



Project Financing and Management (MBA677)

A Financial Feasibility Study on Mumbai Ahmedabad High Speed Rail Project

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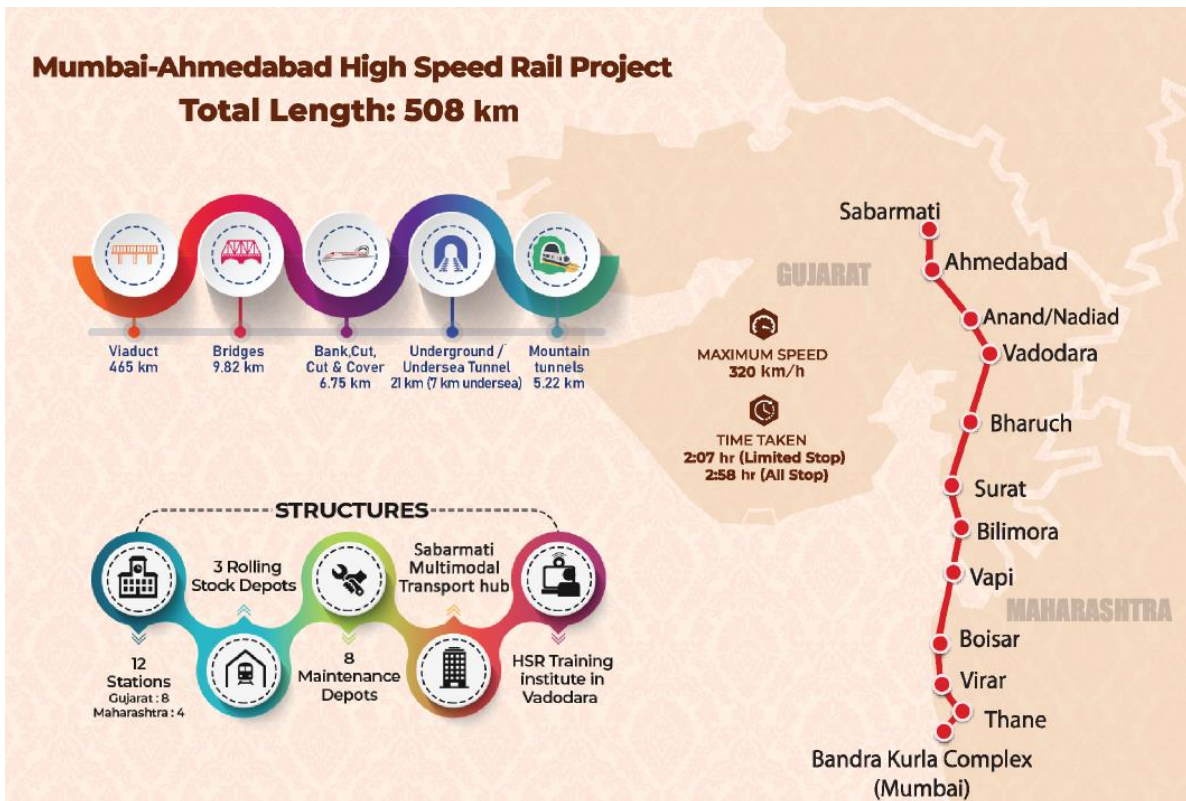
Introduction

India has undergone rapid economic growth in recent years, and along with this growth comes a sharp rise in the volume of people and goods being transported in the country. With this rapid increase in passenger transport activity, high-speed railways seemed one solution to the high passenger demand by high capacity and frequency transport service. Addressing this demand, the Mumbai-Ahmedabad High-Speed Rail Corridor (MAHSR), also known as the Bullet Train Project, is a groundbreaking initiative to revolutionize transportation infrastructure in India. Spanning a distance of approximately 508 kilometers, this ambitious project intends to connect Mumbai, the financial capital of India, with Ahmedabad, the largest city in Gujarat, through an advanced high-speed rail network. The approximately 500 Km long line will be running through the Arabian Sea Coastline, connecting Surat and Vadodara enroute, expected to cover the distance in 128 minutes including 12 stoppages, and achieve a maximum speed of 350 kmph.

