Joint Feasibility Study for Mumbai-Ahmedabad High Speed Railway Corridor

Final Report
Volume 4

July 2015

Japan International Cooperation Agency(JICA)
Ministry of Railways, Republic of India(MOR)

Japan International Consultants for Transportation Co., Ltd.
Oriental Consultants Global Co., Ltd.
Nippon Koei Co., Ltd

EI
CR(5)
15-137

Contents

Volume 1

Volume 5

Volume 6

Abbreviations

Abbreviations	Formal Name
A	Articulated
AC	Alternative Current
ADB	Asian Development Bank
AGV	Automotrice à Grande Vitesse
AP	Affected Person
ASI	Archaeological Survey of India
AT	Auto Transformer Feeding
ATC	Automatic Train Control System
ATP	Auto Transformer Post
AUDA	Ahmedabad Urban Development Authority
AVE	Alta Velocidad Española
BIS	Bureau of Indian Standards
BLT	Build, Lease & Transfer
BOT	Build, Operate & Transfer
BT	Booster Transformer Feeding
BT	Build & Transfer
BTO	Build, Transfer & Operate
CAI	computer-aided instruction
CAM	Cement Asphalt Mortar
CAPEX	Capital Expenditure
CB	Circuit Breaker
CBA	Cost Benefit Analysis
CD	Compact Disc
CDM	Clean Development Mechanism
CDP	City Development Plan
CER	Certified Emission Reductions
CIDCO	City and Industrial Development Corporation of Maharashtra Limited
CMDA	Chennai Metropolitan Development Authority
CMP	Comprehensive Mobility Plans
CMS	Centralized Information Monitoring System
COMTRAC	Computer Aided Traffic Control
CPCB	Central Pollution Control Board, India, India
CRIC	China Rail Investment Corporation
CRT	Cathode-Ray Tube display
CRZ	Coastal Regulation Zone
CTC	Centralized Traffic Control
CVC	Classified Volume Count
CVCF	Constant Voltage Constant Frequency
DB	Deutsche Bahn
DC	Direct Current
DCF	Discounted Cash Flow
DEA	Department of Economic Affairs
DFC	Dedicated Freight Corridor
DMIC	Delhi Mumbai Industrial Corridor development
DMRC	Delhi Metro Rail Corporation Ltd.
DNA-CDM	Designated National Authority-Clean Development Mechanism
DPR	Detailed Project Report
DSCR	Debt Service Coverage Ratio
EAC	Environmental Appraisal Committee, India
EC	Environmental Clearance
ECBs	External Commercial Borrowings
EIA/ESIA	Environmental Impact Assessment/Environmental and Social Impact

Abbreviations	Formal Name
	Assessment
EM&MP	Environmental Management & Monitoring Plan
EMP	Environmental Management Plan
EMU	Electric Multiple Unit
EPA	Environmental Protection Act
EPCS	Electric Power Control System
ERP	Electronic Road Pricing
ES	Executive Summary
EVT	Earthed Voltage Transformer
FEM	Finite Element Method
FMS	Facility Management System
FSI	Forest Survey of India
FSI	Floor Space Index
FTr	Feeding Transformer
GC	General Consultant
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GIDC	Gujarat Industrial Development Corporation
GOI	Government of India
GRDP	Gross Regional Domestic Product
GUDC	Gujarat Urban Development Corporation
HDFC	Housing Development Finance Corporation Limited
HSR	High Speed Rail
HSRA	High Speed Rail Authority
HSRC	High Speed Rail Corporation of India Limited
HUDCO	Housing & Urban Development Corporation
ICC	Integrated Circuit Card
ICE	Inter City Express
ICT	Information & Communication Technology
IDC	Interest During Construction
IDFC	Infrastructure Development Finance Company
IEIA	Initial Environment Impact Assessment
IFCs	Infrastructure Finance Companies
IIFCL	India Infrastructure Finance Company Limited
IL&FS	Infrastructure Leasing & Financial Services Limited
IMF	International Monetary Fund
INR	Indian National Rupees
IOCC	Integrated Operations Control Center
IR	Indian Railway
IR	Involuntary Resettlement
IRFC	Indian Rail Finance Corporation Ltd.
IS	Indian Standard
JETRO	Japan External Trade Organization
JICA	Japan International Cooperation Agency
JNR	Japanese National Railways
JR	Japan Railways
JRTT	Japan Railway Construction, Transport and Technology Agency
LA	Land Acquisition
LA	Lightning Arrester
LAN	Local Area Network
LARAP	Land Acquisition and Resettlement Action Plans
LBS	Load-Break Switch
LCC	Life Cycle Cost
LCX	Leaky Coaxial Cable

Abbreviations	Formal Name
LGV	Ligne à Grande Vitesse
MAP	Million Annual Passengers
METI	Ministry of Economy, Trade and Industry, Japan
MEGA	Metro Link for Gandhinagar and Ahmedabad
MEXT	Ministry of Education, Culture, Sports, Science and Technology
MLIT	Ministry of Land, Infrastructure, Transport and Tourism
MMDA	Madras Metropolitan Development Authority
MMRDA	Mumbai Metropolitan Region Development Authority
MMTS	Multi Modal Transport System
MOEF	Ministry of Environment and Forest, India
MOR	Ministry of Railways, India
MOU	Memorandum of Understanding
MOUD	Ministry of Urban Development
MPSEZ	Mundra Port and Special Economic Zone Ltd
MSK	Minimum Shift Keying
MTC	Metropolitan Transport Corporation
MWCS	Maintenance Work Control System
MoEF	Ministry of Environment and Forest, India
NA	Not Articulated
NATM	New Austrian Tunneling Method
NBFIs	Non-Banking Finance Institutions
NEAA	National Environmental Appellate Authority, India
NH	National Highway
NHAI	National Highways Authority of India
NHSRA	National High Speed Rail Authority
NOC	None Objection Certificate
NRSC	National Remote Sensing Centre
NUDP	National Urban Development Policy
NW-4	National Waterway
O&M	Operation & Maintenance
OCC	Operation Control Center
OCS	Overhead Catenary System
OD	Origin-Destination
ODA	Official Development Assistance
OFC	Optical Fiber Cable
OPEX	Operating Expenses
PAP	Project Affected Person
PAX	Passengers
PC	Power Concentration
PC	Pre-stressed Concrete
PCCP	Power Concentration Concentrated Power
PD	Power Distribution
PDDP	Power Distribution Distributed Power
PDL	Passenger Designated Lines
PE	Private Equity
PH	Public Hearing
PHC	Pre Hardened Copper
PIAs	Project Influenced Areas
PNB	Punjab National Bank
PPDPD	Person Per Day Per Direction
PPM	Post-Project Monitoring
PPP	Public Private Partnership
PPP	Purchasing Power Parity
PRC	Programmed Route Control

Abbreviations	Formal Name
PRIDe	Peninsular Region Industrial Development Corridor
PSU	Public Sector Unit
QC	Quality Control
RBI	Reserve Bank of India (Central Bank)
RC	Reinforced Concrete
RCC	Reinforced Cement Concrete
RDSO	Research Design & Standards Organization, India
RFF	Réseau Ferré de France
RFP	Request for Proposal
RLDA	Rail Land Development Authority
RO	Regional Office
ROB	Road Over Bridge
ROC	Republic of China
ROW	Right of Way
RP	Resettlement Plan
RPC	Railway static unbalanced Power Compensator
RS	Rolling Stock
RSCS	Rolling Stock Control System
RTRI	Railway Technical Research Institute
RVNL	Rail Vikas Nigam Limited
RUB	Road Under Bridge
RYWMS	Railway Yard Work Management System
SBI	State Bank of India
SCADA	Supervisory Control and Data Acquisition
SDH	Synchronous Digital Hierarchy
SEA	Strategic Environmental Assessment
SEAC	State Level Expert Appraisal Committee, India
SEIAA	State Environmental Impact Assessment Agency, India
SFC	Single phase Feeding unbalanced power Conditioner
SHM	Stake Holder Meeting
SNCF	Société Nationale des Chemins de Fer Français
SOD	Schedule of Dimensions
SP	Sectioning Post
SPC	Special Purpose Company
SPCB	State Pollution Control Board, India
SS	Substation
SSB	Single Side Band
SSO	Single Sign-on
SSP	Sub Sectioning Post
SUICA	Super Intelligent Card
TAZ	Traffic Analysis Zone
TBM	Tunnel Boring Machine
TEU	Twenty-foot Equivalent Unit
TGV	Train à Grande Vitesse
THSRC	Taiwan High Speed Rail Corporation
TIFS	Tax Increment Financing Schemes
TOD	Transport Oriented Development
TPS	Transportation Plan System
TSC	Taiwan Shinkansen Consortium
TSI	Technical Specification for Interoperability
TSS	Traction Substation
UN	United Nations
UNFCC	United Nations Framework Convention on Climate Change
UPS	Uninterruptible Power Supply

Abbreviations	Formal Name
USD	United States Dollar
UTI1	Unit Trust of India
UTPCC	Union Territory Pollution Control Committee, India
VA	Volt Ampere
VCT	Voltage and Current Transformer
VFM	Value For Money
VGF	Viability Gap Funding
WACC	Weighted Average Cost of Capital
WPI	Whole Price Index
WTP	Willingness to Pay

Chapter 10 Station Area Development

High speed rail shortens the travel time between the cities. It encourages transfer of people who travel with the purpose of business, tourism and pilgrimage, etc.

Moreover, it is highly expected to exploit the potential of HSR by developing the HSR station and area around the station by connecting smoothly with other transport modes at the HSR station and develop the around station area based on TOD (Transport Oriented Development). The HSR station area has huge potential to be a hub of not only HSR passenger's but other non-railway related user's activity.

This chapter includes the 3 contents regarding the station area development as shown below:

(1) Urban Planning around Station Area: In which some key aspects are mentioned and some insights are shown with specific examples of station area development in the world.

(2) Value Capture Models: High level estimation of value capture by station area development has been done at some stations along the proposed station location.

(3) Non Rail Business: Potential of non-railway business in station is discussed with high level estimation at major proposed stations.

10.1 Urban Planning around Station Area

Key aspects for the development of HSR stations based on the TOD concept and for passenger's convenience for proposed 12 stations are to be discussed on this chapter. Also since high revenue is expected from station area development, discussion of value capture models for HSR from station area development is the key contents of the chapter.

(1) Secure Convenience for Passengers

- Shortening of Access and Egress time
- Good Connection with Conventional Rail, Metro and Other Transport Modes
- Approach Road to HSR Station
- Convenient Station Square
- Convenience for Pedestrians (Barrier Free, Pedestrian Deck and Induction Signs)

(2) Harmonization with Urban and Regional Planning

- Harmonization with Existing Urban and Regional Planning
- Development of Around Station Area (Residential Area for Increased Population and Urbanization, Regional Development Along HSR , Provision to Urban Problem and Smart City Concept)
- Increase HSR User by Station Area Development and New Draws of the City

(3) Benefits by Station Building Development and Station Area Development

- For Railway Operator (By Railway Land Development)
- For Municipality (By Increase of Asset Tax, etc.)
- For Passengers (Passengers (By achieving their purpose at station complex facilities)
- For Businesses (By Generating benefits from land development)
- For Communities (By improved living environment)

10.2 Station Area Development

10.2.1 Secure Convenience for HSR Passengers

Connection with other HSR transport modes such as Metro, LRT , BRT and Taxi at HSR station is important for convenience for HSR passengers and also to increase HSR passengers.

Especially the case of the HSR station major cities in the table below, it is recommended to connect with urban transport modes which are under planning and construction.

Table 10.2-1 Urban Public Transport Modes and Progress

HSR Station	Transport Mode	Progress	Agency
Mumbai	Metro	Under Planning and Construction	MMRDA
Thane	MRT	Under Planning	Thane Municipal Corporation
Surat	BRT	Under Planning	Surat Municipal Corporation
Ahmedabad and Sabarmati	Metro	Under Planning	Metrolink Express for Gandhinagar and Ahmedabad (MEGA)
	BRT	Under Planning and Construction	Ahmedabad Municipal Corporation,

Source: Study Team

There are some successful cases with connection to urban transport modes in the world.

(1) Case Study – Shin-Osaka Station (Tokaido Shikannsen), Japan

This is one example of some help as good connection between newly built HSR station and urban transport.

Shin-Osaka station is located in 3km northern part of Umeda, one of the CBD of Osaka city. Since there was no enough space for Shinkansen station in Osaka existing railway station and from the viewpoint of good route alignment, Shin-Osaka station located apart from the CBD.

- Inauguration of the Metro before Shinkansen's Inauguration

For the connection between Shin-Osaka station and Umeda, Osaka Municipal Subway (Metro railway operated by Osaka Municipal Transport Bureau) was constructed and opened before inauguration of Tokaido Shikansen.

24th September, 1964: Inauguration of Midosuji Line (Umeda ~ Shin-Osaka) of Osaka Municipal Subway
1st October, 1964: Inauguration of Tokaido Shinkansen (Tokyo ~ Shin-Osaka). At the same time, Shin-Osaka station for conventional railway has also inaugurated.

- Station at Present

Now Shin-Osaka station has convenient transfer facility with a variety of places by JR lines and Osaka Municipal Subway and the number of boarding per day at Shin-Osaka Station is shown below:

Table 10.2-2 Number of Boarding at Shin-Osaka Station (2013)

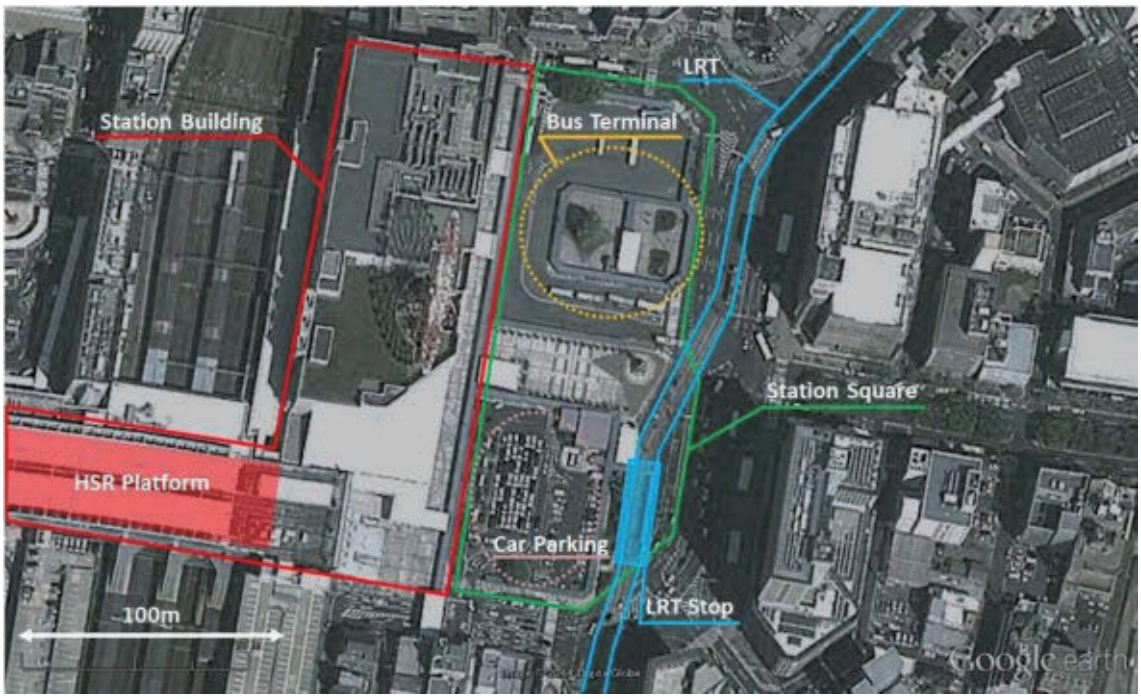
	JR West	JR Central	Osaka Municipal Subway	Total
No. of Boarding	51,720	72,190	63,579	187,489

Source: JR West, JR Central and Osaka Municipal Transport Bureau.

(2) Case Study - Kagoshima-Chuo Station (Kyushu Shinkansen), Japan

Kagoshima-Chuo station was redeveloped with renewal of station building, station square and station around area integrally simultaneously. It contributed to develop the convenience transport hub and station front area.

Before the renewal of station square, it was inconvenient due to scattered bus stop and distant LRT stop from the station. After its development, LRT station and bus stop have been gathered in the station square and thus transfer between the rail and LRT and bus has become much convenient.



Source: Compiled by Study Team Based on Google Earth

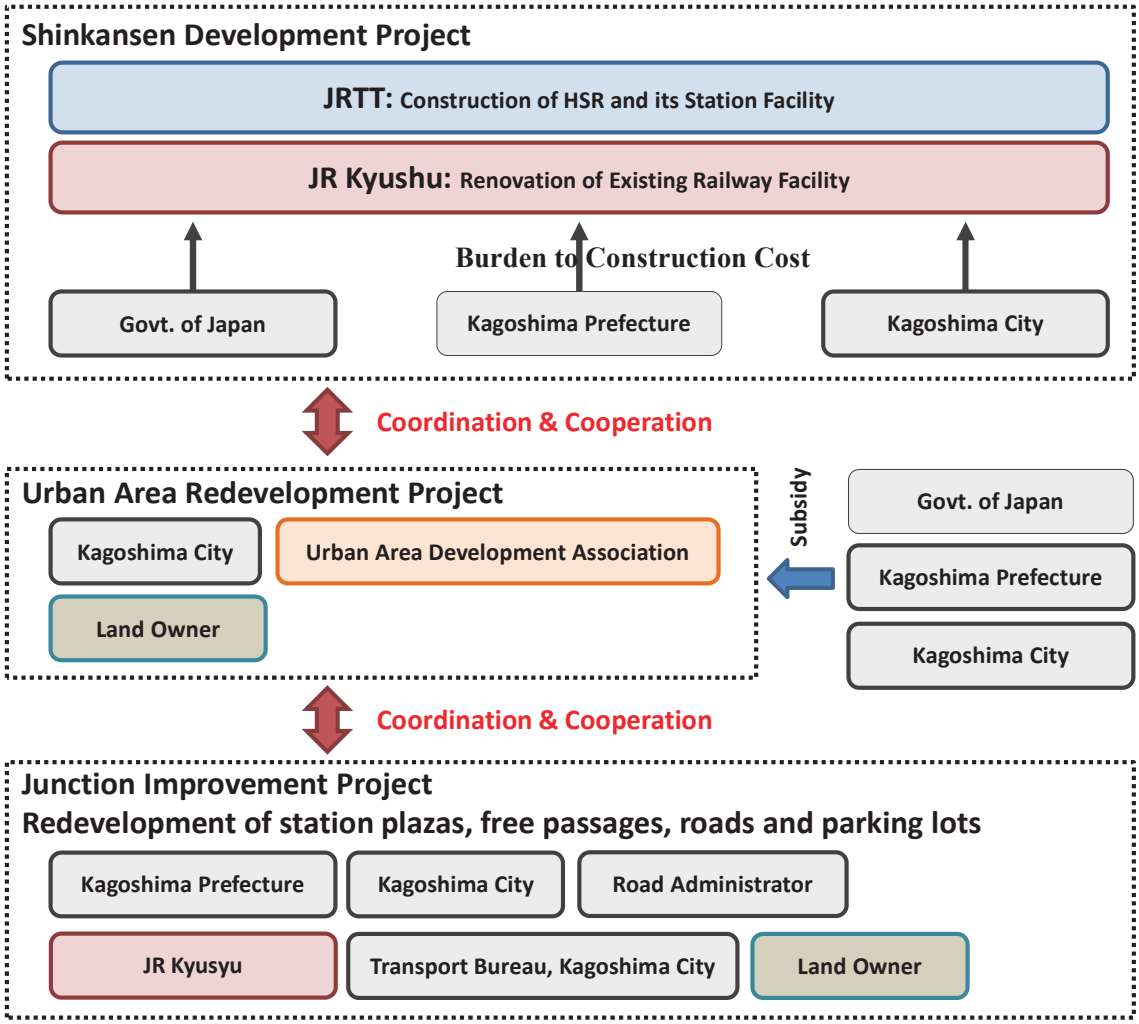
Figure 10.2-1 Station Square at Kagoshima-Chuo Station

Source: JRTT

Figure 10.2-2 Renewed Station Square of Kagoshima-Chuo Station

- Simultaneously Coordinated Three Projects

Three major projects have been conducted simultaneously with the schemes as shown below: The important point is that coordination and cooperation of these 3 projects enable integrated station and station area development.



Source: Study Team

Figure 10.2-3 The Schemes of the Conducted Three Projects

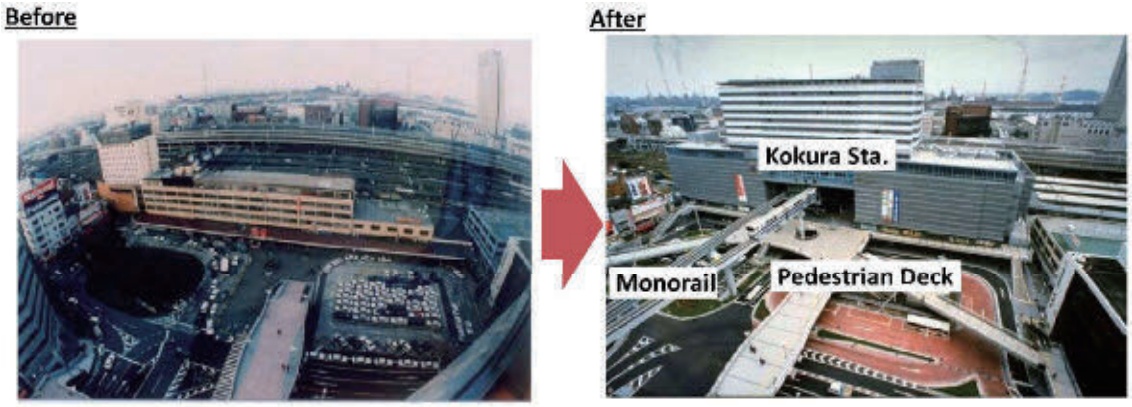
Urban Area Redevelopment Project is a method to improve deregulated congested urban area and create highly integrated complex development area and which method has been widely applied to improve the city center in Japan. the overview of Urban Area Development is described in the next page.

(3) Other Points to be considered for Good Connectivity between HSR and Other Transportation modes.

1) Planning of walkway to smoothly connect HSR and other transport modes

a) Pedestrian Deck

The case of Kokura Station in Japan, new pedestrian deck connects train, bus, taxi and private car smoother.



Source: MLIT

Figure 10.2-4 Before and After Construction of Pedestrian Deck at Kokura Station

b) Elimination of Difference in Level of Floor (As a part of Barrier Free)

For the convenience of all users including elderly people and the physically challenged, installation of elevator and escalator at not only the station but around the station is highly recommended.

The Govt. of Japan is promoting barrier free station area by some ways including elimination of difference in level at the station. Now over 90% of the station (Average user is over 5,000 per day) has been completed

Source: MLIT

Figure 10.2-5 Installation of Elevator

2) Appropriate plan of approach road

To secure the convenience of approach road for cars and pedestrians, approach roads should be designed by considering traffic line and demand of each mode.

3) Connectivity-conscious diagram

Time table of the modes such as HSR, conventional rail, metro bus and LRT should be planned by considering transfer between the modes.

10.2.2 Harmonization with Urban and Regional Planning

It is a way to create new passenger demand that construction of the destinations along the corridor.

Japanese private railways have been tried to stimulate railway use and generate demands by attracting universities, amusement park, baseball parks, shopping malls and high-end residential areas, etc. in suburban area. These trials have contributed not only to increase the population along the corridor but to generate passengers demand which goes opposite direction to the central part of the major cities.

As the example shown in the figure below, creating new destinations in the middle city generates new passengers to the middle cities. Though there are some destination such as office, factory and shopping areas in suburban area, creating new destinations along the corridor is expected to generate much more passenger demand.

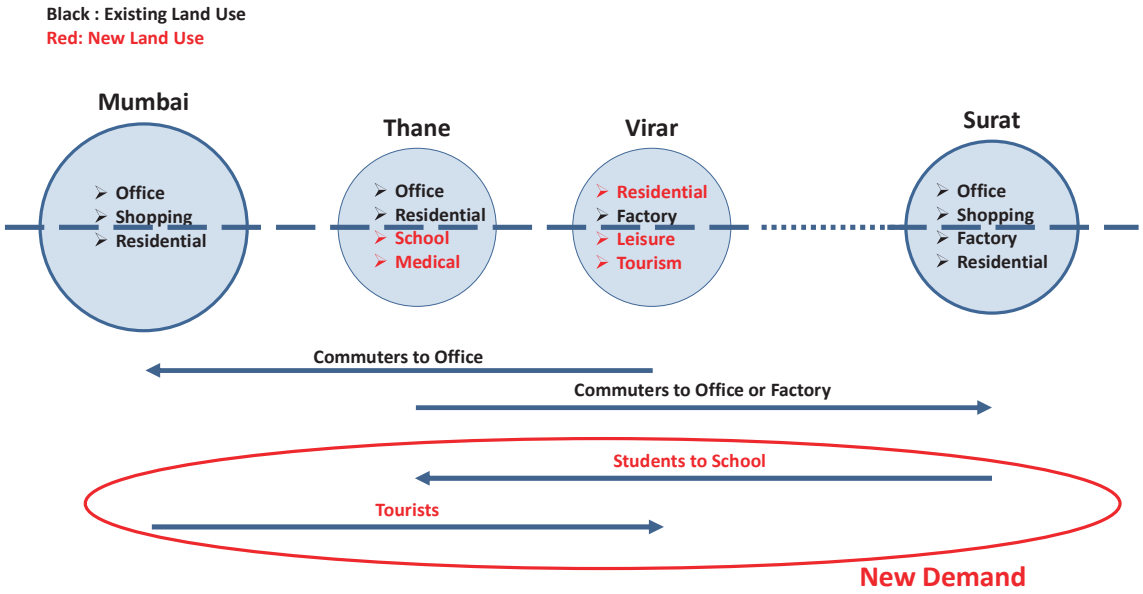


Figure 10.2-6 An Example of Creating New Destinations in the Middle City

(1) Case Study – Station Area Development of Taiwan High Speed Rail, Taiwan

The station area development of Taiwan High Speed Rail is conducted mainly at Taoyuan station, Hsinchu station, Taichung station, Chiayi station and Tainan station (the total area of 15.07 km$^{2)}$ where Taiwan High Speed Rail Corporation has a right of development for 50 years. Each station was given each theme of station area development and the station area development is being carried out based on these themes.

Taiwan High Speed Rail Corporation intends to attract private investment in these areas and let them develop these areas.

