government to ensure timely completion and offers investors a structured view of infrastructure projects for informed investment planning. The total budgetary support for investment in the sector has experienced significant growth over the past four years, reaching approximately ₹1.4 lakh crore during FY23 (as of 31 October 2022), as per the Economic Survey 2022-23.

The Indian government has been actively engaged in enhancing road and highway infrastructure across the country. Notably, initiatives like the Golden Quadrilateral project have focused on augmenting the National Highway network, while the Pradhan Mantri Gram Sadak Yojana has played a crucial role in bolstering rural road connectivity and integrating it with the national highway system. In a bid to further propel the development of road infrastructure, the government introduced the Bharatmala Pariyojana in 2017. This ambitious program aims to establish a comprehensive network of highways and expressways to enhance connectivity throughout India. As of October 2023, an impressive sum of Rs. 4.10 lakh crore has been

allocated for projects under the Bharatmala Pariyojana. Notably, this initiative encompasses the development of 34,800 kilometres of the National Highway Corridor, with an approved outlay of Rs. 5.35 lakh crore. By November 2023, significant progress had been made, with 26,418 kilometres of projects awarded and 15,045 kilometres of the corridor already completed. (Ministry of Road Transport and Highways, 2023; Chaurasia et al., 2022)

TABLE 3: Status of Bharatmala Pariyojana state-wise

State	Length (km)	Awarded Length (km)	Length Constructed (km)
Andhra Pradesh	2,524	1,936	614
Assam	433	431	304
Bihar	1,572	1,152	557
Chhattisgarh	571	471	126
Delhi	203	203	149
Goa	26	26	26
Gujarat	1,576	1,194	707
Haryana	1,058	1,058	765
Himachal Pradesh	167	167	105
Jammu & Kashmir	433	251	85
Jharkhand	1,000	801	353
Karnataka	2,059	1,603	815
Kerala	1,126	708	159
Madhya Pradesh	3,063	2,017	1,092
Maharashtra	3,029	2,174	1,544
Manipur	635	635	332
Meghalaya	170	170	81
Mizoram	593	593	363
Nagaland	208	208	131
Odisha	1,586	967	751
Punjab	1,764	1,553	393
Rajasthan	2,503	2,360	2,120

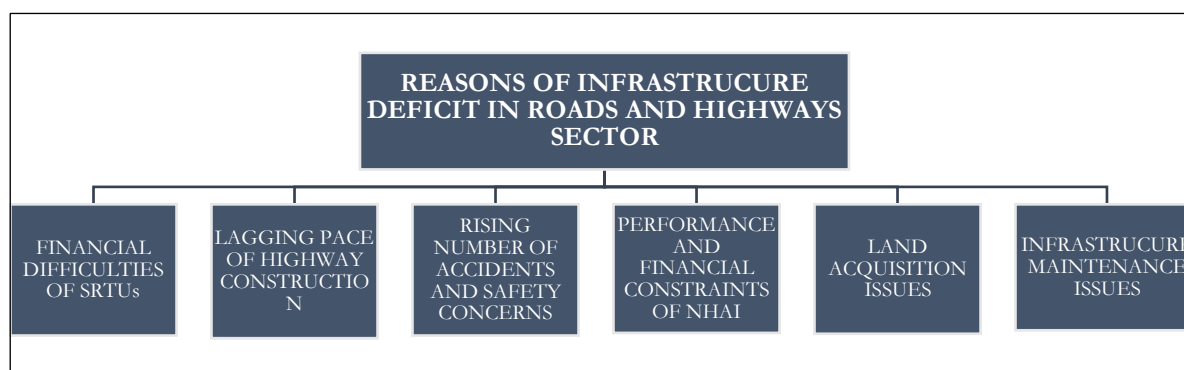
Tamil Nadu	2,414	1,476	989
Telangana	1,719	1,026	463
Tripura	94	94	66
Uttar Pradesh	3,127	2,496	1,576
Uttarakhand	273	264	111
West Bengal	874	385	269
Grand Total	34,800	26,418	15,045
Source: Lok Sabha Unstarred Question No. 3190, Ministry of Road Transport and Highways, 21st December, 2023			