It is a centrally sponsored scheme supported by the Central government, state governments of Maharashtra and Gujarat, and the Japan International Cooperation Agency (JICA). Initially introduced in the 2009 budget, subsequent milestones included the signing of the Memorandum of Understanding (MoU) with Japan in 2017, followed by the laying of the foundation for the project

This project promises a transformative initiative to stimulate regional economies, by creating thousands of direct and indirect job opportunities. The corridor not only enhances mobility but also saves valuable time and resources for businesses and individuals. Aligned with the 'Make in India' initiative, it promotes domestic manufacturing while inviting foreign investments, showcasing India's commitment to modernizing infrastructure. It has the potential to spark a boom in real estate development along its route and foster new industries. With India as an offset to be the largest economy, the high-speed corridor helps in positioning India as a beacon of progress and innovation on the global stage and promotes tourism.

Amidst the anticipation and the ambitious goals set forth by the MAHSR, a comprehensive feasibility analysis becomes imperative to substantiate its viability and ensure successful execution. The analysis focuses on the technical and financial intricacies of implementing high-speed rail infrastructure examining the adoption of cutting-edge technology to achieve the desired operational efficiency, cost estimates, revenue projections, and potential economic returns. Additionally, the feasibility analysis delves into the environmental, social, and political impacts. The subsequent section of this report will examine the detailed findings of the comprehensive feasibility analysis, shedding light on the various dimensions evaluated and outlining the recommendations derived to pave a successful implementation of the MAHSR Corridor.



Japanese Shinkansen Project

The Japan Railways had a plan for the Japanese Shinkansen Project before the Second World War. The Japan Railways started the acquisition of land for this project before 1930. The foundation stone for the project was laid in April 1959. Initially, the project was estimated at a total construction cost of 200 billion yen, and the funds were sourced in the form of government loans, railway bonds, and a US \$80 million low-interest loan from the World Bank. However, the initial estimates were deliberately understated, and the project's total cost reached a whopping 400 billion yen. Finally, on October 1st, 1964, the Tōkaidō Shinkansen (Tokyo and Osaka) began its service. The launch was as popular as it was during the 1964 Tokyo Olympics. Earlier, the journey time was 6 hours 40 minutes, but the Shinkansen made the trip in just 4 hours, which was later brought down to 3 hours 10 minutes during 1965.

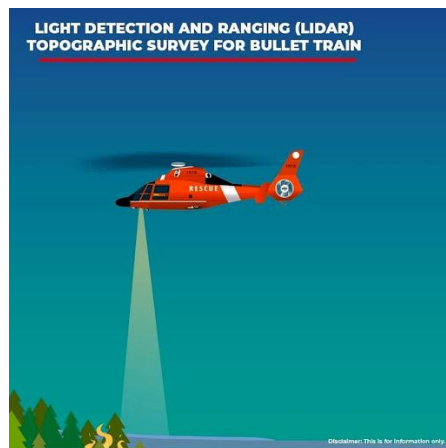


Inaugural ceremony of the Tōkaidō Shinkansen

Highlights of the Mumbai-Ahmedabad High Speed Rail

Starting with the Aerial Lidar topographic survey of India's first undersea tunnel, the project comes with a series of highlights, most of which are taking place for the first time in India.

Aerial Lidar topographic survey: Light detection and ranging (LiDAR) was adopted for the first time in a railway project in India primarily because of its high accuracy (100 mm). This technique uses a combination of laser data, GPS data, flight parameters, and actual photos to provide accurate survey data. This data is then used for the design and alignment of high-speed rail corridors, right-of-way identification of project-affected plots and structures, etc.