The land of HSR station district can be classified into the following five categories:

a. Commercial /Manufacturing Parks (Open tendering development)

b. Station Area (Station area /Ancillary enterprises area, developed by Concessionaire THSRC)

c. Residential Areas (Apportion to landowners, Selling parcels)

d. Commercial Areas (Apportion to landowners, Selling parcels)

e. Public Facilities Areas (School, Road, Parks, Squares, Gas and Water Works)

Source: Bureau of HSR, MOTC

Figure 10.2-7 Future Image of Taoyuan Station

Table 10.2-3 5 Stations to be Developed and Their Abstract

Station	**Abstract**
Taoyuan Station	➢ Designated as an international business zone for international business, shopping and entertainment. ➢ **Cathey Life Insurance Group was chosen by the ministry as a developer to develop 0.22 km^2 of industrial land with exclusive right to use the property for 50 years. It is planned to build a huge shopping mall, office building for international corporations and international hotel resort.**
Hsinchu station	➢ Hsinchu Biomedical Science Park and Hsinchu Science Park exist around Hsinchu station. ➢ The station area is designated to Taiwan's biotechnological development zone.
Taichung Station	➢ Taichung is the third largest city in Taiwan and has 4.5 million of potential consumers. ➢ Taichung station area is being developed as a commercial zone. Shopping malls, entertainments and hotels, etc. are being developed. ➢ **Cathey Life Insurance Group was selected by the ministry as a developer to develop 36,400 m^2 of the land with 30 years exclusive right. Tourism factory and a conference center are planned to build among the area.**
Chiayi station	➢ Designated as tourism & exquisite agricultural park area. There is The National Palace Museum Southern Branch near the station.
Tainan station	➢ Tainan station area is designated as a green energy and eco park area. Low carbon projects are planed around the station.

Source: Bureau of HSR, MOTC

(2) Case Study – Sakudaira Station (Hokuriku Shinkansen), Japan

1) Abstract

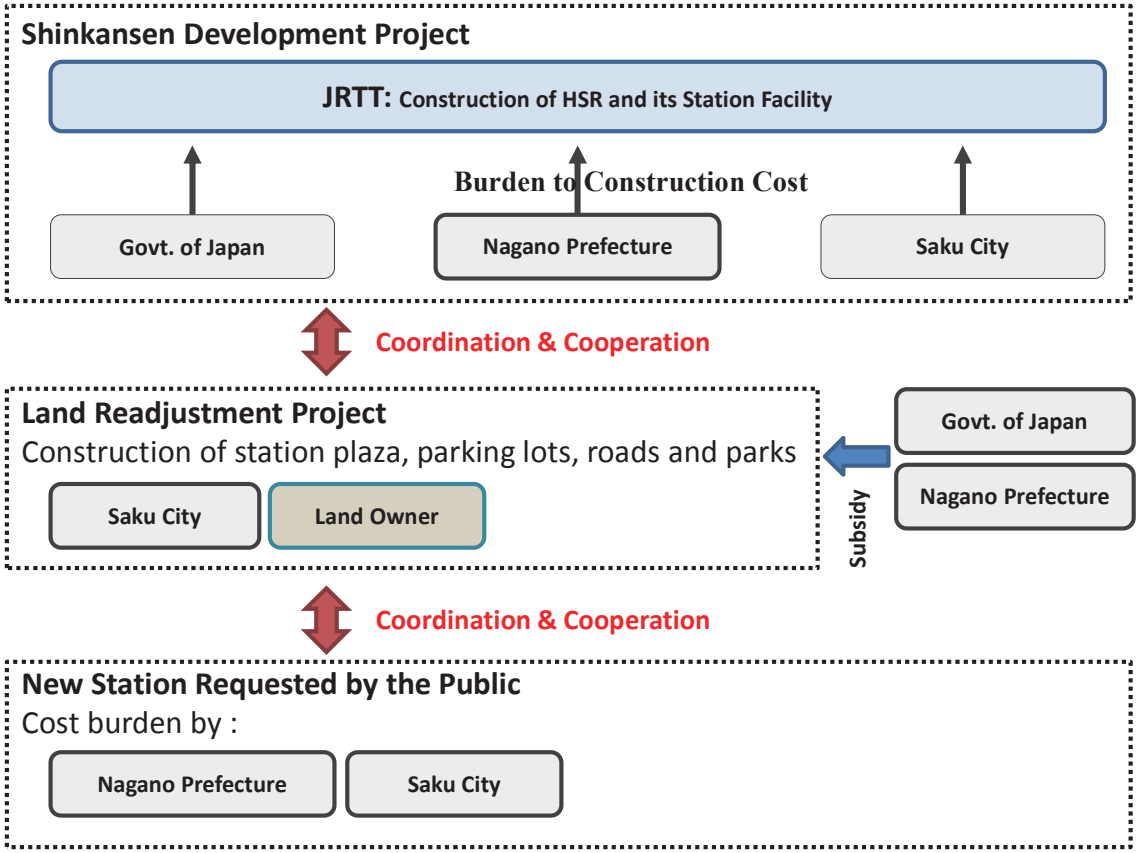
Since HSR can connect major cities and other middle cities by fast transport service, commuter can travel from the 100km or 200km distant cities. It also contributes to shortage of residential in the major cities.

The location of Sakudaira station located approx. 160 km from the Tokyo station was planned far from the existing central part of the city because of alignment issue.

Saku city municipality initiated the station area development such as construction of commercial facility and residence by land readjustment. For station building, Nagano Prefecture and Saku city municipality defrayed station construction cost as beneficiary of HSR. As a background of this cost burden, increase of property tax which Saku city would be able to collect was assumed.

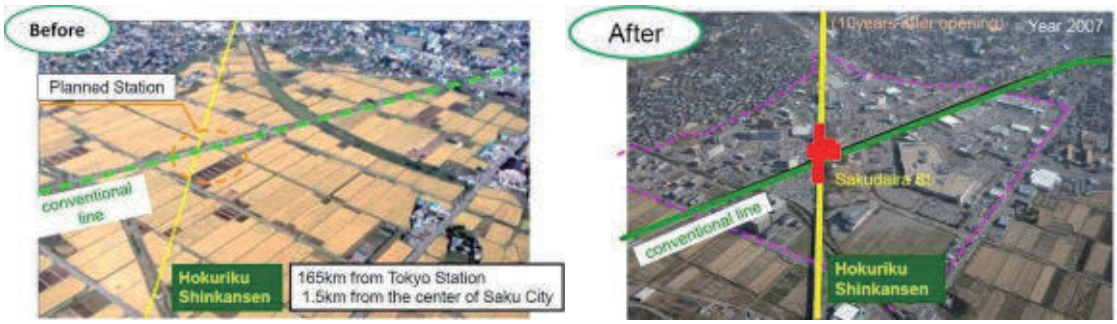
Improvement of accessibility to the roads and conventional line and accumulation of commercial and residential function have been done at early stage of the project, thus the station area development contributed to the city development.

Travel time between Tokyo and Saku city became 1 hour and 20 minutes by inauguration of Shinkansen therefore commuters from Saku city to Tokyo increase and Saku city is now functioning as a commuter city.



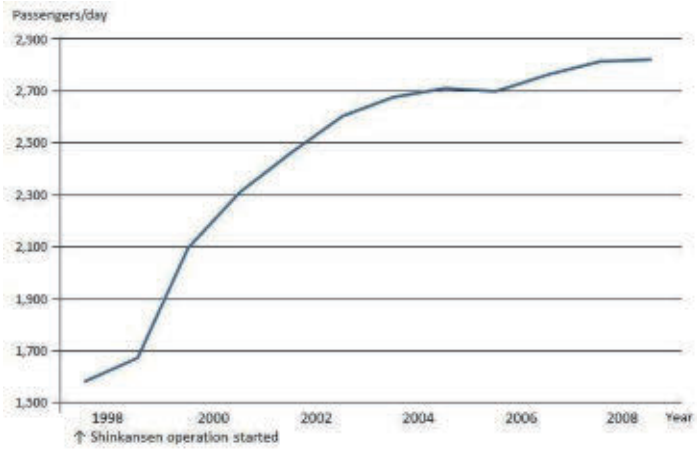
Source: Study Team

Figure 10.2-8 Relevant Projects and Parties



Source: MLIT

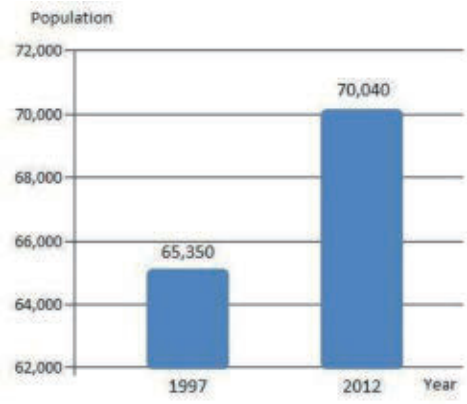
Figure 10.2-9 Before and After the Development of Sakudaira Station



Source: Study Team

Figure 10.2-10 Increase of Passengers at Sakudara Station

2) Effect by the Station Area Development (Increase of Passengers and Tax Income)



Source: Study Team

Figure 10.2-11 Population Growth of Saku City

Station area has been developed and passengers of Shinkansen have increased by the effect of shortened traveling time from Saku city to Tokyo and other city. The travel time to Tokyo became within 2 hours from within 3 hours.

The number of new business around Sakudaira station increased to 60 in 4 years from the inauguration of Shinkansen and fixed property tax income of Saku city in 60ha development area increased to 536 million yen per year (2012) from 4.35 million per year (1996, before the inauguration of Shinkansen).

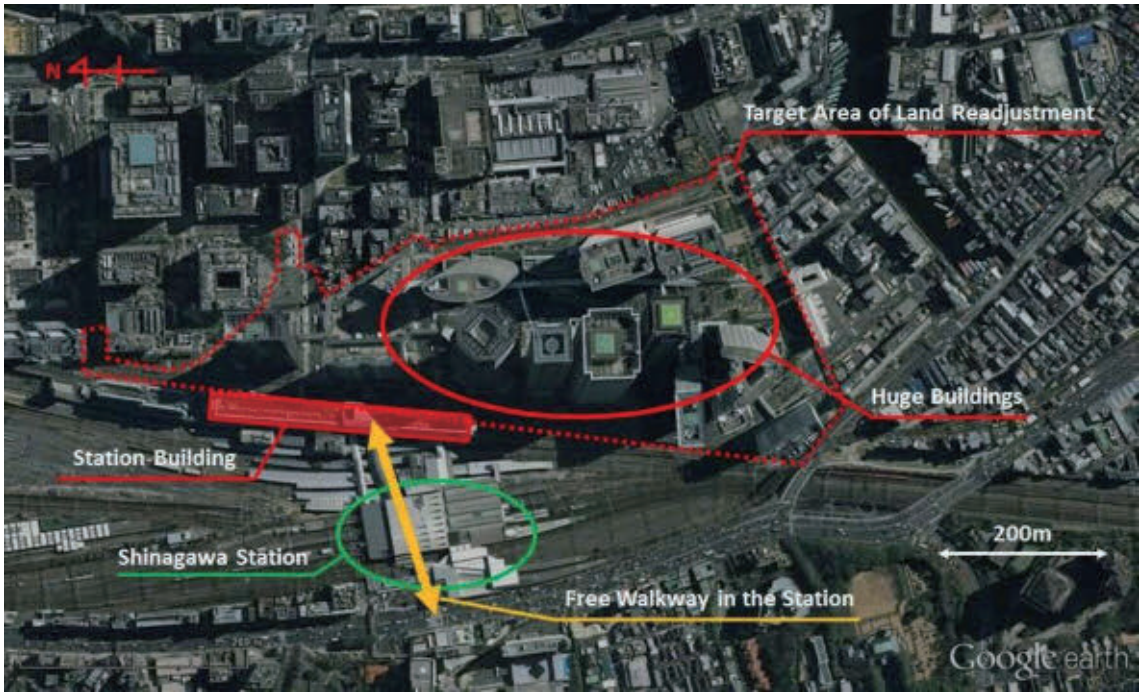
Population of Saku city increased 7% from before the inauguration of Shinkansen (See Figure 10.2-11). It shows high effects considering the decreasing population of Japan.

(3) Case Study - Redevelopment of Shinagawa Station, Tokyo, Japan

This is a case in which railway land and other lands around the area were integrated and readjusted for selling to new development in front of Shinagawa station of Tokaido Shinkansen.

Shinagawa station is located in the central part of Tokyo. There were 330 thousand passengers per day in 2012 at the station.

Shinagawa station area had been developed basically in the west side of the station and the east side was a depot of railway owned by JNR. Then the plan to develop the east side by land readjustment act, etc. appeared. Around the same time, the plan to build a new station of Tokaido Shinkansen at Shinagawa station appeared.



Source: Compiled by Study Team Based on Google Earth

Figure 10.2-12 Shinagawa Station Area

The land readjustment is to generate enough land for huge buildings and public space such as wide road and park by assembling the railway land and other lands around the area, integrating them and changing the shape of the parcels to appropriate shape for intended purposes. (See Table 10.2-4) After the readjustment project, JNRSC (Japanese National Railways Settlement Corporation) sold the land to the private companies. Then the companies built new buildings.

Table 10.2-4 Land Use Before and After Land Readjustment

Before	After
13.7ha (including 9.9ha of Railway Land)	1.4km of Road (width: 25m)
	14,000 m^2 of Station Square
	Park
	Underground Parking
	Land for New Shinkansen Station
	Station Building, etc.

Source: Study Team

At the same time of east area redevelopment, requirement of free walkway to connect the west and east side of the station appeared from the private companies who would own the buildings

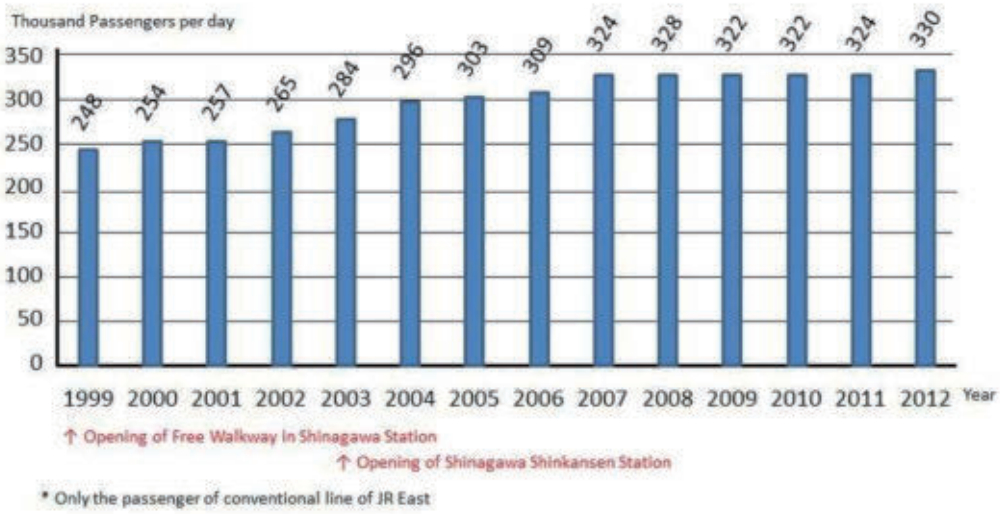
at the east area of station to encourage the traffic between both sides of the station. Construction cost of the free walkway was defrayed by the private companies who would receive the benefit by the walkway.

Source: Study Team

Figure 10.2-13 Free Walkway of Shinagawa Station

Effect of the Development

The east area of the station has been developed as a business area and many high-rise office buildings are there. The area around Shinagawa station became more convenient area by the development of east area and free walkway. As a result, the passengers who use Shinagawa station increases gradually from 1999 when free walkway started to be used.



Source: Tokyo Metropolitan Government

Figure 10.2-14 Increase of Passengers at Shinagawa Station

(4) Smart City Concept

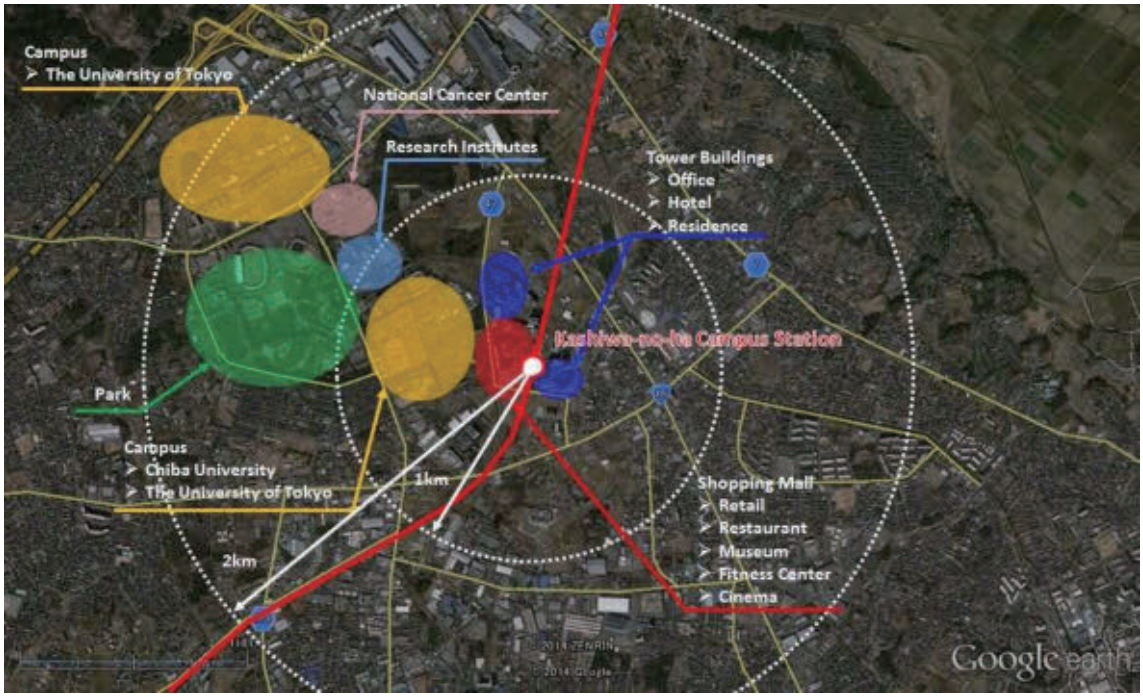
Smart city is a project concept aiming to low carbon society with efficient energy use by the combination of IT technologies and environmental technologies, etc. in the city. HSR, intracity transport network based on HSR station which are very energy saving transport mode and comprehensive transport control can reduce carbon footprint and contribute to the environment of the cities.

1) Case Study – Smart City at Kashiwanoha Station (Tsukuba Express), Japan

Kashiwa-no-ha Smart City is an good case of smart city development mainly conducted by a private developer (Mitsui Fudosan) and associated with other companies at Kashiwa city in Chiba prefecture. Kashiwa-no-ha Smart City is located at 30km from the central part of Tokyo.

Universities, commercial facilities, residential facilities and recreation facilities, etc. are being developed from 2000 around the Kashiwa-no-ha Campus station which is a station on Tsukuba Express Line (TX). These facilities are located within a 2km radius from the station. (Figure 10.2-15) TX is an intercity train and connects the central part of Tokyo and Tsukuba city.

The themes of the smart city are environmentally friendly, health and longevity and new industry creation. To approach these themes, development of energy efficient building, regionally efficient energy control, urban greening, local community formation, resource circulating system, next generation transport system are being conducted.



Source: Study Team

Figure 10.2-15 Land Use around Kashiwa-no-ha Campus Station

This is the project by the cooperation with public, private and academia. Though it is on the process of developing, university, research institute, park, office, hotel, residence and shopping mall were assembled in close proximity to each other successfully and it is established as a very convenient area.

2) Case Study - Gujarat International Finance Tech-City (GIFT), Gujarat, India

GIFT is being implemented by the Gujarat International Finance Tech-city Company Limited (GIFTCL) which has been specifically set up for this purpose. GIFTCL is a Public Limited Company with IL&FS and GUDC both holding 50% each of the share capital of the Company.

The development of infrastructure within GIFT is the responsibility of GIFTCL, which acts as the master developer. The project is located on the banks of Sabarmati River and is around 12 km from Ahmedabad International Airport. The entire GIFT area has been declared by the Gujarat government as notified under section 264A of the Gujarat Municipalities Act, 1963. Following this, the GIFT Urban Development Authority has been constituted as the area development authority for GIFT area as per the Gujarat Town Planning and Urban Area Development Act, 1976. Development mix the different product mix offered is enumerated in the chart below:

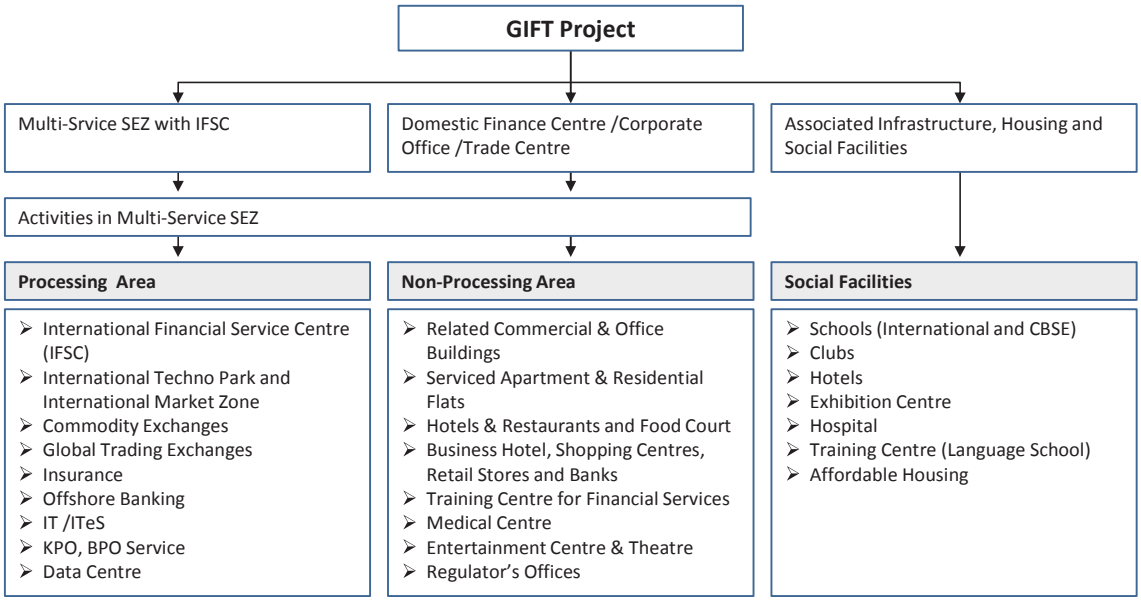
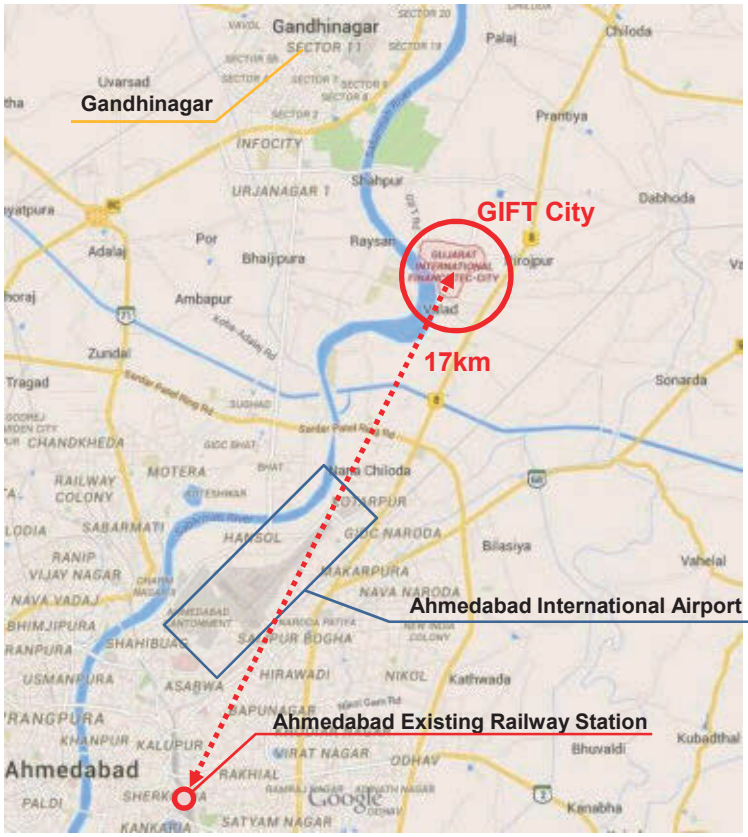


Figure 10.2-16 Organization Structure of GIFT Project



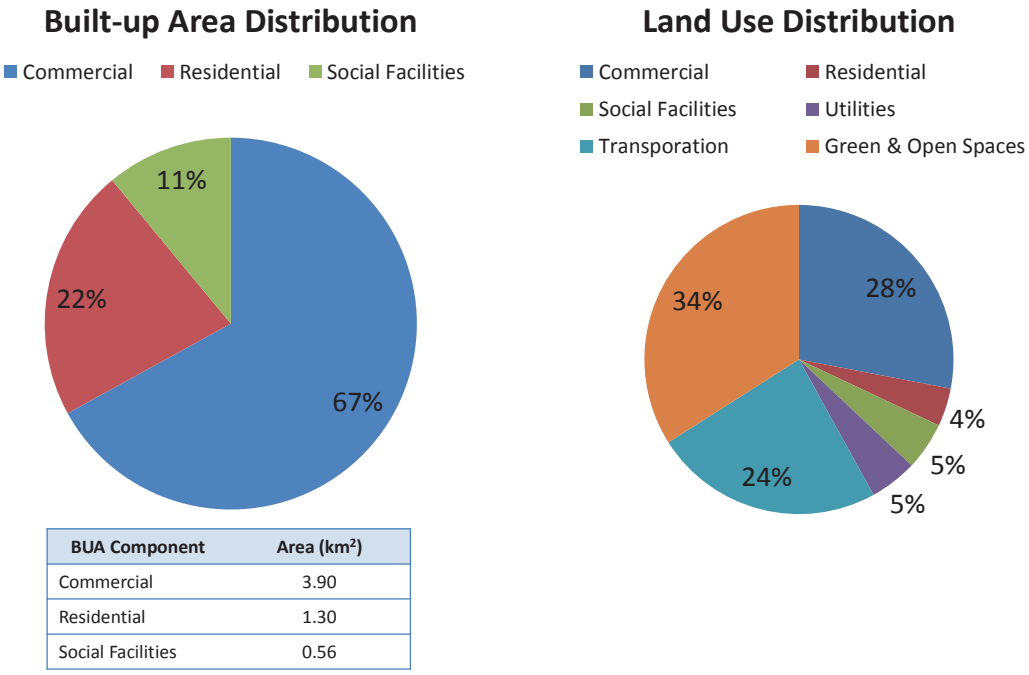
Source: Gujarat International Finance Tech-City Co., Ltd.