Strides in Road length

In 2021-22, the total road length was 63 lakh kilometres, which has increased at an average annual rate of 3.7% from 2015. During this period, the length of NHs and rural roads increased by an annual average rate of 7.8% each. Between 1970-71 and 2018-19, the share of NHs in total roads has decreased from 2.6% to 2%. However, there has been a marginal increase in the share from 2011 onwards (see Figure 2). The length of NHs (in kilometres) has increased at a pace of 4% between 1970-71 and 2018-19. The share of state highways in total highways has reduced from 6% in 1970-71 to 3% in 2018-19. Although this may be because several state highways have been notified as NHs.

State highways typically link important cities, towns, tourist places, and minor ports and connect them to NHs. These are constructed and managed by state governments through state public works departments.

Infrastructure deficit in roads and highways



Increase in vehicle ownership Vs. Bus Transport

As per Mint news report, following a remarkable 27% expansion in FY23, with 3.9 million units sold, passenger vehicle (PV) sales in India are anticipated to witness a moderated growth rate of

6-8% in FY24, as per the findings of an Olx Crisil Mobility report. Over the course of a five-year period, a robust compound annual growth rate (CAGR) of 5-7% is forecasted. India's PV sales continue to progress steadily, outpacing most other markets for the third consecutive year. While sales in other markets have incrementally increased year by year, they still grapple with attaining pre-pandemic levels. Despite this growth, India's car penetration ratio remains notably lower compared to the global average, standing at 24 per 1,000 people in 2022, ranking as the third lowest among the top 13 markets, according to data from World Road Statistics 2023 by the International Road Federation and Crisil Market Intelligence & Analytics. Notably, Italy boasts the highest ratio with 673 cars per 1,000 people, followed by Germany with 583 and France with 559. State-wise car penetration in India also reflects a similar trend of lower figures, attributable to the nation's low per-capita income. With the exception of Delhi, where car penetration is recorded at 103, most other states exhibit penetration rates below 40 per 1,000 individuals.

TABLE 4: ANALYSIS OF COMBINED PHYSICAL PERFORMANCE OF 56 STATE ROAD TRANSPORT UNDERTAKINGS -2016-17, 2017-18 AND 2018-19

Sr. No.	Item	2016-17	2017-18	2018-19	% age Increase /Decrease (2018-19)	% age Increase /decrease (2017-18)
A	Physical Performance					
1	Fleet Held (Number)	1,52,357.00	1,51,880.00	1,49,713.00	0.31	1.45
2	Fleet Operated (Number)	1,34,981.00	1,35,756.00	1,34,446.00	-0.57	0.97
3	Fleet Utilisation (%)	88.6	89.38	89.8	-0.88	-0.47
4	Passenger/km Offered (in lakhs)	84,79,117.40	85,97,651.22	86,90,608.94	-1.38	-1.07
5	Passenger/km Performed (in Lakh)	59,93,474.67	61,60,952.31	59,84,787.73	-2.72	2.94
6	Occupancy Ratio (%)	70.69	71.66	68.86	-1.36	4.06
7	Staff Strength (Number)	7,09,232.00	7,25,358.00	7,40,156.00	-2.22	-2
8	Staff/Bus Ratio	4.66	4.78	4.94	-2.53	-3.4
9	Staff Productivity (bus kms/Staff/Day)	64.04	63.26	61.82	1.23	-2.33
10	Vehicle Productivity (bus- kms/Bus/Day)	298.1	302.11	305.62	-1.33	-1.15
B	Financial Performance					
1	Total Revenue (Rs. in Lakh)	64,55,436.47	59,36,521.43	55,90,249.87	8.74	6.19
	Of which total traffic earnings	50,44,144.27	47,30,534.12	45,17,978.91	6.63	4.7
2	Total cost (Rs. in Lakh)	82,47,828.90	79,67,481.16	73,07,109.97	3.52	9.04
	Of which staff cost	35,04,138.19	35,85,045.45	32,21,707.23	-2.26	11.28