Undersea tunnel: This will pass through Thane Creek in Mumbai. Since this area is a protected sanctuary for flamingos and nearby mangroves, rail tracks will be made undersea through a tunnel, thus ensuring no disturbance to the existing ecosystem. This tunnel will be the longest rail transport tunnel and the first undersea tunnel in India. The tunnel will be a single tube with a diameter of 13.2 meters to be executed by both NATM and TBM methods in different sections.



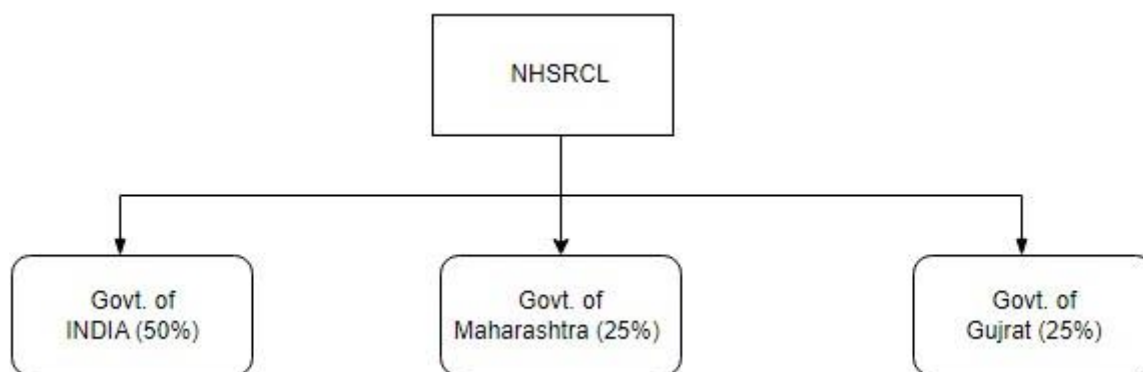
92% elevated track and signaling systems like the DS-ATC Shinkansen Technology and Advanced Telecommunication Technology are some of the of the more prominent highlights of the project.

National High Speed Rail Corporation Limited (NHSRCL)

National High-Speed Rail Corporation Limited (NHSRCL) was incorporated on February 12, 2016 under the Companies Act, 2013 with the object of financing, constructing, maintaining, and managing the High-Speed Rail Corridor in India. The company has been modelled as a 'Special Purpose Vehicle' in the joint sector with equity participation by the Central Government through the Ministry of Railways and two state governments, viz., the Government of Gujarat and the Government of Maharashtra. Apart from the ongoing Mumbai-Ahmedabad HSR project, there are a total 15 projects that are in various phases of development.

Corporate Structure

As mentioned, out of the 1,25,000 crore, 88,000 crore is funded by the Japan International Corporation Agency (JICA) through long-term debt, and the rest is funded by the central and state governments of India. Below is the corporate structure of the project.



The government of India is funding 18,500 crores through the Indian Railways, and both the Maharashtra and Gujrat governments are funding 9,250 crore each.

Japan International Corporation Agency (JICA)

The Japan International Corporation Agency (JICA) is a government agency that delivers official development assistance for the Government of Japan. It was formulated in 2003 with the goal of assisting economic and social growth in developing countries and promoting international cooperation. JICA's global agenda is to work on 20 various thematic issues ranging from urban and regional development to nutrition, transportation, health, education, nutrition, etc. JICA has its development activities going on around the globe. Asia, the Pacific, Latin America, Africa, the Middle East, Europe, etc. are some of them.

Sources and Uses of Funds

This project is initially planned at Rs.1,08,000/- crore and it is supposed to be completed by 2022. Later due to the delays in land acquisition, a pandemic in the year 2020 kept the project delayed. Now according to the restructured plans, the project is supposed to be completed by the year 2028 and the budget is hiked to Rs.1,25,000/- crore. This project will be financed with a loan of Rs.88,000/- crore from JICA and rest comes from

equity through the equity holders in the NHSRCL. As of 2023, around Rs.54,782 crore has been invested. This number is evident from the annual financial statements of NHSRCL. NHSRCL has been investing the idle cash which is not used for the construction purposes into financial assets and has been good money over years.