Figure 10.2-17 Location and Land Use of GIFT City

- Land Use

The development of the Commercial Business Development can be classified into 3 types:

- Commercial: Includes Retail, Restaurants, Hotels, Offices and other associated facilities
- Social facilities: Includes Convention Hall, Exhibition spaces, Schools, Medical, Entertainment and cultural facilities
- Residential: includes apartment and residential buildings



BUA Component	Area (km²)
Commercial	3.90
Residential	1.30
Social Facilities	0.56

Source: Gujarat International Tech-City Co., Ltd.

Figure 10.2-18 Land Use Distribution of GIFT City

- Commercial Project Structuring

Project is implemented under the following structure, where in core infrastructure is being undertaken by the GIFTCL on EPC contract basis, utilities through PPP model and real estate development through third parties on upfront revenue model basis.

GIFTCL gives development rights to other developers (Sangath, Hiranandani, Ganesh Housing, etc) for built-up area. These Development Rights are in the form of 99 year lease and GIFTCL gets a onetime premium as revenue.

- Key Insights:

GIFT being a 50:50 joint venture between IL&FS & GUDC, IL&FS cannot arm twist GIFT to increase its returns while the Government cannot force GIFT to subsidize the services charges.

Land Use (Public, Business, Commercial, Hotel, Leisure, Residence, Culture, etc.)

- Land use is one of the most important factors when considering the station area development.
- Land use of the area is to be determined based the concept of the station are and position in the urban plan, etc.

A variety of land use are to be gathered in the place so that many types of purpose are achieved in the area.

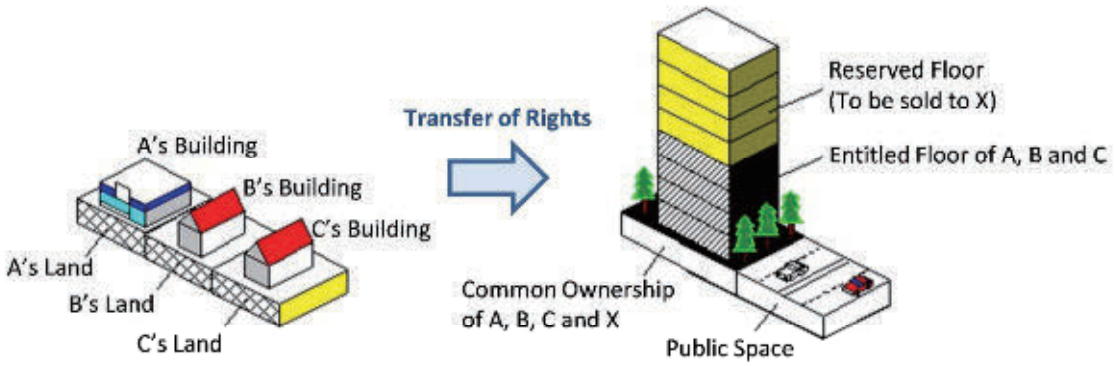
(5) Major Development Scheme

1) Urban Area Redevelopment Project

To improve congested central part of the city with low-rise buildings and generate space for public such as parks streets and squares, the urban area redevelopment project is used to integrate small parcels of land into larger units and rebuild high-rise communal buildings.

Main features are:

- As the redeveloped building has more floors than the previous one, total floor space will be larger than that of previous one.
- The rights of previous landowners will be replaced by the floor space of the redeveloped building so that they will generally have the same value as the previous building (right floor).
- The remaining floor space of the redeveloped building (reserved floor) will be sold to third parties (X) and the profits from sale will be appropriated to redevelopment project expense.
- As the land of the newly built building will be narrower than the previous one, the rest space will be used for public space (Park, road and street).



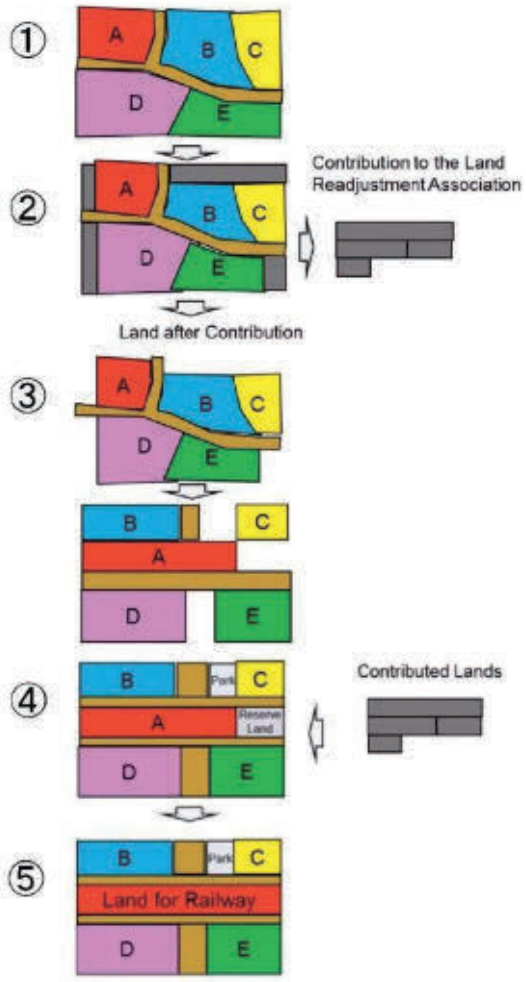
Source: MLIT

Figure 10.2-19 Image of Urban Area Redevelopment Project

2) Land Readjustment Project

Land Readjustment Project is known as a method to increase the value of the land by arranging the shape of the land and create new space for public space for the better living life. Which method has been widely applied in Japan.

Multiple landowners arrange the land lot by exchanges and generate the land for urban facilities and project expenses by reduction of land space of private owners. If a railway operator participates in the land readjustment project by acquiring the land, the enterprise may acquire the railway land by exchange of land and purchase of reserved land.



Application Flow of Land Readjustment Project:

① A railway operator purchases the irregular land lot A, and becomes one of the landowners.

② Each landowner contributes part of their land to the land readjustment association (space reduction)

③ Each landowner exchanges the remaining land to make the land lot in regular shape. (land exchange)

④ Reduced land shall be appropriated to the land for urban facilities, including roads and parks, etc. and reserved land.

⑤ A railway operator purchases the reserved land and collects the exchanged land into one place to appropriate to railway land.

Features:

- Although the land space decreases from before, as the lot becomes rectangular shape and improvement of roads, etc., which increases the asset value per space and the asset value of the entire land will increase.
- Subsidies from the national and local governments may be given.

Source: Study Team

Figure 10.2-20 Flow of Land Readjustment Project

10.3 Value Capture Models

The methods to capture the value from station area and other land development are discussed. Here specific methods to capture the land value are discussed with high level assessment on the proposed stations along the corridor based on high level market research and also obtaining some insights from the prior examples in India has been done for station area development and above station development.

10.3.1 Existing Market Status and Regulations, etc.

(1) Overview of Real Estate Market in Major Cities

1) Mumbai Cities and MMR (Mumbai Metropolitan Region)

The MMR is an urban agglomeration consisting of the city of Mumbai and its satellite towns.

- Office Market

Office market in Mumbai has largely remained concentrated in the Island City, however, Bandra-Kurla Complex (BKC) and suburban region of Andheri-Kurla has seen enormous growth in the last decade.

Mumbai market has seen decline in net absorption y-o-y in 2013 but have shown improving market signs in 2014. Market has seen increasing transaction activity and is expected to grow in near future. Improved economic sentiments and stable government has helped revive market and also given the healthy supply, the prices are expected to remain stable.

However, trends in net absorption for various micro-market show improving trends in Lower Parel, BKC and Andheri-Kurla area, however, show declining trend in other parts of the city.

Table 10.3-1 Office Market in Mumbai

	2012	2013	2014	12 month forecast
Overall Vacancy	19.8%	19.4%	18.9%	↑
Net Asking CBD Rents (INR/m^2/month)	2962.9	2967.2	2689.6	→
Year to Date Net Absorption (m^2) Grade - A*	61,005,389	48,551,573	44,578,506	→

2) Surat

Surat is the second largest city of the Indian state of Gujarat with a population of around 4.8 million. It is also the administrative headquarters of the Surat district.

- Office Market

Commercial office demand mainly comprises of textile office space, corporate offices, banks and the financial sector, etc. Area along the Ring Road is emerging as the new attractive location for the office demand.

Adajan is one of the prime office locations in the CBD of Surat city.

Sale price range Rs 79,624 to 103,296 per m^2

Average rental rate range Rs 408.9 to 516.5 per m^2 per month

Ring Road, one of the emerging office destinations in the CBD of Surat city, is commanding lease rentals in the range of

Average rental rate range Rs 419.6 to 505.7 per m^2 per month

- Retail Market

Retail real estate market is seeing a growth with the growing population, improving standard of living and young working professionals. The city is seeing or has seen coming up of new multiplexes, malls and retail shops in the past few years.

Adajan is one of the prime commercial retail destinations in the CBD of Surat city with an average rental rate in the range of Rs 516.5 to 731.7 per m^2 per month during Q4 2014.

- Residential Market

Residential market is one of the most preferred real estate segments in Surat owing to industrial and economic activities. Surat is continuously growing in size in both population and geographic area (which grew over 2-3 times since 2005).

Typically, quality apartments in a good locality in Surat (especially in the central and eastern part of Surat) are commanding a sale price in the range of Rs 53,800 to 64,560 per m^2.

Table 10.3-2 Expected Market Parameters in Surat

Product	Absorption*1	Lease Rental (Rs/m2/month)	Sale Rate (Rs/m^2)
Office	1613760 - 2151680	376.544 - 537.92	53792 - 96825.6
Retail	1075840 - 1398592	537.92 - 968.256	-
Residential	1613760 - 2151680	-	43033.6 - 59171.2

*1: In the absence of secondary market information with respect to absorption, the same for Surat has been assumed quivalent to that for Ahmedabad

3) Vadodara

Vadodara is the third largest city of the Indian state of Gujarat with a population of around 1.8 million. It is also the administrative headquarters of the Vadodara district.

- Office Market

After witnessing the decline in office market transaction in 2013, the city has seen increase in transaction activity as well as supply which are expected to remain high exerting downward pressure on prices as well as increase in vacancy levels. The city will soon be a home to India's biggest IT parks and would be counted among the cosmopolitan cities.

For Sale: Prime market place for office space Makar pura, Old Padra road is witnessing Rs 32,280 – 75,320 per m^2.

For Rent: Prime market place for office space Makar pura, Old Padra road is witnessing Rs 408.8 – 538.0 per m^2. Whereas office place for rent at Akota area costs around Rs 258.2 – 322.8 per m^2.

Vadodara is also growing as one of the IT destinations, for instance,

IT Park: L&T has proposed a Rs 60 bil technology park in Bapod-Ankhol. Envisaging carving the same niche is Parkway Realty which is all set to build IT park in Dena and Nimeta.

Bio IT Park: The famous Mumbai based real estate developer Akruti Nirman has signed a MoU to develop a Bio IT park on 2.87 km^2 of land in Savli, Vadodara. The company is holding high talks with different companies to set up the facilities at the Park.

- Retail Market

Retail market has missed out the growth trend earlier but now it is catching up with the growing real estate market. Increasing residential demand and population growth are driving the demand for retail segment. The Kalani Group is planning set up an exclusive mall cum multiplex on a large area of 32,527.9 m^2 in Vadodara as part of its retail development plans.

Some of the major shopping malls in the city include Vadodara Central Mall /Centre Square Mall /Landmark /Cine Mall /Sevenseas Mega Mall /M Cube /Spencers Retail /Narubhai Leisure World, etc.

Hotel and Hospitality: Hotel and hospitality is also growing by leaps and bound in the city, largely driven by the growing industrialization as well as tourism important of the city. The sector will see further growth owing to continued

- Residential Market

Rapid urbanization in and around Vadodara is driving the residential market demand, primarily in the low-mid segment. Typically, quality apartments in a prime locality in Vadodara (especially Alkapuri area) are commanding a sale price in the range of Rs 43,040 to 59,180 per m^2.

Table 10.3-3 Expected Market Parameters in Vadodara

Product	Absorption*2	Lease Rental (Rs/m2/month)	Sale Rate (Rs/m^2)
Office	1613760 - 2151680	268.96 - 537.92	43033.6 - 64550.4
Retail	1075840 - 1398592	430.336 - 753.088	-
Residential	1613760 - 2151680	-	32275.2 - 53792

*2: In the absence of secondary market information with respect to absorption, the same for Vadodara has been assumed quivalent to that for Ahmedabad

4) Ahmedabad

Ahmedabad is the largest city with a population of over 6 million and the former capital of the western Indian state of Gujarat.

- Office Market

After witnessing the decline in office market transaction in 2013, the city has seen increase in transaction activity as well as supply which are expected to remain high exerting downward pressure on prices as well as increase in vacancy levels.

- Retail Market

The commercial malls in the city have seen limited transaction activity in the recent quarters, mainly due to limited availability of quality space at key locations and no new supply is expected in the near future. S.G. Highway has emerged as the new retail and commercial hub in the city after C.G. Road. Vacancy levels remain high at around 30% and hence prices are expected to remain stable in the near future.

- Residential Market

Most of the residential demand in the city is in the affordable housing segment. The city is also seeing the increasing trend in "Integrated Township Development" such as:

Godrej Garden City: Godrej properties has launched a township project spread over 1.01 km^2 of land, located in the heart of the city, Off S.G. Highway.

Shantigram: Adani group has taken up an integrated township development spread over 2.43 km^2. It is located near S.G. Highway and in close proximity to airport. It is proposed to be a mixed use development.

Applewood: Sandesh group has launched an integrated township spread over 0.52 km^2 near S.P. Road, It will comprise of 400 bungalows, 1 mn sq ft of commercial space and 3500 units of apartment of varying sizes.

Other projects: Smile City (Ganesh group, 2.16 km^2 Golf Township near S.P. Ring Road), Savvy Infrastructure (3,000 – 3,500 residential apartments), etc.

- Sale Price Trends in key residential areas of the city

Satellite Area: Prices have remained in the range of Rs 53,800 to 64,560 per m^2 over the past 3 years

Prahladnagar: Prices have remained in the range of Rs 48,420 to 69,940 per m^2 over the past 3 years

Ambawadi: Prices have remained in the range of Rs 53,800 to 91,460 per m^2 over the past 3 years, however has seen spike up to Rs 107,600 per m^2 in upper range in the recent quarters

Table 10.3-4 Expected Market Parameters in Ahmedabad

Product	Absorption	Lease Rental (Rs/m2/month)	Sale Rate (Rs/m^2)
Office	1350000 - 1800000	270 - 342	45000 - 63000
Retail	900000 - 1170000	675 - 900	-
Residential	-	-	45000 - 63000

(2) Overview of the Regulatory and Legal Framework

The real estate development or land area development is a State subject under the Constitution of India. Accordingly, state governments have enacted respective laws governing development, one of the key Acts being related to town planning and urban development. For instance,

Gujarat State – Gujarat Town Planning and Urban Development Act (GTPUDA), 1976

Maharashtra State – Maharashtra Regional and Town Planning Act (MR&TP), 1966

The implementation of the Act lies with the Urban Development Department (UDD) of the respective states. The administrative structure in both the states can be summarized as follows:

Table 10.3-5 Regulatory and Legal Framework of Maharashtra State

Act	Salient Features
Maharashtra Regional Town Planning Act (MR&TP), 1966	● MRTP Act, 1966 promotes and regulates developments in the urban area and well as areas having potential of being urbanized. It is a comprehensive planning act with development functions. ● This Act comes under one of the five basic models of town and regional planning in India and was adopted subsequently by other states like Gujarat, Himachal Pradesh, Tamil Nadu, Madhya Pradesh etc. ● Objectives of Enactment of MRTP Act, 1966 The main objectives as mentioned in the preamble of the Maharashtra Regional and Town Planning Act, 1966, is: *To make provision for planning the development and use of land in "regions" established for that purpose and for the constitution of Regional Planning Boards.* ● The Salient features of this act include the provisions for - Regional Planning, - Development plan, - Town planning Schemes and - Implementation schemes such as Land Acquisition, Transfer of Development Rights and Plot Reconstitution Techniques. ● The Finance Aspect (Finance account and Audit) and the Governance for Plan Enforcement (Planning Authority) are available under this Act.
Maharashtra Housing (Regulation and Development) Act, 2012	● In addition to regulating and promoting the construction, sale, management and transfer of flats in Maharashtra, the proposed Act seeks to establish Housing Regulatory Authority ("HRA") and Housing Appellate Tribunal ("HAT"). ● The Bill, when enacted, is expected to ensure transparency and discipline in the transactions of flats and to keep a check on malpractices. ● Salient features of the bill: - Establishment of the Housing Regulatory Authority and the Housing Appellate Tribunal - **Registration Process:** The Bill requires every developer to register his project with the HRA. Also, the HRA shall have to register such project within a period of 7 days from the receipt of an application from the promoter. - Extensive Responsibilities and or Restrictions on the Promoter - **Penalties:** The proposed Bill also contains penalties for persons who fail to comply with the directions of the HRA or the HAT. The aforementioned penalties range from Rs 50,000 to Rs 10,000,000.

Table 10.3-6 Regulatory and Legal Framework of Gujarat State

Act	Salient Features
Gujarat Town Planning and Urban Development Act (GTPUDA), 1976	● The GTPUDA mandates the delineation of a ―Development Area‖ around a city or a town for planning purposes. ● It encompasses a much larger area around the city or town that is likely to see development. This ensures and allows for better planning and for guiding the development in the area. ● The GTPUDA also mandates the creation of a special planning authority — the Urban/Area Development Authority (UDA/ADA)—which is charged with the task of undertaking planning within the delineated Development Area. ● Urban planning in Gujarat is a two-step process and is prescribed in the GTPUDA and its Rules. - The first step – Preparation of a ―Development Plan‖ (DP) for the entire city or development area. - The second step - Preparation of ―Town Planning Schemes‖ (TPSs) for smaller portions of the development area for which the Development Plan is prepared.
The Urban Land (Ceiling and Regulation) Act, 1976	● The objective of the Urban Land (Ceiling & Regulation Act), 1976, (hereafter ULCRA) was to facilitate the availability and affordability of urban land by increasing its supply in the market and by establishing an efficient land market. ● The ULCRA provided for imposition of a ceiling on both ownership and possession of vacant land; acquisition of excess vacant land by the state government with powers to dispose of the land for the common good; payment of compensation for the acquisition of the excess land; and granting exceptions in respect of certain specific categories of vacant land. ● **Repeal of the ULCRA** has been included as one of the mandatory reforms suggested in Jawaharlal Nehru National Urban Renewal Mission (JNNURM). States have to commit to repealing it within a committed time frame. It is envisaged that the repeal of the Act would go a long way in reviving the stagnant housing industry and facilitate construction of dwelling units both in the public and private sector. ● **The Act has been repealed in both the states of Gujarat and Maharashtra**

- Town Planning Scheme in Gujarat, India

In a TPS (Town Planning Scheme), the government authority pools land possessed under different ownerships. After deducting the land for open spaces, social infrastructure, housing for EWS (Economically Weak Section) /LIG (Low Income Group), Services, road network etc., it redistributes the land in a properly reconstituted form.

In Gujarat the TPS has two stages as follows:

- Macro Planning – Preparing development plan for overall city area
- Micro Planning – Preparing development plan of a particular area/region of 1 -2 km^2

The development authority takes up development of smaller areas of TPS. It creates the trunk infrastructure, support infrastructure, road network, green spaces etc. in these areas. It develops the remaining land into plots and returns back the same to the original land owners. It generally keeps around 10% of the developed land in form of plots with itself for recovering the cost of overall development

The land owners also agree to this model as the value of the developed land plot is generally much higher than the value of undeveloped land owned by them.

Urbanization through TPS has been taking place in Gujarat, Maharashtra, Kerala, Andhra Pradesh & Tamil Nadu.

- Development Control Regulations (DCR)

Table 10.3-7 Summary of DCR Regulations for the Four Major Cities

	Mumbai (MCGM)	Surat	Vadodara	Ahmedabad
FSI (Floor Space Index)				
Residential Use	1.0 + 0.33 (at Premium) + 0.67 (TDRs)	1.8	1.2 – 1.6 (Up to 2.5 based on road width)	1.2 – 1.8
Commercial Use	1.0 + 0.33 (at Premium) + 0.67 (TDRs)	1.8	1.6 (Up to 2.5 based on road width)	1.8
Min & Max FSI	1.0 – 4.0 (BKC)	1.0 – 2.0	1.0 – 2.0	1.0 – 2.0
Parking	Mandatory parking space (free of FSI)	Mandatory parking space (As % of max permissible FSI)		
Height Limit	Related to access road width & distance from aerodrome	40m	40m	40m

10.3.2 Around Station Development

There are 12 proposed stations on the Mumbai Ahmedabad high Speed Rail corridor. Of these 12 stations, some of the stations pass through the city or existing CBDs while some are located away from the city centers.

A broad framework was used to identify potential sites suitable for medium to large scale around station development as integrated townships. The two of the three key aspects for the same is availability of the large tract of vacant land as well as location with respect to existing CBD. During study team's interaction with municipal corporations, it was highlighted that any large development within the city or CBD area will be a herculean task and hence it was recommended that lesser dense or away from CBD areas will be preferable for such development, which will also help the city to expand.

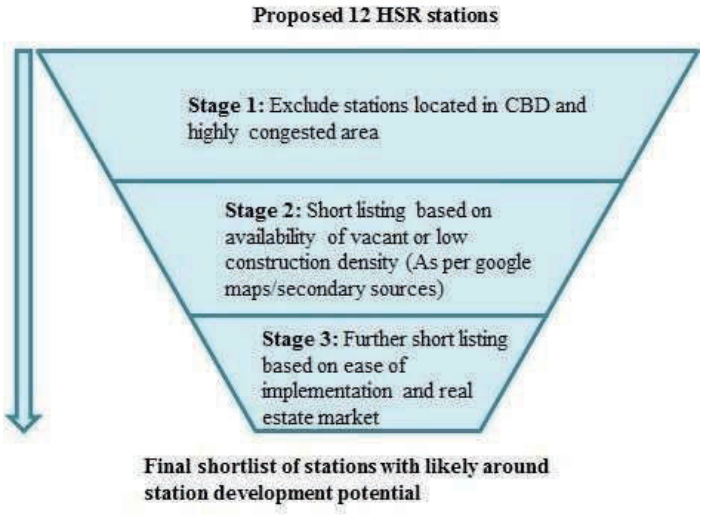


Figure 10.3-1 Framework to Identify the Potential Stations

Using these framework and insights from interactions with municipal bodies, the 12 proposed HSR station locations were mapped based on preliminary available information (and using Google Earth images). It shows that

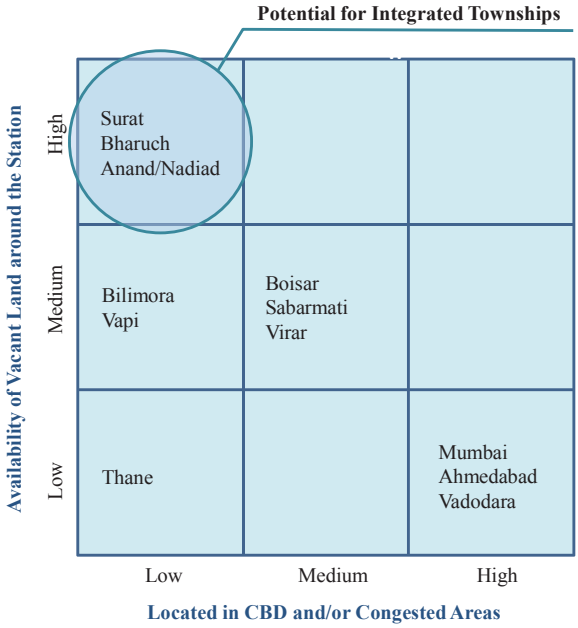


Figure 10.3-2 Identification of Potential Stations for Integrated Township

- Large Greenfield area may be available around proposed HSR stations at Surat, Bharuch and Anand/Nadiad.
- Vapi & Bilimora offers medium scale around station development opportunity.
- However, all the land is expected to be privately &/or government owned as these sites are away from existing Indian Railway Network.
- Key aspects which will affect the value capture from around station development
  - Land ownership & acquisition
  - Development model
  - Share in indirect value capture by way of taxes & cess
  - Real estate market (Demand – Supply)

(1) Guiding Principal & Boundary Conditions

The high level assessment was carried out for the around station development potential at Surat and results of the same has been extrapolated for the four additional such development.

It was assumed that each of such HSR Townships will have approx. 93 hectares. of development.

Estimation takes into account the best implementation model guided by the past experiences and interaction with leading developers, i.e. State-initiated development on partnership model

It is recommended that the primary market survey with clearly identified land parcel details for the accurate estimation of the potential is undertaken for around station business development.

(2) Development Model

The three major development models are envisaged for the proposed HSR Townships or Around Station Business Development as follows:

1) Model-1: Area Development Authority led business model

Model-1a: HSRC as a development authority for the notified area around stations

Model-1b: State Government (or state agency) as a development authority for the notified area around stations

2) Model-2: Monetization of railway's surplus land assets located at prime locations

3) Model-3: Transferrable Development Rights

Each of the above models if implemented can contribute to the project capex financing as well as enhancing non-fare box revenues.

(3) Model-1: Area Development Authority led business Model

This is the typical model used across the world, wherein a transit agency or other government agency undertakes the township development. In India, very few success stories (for instance, DMRC) can be found in case of transit agency (completely owned by the central government) acting as a development authority. This is primarily due to lack of state government involvement as a critical stakeholder.

Given the complexity of real estate development, state authorities may be better positioned to act as development authorities.

Table 10.3-8 Comparison of the Cases

	Model-1a (HSRC as authority)	**Model-1b (State Government Agency as authority)**
Land Acquisition aspects	● Land for HSR (around station development) would be under purview of Central Government (MOR Land), two state governments or private land. ● In any case notification and acquisition of land would need to be done by state agencies and then mechanism of transfer of land to HSRC would need to be developed.	● Land and real estate is a state subject. ● State has powers to notify/de-notify land title, land use, etc. or use land pooling effectively. ● State/Government agency handling land acquisition aspects would comparatively smoothen the procedural processes.
Legal & Regulatory aspects	● For land use changes, FSI, etc. and related aspects HSRC will need to coordinate with state & city governments.	● State agency undertaking real estate/town development falls directly under UDD‘s purview and coordination is very effective.
Operational aspects	● Integration of proposed developments functions utilities, connectivity with state/city supply involves coordination with various state/city level agencies.	● State agency undertaking real estate/town development falls directly under UDD‘s purview and coordination is very effective.
Overall impact for HSRC	● If land is not allotted at free, it will add to overall project cost. ● Also, additional capex will be required to undertake real estate development. ● High level of coordination for approvals & clearances needed between state, city & central governments.	● Easier to implement, as all approvals & clearances typically lie with UDD or UDD appointed authority. ● However, revenue sharing mechanism between the state govt. & HSRC would need to be decided.