3	Net profit/loss(-) (Rs. in Lakh)	- 17,92,392.43	- 20,30,959.73	-17,16,860.10	-11.75	18.3
C	Cost to Revenue Ratio (B2/B1)	1.277	1.342	1.307		
Source: Annual Report of MoRTH 2022-23 and Authors' calculation						

In contrast to the significant growth observed in private vehicle ownership, state-operated bus transport systems in India have experienced a notable lag. Despite India boasting one of the most extensive and densely populated road networks globally, the financial performance of state road transport undertakings (SRTUs) paints a grim picture.

The data presented in Table 3, covering the years 2016-2019, reveals that the cost-to-revenue ratio for SRTUs has consistently exceeded 1. This situation is inherently unsustainable, as it indicates that these entities are operating at a loss, signifying severe financial distress.

There exist various reasons for a high cost-to-revenue ratio, including inefficient operation processes, elevated overhead costs, or inadequately priced products or services. To rectify this situation, SRTUs must meticulously identify the underlying causes of the issue and implement measures to either reduce costs or enhance revenue streams, ideally pursuing both avenues concurrently.

Lagging pace of Highway Construction

Highway construction has exhibited sluggish growth, significantly undershooting the targets set for the ongoing fiscal year. Data provided by the Ministry of Road Transport and Highways (MoRTH) indicates that between April and December 2023, only 6,216 kilometres of national highways were constructed, representing a mere 45% of the targeted 13,800 kilometres. Despite a substantial increase in capital expenditure amounting to ₹2.16 trillion, with a considerable portion directed towards the National Highway Authority of India (NHAI), the primary agency responsible for road construction (Narayan, 2024).

Reviewing historical performance, the pace of highway construction has been inconsistent. Prior to the pandemic, in FY20, 10,237 kilometres were built, averaging 28.04 kilometres per day. The following fiscal year, FY21, saw a significant surge attributed to pandemic-induced lockdowns, reaching a record 13,327 kilometres at a daily rate of 36.51 kilometres. However, construction rates have since declined, with FY22 recording 10,457 kilometres at 28.64 kilometres per day and FY23 concluding with 10,331 kilometres overall, equivalent to 28.3 kilometres per day (Narayan, 2024).

Experts speculate that although the current construction rate may exceed that of the previous year, achieving the ambitious target remains doubtful. The underperformance is further compounded by a reduction in the awarding of road projects, with only 3,111 kilometres awarded by December compared to 7,123 kilometres in the corresponding period of the preceding fiscal year (Narayan, 2024).

Accidents and safety concerns

As per the World Road Statistics, 2018, India ranks first in the number of road accident deaths (among 199 countries reported), followed by China and the US. The United States has a longer

road network than India (66 lakh km). As per the WHO Global Report on Road Safety 2018, about 11% of the accident-related deaths in the world occur in India. The Motor Vehicles (Amendment) Act 2019 seeks to prevent road accidents. It provides for penalties for road traffic violations, electronic monitoring, and greater penalties for underage driving. In 2021, the Ministry stated that implementation of the Act has led to improved road safety.

The Standing Committee (2021) observed that the number of ambulances (111), patrol vehicles (509), tow away cranes (443) available with the Ministry are not commensurate with the size of the NH network in India. In September 2021, the central government constituted the National Road Safety Board, which will advise the central and state governments on all aspects of road safety and traffic management. The Ministry has notified several Rules to implement provisions of the Act, such as: (i) protection of Good Samaritans, (ii) conditions for states to levy higher penalties than those in the Act, and (iii) amendments to obtaining driving licenses, among others.