The following exhibits show the sources and uses of cash that had happened until the financial year 2023. Till now the loan from JICA came in five tranches in 4 different financial years.

Sources of Funds Till 31st March 2023	
Source	Amount in Rupees (Crore)
Central Government	10000
Gujarat Government	4205
Maharashtra Government	6
JICA (Loan)	40571

Uses of Funds Till 31st March 2023	
Item	Amount in Rupees (Crore)
Construction Cost	25154.86
Equipment Cost	15874.47
Service Cost	667.04
Software	71.95
Financial Assets	881.52
SGA & Others	12132.30

The projected figure for the sources and uses of the cash considering the project completes by the year 2028 with an estimation of Rs.1,25,00 crore is as follows,

Sources of Funds	
Source	Amount in Rupees (crore)
Central Government	18500
Gujarat Government	9250
Maharashtra Government	9250
JICA (Loan)	88000
Total	125000

Uses of Funds	
Item	Amount in Rupees (crore)
Construction Cost	57397.49
Equipment Cost	43142.59
Service Cost	1522.02
Software	164.17
Finance Costs	2011.43
SGA & Others	20762.30
Total	125000.00

The numbers for the upcoming years are assumed in line with considering that fifty percent of the remaining funds will be utilised in the next two financial years and the thirty percent for the years thereon and twenty percent of funds in the last financial year.

Present-day traffic

As of today, April 20, 2024, there are 41 flights running from Mumbai to Ahmedabad on a daily basis, and the travel time is 1 hour and 2 hours and 15 minutes, including the boarding. Roughly, the fare stands between Rs. 2500 and Rs. 3000. Along with air travel, there are 8 trains, which include superfast and express trains, running from Mumbai and Ahmedabad. The travel time of these trains' ranges from 6 hours to 9 hours. The price for rail travel stands between Rs. 1100 and Rs. 2300.

The below image also shows road travel options by bus and car.

Existing Prices on different modes of Transport		
Mode of Travel	Time	Cost incurred
Flight	2hr 15min (Including Boarding)	2500 - 3000
Train (Shatabdi) - 2A	6 hr	1800
Train (Shatabdi) - 1A	6 hr	2250
Train (Superfast) - 2A	8 hr	1100
By own Vehicle	9 hr	3500 - 4500
Train (Superfast) - 1A	8 hr	1800
Vandebharat	5.5 hr	1200/2300
Bus	10.5 hr	1500

On daily basis these services are utilised by more than 1 lakh people in one side, As Mumbai is the financial capital of India and Ahmedabad is the largest city in Gujrat.

Traffic per day in each mode of Transport	
Mode of Travel	Traffic
Flight	8400
Trains	24500
Road Transport	73500

NHSRCL Operational Plan

NHSRCL has an ambitious plan for this prestigious project for the next 30 years. After considering the population, traffic and business projections between two major cash cows, Mumbai and Ahmedabad, NHSRCL came up with a detailed plan to roll out the number of trains and their frequency.

Projections by NHSRCL				
	1st year	10th year	20th year	30th year
Train Configuration	10	10 or 16	16	16
Number of Trains (per day/one direction)	35	51	64	105
Train Capacity	690	690-1250	1250	1250
Passenger seats (per day/one direction)	17900	31700	56800	92900
Peak-hour Trains (7-10 Am, 5-9 Pm)	3	4	6	8
Non-Peak Hour Trains	2	3	3	6
Total number of passengers per day in one direction	35800	63400	113600	185800

The plan was backed by the traffic surveys of NHSRCL. The traffic surveys that were carried out by the NHSRCL Team to understand the present travel patterns and to build models for forecasting future passenger demand for High-Speed Rail are Willingness-To-Pay (WTP) Survey, Classified Traffic Count Survey, Car O-D Interview Survey. Based upon these surveys NHSRCL came up with a conducive plan for the high-speed train project.