Precedents also show that RLDA (Rail Land Development Authority) has not been able to successfully monetize surplus railway land parcels entrusted to it (for instance, Bandra East land) unlike MMRDA and CIDC (City and Industrial Development Corporation of Maharashtra Limited) in Maharashtra. DMRC, which is successful in capturing real estate value as transit agency in India, state government is an equal stakeholder.

1) Commercial Structure between the Authority and the Developer

Three broad commercial structures can be explored considering the implementation of the project as described in the following table.

Table 10.3-9 Comparison of Structure

For Authority	Self-Development	Joint Development (Partnership Model)	Third party development
Preferred revenue model	Project cash flows	Revenue share	Upfront lease payment
Pros	● Can expect high return - increased cash flows. ● Opportunity to capture land value appreciation.	● Shares market risk with the developer. ● Access to private sector flexibility, skills & resources (financial & human). ● Limited or no capex commitment from Agency. ● High returns but lower than self-development option.	● No capex/investments. ● Complete market risk with the developer. ● Access to private sector flexibility, skills & resources (financial & human). ● Upfront &/or certain annuity cash flow stream.
Cons	● Agency incurs high capex. ● Entire market risk lies with the agency.	● Most developers prefers revenue share model, which necessitates the need to monitor / keep a check on the commercial aspect of operations.	● Low return/value realization. ● Lesser interest among market players for large area on upfront model.
Illustration	● E.g. CIDCO – Vashi & Belapur above & around station development.	● E.g. GIFT City – 50:50 JV between GUDC (Gujarat Urban Development Corporation) and IL&FS.	● E.g. RLDA model, CIDCO - L&T Seawoods, DMRC.

Real estate experts and developers during interaction revealed that

- It is much better if state leads the development initiative, mainly due to
  - ✧ Real estate/township is a state subject
  - ✧ There is an established trust factor between state/local government and private sector
  - ✧ And capability of railways in such a specialized sector given their past experience
- Also, the private sector is wary of large scale development on upfront payment structure, as it can be seen very few deals are taking place between government and private sectors on upfront payment basis.
  - ✧ Joint development structure is the preferred model on revenue share basis with empowered decision making body/panel to fast track any decisions.
  - ✧ Ensure state/local government commitment and interest in the project for a longer tenor.
  - ✧ Easier decision making and implementation of the business plan.

Hence, the around station business development has been assumed as

- ✧ State-led area development authority (with financing arrangement between the authority and HSRC).
- ✧ Joint development model with revenue share structure.

The following section evaluates the potential from such development for the case of HSR Township at Surat.

2) Case Example: Surat HSR City, Gujarat, India

The following schematic shows the delivery and commercial structure between four entities:

- State Government
- State Agency (GUDC)
- HSR Project Development Authority (HSR PDA)
- Private Developer

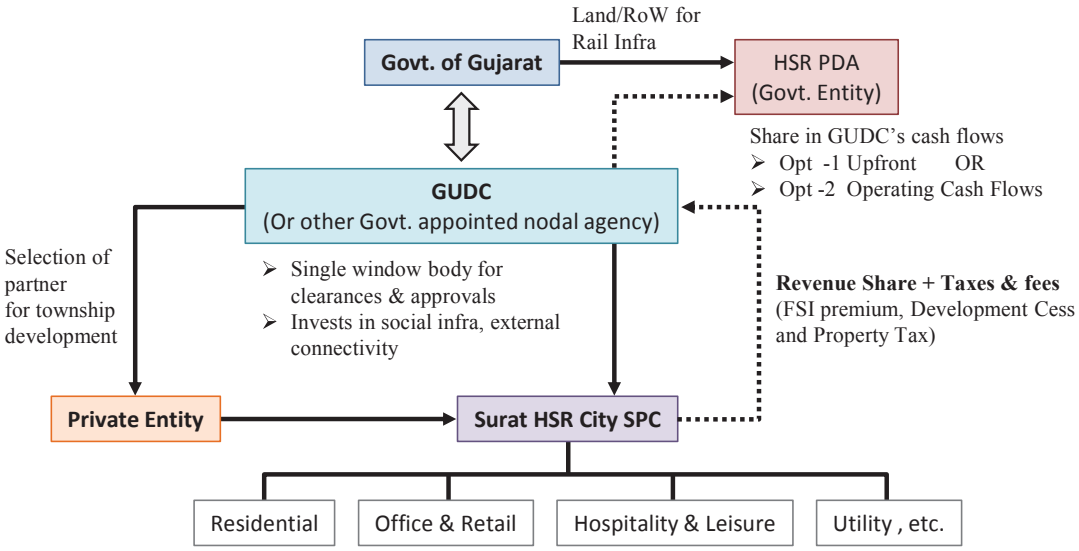


Figure 10.3-3 Development Scheme of the Case in Surat

The financial arrangement between the state government agency, Gujarat Urban Development Corporation (GUDC), and HSR PDA (or HSRC) can be either (a) upfront payment as share in capex or (b) operating cash flows to HSRC.

- Key Assumption

Table 10.3-10 Key Assumptions

Site Specific	
Plot Area	0.47 km^2
Land Value	Rs 41.0 bn
FSI	2.0
Built-up Area (BUA)	0.93 km^2
FSI Premium	Rs 3,228 per m^2
Development Surcharge	2.5% of construction cost
Property Tax Rate	1% (of the market value)

Timelines, Construction & Opex	
Land notification & acquisition, partner selection, construction of JV	By FY 2017
Construction starts	FY 2018
Construction Cost	Rs 12,912/m^2
Cost Escalation	6%
Opex	10% of Revenue

Project Financing & Returns	
Debt : Equity	1:1
Interest Rate	13.5%
Min DSCR	1.5
Equity Returns to the Developer	Min 22.5%
Financial Return to the State Agency	Min 12%
Sharing of Taxes with HSRC	50%

Product Mix & Revenue Assumption			
Product Mix	Proportion	Prices (Rs/m^2) (Rs/m^2/month)	Escalation Rate
Residential (Sale)	25%	5,000	10% p.a.
Office (Sale)	15%	6,000	
Office (Lease)	15%	40	15% every 3 years
Retail (Lease)	20%	100	
Public/Social	25%	-	-

Concession Period for the commercial development was assumed as 45 years in line with the existing model of RLDA.

Table 10.3-11 Assumed Cases of Absorption

Absorption	**Case -1**	**Case -2**
Residential	150,000	200,000
Office	150,000	200,000
Retail	150,000	150,000

- Potential Estimation (High Level Assessment)

About 1 km^2 of development at Surat can lead to upfront contribution of Rs 4 – 6 bn from state agency to HSRC (assuming 12% as return expectations).

Table 10.3-12 Result of the Estimation

Savings	**Case -1**	**Case -2**
Option -1		
Upfront Payment Range	Rs 4 – 5 bn	Rs 5 – 6 bn
Option -2		
5th year operating cash flows (FY 2028)	Rs 0.8 – 0.9 bn	Rs 1.1 – 1.3 bn
10th year operating cash flows (FY 2033)	Rs 1.1 – 1.3 bn	Rs 1.0 – 1.1 bn

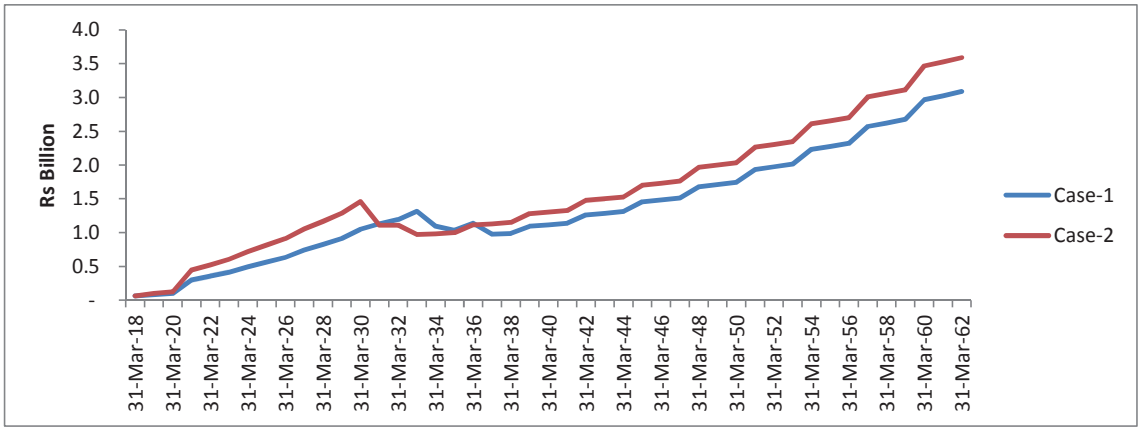


Figure 10.3-4 Estimated Operation Cash Flow for HSRC

(4) Model -2: Standalone Land Parcels for Monetization

Indian Railway is one the largest land owner in India. Not all of these land parcels are in operational use. Some of the land parcels are vacant or surplus which can be monetized to enhance revenues. Rail Land Development Authority (RLDA) has been formed to monetize such land parcels.

Real estate monetization or bundling with project is being practiced in a large scale transport project. For instance,

- DMRC Case
  - 5% of the Delhi Metro phase-1 funding was proposed to be achieved from property development. DMRC was allocated land parcels (stand alone as well as linked to metro stations/corridor) for monetization.
    - Till date, DMRC has leased five large plots (total area – 128,425 m^2) for residential purpose generating an upfront receipts of Rs 5,878 million
    - Also, it has leased area of around 357,982 m^2 for various commercial purposes on upfront and/or annuity model.
- Other Cases
  - Around 1.67 km^2 of real estate has been bundled with Hyderabad Metro.
  - MOR has proposed real estate bundling with the Churchgate Virar Elevated Corridor.
- Similarly it is proposed that
  - MOR entrust some of the prime land plots in cities like Mumbai to HSRC (similar to the case of Delhi Metro).
  - HSRC can then sales/leases these land plots on long lease tenor of 80 to 99 years.

1) Potential Estimation

The assessment was made based on preliminary research for railway land parcels in Mumbai; however, one needs to be cognizant of related issues, such as

- Railway land plots in the city are typically of longitudinal shape with highly skewed length to breadth ratio.
- Connectivity, access to property owing to congestion, encroachment are other key aspects that can cause delays in monetization of the assets.
- Many of the identified land parcels for commercial development are earmarked for some purpose, for instance.
  - Bandra land – for MUTP
  - ~13 lands in western line – bundled with the proposed Churchgate - Virar elevated corridor
- Also, strong coordination will be required with the state & city governments for land use change & FSI approvals.
- Many of the railway lands parcels are classified as “Operational Use”, which needs to be change in order to have commercial development.

Preliminary research shows that around 809,400 m^2 of railway land in MMR can be commercially exploited. However, proper shortlisting of land plots need to be done to bundle some of these plots with HSR project. One such shortlisting criteria are illustrated below:

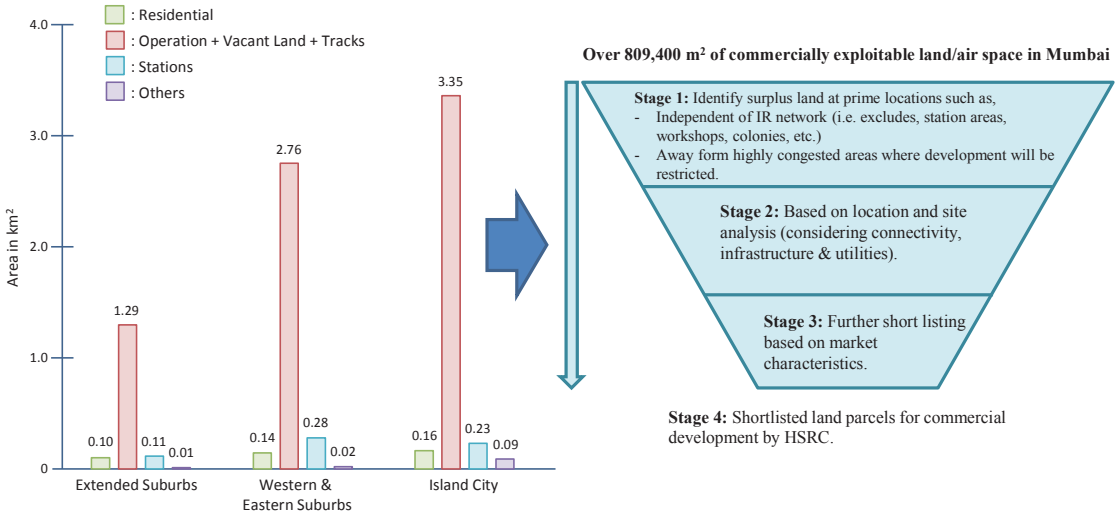


Figure 10.3-5 Existing Inventory of Railway Assets in MMR (Left) and Identification Flow of Exploitable Land

The sites identified offers development potential for mixed use or residential use.

Table 10.3-13 Identified Railway Land Parcels in Mumbai

Sr. No.	Land Parcels	Area (m^2)
1	CSTM station carnac-bunder side area connected by D'mello Road	~ 60,000
2	Wadi Bunder	~ 121,000 – 141,000
3	Byculla(West) on North of station with direct connectivity from existing road	~ 8,000
4	Currey Road depot between Parel & Elphinstone Road stations	~ 80,000
5	Chinchpokli (siding, between Nirmal park & Chichpokli Station)	~ 8,000 – 12,000

2) Case Example – Sabarmati Station, Gujarat, India

Some railway land (largely vacant) may be available neat proposed Sabarmati HSR station area. However, the land title and other operational status need to be ascertained. These land parcels (in and around Sabarmati) are not yet identified for commercial development or entrusted with RLDA for commercial development.

The land parcels at Sabarmati, if any, can be entrusted to HSRC for monetization.

However, the commercial realization from Sabarmati land parcels will be much lesser as compared to that in cities like Mumbai. For instance, land area will cost Rs 450,000 per m^2 in Mumbai which is 20 times higher than that in case of Ahmedabad/Sabarmati, where prevailing rates are Rs 22,334 per m^2.

Hence, at high level estimation, about 220,000 m^2 of land (the area is shown in the next page) in Sabarmati may be able to generate around Rs 2 billion as upfront premium only.

Source: Study Team

Figure 10.3-6 Proposed Development Area of Sabarmati Station

(5) Model -3: Transferrable Development Rights (TDRs)

TDR is one of the instruments to capture real estate potential. It can be used to generate revenues from non-viable land/station area development by selling of TDRs in the market. However, support of local and state government will be required to enable market for TDRs to function in favor of transit agencies like HSRC.

1) Key Required Enablers for TDRs

- City to freeze its FSI limits & create market for TDR
  - For instance, as in Mumbai
    - ✧ FSI of 2.0 can be split as 1.33 FSI + 0.67 TDR
    - ✧ Thus creating a demand side for TDR market
- City should amend DCR laws to enable
  - Market demand for TDR
  - Supply side for TDR by way of granting TDRs to HSRC
  - Incentives to use TDRs from HSRC (such as lower premium on use of TDRs procured from HSRC)
  - Flexibility on supply side

2) Commercial Model

- Premium FSI seeker to approach HSRC to purchase TDRs
- Sale at market rates
- Net proceeds of sale after meeting any agreed share towards cost of civic amenities shared with ULB/SPA

3) Case Example – Pimpri – Chinchwad Municipal Corporation (PCMC), Maharashtra, India

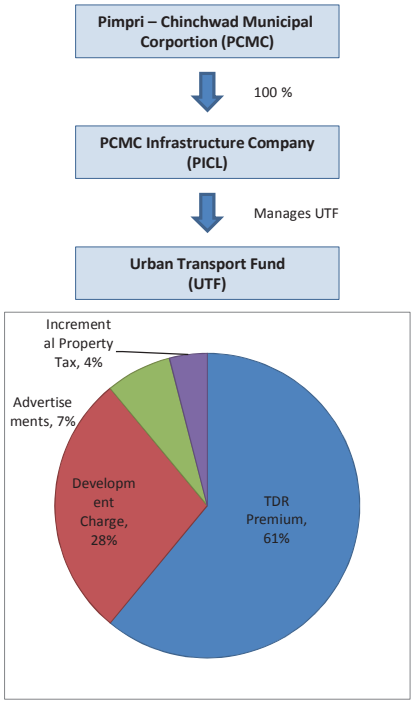


Figure 10.3-7 Organization Structure and Funding Share of PCMC

- PCMC is developing 130km of Bus Rapid Transit Corridors.
- Created an Urban Transport Fund (UTF) to fund the project.
- Designated 100m on either side of BRT corridor asn BRT influence zone.

<u>TDR as a major source of revenue for UTF</u>

- Increased ceiling FSI from 1 to 1.80 in the BRT influence zone, with incremental 0.80 FSI loading TDR with payment of a premium.
- Estimated Potential
  - Demand for TDR – ~ 2.1 km^2
  - TDR Premium - ~ Rs 17 ~ 18 bn

Advantages:

- Does not release additional FSI in the city, only realigns the FSI from other zones to BRT corridor.
- Will protect the value of TDR and make it more attractive.
- Help PCMC facilities focused service provision by densification.
- Ensure the attractiveness of mass transit and protection to environment.

Similar influence zones can be created across the station areas of HSR. These could be typically between 500 m to 1 km area where the major impact of transit oriented development is expected to happen.

10.3.3 Land Value Capture Flow for HSR

Land values and property prices see upside trend as large connectivity projects are implemented. Hence there is need for proper instruments such as tax/cess on property tax, development surcharge or betterment levy, etc. to capture such an upside in value. One of such model for the HSR influence zone has been schematically shown as follows:

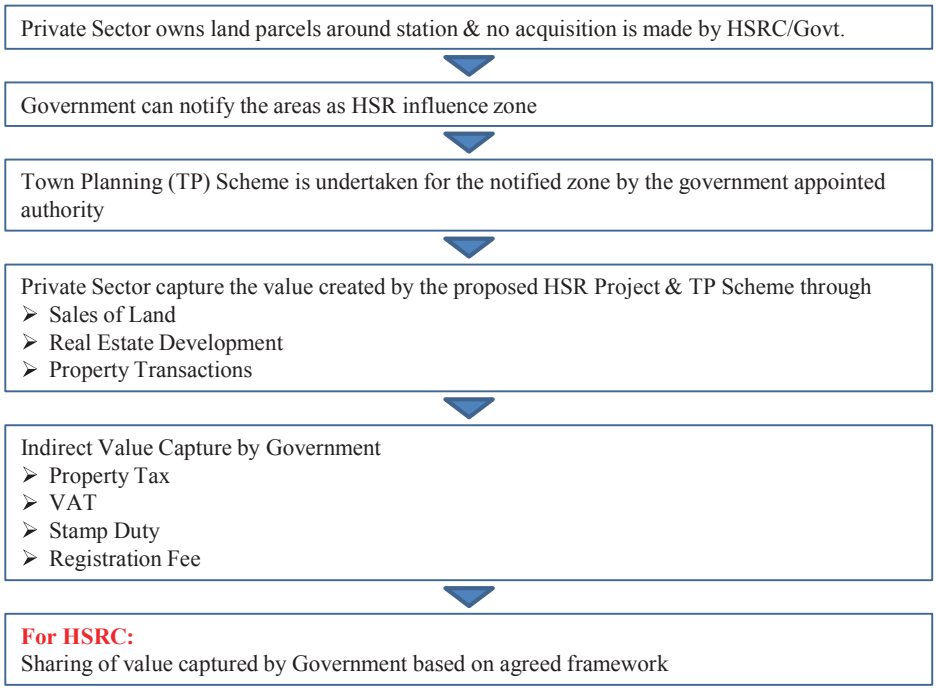


Figure 10.3-8 Flow of Land Value Capture

1) Case Example – Ahmedabad BRTS, Gujarat, India

Ahmedabad BRTS is a successful example receiving steady income stream from a dedicated Urban Transport Fund (UTF). The UTF is managed by an SPV, Ahmedabad Janmarg Limited (AJL), wholly owned by Ahmedabad Municipal Corporation (AMC). The fund is proposed to sustain transit operations and for development of transit infrastructure. The fund contributes 2-3% of total annual revenue as grant. Revenue sources of the fund include: - Net revenues from Pay and Park Facilities - Advertisement Charges - Charges on outsourced activities such as Ticketing System, Seasonal Ticket Issue - Land Value Capture: All new developments in the vicinity of BRT corridor (250 Mts) will have the permission to build up to FSI 1.8 plus an additional F.S.I of 1. Value capture is through impact charges.

- Grants, if any.
- Other sources in terms of cess/ charge as travel demand management measure are under consideration.

Key insights:

FSI (Floor Space Index)

- Maximum FSI is determined in the local guideline in each city.
- Development with high FSI basically requires greater capital cost.
- Since FSI effects supply of real estate, it is important to observe demand – supply balance of the region when making the decision of maximum FSI.
- TDR (Transferrable Development Right) is to be applied to buildup highly integrated area by assembling FSI from other areas. It also can contribute to control real estate supply of whole area.

2) Case Example - L&T Seawoods, Maharashtra, India

As a part of financing arrangement of Harbour Line in Mumbai, CIDCO retained station area commercial development rights. Having developed 5 out of the 6 stations, CIDCO opted for PPP model for TOD development at Seawoods Darawe station. L&T Realty was selected as a successful bidder. L&T's bid value was around Rs 18 billion as upfront payment (payable in 4 instalments), it being higher than second highest bidder by around Rs 3 bn.

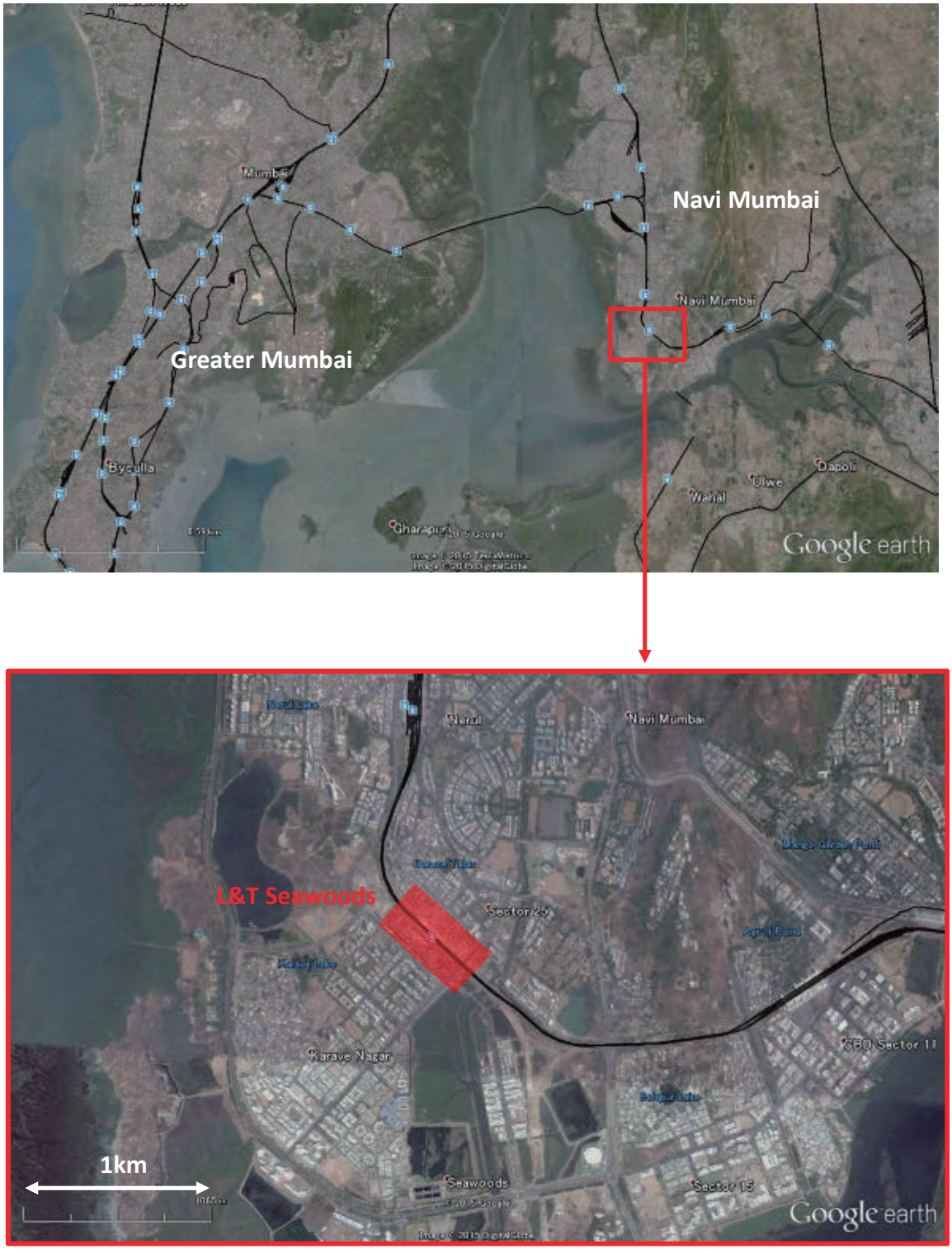
- Development Model
  - ➢ Upfront payment – in 4 instalment
  - ➢ FSI – 1.5
  - ➢ Built Up Area - 2.6 mn
    - ✧ Retail – 1.0 mn sq ft
    - ✧ Offices – 1.6 mn sq ft
    - ✧ 3-level basement parking (2500 slots for car)
  - ➢ 2-phase development – Tenants in Phase-1 will start occupying space by end of 2015 or early 2016.
  - ➢ Most attractive destination for offices with MSME & logistics as key target tenants

L&T Seawoods Management opines that their experience with upfront model and in general for industry is not so good in the present time.

Going forward, large scale private participation can be expected where the model is based on revenue share with no (or minimum) upfront payment.

Source: L&T Realty

Figure 10.3-9 Plan of L&T Seawoods



Source: Google Earth

Figure 10.3-10 Location of L&T Seawoods

10.4 Non Railway Business

The types of non-railway business are categorized into 4 types. These non-railway business have been considered and applied by railways in the world.