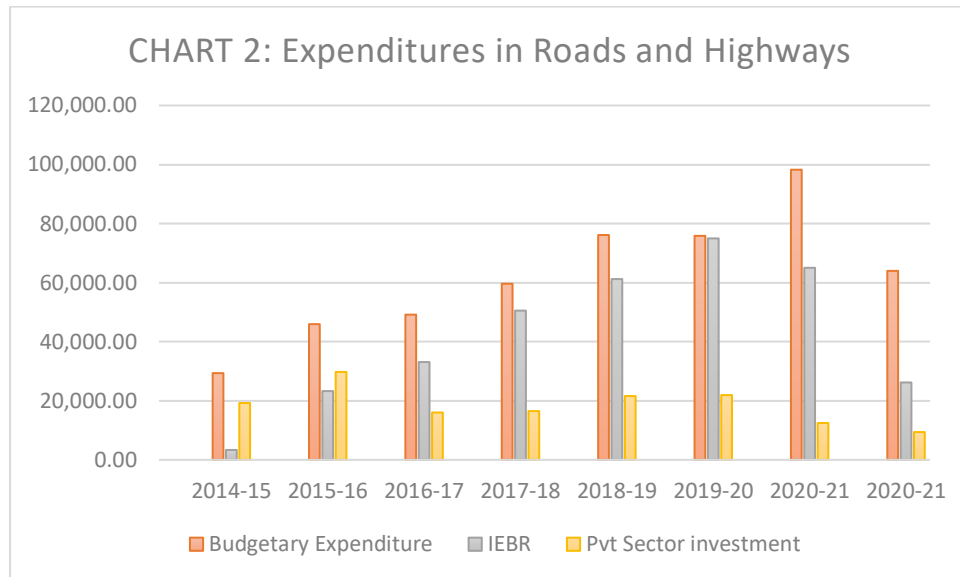
Performance and financial constraints of NHAI

The analysis of the Union Budget 2023-24 by PRS sheds light on the allocation for the Ministry of Road Transport and Highways in India, which has received a sum of Rs 2,70,435 crore. This allocation marks a 25% increase from the revised estimates for the previous fiscal year of 2022-23. Notably, a significant portion (60%) of the additional funding has been designated for investment in the National Highways Authority of India (NHAI). This surge in budgetary allocation is attributed to NHAI's decision to refrain from borrowing from the market. However, despite substantial investments and budget allocations, NHAI, the principal agency tasked with highway construction, faces numerous financial and procedural challenges that impede its ability to meet infrastructure demands effectively. (Mishra & PRS Legislative Research, 2021 and Asthana & PRS Legislative Research, 2022)

The Standing Committee on Transport (2020) highlighted the concerning escalation in NHAI's debt, which had surpassed twice the Ministry's annual budgetary allocation for 2020-21 by March 2020. This debt burden was exacerbated by procedural inefficiencies within NHAI, as identified by the Comptroller and Auditor General of India (2016). These inefficiencies included delays in toll collection due to approval delays and operational lapses, non-compliance with maintenance guidelines, and revenue loss from inefficient bidding processes. The underutilisation of allocated funds and the insufficient gap between funds released and allocated to NHAI, as observed by the Committee on Public Undertakings (2017), further compounded the financial strain on NHAI. Despite receiving budgetary support and resorting to borrowing, NHAI encountered difficulties in raising the necessary funds, raising concerns about the government's ability to complete projects, as highlighted by the Standing Committee on Transport (2018). Mishra & PRS Legislative Research, 2021; Asthana & PRS Legislative Research, 2022)