Revenue Projections and Cash flows

After going through the various price points of different modes of transport between Mumbai and Ahmedabad, the price point of 1st class AC ticket of a Shatabdi train and the economy seat cost in flight are more or less the same with a difference hardly in the

hundreds of rupees. The recent special trains by the government (Vande Bharat) price point are also on par with the flight ticket. The price point for this High-speed train cannot be definitely more than the flight ticket to get the occupancies in the long run and also cannot be lower than the Vande Bharat train series as this train will be far superior in the comfort, time taken and the kind of investments that went into this project. The bare minimum price point that should be considered as of today should be at least Rs.2,500/- per seat. Considering this price point as of today, given the inflation of at least 6 percent, by the time this high-speed train gets operational the price point will stand at Rs.3,190/- per seat in the year 2028.

Based on the price point of Rs.3,100/- per seat for this train starting in the year 2028, and with the given operational plan by NHSRCL for the next 30 years, with at least 90 percent occupancies averaging over the years, this project will have an operational income to the tune of Rs.3752.36 crore. As the charges of the ticket increases the project operational revenues in the year 10 of the operations will stand at Rs.5,200/- crore. With further increase in the frequency of trains in the subsequent years and also the charges of the ticket, the operational income for this project in the year 30 might stand at Rs.15,880/- crores. This indicates an increase of 323 percent in 30 years of operations. If the occupancy goes up to 100 percent, the increase can be even to the tune of 400 percent.

The non-operational revenues play a crucial role for this project. The multimodal hub at Sabarmati station is a monument in this project. The seven floors commercial space generates huge revenue to this project in the forms of Royalty, Rents, Parking fee etc., Based on the real estate value of the commercial space, rental values at different stations, the non-operational revenue can make up to 11 percent of the operational revenues in the initial years and have the potential to go up to 15 to 18 percent of the operational income by the 30th year.

The detailed projections and the income statements can be referred to the excel sheet attached at the references section.

Debt Servicing

The financing by JICA of Rs.88,000/- crore has an interest rate of 0.1% and for a period of 50 years. The loan will have a moratorium period for 15 years with respect to principal payment, that leaves 35 years of period to repay the loan. The notion behind the low interest rates is with respect to the economic indicators in Japan. Interest rates in Japan are negative, Japanese banks are sitting on very big liquidity. Rather than charging depositors, they give low interest rate loans to a reliable borrower. One more advantage behind giving loans at miniscule interest rates is that huge currency fluctuations are in favor of Japan historically. Japan will gain additionally on account of currency fluctuation.

The loss for this project on the account of foreign exchange is in the tune of Rs.33,606.66 crore. The loss on the interest account is in the tune of Rs.698.68 crore. The loss is calculated after considering the currency appreciation of Japan at 1 percent, which is arrived after going through historical rates in the currency fluctuation of Japan with respect to India. The DSCR in the initial loan repayment

years is below 1 and it improves thereafter. The detailed loan repayment schedule and the DSCR can be referred to the excel sheet attached at the references section.

Scenario Analysis

Scenario analysis in this project involves evaluating the potential impact of various scenarios on the financial viability of a project. This technique is commonly used to assess the risks associated with a project and to make more informed decisions. The scenarios identified are the occupancies and price point for the charges of the ticket per seat. The occupancies can be defined based on the number of tickets that are purchased in the year. Each scenario is then modeled to determine its potential impact on the project's financial metrics such as cash flow, net present value (NPV), internal rate of return (IRR).

The NPV and IRR is estimated for this project after arriving at the free cash flows. Now the different scenarios are conducted based on the different price points and different occupancies. The occupancies that are considered are 85%, 95%, 100% and the price points that are considered are Rs.2,000/-, Rs.2,500/-, Rs.3,000/- per seat. The following table gives a glimpse about the NPV and IRR for this project in different scenarios.