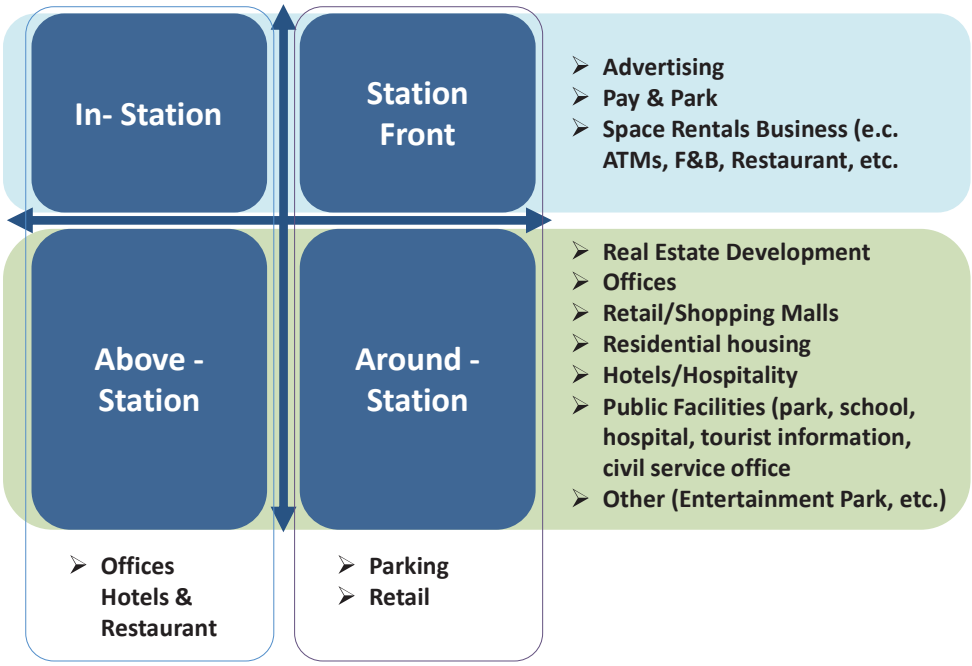


Figure 10.4-1 Non-Railway Business

(1) Development Potential

There are 12 proposed stations on the Mumbai Ahmedabad high Speed Rail corridor. Of these 12 stations, except few, above station development can be undertaken at most of the station. The following table gives a glimpse of development potential for above station development in the four major urban regions.

Table 10.4-1 Potential of Above Station Development

Proposed HSR Station	Above Station Potential	Remarks
Mumbai	Nil	Underground station
Thane	Low – Medium	Will depend on the development of surrounding areas linking with the adjacent suburban railway stations. Also catchment can be extended till Pune.
Surat	Medium	Greenfield area, but closer to Surat CBD (Around 15km) as well as NH-8 (Less than 1km) and proposed integration with the around station area development.
Vadodara	High	Proposed to be located close to existing station in the CB Dog the city.
Ahmedabad	High	Proposed to be located close to existing station in the CBD of the city.

(2) Assumption

- Station area : 400 m x 150 m, i.e. 60,000m^2
- Maximum available area for above station development : 50%
- Development (FSI and BUA):

Table 10.4-2 Assumed BUA

Station (Potential)	FSI used	BUA (m^2)
High	2.0	60,000
Medium	1.0	30,000
Low	0.5	15,000
Nil	0.0	0.0

- Product mix:
  - Retail (including Hotels & Restaurants) : 50%
  - Offices (largely small floor plates) : 50%
- Construction related assumptions : assumed as similar to that in case of Around Station Development

(3) Commercial Model

- Model-1: HSRC develops the above station area and lease out to prospective tenants
  - For instance, Shri Mata Vaishno Devi Katra railway station where Indian Railways have developed station area with own investments and leased out various spaces. Also the hotel & restaurants are being managed by IRCTC, PSU under Ministry of Railways (MOR).
- Model-2: HSRC develops the above station area and appoints a property management firm on OMT (Operate-Maintain-Transfer) model basis.
- Model-3: Public-Private partnership model for station development (main station and above station area) wherein :
  - Construction cost of station area will be borne by the private sector
  - Project SPC mandatory shares revenue with HSRC after several years of operations (for example, in case of concession tenor of 30 years, HSRC can contractually mandate revenue share from 15 years onwards)
  - If revenue potential is high, HSRC can earn upfront premium, while in case low potential, HSRC can provide Grant/VGF
    - Benefit for the HSRC will be the minimum fund allocation for the construction of station area, while also realize additional revenues in future

For the estimation of high level revenue potential for HSRC, the following assessment has been carried out assuming model-1 only, given the availability of limited details with respect to model-3. Model-2 is a slight variant of model-1 only, but will be useful as HSRC may not readily have the requisite capability.

(4) Estimation of Potential Revenue

High level estimate of revenues indicate that above station at the four stations, viz. Thane, Surat, Vadodara and Ahmedabad can generate net cash flows for HSRC as listed in the following table and chart (cumulative).

Table 10.4-3 Estimated Potential Revenue

Year (Operation)	Net Cash Flows (in Rs Million)
5th Year	1,580
10th Year	1,770
20th Year	2,025

(5) Case Example - Mumbai Railway Vikas Co. (MRVC) –Proposed Commercial Development at Thane (E)

Railway Land Development Authority (RLDA) and MRVC entered into MOU (dt. 16.07.2013) for commercial development of Railway Land / Air Spaces at stations in Mumbai. Accordingly, three land parcels in Mumbai/MMR region, viz., Thane (E), NGSM at Nahur/Mulund and Bhadup yard have been entrusted with MRVC. MRVC appointed PricewaterhouseCoopers (PwC) as their consultant to prepare concept plan and feasibility report.

Currently the land use conversion and approval for enhanced FSI are in progress for all the three plots. The following chart shows the underlying philosophy of the proposed commercial development model wherein the funds generated in the process are proposed to be utilized towards meeting station development and/or related infrastructure projects.

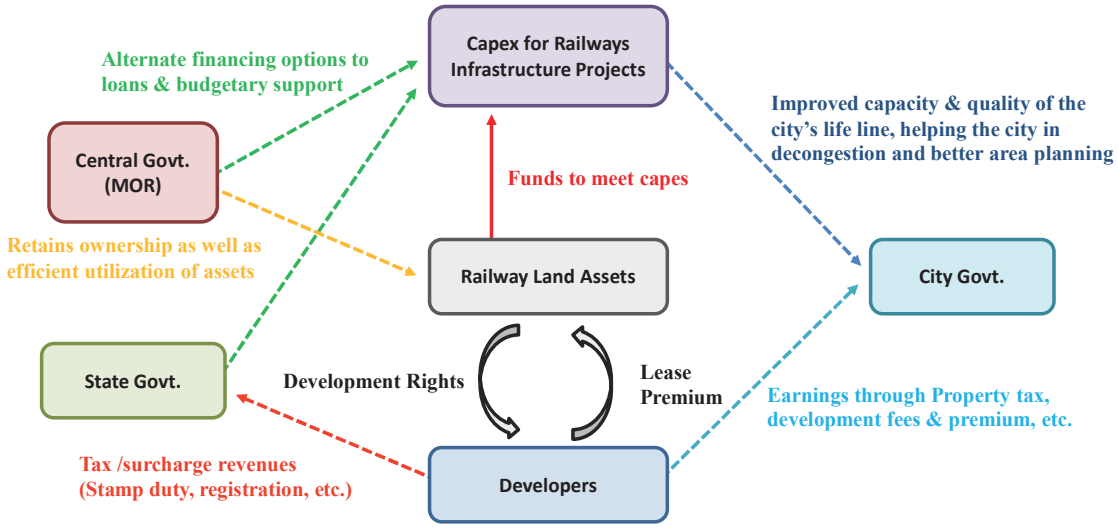


Figure 10.4-2 Scheme of the Project

Salient features of Commercial Structure:

- Min. Return on Equity offered (EIRR) – 22.5%
- Min. Internal Rate of Return on project – Cost of borrowings + 5% (subject to min. of 15%)

Bidding Criteria:

- Annual rental, or
- One-time upfront lease payment, or
- Combination of both

Payment terms:

- Upfront lease payment (in single or maximum 4 instalment)
- Annual lease payments, escalated at 15% every 3 years

Thane (E) plan is based above station development or air space development over operational platform area and adjacent land plot. It is expected to the first pilot project by MRVC under the above framework.

Source: Study Team

Figure 10.4-3 Proposed Development Area at Thane Station

10.5 Recommendation

(1) Connection with Other Transport Modes at HSR Station

Good connection with other transport mode is a key factor for HSR passenger's convenience.

- The connection with HSR and other planned transport modes should be considered especially in Mumbai, Thane, Vadodara, Ahmedabad and Sabarmati where there are urban transport systems are under planning and construction. It is recommended to consult with stake holders of each transport project regarding the key factors below:
  - Location of the planned transport facilities
  - Pedestrian walkway
  - Elimination of level difference

(2) City Development along HSR Corridor

It is recommended to develop an area around the station by the operator itself or attracting developers or with state related governments because the area in front of the station has huge economic potential.

Also it is recommended that consideration of new land use or creating of new destinations for passengers such as university, amusement park, medical center, IT parks, tourist destination and residential township around the HSR city especially in suburban area such as Virar, Boisar, Vapi, Bilimora, Surat, Bharuch and Anand/Nadiad. These destinations can stimulate passengers and increased traffic volume can bring an economic effect to the areas around the station.

These kinds of new development should be considered by related governments and reflected to the regional development plans.

(3) Value Capture by Station Area Development

There are some ways for HSRC to capture a benefit from station area development. Which are:

Area development authority led business model: Which can be comparatively easily applied at Thane, Virar, Boisar, Vapi, Bilimora, Surat, Bharuch and Anand/Nadiad where there is less land development around the HSR station location at the present moment. As estimated in the report, financial contribution of station area development to the HSR project can be expected at some extent. Since state govt. or its agency is to be a key player for the project, it is recommended to consult with them to coordinate for the project.

Transferrable Development Rights (TDR): HSRC generates revenues by selling TDR of non-viable railway land or station area and TDR contributes to concentrate the development activities on around the station. Support of state govt. is required to enable market for TDR to function in favor of HSRC.

Monetization of Railway's Surplus Land Assets located at Prime Locations: Some vacant or surplus railway land can be utilized for monetizing. HSRC is allocated land parcels and sells or leases the land to generate revenues. Some land railway land parcels can be seen especially in Mumbai and Sabarmati.

(4) Others

For the case of the HSR stations adjacent to existing railway station, it is recommended to re-build integrated station complex for better convenience for passengers, efficient use of land.

Summary for each station are written in the table below:

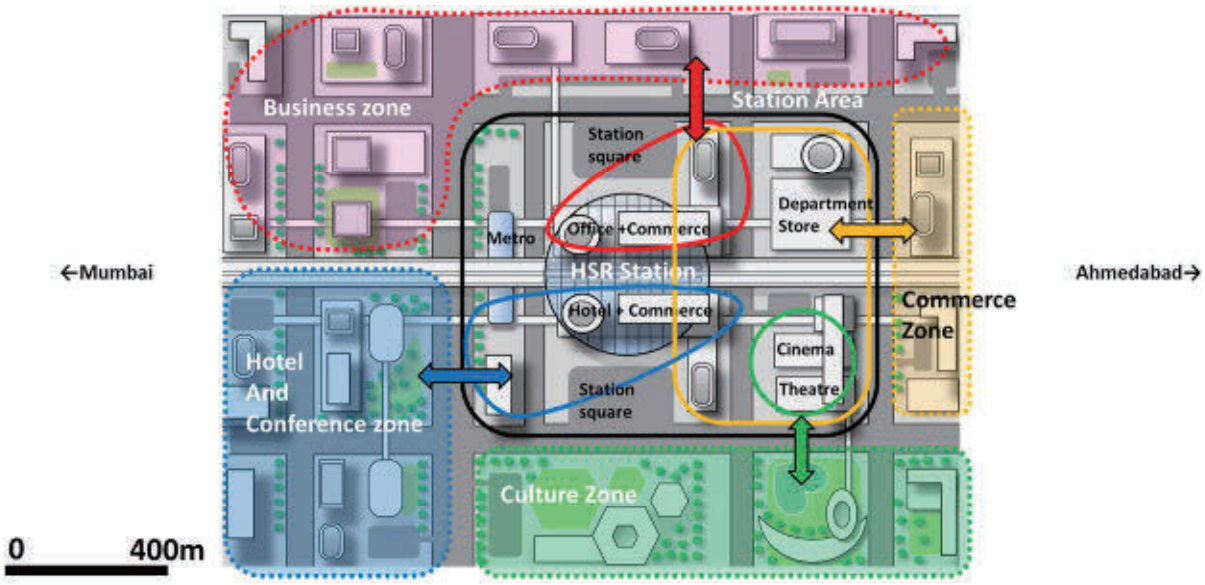
Table 10.5-1 Summary for Each Proposed Station

No.	Station	Current Status	Future / Proposal
1	Mumbai	➢ Located at Bandra Kulra Complex, central part of Mumbai. ➢ Being close to CBD. ➢ Closer to Airport (5km) ➢ Closer to Bandra station (3km) ➢ Closer to planned metro(approx.100 m)	➢ Connection with planned metro lines ➢ Secure access to Bandra station. ➢ Integrated development with MMRDA.
2	Thane	➢ Located at vacant land along the conventional railway. ➢ Less development around the station. ➢ Distance to Thane CBD is approx. 8km ➢ Distance to Navi Mumbai CBD is approx.18km.	➢ Integrated development of Thane HSR station and proposed conventional railway station. ➢ Around station area development of vacant land. ➢ Access to Navi Mumbai and Thane CBD thorough conventional railway.
3	Virar	➢ Located at vacant land but hilly area ➢ Rapid development is occurring close to the location ➢ Virar is being developed as a commuter town	➢ Station and around station area development. ➢ Access to Virar CBD. ➢ New around station area development Commuter town
4	Boisar	➢ Located at vacant land ➢ Close to central part of Boisar (2km). ➢ Closer to new residential park. ➢ Closer to Industrial area of MIDC (Mumbai Industrial Development Company). ➢ Distance to Dahanu industrial area is approx. 17km.	➢ Station and around station area development. ➢ Development of area between HSR station and existing station. ➢ Access between HSR station and Boisar existing station.
5	Vapi	➢ Located at vacant land ➢ Closer to central part of Vapi (4km). ➢ Closer to Vapi existing station (6km). ➢ Closer to GIDC (Gujarat Industrial Development Corporation) industrial area (4km). ➢ Distance to Daman and Diu is approx. 13km. ➢ Approx. 8 colleges are located in Vapi.	➢ Station and around station area development. ➢ Access to central part of Vapi, GIDC area and Daman and Diu.
6	Bilimora	➢ Located at vacant land. ➢ Closer to central part of Bilimora (3km). ➢ Closer to GIDC area (1km). ➢ More than 10 colleges and schools are located in Bilimora.	➢ Station and around station area development. ➢ Access to central part of Bilimora and industrial area.
7	Surat	➢ Located at vacant land. ➢ Closer to Surat CBD (10km).	➢ Station and around station area development.

		➢ Closer to existing railway (1.6km)	➢ Access to existing station and CBD of Surat.
8	Bharuch	➢ Located at vacant land. ➢ Closer to central part of Bharuch (6km). ➢ Junction to Dahej industrial area.	➢ Station and around station area development. ➢ Access to central part of Bharuch and Dahej industrial area.
9	Vadodara	➢ Located at Vadodara existing Vadodara railway station. ➢ Less undeveloped area around the station. ➢ Closer to Vadodara CBD.	➢ Integrated station building with Vadodara existing station. ➢ Improvement of station front area with renewal of station square and pedestrian walk way.
10	Anand/Nadiad	➢ Located at vacant land. ➢ Closer to Anand and Nadiad city (Approx. 8~10km).	➢ Station and around station area development. ➢ Access to Anand and Nadiad city.
11	Ahmedabad	➢ Located at Ahmedabad existing station. ➢ Closer to CBD in Ahmedabad. ➢ Less undeveloped land around the station. ➢ Closer to planned metro and BRT station.	➢ Integrated station building with Ahmedabad existing station. ➢ Access to planned metro and BRT. ➢ Improvement of station front area with renewal of station square and pedestrian walk way.
12	Sabarmati	➢ Located at Sabarmati existing station. ➢ Closer to CBD in Sabarmati. ➢ Closer to Airport in Ahmedabad. ➢ Distance to Gandhinagar is approx. 18km. ➢ Closer to planned metro and BRT.	➢ Integrated station building with Ahmedabad existing station. ➢ Development of surplus railway land. ➢ Access to planned metro and BRT. ➢ Improvement of station front area with renewal of station square and pedestrian walk way.

Careful discussion and coordination with related government and agencies are required for further development studies. The Figure bellow shows some ideas for station area development for Surat and Sabarmati, design based on the following imaginary conditions.

An idea image for Surat station area development: (If the new station and the surrounding area will be owned by HSR, and would be developed by the HSR's initiative.)



Source: Study Team

Figure 10.5-4 Idea Image of Station area Development at Surat Station

An idea image for Sabarmati station area development: (If the vacant railway land is permitted to be developed By HSR or by HSR and Indian railways partnership.)

Source: Study Team

Figure 10.5-5 Idea Image of Station area Development at Sabarmati Station

Chapter 11 Operation and Maintenance Plan

11.1 Safety Management Plan

11.1.1 Safety Management in High-Speed Railway

(1) Concept of Safety Management in High-Speed Railway

In high-speed railways to run trains at a speed over 200 km/h, signaling and the mechanism to prevent train collisions, or a train safety system, are different from those of existing railways in terms of concept and contents. The safety mechanism in high-speed railway is constituted based on the concept described below:

- Adopt facilities and rolling stock to cope with high-speed operation and establish a comprehensively harmonized modern mechanism.
- Minimize the elements relying on attentiveness to eliminate troubles due to human errors.
- Adopt multi-redundant systems for important safety equipment/facilities to improve reliability and make the concept of "fail-safe" thoroughly prevail.
- Take measures to avoid the effect of windstorms, floods, earthquakes and other damages caused by natural phenomena as far as possible.
- Introduce equipment/facilities to minimize automobile falling accidents and other troubles and institute legal/regulatory measures against deeds to compromise the safety of train operation.

(2) Safety Measures in High-Speed Railway

1) Prevention of accidents in train operation

a) Prevention of collision between trains

In view of their long braking distance, it is not possible to protect high-speed railway trains by using fuses or special flash signals used for existing railways. High-speed railways have introduced a protection mechanism, therefore, to quickly protect trains by using ATC.

b) Prevention of the invasion of obstacles

To prevent people and impeding obstacles from entering the right of way, high-speed railways install no entry fences along the boundary against external areas and No Jettisoning fences along the flyovers across high-speed railways. Level crossings with roads are totally eliminated. Grade-separated crossings completely wipe off the possibility of invasion by cars or pedestrians, with only those concerned having a certificate allowed to enter the right of way of high-speed railways while others totally shut out by law.

c) Separation of the time zones for train operation and maintenance work.

The following three points shall be observed in the maintenance work for Shinkansen:

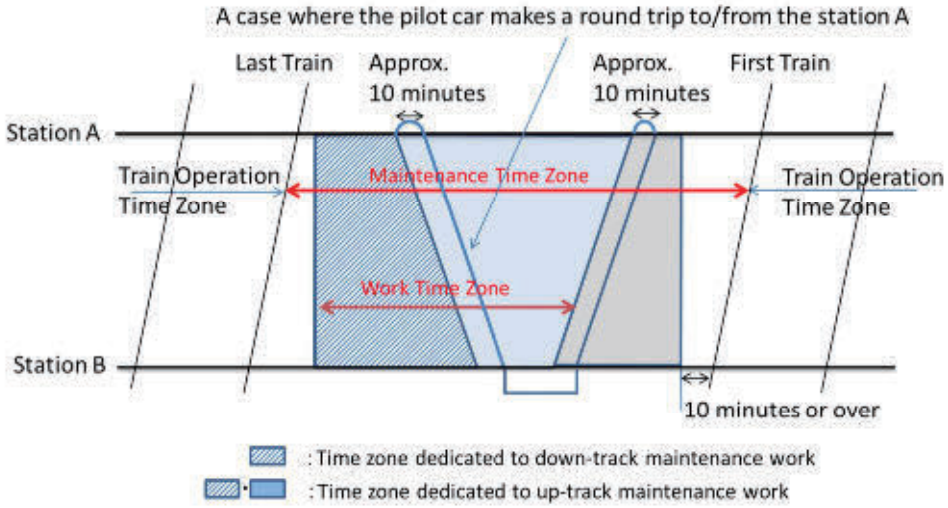
- Mechanical power is utilized as much as possible.
- The distance between stations is significantly long.
- Trains run at ultra-high speed.

In view of the above features, a maintenance work time zone when trains don't run is specified in advance, in which an interval between two trains dedicated to maintenance work called the "maintenance time zone" is set as Table11.1-1, with overall maintenance control centralized by the maintenance work dispatcher.

Table 11.1-1 Separation of the Time Zone

Operation time zone	6:00～24:00 (0:00)
Maintenance time zone	0:00～6:00

After the completion of maintenance work, a maintenance car is run as a pilot car to confirm that the permanent way is free from obstacles that would impede train operation. Bi-direction operation shall not be operated because the operation time zone and the maintenance zone are separated.



Source: Study Team

Figure 11.1-1 Concept of the Maintenance Work Time Zone

d) Prevention of accidents on platforms

Platform width is guaranteed to cope with the demand sufficiently for 30 years after inauguration to prevent passenger falling accidents and contacting trains. Furthermore, fixed fences are installed for all platforms to prevent passengers from falling onto the track pushed by the train draft. Also, the space for installing platform screen doors is reserved for the future.

e) The method of rescue

Safety is the first priority in HSR system. HSR system is designed on premise of preventing accidents. The methods of rescue in case of accidents or disasters are as follows. The detail procedure should be considered in the next stage.

- If the rescue train can come to the accident site, passengers transfer to the rescue train.
- If the rescue train cannot come to the site, passengers get off the train and are rescued from maintenance slopes or emergency stairs.
  *The same train car as operating train is used for the rescue train.
  *Maintenance slopes are located in every 5~7km.
  *Emergency stairs are located in every 1.5~3.0km.

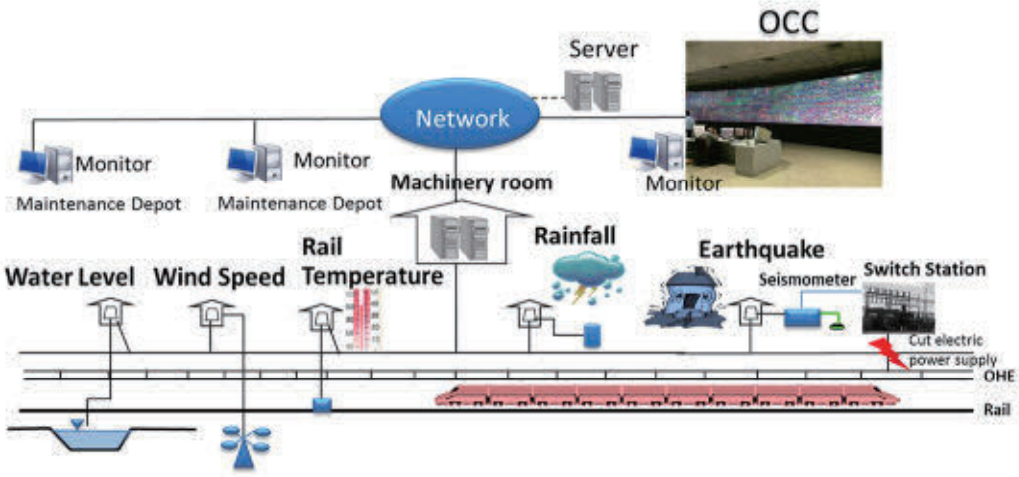
2) Disaster preventing system

Safe and stable transport is required for high-speed railways. The natural conditions along the corridor between Mumbai and Ahmedabad feature high temperature, heavy rains in the monsoon and risk of earthquake in the northern areas. In structure designing, it is important not only to guarantee earthquake resistant performance and strength against rains but also to make arrangements to quickly catch meteorological information to prevent occurrence of disaster or minimize damage therefrom, thereby protecting running trains against damage due to natural phenomena. Therefore, introducing a disaster preventing system into this project to automatically collect disaster preventive data is recommended. Terminals of the disaster preventing system will be installed at the operation center and each maintenance depot aiming at establishing a communication system that makes it possible to renew data at a stretch from the

operation control center in charge of train operation to field organizations. About rainfall, wind speed & rail temperature, OCC dispatchers check the situation from Disaster Detection and Warning System (DWS), order restriction speed to train drivers and directly send command to high-speed trains. About earthquake, OHE is tripped automatically based on information from distributed seismometers (Figure11.1-3). The merits of the introduction of disaster preventing system are as follows.

- Assessment of observation data on a real time basis (efficient regulation of train operation)
- Automatic data transfer through observation devices under on-line connection
- Perusal of regulatory/disaster data in the past

Disaster detecting equipment should be installed based on the policy in Table 11.1-2, where disaster detecting instruments are not under a redundant system. In case of failure of sensors, supervision using human system is carried out although maintenance staffs repair it as soon as possible. In the meantime, site conditions will be manually checked.



Source: Study Team

Figure 11.1-2 Image of Disaster Prevention System

Table 11.1-2 Installation Plan of Disaster Detecting Equipment

Disaster	Disaster detecting devices	Installation Policy
Earthquake	Earthquake resistant train protection device	Wayside detecting point (set at approx. 20 km intervals) Coast/inland areas detecting points (each set at approx. 75 km intervals)
Rain	Rainfall alarming device	Cuts, embankment, tunnel entrance/exit and other places requiring attention (each set approx. 10 km intervals)
Wind	Wind direction /speed monitoring device	River catchment areas where winds concentrate and places subject to gusts
Landslide	Landslide alarming device	Places subject to landslides (irrelevant to this project)
Rail temperature	Rail temperature alarming device	Points requiring attention in sections subject to deformation due to temperature change.

a) Earthquake

To minimize the damage due to earthquake when trains are running, high-speed railways require

an earthquake damage preventive system to immediately decelerate trains at earthquake. Japan introduced a secondary seismic wave (S-wave) detecting system at the inauguration of Tokaido Shinkansen and the primary wave (P-wave) alarm system relying on the information on the earthquake dimension estimated based on the initial micro vibration (P-wave) the inauguration of Tohoku Shinkansen to eventually establish an urgent earthquake detection and alarm system (UrEDAS)(Table 11.1-3). The P-wave urgent earthquake alarm system makes judgment to stop trains based on the damage on railways caused by earthquakes in the past. To introduce this system into India, therefore, it is required to collect information on earthquake damage in the past.