In response to the mounting debt and financial challenges, NHAI continued to borrow substantial amounts, averaging Rs 63,300 crore annually between 2017-18 and 2021-22, resulting in a significant increase in total debt. The escalating debt servicing costs prompted recommendations from various committees to explore alternative funding sources, such as insurance companies and pension funds, and to seek priority sector lending status from the Reserve Bank of India (RBI). Furthermore, the committees stressed the importance of enhanced due diligence and oversight within NHAI, including regular comparisons of project cost estimates with actual costs, review of cost estimation methodologies, and assessment of the financial strength of private players through the appointment of credit rating agencies. Mishra & PRS Legislative Research, 2021; Asthana & PRS Legislative Research, 2022)

Despite these recommendations, NHAI's financial sustainability remained a concern, with the Standing Committee on Transport (2020) advocating for increased toll charges and project postponements to address immediate financial challenges. Additionally, the committee called for the establishment of an Advisory Committee to monitor NHAI's debt and assess measures to monetise assets effectively. (Mishra & PRS Legislative Research, 2021; Asthana & PRS Legislative Research, 2022)



Land Acquisition issues

In the past five years, the land acquisition cost of NHAI has been reduced, while the project expenditure costs have been rising. Although the share of loan repayment is lower than other costs, it rose by 38% between 2016-17 and 2020-21. Land acquisition costs may have been reduced since several states have agreed to bear at least 25% of the land acquisition costs for projects executed through NHAI. For instance, Kerala has agreed to such an arrangement. States such as Andhra Pradesh, Telangana, and Madhya Pradesh have also proposed similar land-sharing arrangements. Although the share of land acquisition costs has been reduced, delays in projects due to land acquisition persist. As of January 1, 2023, the Ministry of Statistics and Programme Implementation was monitoring 724 projects related to road transport. Of these, 428 have been delayed, and 105 have cost overruns. (Mishra & PRS Legislative Research, 2021; Asthana & PRS Legislative Research, 2022)

Maintenance of roads and highways and safety concerns

The National Transport Development Policy Committee (2014) observed that the expenditure dedicated to road maintenance is insufficient. Consequently, roads suffer from potholes, weak bridges, and inadequate pavements, leading to safety hazards. Moreover, maintenance activities are typically reactive rather than being part of proactive preventive measures. The Standing Committee on Transport (2018, 2020) also expressed concerns regarding the underutilisation of the allocated maintenance budget. According to an analysis conducted by PRS Legislative Research, the Standing Committee has consistently highlighted the inability to maintain the entire length of National Highways (NHs) in the country with the allocated funds. NITI Aayog (2018) pointed out that the allocated amount for maintenance accounts for only 40% of the actual requirement. In the fiscal year 2022-23, the Ministry has allocated Rs 2,586 crore for road and highway maintenance, including toll bridges. This allocation represents a 7% decrease

compared to the revised maintenance expenditure in 2021-22. Furthermore, in both 2018-19 and 2019-20, the actual expenditure on maintenance fell below 60% of the budget estimates (Asthana & PRS Legislative Research, 2022).

During a recent conference organised by the MoRTH, Union Minister Shri Nitin Gadkari highlighted a concerning statistic regarding road accidents in India. He stated that the country witnesses close to 5 lakh road accidents annually, a figure that ranks among the highest globally. Tragically, approximately 1.5 lakh people lose their lives in these accidents. Furthermore, it was noted that a significant portion, approximately 60%, of all road accident victims fall within the 18–34-year age bracket.

In response to these alarming statistics, Shri Nitin Gadkari emphasised the urgent need for improvements in road engineering practices. He proposed the involvement of experts and specialised organisations such as the Indian Institutes of Technology (IITs) to enhance road design and construction standards. Additionally, there was a strong emphasis on enhancing Detailed Project Reports (DPRs) for infrastructure projects to ensure comprehensive planning and mitigation of potential risks at the outset. Shri Gadkari also underscored the importance of conducting thorough road safety audits to identify and address potential hazards on existing road networks. He also added that there should be penalties for contractors and engineers in case of poor-quality repair, maintenance, and construction.