	NPV	IRR
Occupancy - 85%		
Price @ Rs.2000/-	-15416.49	-0.93%
Price @ Rs.3000/-	-10868.56	-0.63%
Price @ Rs.3000/-	-6372.84	-0.37%
Occupancy - 90%		
Price @ Rs. 2500/-	786.55	0.06%
Occupancy - 95%		
Price @ Rs.2000/-	3190.47	0.19%
Price @ Rs. 2500/-	12415.90	0.64%
Price @ Rs.3000/-	21641.34	1.04%
Occupancy - 100%		
Price @ Rs.2000/-	12493.95	0.64%
Price @ Rs. 2500/-	24045.26	1.14%
Price @ Rs.3000/-	35596.56	1.58%

Risks Involved

Generally, there are many risks involved in high-budget projects; the case is the same for the Mumbai-Ahmedabad high-speed rail project. From operational to financial and political to social, the risks are widespread in various aspects.

Cost Overruns: Initially, the project was estimated to have a total cost of 1,08,000 crore during 2015 and a deadline for the completion of the project in 2020, but due to various issues pertaining to land acquisition, environmental challenges, etc., the project started in 2021, and as of today, April 2024, the project is estimated to have a total cost of 1,25,000 crores with a deadline for completion in 2030. It is expected that by the end of completion, the project may reach an overall cost of whopping 1,45,000 crores.

Land Acquisition: The survey started in 2017, and after 6 years in 2023, 100% of the of the land acquisition was completed. This was the main reason for the delay in the project, as landowners were not ready to give their land, as that was the only source of income for many.

Political opposition: the political parties were opposing some of the terms that were set in the project, which resulted in a delay in fund allocation from both the Gujarat and Maharashtra governments. As of today, the Maharashtra government allocated only 6 crores out of the 9250 crores, which is less than 0.1%. And the Gujarat government allocated 1,275 crores, which is 13%.

There are many other risks involved in terms of technical challenges, social oppression, timely allocation of funds, etc.

Viability and Bankability

Viability refers to whether a project is feasible and capable of achieving its objectives, particularly in terms of generating sufficient revenues to cover its costs and produce a return on investment. It involves assessing the technical, economic, environmental, and social aspects of the project to determine whether it is achievable and sustainable.

The Shinkansen technology includes Dedicated Rail Tracks, Wider Rail Gauge, Electric Multiple Unit, Digital Cab System (Automatic Train Control), Aerodynamically Shaped Nose, Tilting Device, and Active Suspension System, used for the High-Speed Rail (HSR) is to be imported from Japan wherein all the necessary manufacturing is to be done in India. This strategic decision not only facilitates the integration of advanced technology but also significantly contributes to the Make in India initiative. Manufacturing crucial components locally not only stimulates domestic manufacturing capabilities but also fosters the growth of India's HSR industry, which can further be extended to other routes easily. This project encompasses innovative civil engineering techniques such as First Reinforced Concrete Track Bed, Full Span Box Girder Launching Technology, Longest Steel Bridge in India, Tunnelling, and Underwater Rail Network Construction, underscoring the project's commitment to technological advancement, efficiency, and resilience in establishing a world-class high-speed rail network in India. Speaking about technical aspects this project puts India onto a new pedestal. The shinkansen technology gives Indian infrastructure a huge push. This opens the doors to adapt our infrastructure to the new means of transport. The environmental impact is huge but the offset should be done by afforestation measures and this project also reduces the pollution levels on the highways that connect between Mumbai and Ahmedabad. The social aspects and the environmental impact are separately discussed in the follow up document.

In terms of the revenues, we have seen the scenario analysis, any occupancy less than 95 percent and price point less than Rs.3000/- per seat, does not seem profitable in the foreseeable future of 50 years. The break-even would be very tough to achieve if the occupancies fall below 90 percent. As of now the IRR is barely above 1 percent at 100% occupancy, only the increase in the price point above Rs.5000/- per seat would generate good returns and yields good profits through this project. The increase in price point will have an effect on the occupancies, as the flight charges half the price at

the projected, Rs.5,000/- per seat. This puts the viability opportunities for this project on a wafer-thin margin.