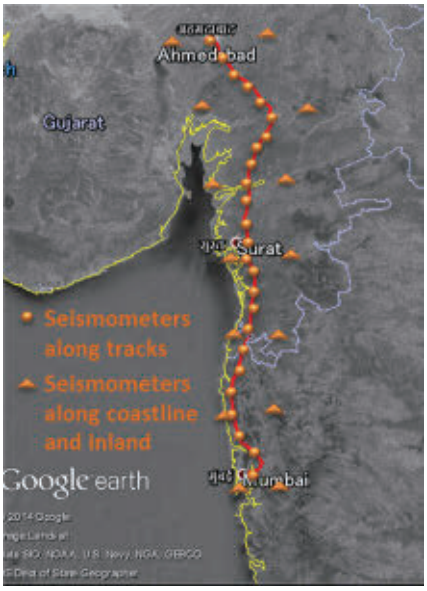
Table 11.1-3 Categories of Earthquake Alarms

S-wave alarm	An alarm based on the magnitude of the secondary seismic wave (S-wave)
P-wave alarm	An alarm relying on the information on the earthquake dimension based on the initial micro vibration wave (P-wave): Urgent earthquake detection and alarm system

There are two categories of detecting points, i.e., coast and inland detecting points, where system components are installed based on the installation standards in Table 11.1-2. To make the system exert performance to the full, room temperature, humidity, power source and other environmental conditions shall be kept at appropriate levels at the detecting points, with the door open/close status be strictly monitored at the same time for the purpose of security. See Figure 11.1-4 for the scene of seismographic system installation.

Source: Railway Technical Research Institute (RTRI)

Figure 11.1-3 Scene of a Seismographic System Installed at a Detecting Point



Source: Study Team

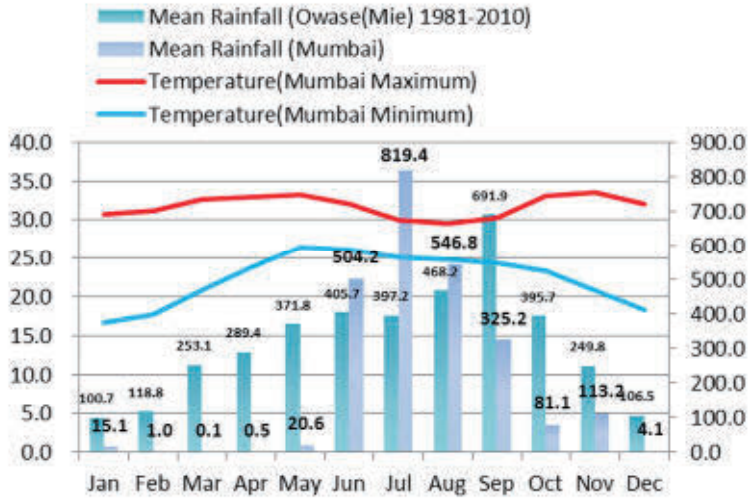
Figure 11.1-4 Image of Earthquake Detecting Point

b) Strong wind

Wind speed should be continuously observed with the anemometers installed along the track and perform operation control in case the wind speed has exceeded a regulatory value. For operation control, stepwise regulatory values shall be set according to the condition of windbreak fence installation. When the wind speed hasn't exceeded a regulatory value for 30 minutes or over, operation control relevant to the regulatory value will be relaxed step by step. It needs to be examined for deciding regulation value of strong wind in this corridor.

c) Rain

Between Mumbai and Ahmedabad, the high-speed railway runs along the coast that is subjected to the influence of the monsoon. In Mumbai, the average monthly amount of rainfall in July is 819.4 mm/month (1951-2000) which is larger than the average yearly precipitation (1981-2010) at Owase, Mie prefecture, an area featuring the largest amount of precipitation in Japan (Figure 11.1-6).



Source: Monthly mean maximum & minimum temperature and total rainfall based upon 1901-2000 data (India Meteorological Department, Ministry of Earth Science)
Source: Japan Meteorological Agency

Figure 11.1-5 Amount of Rainfall in Mumbai

When it rains, train operator control the trains according to the alarm indication at the pluviometers installed approx. 10 km intervals along the track or required by the maintenance staff mobilized in advance to guard the permanent way. As the effect of rainfall is closely linked with track structure, geology and topography, the criteria on train operation control shall be determined based on the short-time amount of rainfall (amount per hour) and the long-time amount of rainfall (amount per 24 hours) for particular sections.

To lift train operation control, return train speed to the normal level or resume train operation after inspecting tracks to confirm safety. Application of rain disaster preventive measures at the tunnel entrance near a slop to minimize the section for train operation control will lead to raising the passenger service level. It needs to be examined for deciding regulation value of heave rain fall in the high-speed rail corridor.

d) Rail temperature

Long-rails shall be laid at the temperature to prevent both jutting (at high temperature) and rupture (at low temperature) of the rail. Therefore, a proximity limit value shall be set against the anticipated maximum temperature and another against the anticipated minimum temperature. Then make arrangements for long-rail temperature alarming devices to issue an alarm when either limit value has been infringed. The long-rail temperatures alarming devices measures /displays digitally the rail temperature and inform/output alarms when so required. Another consideration is required for deciding regulation value of high temperature.

11.2 Operation and Maintenance Plan

11.2.1 Importance of Cooperation between Operation and Maintenance (O&M)

To implement safe and stable transport, operation and maintenance of railways shall be closely linked with each other. Therefore, study team discussed the operation and maintenance plan on the precondition that the operating subject takes charge of management.

11.2.2 Recommended Structure Type of O&M Organization

Table11.2-1 shows the comparison of structure types of O&M organization. Separated organization from IR is recommended by the comprehensive evaluation.

Table11.2-1 Comparison Table of O&M Structure Types

Types Items	Case1 Separated Organization from IR	Case2 Unified Organization with IR	Case3 Separated Organization in aspects of finance and account
Example	-Taiwan HSR -HSR in Japan (Infrastructure) -Former Highway in Japan*	-HSR in Japan (before JR) -HSR in Japan (Operation) -HSR in China	
Finance and Accounting	-Different financial resources from IR -Independent accounting from IR -Advantage of financial resources for further development of HSR network.	-Same financial resources with IR -Same accounting with IR -Disadvantage of financial resources for further development of HSR network	-Different financial resources from IR -Independent accounting from IR -Advantage of financial resources for further development of HSR network
Technical	-HSR technology should be introduced	-Railway technology (conventional line) from IR can be utilized.	-HSR technology should be introduced
Human Resource	-New members of staff will be needed. -Some IR staff will be transferred to HSR.	-IR staff will be transferred to HSR.	-IR staff will be transfer to HSR.
Land Acquisition	-Some part of land might be provided by IR.	-land of IR can be utilized.	-Some part of land might be provided by IR.
Safety	-New safety management for HSR can be adopted.	-As safety management for HSR will be mixed with IR, safety system will be complicated.	-New safety management for HSR can be adopted.
Evaluation	✔✔✔	✔	✔✔

*1 Former Japan Highway Public Corporation

11.2.3 Organization for Management, Indian HSR Line1

This chapter will be discussed how to position the organization for management after inauguration, Indian HSR1 Line, including the relation with the Indian government and Indian Railways. The management organization of the HSR operating company, including work-site organizations shall be self-reliant. This holds true from the viewpoint of safety measures as well, in case there emerge a number of differences between the technological levels required for HSR and those of existing railways, as referred to later regarding the cases of the Tokaido and

Tohoku/Joetsu Shinkansen railways in Japan.

The railway technological level in India is quite high when compared with those in the South-East Asian countries. Nevertheless, however, technologies of train operation at 300 km/h or over remain in the realm of the unknown for India. For this reasons as well, the management of Indian HSR1 line shall belong to an independent organization to stand by itself.

It is thought that a management organization also depends on assets holding schemes or other factors. In the case of Indian HSR1 line, a scheme shall be contrived to put management and maintenance under a monistic system. In the 1990s, railways in Europe were privatized with separation system of railway infrastructure and operation. A disastrous accident occurred in the UK in the wake of the privatization of railways, however, as a railway infrastructure holding company cut maintenance costs to a great extent in order to secure an excessive amount of profit. In and after 2000, the policy of privatization under the said new concept was modified, therefore. In France, for example, despite that the French Railways (hereinafter referred to as "SNCF") has reorganized the infrastructure holding company as a separate organization, maintenance services for rolling stock and railway networks are still being performed by SNCF under a contract with the said infrastructure holding company. In the case of German Railways, there are an operating company and an infrastructure maintenance company within a group under a holding company system. In this manner, train operation and infrastructure maintenance are so closely related with each other that they shall never be separated. This also holds true in the sense that railways shall never follow the wake of the UK.

(1) Role of the Head Office

1) Differences from the existing railways

Study team describe below the difference between a high speed railway (hereinafter referred to as "HSR") and existing railways. Railways are a huge system consisting of ① tunnels, bridges, roadbeds, tracks, rolling stock to run thereon, power plants to supply power thereto, internal combustion engines, telecommunication and signal systems required for train operation and ② operators to control train operation, train dispatchers and other human resources. In the case of existing railways, it is possible for train drivers to activate the brake system after noticing an obstacle ahead, if any, to stop trains in safety. In contrast, however, HSR trains running at 300 km/h cannot stop for approximately five kilometers after application of emergency brakes. In other words, HRS trains cannot stop safely even though the train driver applies brakes after noticing emergency, which means HRS is beyond the sensory function of human beings. This is one of the most distinctive differences between HSR and existing railways. This difference is specific to HSR not only in the relation with train drivers but also in the relation with those in the divisions of civil engineering and electric engineering, because those divisions are also required to take prompt action to stop trains or provide maintenance services in the case of failure, given the high speed of HSR trains and heavy loads on equipment/facilities. To regulate train operation at disasters due to strong winds or heavy rains as well, it is extremely important that the conditions of the disaster shall quickly be assessed to take appropriate action immediately.

2) Concept of the Management Organization of HSR

As mentioned above, railways feature a gigantic system. Therefore, divisions composing a railway organization such as those of train operation, rolling stock, signals, power supply, track maintenance and other technological matters are minutely specialized. Thereby, coordination between each department extremely become difficult and the function of railways as a system tends to be inadequate. To raise the safety level and strengthen organizational functions toward a railway that claims high cost-performance, integrated cross-divisional judgment is important. Therefore, the organization shall be structured to be able to make such judgment.

In particular, HSR strongly smacks of the feature of system composition, with technologies in different disciplines being in concert with each other. Therefore, HSR is required to compose cooperative relations crossing the boundaries between different technologies and an organization capable of implementing decision-making on the spot in case an emergency situation has arisen. In concrete terms, the subjects to be addressed by HRS include ① corresponding to abnormalities, ②relations between contact wires and pantographs, between wheel and rail, between operation control, information on maintenance and IT systems and ③ utilization of the time zone for track maintenance.

As referred to later in this report, Japan and Taiwan reviewed at later stages the HSR management organization once instituted at inauguration to cope with the technological development and subjects arisen thereafter. In this manner the management organization of a company shall not be rigid, but be flexible to respond to technological advancement and requirements by the company.

3) HSR Management Organizations in Japan and Other Countries

a) HSR management organization in Japan

i) Tokaido Shinkansen

As the "track addition work for the Tokaido mainline between Tokyo and Osaka", the construction work of Tokaido Shinkansen obtained approval of Minster of Transport in April 1959, with the Kansen Department (where "Kansen" stands for a trunk line) organized at the Head Office, Japanese National Railways (JNR), and the Tokyo Kansen Construction Work Regional Department as a local organization at the same time. In addition, three Kansen Construction Work Departments are set, each at Shizuoka, Nagoya and Osaka. Furthermore, to strength the competence to promote the construction work, the said Kansen Department was re-organized into the Shinkansen General Department in April 1960.

In parallel with the construction of a Shinkansen railway claiming high-level technologies to run trains at a maximums speed of 210km/h, a test track was constructed to train and make employees acquire new technologies at the Kamonomiya Model Track Control Depot in 1962. The Tokaido Shinkansen Inauguration Preparatory Committee instituted in 1960 determined that the management organization at inauguration be a branch organization of JNR Head Office to manage the Tokaido Shinkansen railway integrating all internal divisions en bloc. See Figure 11.2-1 for the organization of the Tokaido Shinkansen Branch Office. Under such an organization, the Tokaido Shinkansen railway was opened for revenue service on October 1, 1964. At the same time, the Shinkansen General Department at the Head Office was abolished and the Kansen Construction Work Departments at Tokyo, Shizuoka, Nagoya and Osaka were all reorganized into local organizations belonging to the Tokaido Shinkansen Branch Office.

The most characteristic internal organization at the Tokaido Shinkansen Branch Office was the Safety Management Office having a role to discuss new technologies studied and developed for the operation and security of high-speed trains and plan/implement safety measures comprehensively.

As computerized information processing became increasingly important to quickly and correctly promote train operation control and various management services for Shinkansen, a committee was organized to discuss the issue of computerized information processing and the Information Management Office followed suit in 1970. At present, the same role is being played by the Information Control Office, Integrated Train Control Center of Tohoku/Joetsu Shinkansen.

As work-site organizations at the inauguration of the Tokaido Shinkansen railway, four Accounting/Materials Offices were placed, each at Tokyo, Shizuoka, Nagoya and Osaka, to constitute a materials supply system directly belonging to the Shinkansen Branch Office, for the

reason that a variety of materials shall quickly be supplied in quantities to relevant places in the case of Shinkansen, in contrast to the Materials Supply Center belonging to the Accounting Department in charge of the mechanism to supply materials to relevant places as a materials supply system in the JNR age. It is important that a quick materials supply system shall be established in India not to disturb the operation of HSR due to delayed procurement of parts.

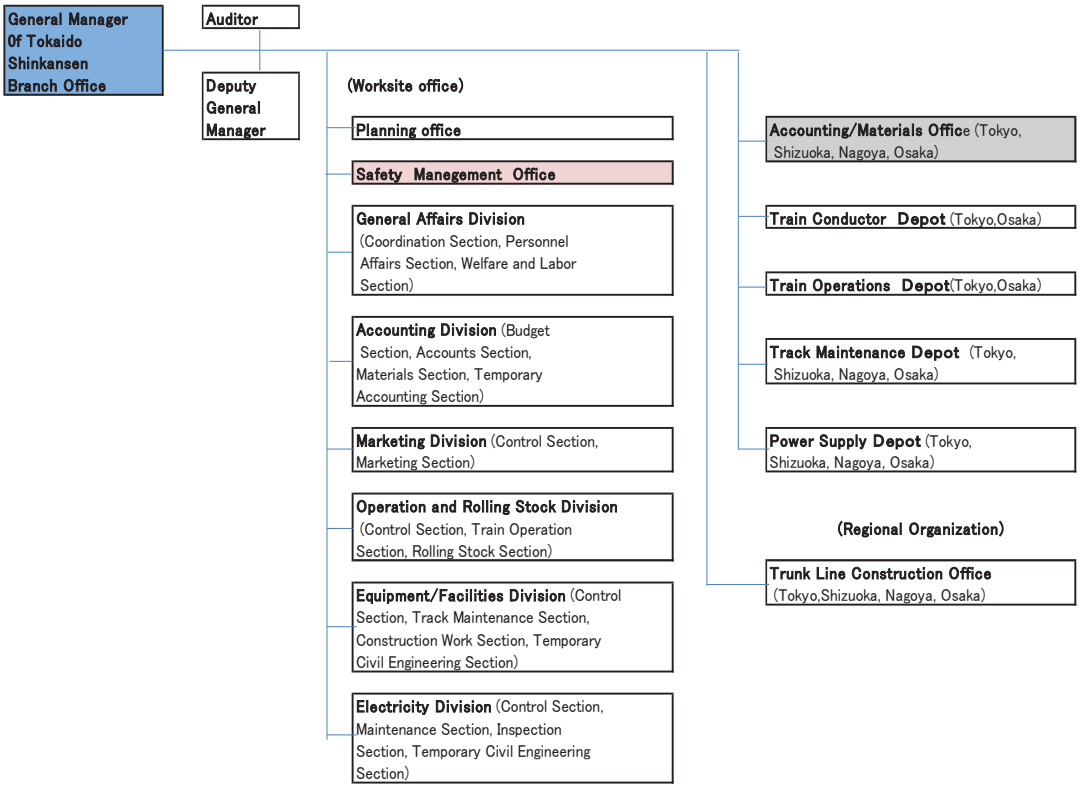


Figure 11.2-1 Organizational Chart, Tokaido Shinkansen Branch Office (as of October 1, 1964)

Figure 11.2-2 shows the current management organization of JR Central, a post-JNR organization, in which a noteworthy point not seen in the past is that the Kansai Branch Office has been organized to exert jurisdiction over the area west of Maibara, in order to address problems in controlling remote areas. Its assignment centers on work-site management, with Shinkansen operating policies determined by the Shinkansen Railway Business Headquarters. As organizations in charge of safety measures, the Safety Measure Division is organized in the Head Office and the Safety Section in the Transport and Marketing Department, Shinkansen Railway Business Headquarters.

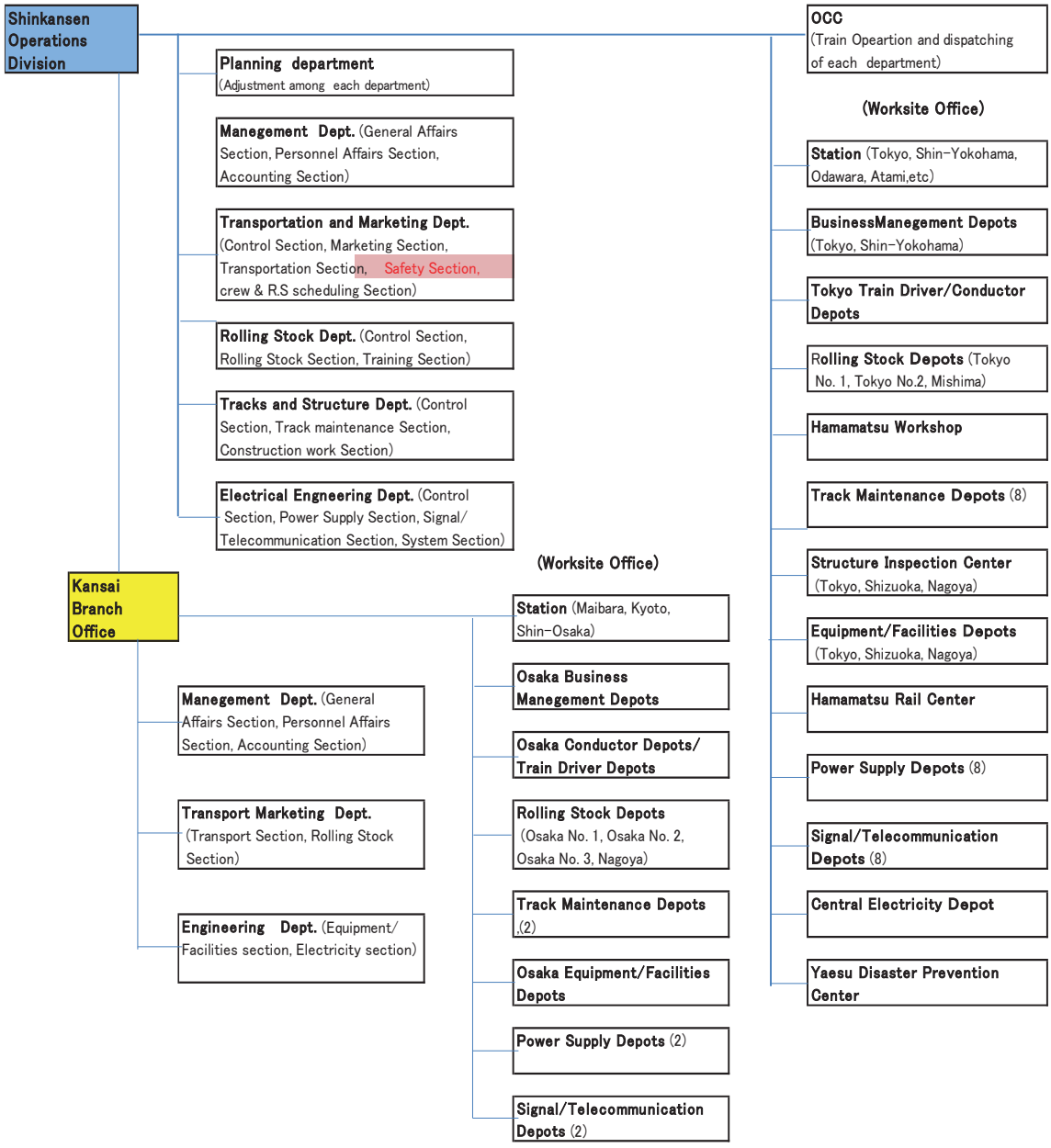


Figure 11.2-2 Organizational Chart, Shinkansen Railway Business Headquarters, JR Central (as of February, 2013)

ii) Tohoku/Joetsu Shinkansen

To prepare for the inauguration of Tohoku/Joetsu Shinkansen, Shinkansen Inauguration Preparation Offices were set at the Morioka, Sendai, Niigata, Takasaki and Tokyo-Kita Regional Railway Control Bureaus in March 1979. Regarding the management organization of the Tohoku/Joetsu Shinkansen railways, the Board of Directors decided the following in February 1980 to utilize the experience in the Tokaido/San-yo Shinkansen railways in consideration of the local features of Tohoku/Joetsu areas.

As technologies for maintenance and other matters for Shinkansen had stabilized and anchored in local areas as well based on the experience for more than 17 years since its inauguration, technologies limited to Shinkansen in the past had spread over the existing railways to level and

upgrade JNR's technologies as a whole, it was decided that the Regional Railway Control Bureaus having jurisdiction over respective areas control not only existing railways but also Shinkansen railways, with the Tohoku/Joetsu Shinkansen Central Dispatching Office installed as a single organization to centralize overall train operation control and direct Regional Railway Control Bureaus in regard to Shinkansen train dispatching services. See Figure 11.2-3 for the internal organization of the Tohoku/Joetsu Shinkansen Train Control Center. There are two categories of work-site organizations: one dedicated to Shinkansen and the other belonging to each Regional Railway Control Bureau to control both the existing railways and Shinkansen together therewith.

This organization shall not be adopted as the Indian HSR organization given the difficulty in commanding and dispatching channels for train operation and the fact that the technological levels for Shinkansen and existing railways are not much different.

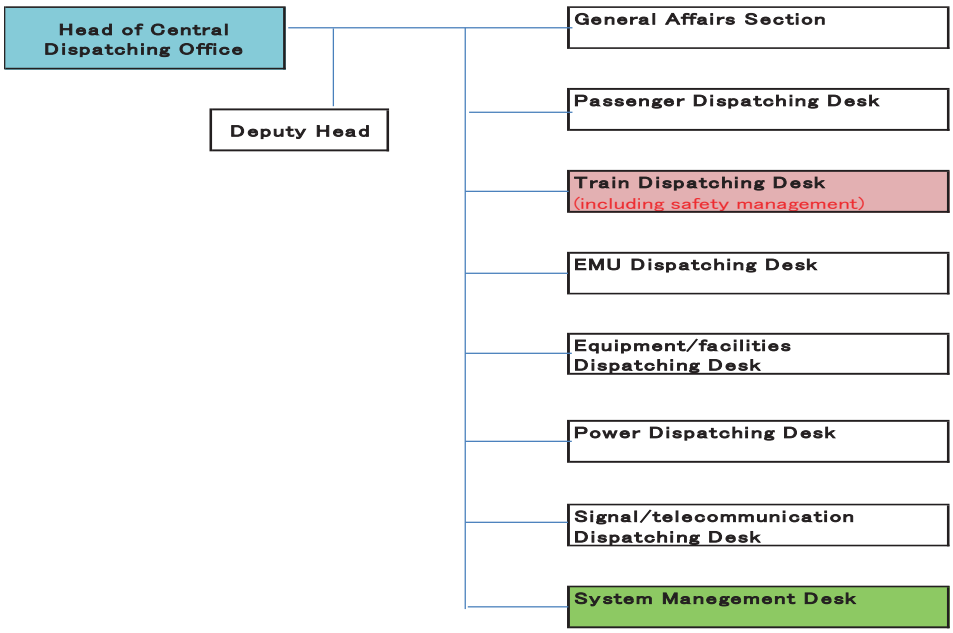


Figure 11.2-3 Organizational Chart of the Tohoku/Joetsu Shinkansen Train Control Center

iii) JR East
See Figure 11.2-4 for the organization of JR East including the Tohoku/Joetsu Shinkansen Train Control Center referred to above.

1. The Railway Operation Headquarters is installed as an organization to control under an umbrella the divisions for transport and maintenance of civil engineering equipment/facilities and electric systems.
2. The Railway Operation Headquarters includes the Transport Safety Department.
3. As the divisions to take charge of the IT system, two organizations are installed: one the Information System Planning Department and the other the IT & SUICA Business Development Headquarters, where SUICA stands for integrated circuit card.
4. As a training organization, JR East General Education Center is organized.

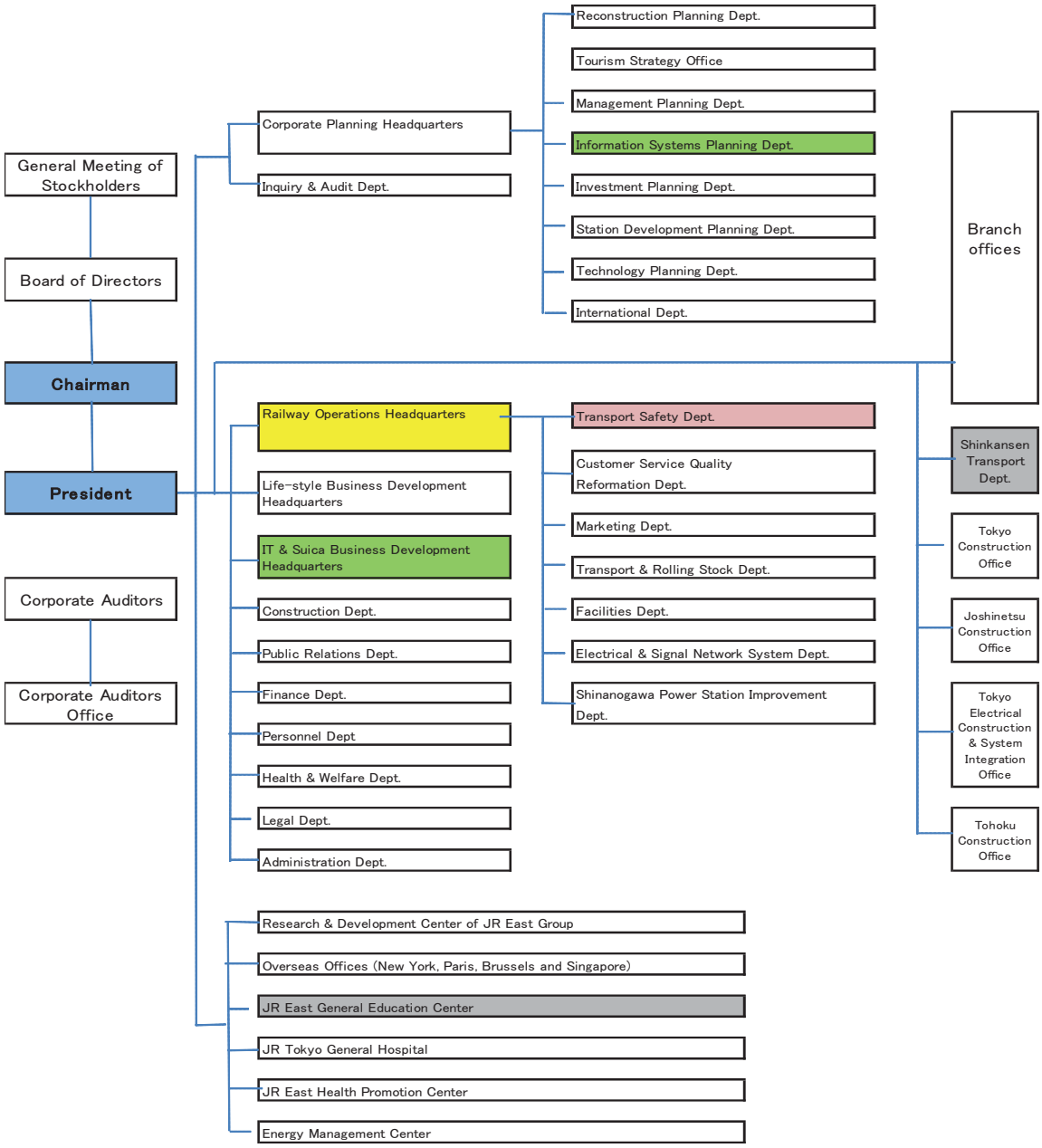


Figure 11.2-4 Organizational Chart of JR East including Tohoku/Joetsu Shinkansen Railways
(as of February 2013)

b) Management organization of Taiwan HSR

i) Organizational chart at inauguration

The Taiwan HSR started revenue service in January 2007. According to Figure 11.2-5 indicating the organizational chart at inauguration, there are two noteworthy divisions: the Market Development Division and the Station Area Development Division, that are not related to Shinkansen technologies but aims at promoting marketing activities and dealing with the tactics to increase revenues. The organizations for technologies are basically not different much from those of Shinkansen railways in Japan. As construction and procurement affairs remained immediately after inauguration, however, the organization includes the Construction

Management and Procurement Division, which is the same as the organization set at the initial stage of Tokaido Shinkansen in Japan.