Furthermore, the Standing Committee (2020) has advised augmenting the budget allocated for the maintenance of National Highways (NHs). NITI Aayog has proposed that 10% of the MoRTH's yearly budget should be specifically designated for maintenance purposes. Additionally, the Standing Committee (2015) recommended the establishment of an efficient monitoring mechanism to oversee road repair and maintenance activities. (Asthana & PRS Legislative Research, 2022)

Changing nature of the Government's Outlook

The transition of the government's role from implementation to facilitation in infrastructure development is evident through its emphasis on market expansionary activities and the regulation of private investments in road and highway infrastructure. For example, a report by Mint states that NHAI, through the National Highways Infra Trust (NHIT), an InvIT, aims to conduct a third round of fundraising involving the monetisation of six 250km highway stretches, which will be conducted in phases, targeting domestic and global investors. Additionally, a proposed non-convertible debentures (NCD) issue, the size of which would be similar to the one issued in 2022 amounting to ₹1,500 crore, would also be offered to retail investors with assured returns of close to 8%. (Narayan, 2023)

Such approaches have been used to address the substantial funding requirements for infrastructure projects, and the government has adopted innovative approaches. One such initiative is the National Monetization Pipeline, a program worth 5 lakh crore that enables private companies to oversee the management of existing, well-functioning infrastructure assets, such as toll roads. This strategy not only reallocates government funds for new projects but also leverages the efficiency and expertise of private companies.

Additionally, the market expansionary approach is driven by the debt burden and financial constraints faced by agencies like the National Highways Authority of India (NHAI). As of November 2021, NHAI's total debt stood at Rs 3.38 lakh crore. This is nearly 150% more than the allocation to NHAI in 2022-23.

Encouraging private entities to manage public assets fosters market expansion, marking a transition from project implementation to facilitating a market-driven approach to infrastructure development.

CONCLUSION

In the past several years, India has undergone significant expansion and upgrades in its transport infrastructure, covering roads, railways, waterways, ports, and airports. This comprehensive development has transformed the country's transportation system from unimodal to multimodal, opening avenues for private sector investment and reinvestment in these assets, facilitated by the policy of asset monetisation. Alongside expansion, there has been notable progress in modernisation, achieved with commendable speed. However, India's per capita investment in infrastructure remains one of the lowest globally, with investment in 2022 amounting to around 4.6 per cent of GDP, equivalent to US\$ 88.6 billion in constant 2015 dollars. (Patra, 2022)

To address infrastructure development comprehensively, the government has adopted a multifaceted approach. This includes introducing new financial instruments like Infrastructure Investment Trusts (InvITs) and Real Estate Investment Trusts (REITs) to attract private investment. Additionally, dedicated funding institutions like the National Bank for Financing Infrastructure and Development (NaBFID) are being established, while existing ones are being revamped to enhance available resources. Moreover, the government is promoting public-private partnerships (PPPs) through standardized agreements and bolstering support for social infrastructure development via improved funding mechanisms. These efforts signify a transition from sole reliance on government funding to a system that encourages private investment and fosters infrastructure development comprehensively.

Within this framework, the Land Transport Infrastructure, comprising Railways, Roads, and Highways, has been a focal point of state intervention in India. Recognizing the transport sector's pivotal role in driving economic growth and social welfare, state intervention was deemed necessary due to several factors, including market failure hypotheses, high-risk perceptions, economies of scale, and natural monopolistic tendencies.

The current study identifies the overburdening of Railway infrastructure and declining freight share as major contributors to its deficit. Cross-subsidies of passenger transportation by freight have led to some of the highest freight rates globally. In the roads and highways sector, concerns persist regarding the slow pace of highway construction, limited private investment, and safety issues contributing to deficits.

To effectively address this deficit, there is a pressing need for transparent and expeditious regulatory processes, efficient land acquisition, and sustainable infrastructure financing mechanisms that consider the long gestation periods associated with infrastructure projects. These measures are crucial for fostering robust infrastructure development, essential for sustaining India's economic growth and improving citizens' quality of life.

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