Bankability refers to the attractiveness of a project to lenders, particularly banks and financial institutions, as a potential investment opportunity. A project is considered bankable if it meets the criteria and requirements of lenders for financing, such as having a stable revenue stream, strong cash flow projections, and acceptable risk levels. The due-diligence for this project is completed before the year 2016 and JICA has agreed to finance this project. The extensive analysis done for this project by JICA might have made this project actually bankable, but our projections of revenues and the free cash flows differ. Another strong reason that can be counted to make this project bankable is the fact that the entire corporate structure behind this special purpose vehicle - NHRCL, created for this project is completely backed by three governmental bodies. The backup of the Central government of India, Government of Gujarat and Government of Maharashtra and the notions under which this project is taken up might make this project bankable. The prestigious push by these governmental bodies might make this project quite bankable and

the future vision with respect to building this High-Speed Rail, popularly called Bullet Train in seven different routes in the country might bring economies of scale.

Social Impact

It is anticipated that approximately 14,000 households, 4000 structures, and 37 common property resources will be affected by land acquisition. Land acquisition and fair compensation to the affected people for the construction of the HSR pose a huge roadblock to its timely completion. Additionally, the land is home to tribal communities, thus ensuring their inclusion, livelihood security, and adequate rehabilitation measures requires special attention. It is an undeniable fact that this project is poised to generate significant direct and indirect employment and business opportunities, benefitting local economies and communities along the corridor. Furthermore, it presents an opportunity to facilitate tourism by designing railway stations, especially in the tribal region reflecting and celebrating the local heritage, traditions, and art forms.

Environmental Impact

The proposed Mumbai-Ahmedabad High-Speed Rail Corridor (MAHSR) project, while aiming for transformative advancements in transportation, faces significant environmental impact. For the 508 km long track, approximately 37,000 trees are to be cut down impacting on natural habitats. The corridor trajectory's 155.76 km falls within Maharashtra which passes through fertile agricultural lands, hilly terrains, Marshy lands, and fruit orchards. 23.5 km stretch lies within the state's coastal regulation zone (CRZ), raising concerns about heightened vulnerability to rising sea levels, coastal inundation, and erosion. A 21-km underground corridor from Bandra-Kurla Complex (BKC) to Kalyan has been planned with 7km passing under the Thane creek. A total of 5.2km of mangroves and mudflats will be lost on either side of the creek, while 1.8km is to be built under the sea bed passes through the Thane Creek Flamingo Sanctuary and 3 Eco-Sensitive Zones (Sanjay Gandhi National Park, Tungareshwar Wildlife Sanctuary, Thane Creek Flamingo Sanctuary). Eleven types of mangrove species, the habitat of 177 species of resident, and migratory birds frequently entering the mangroves for feeding and shelter will be directly affected. A well-planned afforestation to revive

the ecosystem, construction of boundary walls or elevated corridors with noise barriers or other reduction measures to avoid direct contact with the wildlife, proper drainage and

waste management planning, promoting and subsidizing vertical farming techniques, sustainable development modeling for railway stations and adoption of renewable energy sources for operational purposes, are a few mitigation techniques to compensate the ecological impact.

Conclusion

It is a never-ending debate between infrastructure development, its financial viability and ecological damage. This High-Speed Rail project emerges as a pivotal solution, not merely for its potential to alleviate urban congestion but also as a catalyst for attracting foreign investments. With all the major economies employing this technology, the emphasis extends beyond speed; the primary aim is to enhance passenger volume movement. This

technological marvel aimed to facilitate the replication of its model across seven other HSR projects in India, signaling a paradigm shift in the country's transportation landscape.

Economies of scale hold the promise of making high-speed rail services more cost-effective, ultimately benefiting a larger number of people by offering them an affordable yet efficient mode of transportation.

Excel Worksheet Link

https://drive.google.com/drive/folders/1Cv-krwRYZq9pC62r8_6qamubDG5_W9uG?usp=sharing

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