For the purpose of HSR train operation control, the Railway Operation Headquarters integrates the control services at the Train Operation Division and the Maintenance Division, to facilitate smooth coordination between different divisions as explained in the "Concept of HSR management organization."

Besides the Operation Safety Office, the Disaster Management Office is set in the Railway Operations Headquarters to reflect the large-scale earthquake occurred during the period of construction work. In addition to the divisions for routine affairs, there are two committees: the Safety Committee and the Labor/Hygiene Management Committee having very important missions to ensure the safety of train operation and prevent injury and death accidents of workers.

Although the safety of train operation is assigned to the Operation Safety Office in the Railway Operations Headquarters, it is important that the issues related to safety shall be discussed at committees including the top executives. The HSR in India shall also organize such an organization in one form or another.

In view of the importance of the application of IT systems, Taiwan HSR instituted at its inauguration such organizations as the Information System Division and the System Construction Section.

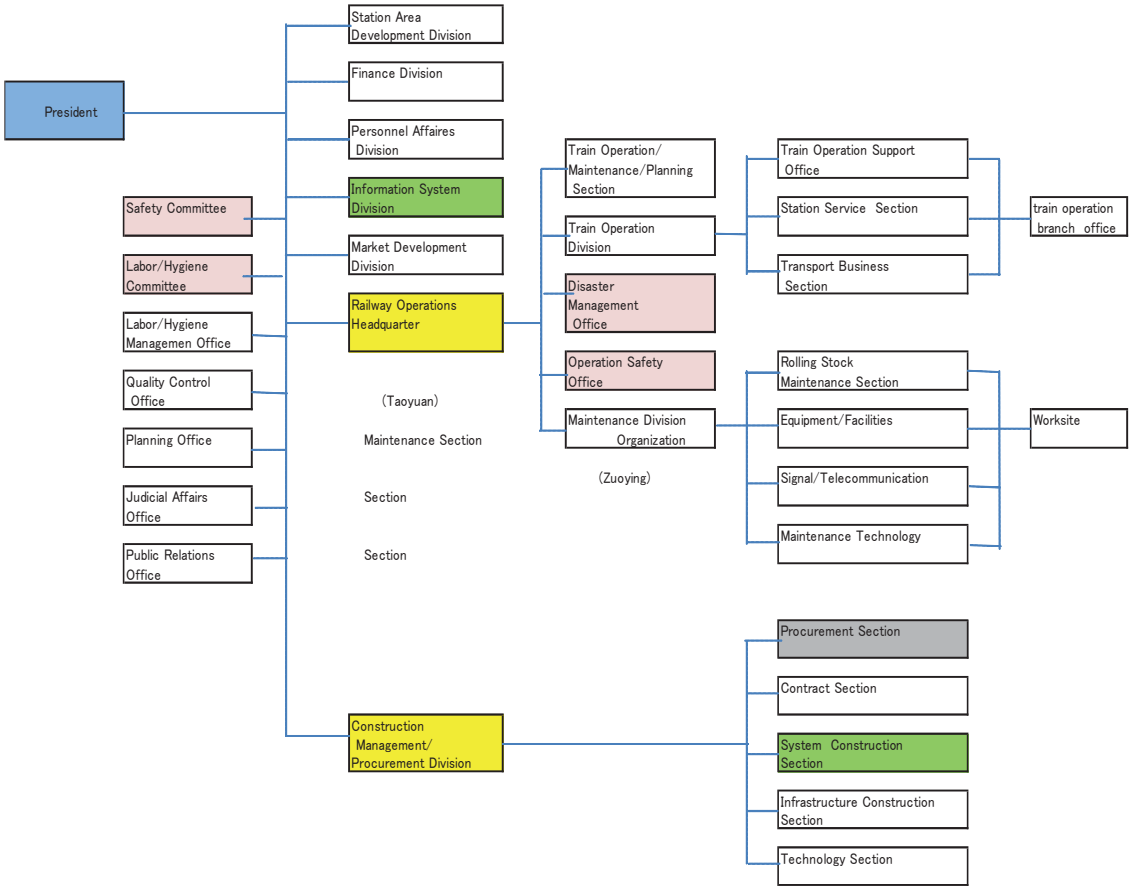


Figure 11.2-5 Organizational Chart of Taiwan HSR at Inauguration

ii) Present organizational chart

Figure 11.2-6 illustrates the present organizational chart of Taiwan HSR. As seven years have passed since its inauguration, there are some changes in the organization of Taiwan HSR as described below:

1. The Disaster Management Office set besides the Operation Safety Office has been integrated into the Disaster Management & Safety Office.

2. The Station Area Development Division and the Market Development Division existed at inauguration have been integrated into the Sales Division, with the important mission assigned thereto succeeded by the latter seemingly unchanged.

3. The Service Management Section has been set up to suggest that the importance of customer services might have been put on a chopping board.

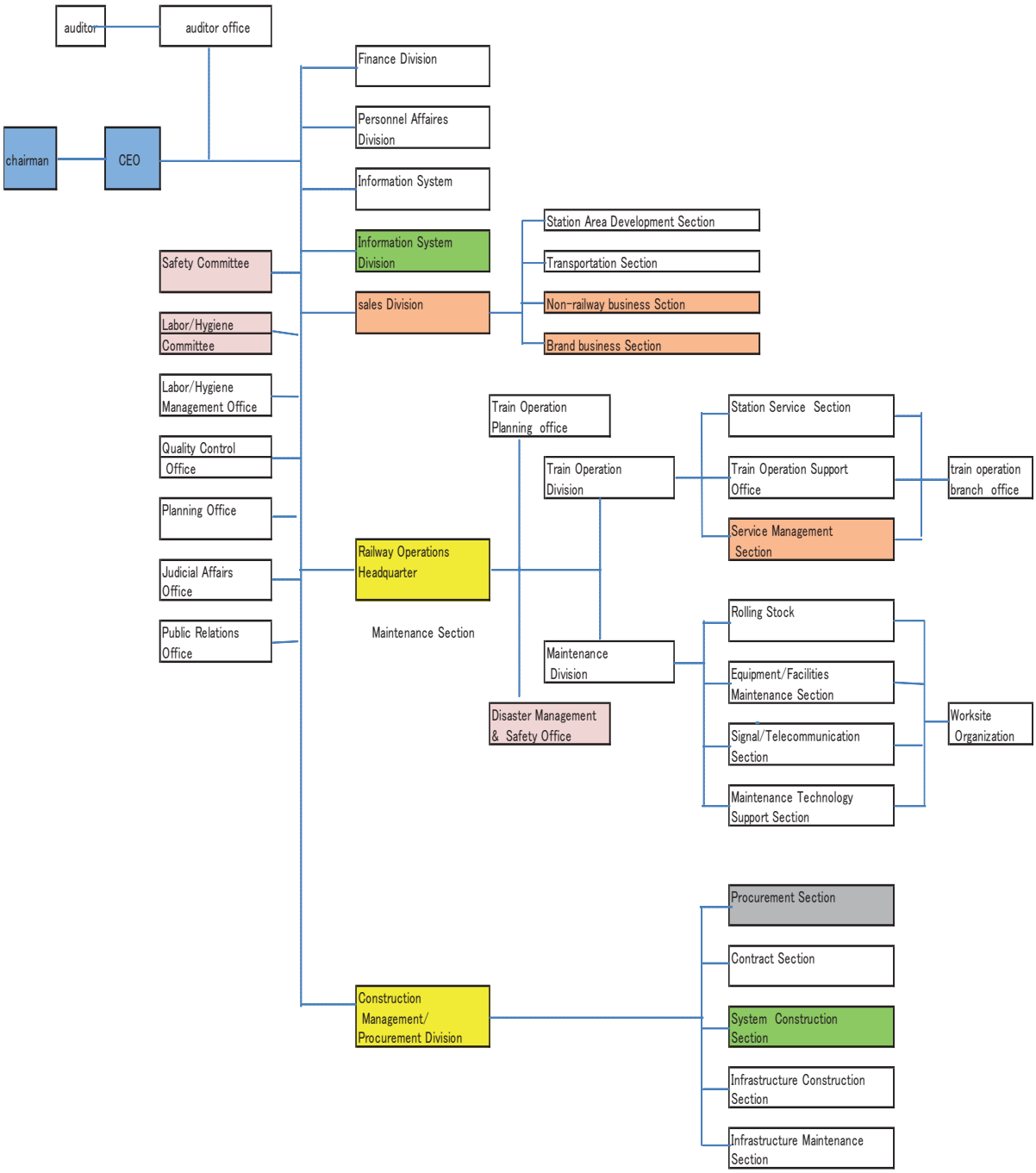


Figure 11.2-6 Present Organizational Chart of Taiwan HSR

c) Railway operation styles in Europe

As described above, railways in Europe were privatized in the 1990s, with the possession of railway assets and railway business promotion separated. A disastrous accident occurred in the UK in the wake of the privatization of railways, however, as a railway infrastructure holding company cut maintenance costs to a great extent in order to secure an excessive amount of profit. In 2000, the policy of privatization under the said concept was modified, therefore.

Study team introduces below the railway management styles in German and France and describe the management organizations centering on the safety control in particular.

i) French Railways (SNCF)
SNCF is a railway business undertaker promoting the businesses of French national railways, of which the enterprise style is Établissesment public à caractère industriel et commercial (hereinafter referred to as "EPIC") that is similar to the public corporations in Japan. The Head Office of SNCF, assigned with corporate functions to control divisions and Branch Offices, consists of five specialized service divisions. See Figure 11.2-7 for detail. Infrastructures, except the station facilities owned by SNCF, belong to the Réseau Ferré de France (hereinafter referred to as "RFF") separated from SNCF in 1997 to control SNCF's permanent ways. Unlike in the UK, however, the INFRA division in SNCF is performing maintenance services for permanent ways under contract with RFF. Namely, the party that is performing maintenance services for SNCF's permanent ways is an internal division of the SNCF group. For this reason, SNCF can cope with the open access by the trains belonging to other organizations.

The party in charge of safety control in the SNCF group is the Railway Service Quality and Safety, one of the corporate functions of Head Office, and the division in charge of HSR operation in SNCF is the SNCF VOYAGES that controls TGV France and TGV Europe.

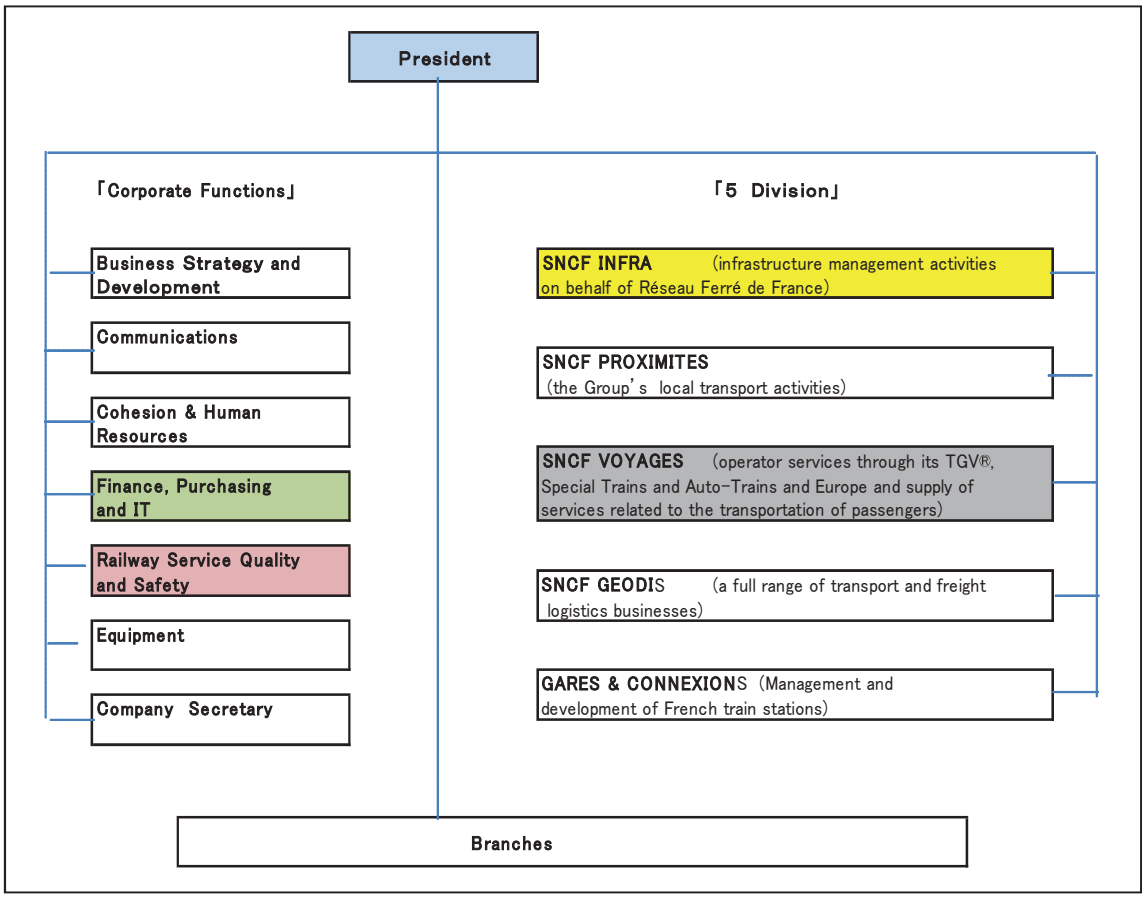


Figure 11.2-7 Organizational Chart of SNCF Group

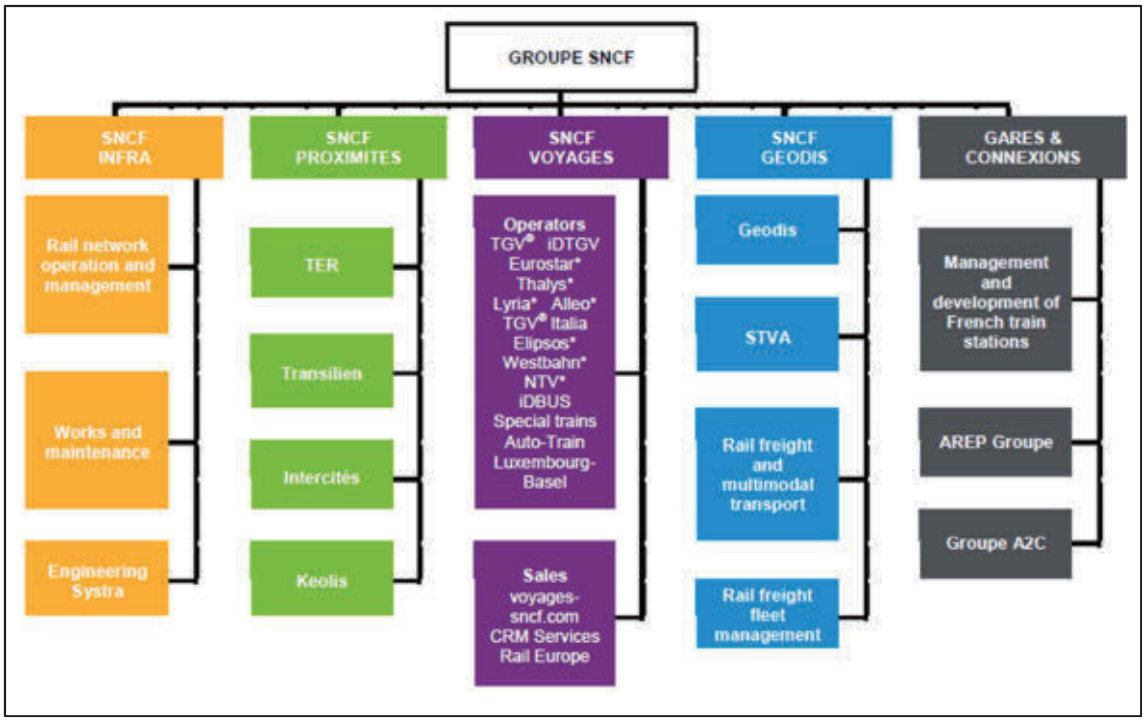


Figure 11.2-8 Five Service Divisions in SNCGF

ii) German Railways (DB)

The German Railways (hereinafter referred to as "DB") is a stock company, born in 1994, with the former West German Railways and East German Railways merged and privatized, with its stocks still owned 100% by the Federal Republic of Germany, however. In 1999, a DB Holding Company was established to have six companies under its umbrella. They are companies to undertake (1) long-distance passenger train operation (DSB Reise and Touristik) , (2) short-distance passenger train operation (DB Regio), (3) intra-city transport (DB Stadtverkehr), (4) freight train operation (Railion), (5) management of stations (DB Station and Service) and (6) maintenance services for tracks (DB Netz). In 2006, the Government of Germany made public a plan of stock market flotation excluding stocks for permanent ways and passenger stations to imply their nationalization. In the passenger and freight transport divisions, the government didn't wholly offer stocks for public subscription but suppressed the rate of stock market flotation to minimize the influence of stock holders on railway management. To keep abreast of this movement, the government established the Sub-Holding Company as a "DB Mobility Logistics AG" in 2008. As the economic situation changed thereafter, however, the government determined to quit stock market flotation in October 2008. As a result, DB's management organization is now as shown in Figure 11.2-9. In the case of DB as well, construction and maintenance/upkeep of permanent ways is undertaken by the "DB Nets Track," one of the companies in the DB group, to cope with open access.

The party in charge of safety in the DB group is the Safety and Quality Assurance Division, in the Rail Technology, Deutsch Bahn Group and DB Mobility Logistics sub-group. Operation of ICE trains and other HSR trains is performed by the "DB Bahn Long-Distance."

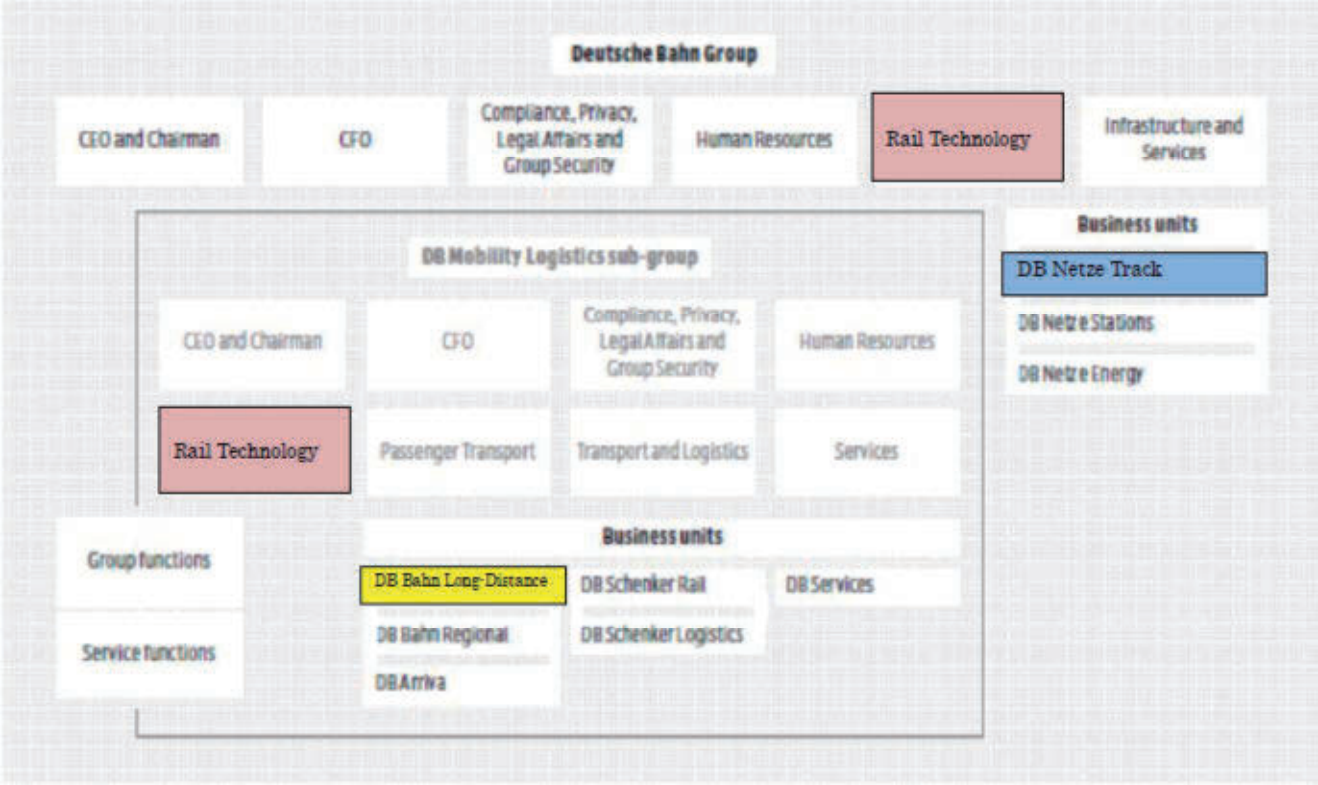


Figure 11.2-9 Organizational Chart of DB Group

d) Management organization in India
i) Indian Railways
Study team referred to the management organization of Indian Railways in "Chapter 3, Interim Report 1." The Head Office organization having employees as large as approximately 1.4 million in number is not much helpful in discussing the management organization of Indian HSR line 1. Instead, what would be more informative is the organization of Western Railway, a local organization of Indian Railways, or that of Delhi Metro (hereinafter referred to as "DMRC), on which study team implemented a survey, therefore.

- Management organization of Western Railway

The Western Railway is a local organization of Indian Railways, having an approx. 6,000 km-long revenue service line centering on the Ahmedabad–Mumbai section. See Figure 11.2-10 for the chart of its organization, which is basically a division-wise vertically split cascade-type organization like that of JR East.

For the organization on safety control in the Western Railway, see Figure 11.2-11. A Safety Officer of each division is posted under the Chief Safety Officer (CSO), Western Railway Head Office, and also a Safety Officer at each Branch Office (Division), to constitute a safety control organization considerably similar to that of the railways in Japan. The Western Railway also has an independent materials division to reveal a fact that it is strongly conscious of the problems in procurement of parts seen in Southeast Asian countries. There is also a division dedicated to "security," an issue specific to India. For Indian HSR line 1 as well, discussions will be called for regarding this inevitable subject.

As an extremely important issue for Indian Railways, the "necessity to delegate power to local

or subordinate organizations" is cited in the "Report of the Expert Group for modernization of Indian Railways" (Feb. 2012) and the "Report of High Level Safety Review Committee" (Feb. 2012). Like in the case of JNR, Japan, it seems that the larger the organization is, the more difficult solving this problems becomes.

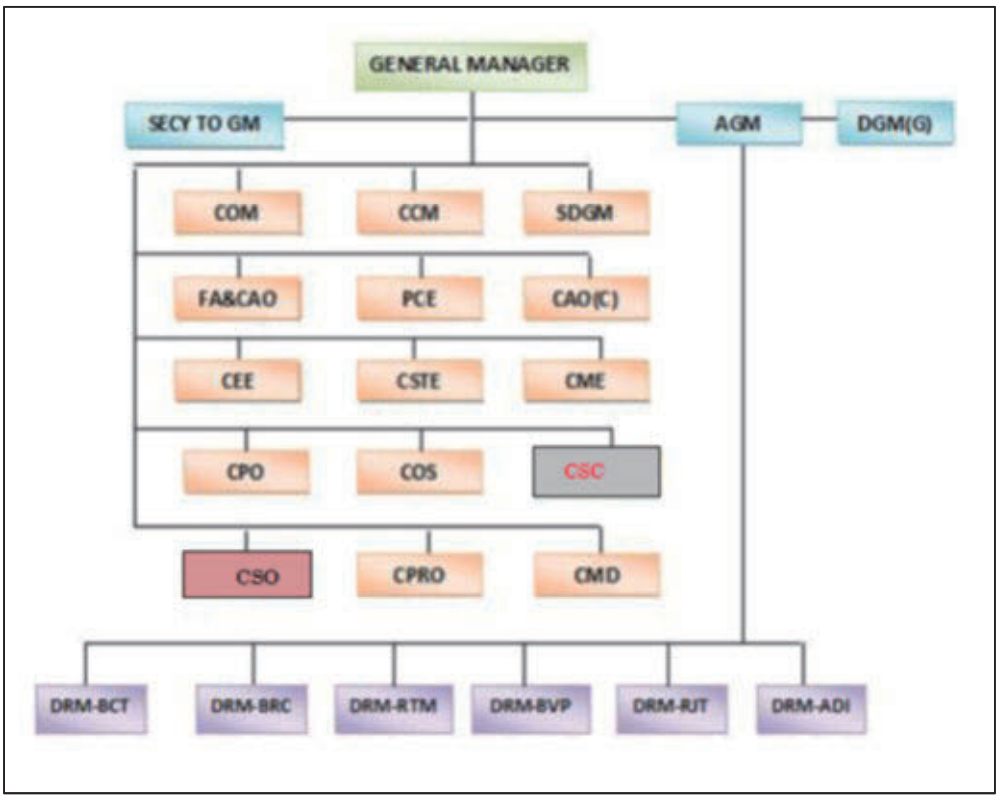
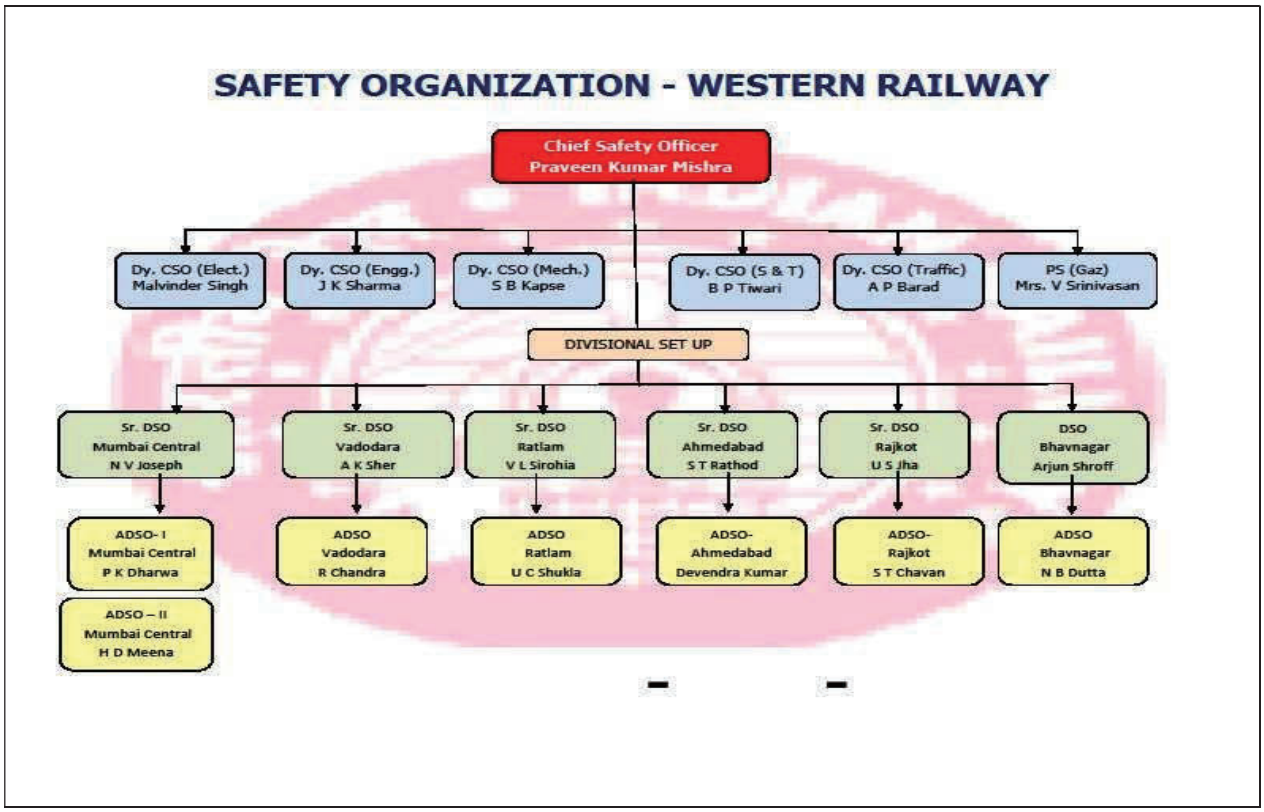


Figure 11.2-10 Organizational Chart, Western Railway

AGM: Additional General Manager
Secy to GM: General Admin
DGM: Deputy General Manager
COM: Chief Operating Manager
CCM: Chief Commercial Manager
SDGM: Sub Divisional General Manager
FA&CAO: Finance & Chief Accounts Officer
PCE: Principal Chief Engineer
CAO (C): Chief Administrative Officer (Construction)
CEE: Chief Electrical Engineer
CSTE: Chief Signal & Telecommunication Engineer
CME: Chief Mechanical Engineer
CPO: Chief Personal Officer
COS: Chief Officer & Stores
CPRO: Chief Public Relations Officer
CMD: Chief Medical Department
CSC: Chief Security Officer
CSO: Chief Safety Officer,
DRM-BCT: Divisional Railway Manager–Mumbai Central
DRM-BRC: Divisional Railway Manager–Vadodara
DRM-RTM: Divisional Railway Manager–Ratlam
DRM-BVP: Divisional Railway Manager–Bhavnager
DRM-RJT: Divisional Railway Manager–Rajkot
DRM-ADI: Divisional Railway Manager–Ahmedabad,



CSO: Chief Safety Officer,

DSO: Divisional Safety Officer
ADSO: Assistant Divisional Safety Officer

Figure 11.2-11 Organization of Safety Control, Western Railway

ii) Management organization, Delhi Metro (DMRC)
DMRC is implementing revenue service on seven lines having a route length of approximately 190 km in total. See Figure 11.2-12 for its organization chart. Similarly to Indian Railways, DMRC has a management organization, basically of the division-wise vertically split cascade-type like that of JR East, except a fact that the General Manager of Personnel Affairs, is posted under the Director of Finance. This means that general, personnel and financial affairs are all integrated into one division.

Under the safety management organization of DMRC, an Executive Director/Safety & TI is assigned under the Director of Operation. Although the organizational chart doesn't explicitly indicate, an Executive Director/Safety & TI is temporarily appointed under the Director of Project, as several large-scale accidents have occurred in the permanent way extension work.

As seen in the organizational chart of DMRC, most of the engineering divisions are vertically split, seemingly to make the coordination in between an important subject for the organization.

As already referred to in the above "Concept of the Management Organization of HSR, it is important to establish a system for different divisions to implement decision-making on the spot in unison.

In regard to "security," the Chief Security Commissioner (CSC) is organized under the Director of Operation," with CCTV monitors are installed at a place adjacent to the Operation Control Center (OCC) to grasp the situation of each station.

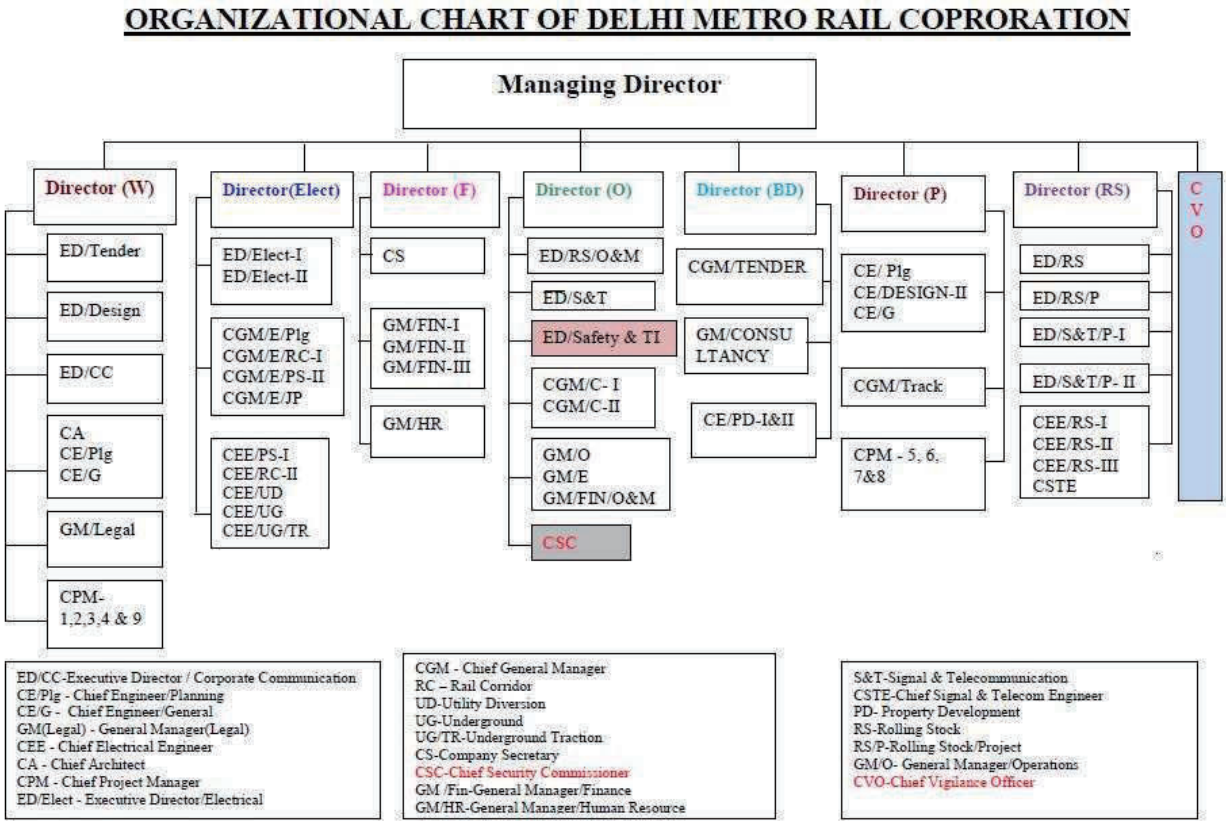


Figure 11.2-12 Organizational Chart of DMRC

(2) Concept of the management organization of Indian HSR line 1

What shall be considered first in discussing the HSR's management organization is the method to guarantee the safety of HSR trains running at 300 km/h or over. A system to guarantee safety for HSR shall be established first at the stage of construction, which is verified by the fact that Japan established the introduction of fail-safe and abnormality detecting systems into Shinkansen at inauguration as a fundamental idea of safety and subsequently succeeded in maintaining Shinkansen totally free from serious accidents for several decades ever since.

However complete a system may have been established, guarantee of safety is questionable, unless the management organization therefor is firm and solid. It is not deniable, however, that the system partially fails or accidents may occur due to errors in train operation, improper maintenance services, disasters or other events beyond imagination. Railways are a system in which different technologies are closely linked with each other. It is extremely important, therefore, to establish an organization to enable cooperation at emergency beyond the boundaries between each technology category . Even in the Shinkansen railways in Japan and Taiwan, management divisions and work-site organizations constitute a formation sorted by technology categories. This is an excellent idea in the sense that different divisions polish/upgrade their own technologies in a friendly rivalry with each other, while maintaining

tension in between. In some cases, however, self-assertion of some divisions would become too strong to make much energy spent in coordination between different divisions and subsequently impede the efficiency of management as an ill effect. It is true, therefore, that an organizational mechanism has normally been established in organizations to make smooth coordination possible between different divisions. In discussing the management organization of Indian HSR, a mechanism shall be contrived to eliminate such evil practices.

1) An Independent Management Organization of HSR and Control/Execution of Train operation/infrastructure maintenance within one organization

As described in the preface to "11.2.1 Management organization of India HSR line 1," the HSR in India is extremely different from the existing railways in the country. Therefore, the former shall never be managed mixed with the latter. Whatever a shape the assets possession scheme may take, an independent HSR management organization shall directly control the services ~~at~~ including work-site organizations, with train operation and infrastructure maintenance that are inseparable therefrom, shall never be separated but be controlled and executed under the same umbrella.

2) Organization for Safety and Disaster Measures

As described above, the Safety Management Office in charge of planning and implementing comprehensive safety guaranteeing measures played an important role at the inauguration of Tokaido Shinkansen in Japan. This is thought to be a precedent case that should duly be observed by India. The theme what division shall take charge of safety measures was discussed frequently in the JNR age and also after it was reorganized as a JR group. In the JNR age, the Security Section in charge of safety control was in the Train Operation Department executing train operation control. At present, JR Central has the Safety Section in the Transportation and Marketing Department, Shinkansen Operations Division. In JR East, the Transport Safety Department is an organization separated from the Transport and Rolling Stock Department and from the Maintenance related sections.

In view of the fact that the Indian HSR line 1 is the first one of its kind in the country, its organization shall (1) comprehensively plan and implement safety measures in the same way as Tokaido Shinkansen did at its inauguration and (2) be independent of other divisions and positioned close to the top in order to facilitate smooth coordination between different divisions.

a) It is clear that safety measures shall include not only those related to HSR operation but also those to ensure safety of passengers and services implemented by employees.

In the management organization of Indian HSR line 1 under discussion, services shall be executed in principle by the organization itself, though there may be some to be outsourced exceptionally. When some time has passed after inauguration, the issue of outsourcing inevitably comes to the fore. What shall be noted then is the fact that a safety system shall be established not only for the HSR managing company but also for outsourced service operators .

b) In promoting concrete safety measures, the company shall clarify the fundamental policies on safety first and make them thoroughly understood among employees. This requires (1) methods to routinely guide employees to ensure safety at workplace, (2) correctly grasping the accidents already occurred and establishing countermeasures therefor, (3) information sharing to prevent repetition of accidents based on those in the past and (4) training of employees for assumed emergencies on a regular basis. Furthermore, additional arrangements required include a plan of investment into safety equipment/facilities based on the situation after inauguration, with a budget guaranteed therefor.

c) What shall be noted in discussing safety measures is the accidents caused by compound

factors encompassing different technologies in different categories. It may be acceptable that engineers tend to be absorbed in the technologies belonging to their own categories. As railways are a composite system composed of different technologies, however, it is true that countermeasures are hardly be established satisfactorily against accidents caused by the factors related to a number of different technologies in different categories. Typical cases of this complexity are the relations between wheel and rail and between pantographs and overhead contact lines. To solve the problems in this category, it is important to establish an organization for safety control independent of other divisions.

d) There are meteorological and other natural conditions specific to India, such as heavy squalls, floods and earthquakes. It is said that the Disaster Management Office was set up in the Railway Operations Headquarters of Taiwan HSR, at its inauguration, in consideration of the earthquakes that hit Taiwan immediately before. The issue of disaster management is equally important for India. Although an independent organization may not be necessary, it is required for India to discuss at least installation of a safety/disaster management office integrated with a safety control office.

e) Based on the experience in pursuing railway accident preventive measures for long years, it is said in Japan that a small-scale accident precede a large-scale accident as a premonition thereof. It is important that a safety management committee participated in by the top executives shall be organized in the company, therefore, to discuss (1) whether it isn't a premonition of large-scale accident in case a small-scale one has occurred and (2) investigation of accidents, verification of causes and establishment of countermeasures. This convention has been introduced into most of the railway companies in Japan and the Taiwan HSR company. What is required for the safety of railways is a corporate stance to address issues related to safety not only by the top executives but also by the rank and file rolled into one.

In the aftermath of the Fukuchiyama line accident that claimed more than 100 lives, the Ministry of Land, Infrastructure, Transport and Tourism, Japan, adopted a new rule regarding the safety control measures to be observed by railway business operators. The rule emphasizes the importance of the safety management organization including the top executives.

f) Therefore, as the management organization of the Indian HSR1 line, Study team recommends that the Safety and Disaster Management Office be organized and headed by a vice-president. By this arrangement, the Safety and Disaster Management Office is placed above other divisions, because safety and disaster management are closely related not only with technological divisions but also with management/planning divisions, when investment into equipment/facilities required for safety and disaster management and education/training of relevant employees are taken into consideration. The Vice-President in charge of Safety and Disaster Management shall, therefore, comprehensively address safety/disaster countermeasures including coordination between different divisions regarding the above theme. The Safety and Disaster Management Office shall also be the secretariat for the Safety Committee belonging to the President.

3) Institution of Transport Headquarters

In addition to the important and comprehensive coordination between divisions referred to above, coordination between different engineering divisions is equally important in daily transport control and at emergency in particular. The Railway Operations Headquarters is organized to address this subject. The divisions most closely related to this organization are divisions of (1) transport/operation, (2) rolling stock, (3) civil engineering and (4) electric engineering. These four divisions are thought to be an inseparable and closely-linked organization with OCC at the center including support of logistics services thereof. Therefore, Study team recommends that "a Director of Transport Headquarters" be appointed to facilitate

daily train operation while combining these four divisions.

4) Installation of the Marketing Division

The Commercial Management Division at the head office, Western Railway, is in charge of affiliated businesses in addition to ticket selling/booking and dealing with customers' complaints. In contrast, DMRC rather aims at utilization of assets at the project implementation stage.

In the case of Indian HSR line 1 as well, a marketing division shall be set up to secure income from affiliated businesses in addition to that from the primary railway operation services. For this purpose, it is important to discuss how to secure assets to be appropriated for affiliated businesses at the project implementation stage. In view of the fact that DMRC seems to have some restrictions in appropriating unused spaces to affiliated businesses, Study team recommends that an affiliated business section be installed, assigned with supporting the services for such conditions, in the marketing division of Indian HSR line 1.

5) Concept of Other Divisions Requiring Particular Attention

a) Organization of training and education

Given the number of the employees required for the HSR to operate the line 1, education and training of employees to serve HSR shall start at least one and a half years before inauguration. Furthermore, a test/training center prior thereto should have been completed two years before inauguration when the periods required for construction of education and training facilities and introduction of HSR rolling stock are taken into account. This time schedule is far from one having much time in reserve when compared with the lead time prepared for the inauguration of Tokaido and Taiwan Shinkansen railways. For reference, it took approximately two years for Taiwan Shinkansen from the first test run to the start of revenue service. To acquire technologies before inauguration, it is important to transfer construction technologies to India at the construction of test tracks and implementation of practical exercises on test and training tracks.

Education and training of employees shall be done not only before but also after inauguration aiming at upgrading the technical level of those working for HSR operation. It is a matter of course that education and training shall also be implemented for those newly recruited to prepare for increases in the frequency of train operation to cope with the increased transport demand after inauguration. For this purpose, the test/training center prepared for tests and training before inauguration shall be used as training facilities. Furthermore, it is thought that an Education and Training Section be installed in the Administration/Personnel Affairs Division, Head Office, to formulate education and training plans for related employees and perform coordination with the Education and Training Institute.

b) Materials procurement division

In the organization of Tokaido Shinkansen at inauguration, a materials center was installed as one of the work-site organizations belonging to the Tokaido Shinkansen Branch Office. In the same way, the organization of Indian HSR line 1 shall be constituted to quickly supply materials to relevant workplaces.

As an important mission for materials procurement, issues related to (1) quality, (2) delivery time and (3) costs shall duly be observed. In the case of Tokaido Shinkansen, work-site organizations for maintenance such as train operation centers, track maintenance centers and power supply centers are located side by side in the same area. Therefore, Study team recommends India to concentrate materials-related services conducted by these work-site organizations into an accounting/materials center, thereby aiming at specialization of services and improvement of efficiency. Furthermore, Study team aims at establishing an organization to make work-site maintenance organizations dedicate themselves to their primary services while

minimizing the volume of deskwork as far as possible.

Most of the materials used for HSR are related to the most-advanced technologies, making high-level quality assurance therefor essential to guarantee the safety of HSR's high-speed operation. As these materials feature little marketability and long manufacturing periods, it is important to keep appropriate quantities of these materials in stock not to disturb train operation after inauguration. In the railways in Southeast Asian countries, it is often the case that parts to replace defective ones cannot be procured in time or those on a car in service are appropriated for other cars to replace defective ones, thereby coping with short budgetary amounts. As a result, trains cannot be operated as scheduled due to shortage of active cars. Such a situation shall never be allowed for Indian HSR. For this reason as well, Study team wants to streamline the organization for materials procurement, set up a materials section in the finance/procurement department division, therefore.

c) Operation control center (OCC)
Train operation will sometimes delay due to failure of rolling stock or restrictions of meteorological conditions. On such occasions, those in relevant divisions shall cooperate to correctly assess the situation and quickly and appropriately issue instructions or make necessary arrangements. This mission is normally assigned to the OCC.

In this context, DMRC's OCC may be one of the most suggestive OCCs for India. Despite that DMRC is an urban railway with train speed much different from that of HSR, the HSR's OCC may be regarded as one similar to that of DMRC in principle partly in the sense that train operation and equipment/facilities monitoring are computerized in both the HSR and DMRC systems. One of the most conspicuous features to distinguish HSR from urban railways is the fact that the time zones for train operation and maintenance work are distinctively separated to guarantee the safety of train operation. The services related thereto shall be implemented based on the conjunction between train dispatchers and the maintenance services related dispatchers. This makes the communication and coordination between different divisions within OCC a matter of utmost importance. For the purpose of recovering from the emergency state in case one has arisen, OCC office layout shall be designed to allow dispatchers related to different divisions to coordinate face to face with each other on the same floor in the OCC.

d) IT system
High-frequency HSR train operation cannot be realized without relying on computer systems. In the case of Tokaido Shinkansen in Japan, computers are used to draw train operation diagrams and control train operation/maintenance services of various categories. Computerization is extremely important for HSR assigned with a mission of high-speed mass transport. For the Indian HSR line 1, therefore, it is a subject of utmost importance to what extent IT system technologies be introduced in the future. Although some IT systems have already been developed in India, including those for seat booking and freight transport, introduction of IT systems into special fields related to railway operation is far behind the times. The IT system on train operation is rather advanced in DMRC than in Indian Railways.

For the Tokaido Shinkansen railway, the Information Management Office was set up in 1970 as referred to above, six years after inauguration, to introduce IT systems on a full-fledged scale. To use a computerized system to quickly and correctly control the train operation of Shinkansen and implement various maintenance services, it is not sufficient to establish the system alone, but it is extremely important to improve the system according to the results of application, perform troubleshooting and educate operators who use the system. In particular, systems for train operation control are directly related to safety issues. At the stage of system composition, therefore, railway operators in Japan delegate employees who will use the computer system to computer manufacturers to acquire the skill for computer applications.

The importance of this practice will be revealed by the fact that, in the Taiwan Shinkansen Railway, the Information System Division is set as an independent division in the head office organization and the System Construction Section is in the Construction Management/Procurement Division. Furthermore, JR East has two organizations, the Information System Planning Department and the IT & SUICA Business Development Headquarters as referred to above.

In the Indian HSR line 1, it may not be possible, at an initial stage when the number of train is still limited, to install a comprehensive management system similar to that of Shinkansen in Japan, but such a system will become important sooner or later, if India wants to make HSR a safe and efficient transport means in the future. India shall contrive an organization for this purpose in advance, or install an IT System Office as an independent organization at inauguration to prepare for the future.

e) Security measures
Although it doesn't come to the fore in Japan, what is essential for India may be establishment of security measures. Both in the Indian Railways and DMRC, security measures are put in force by the Railway Protection Force (RPF) and the Government Reserve Police (GRP). RPF is a subordinate organization of the Ministry of Railways (MOR) in charge of the safety of passengers and railway facilities, while GRP is an organization under the state government to maintain strict control over violation of law in the territory of railways. As the salaries/wages for the members belonging to these two organizations are born by the government, HSR shall set up the Security Management Office and facilities where RPF and GPR members are to be stationed.

f) Vigilance organization
Although it is not shown in the organizational chart of Western Railway, the CVO-Chief Vigilance Officer exists in DMRC, which is an organization to prevent wrongdoing and corruption by employees and executive members. A number of enterprises in Japan has the Inquiry & Audit Department to take charge of internal inspection, though a little different from the vigilance organization. Which shall India adopt, CVO-Chief Vigilance Officer or an organization similar to the Inquiry & Audit Department in Japan? It is all right to answer this question by the time of inauguration based on discussions among stakeholders.

(3) Management Organization for the Indian HSR line 1 (draft)

See Figure 11.2-13 and Table 11.2-1 for the organizational chart of the Indian HSR line 1 centering on the Head Office (draft) and division-wise assignments formulated based on what have been discussed above.

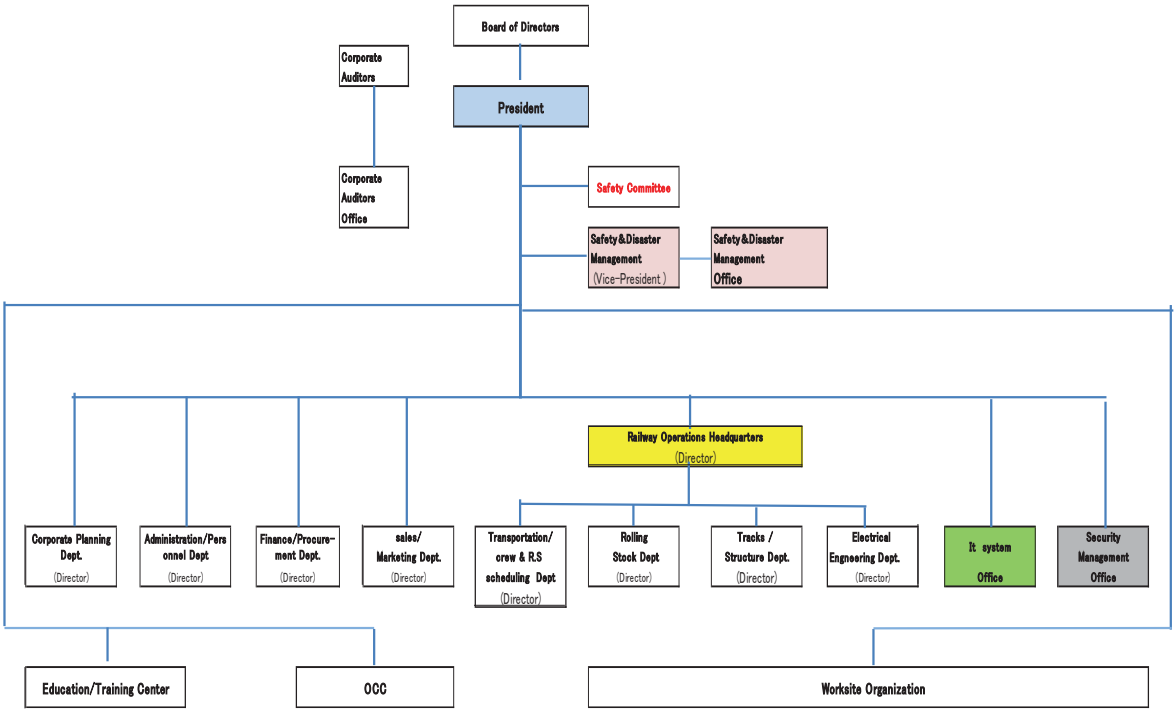


Figure 11.2-13 Organizational Chart, Head Office, Indian HSR Line 1

Table 11.2-1 Division-wise Assignments, Head Office, Indian HSR Line 1

Designation		Principal assignments
President		President's duties
Vice-President, Safety and Disaster Management		Vice-President's duties and safety and disaster management
Corporate Auditors		Auditing
Corporate Auditors' Office		Support of auditor and internal inspection
Safety & Disaster Management Office		Planning safety and disaster measures and overall coordination: (1) Safety, (2) Passengers, (3) Transport, (4) Rolling stock, (5) Civil engineering, (5) Electric engineering, (7) Disasters
Corporate Planning Dept.	Planning Division	Management planning, control of corporate duties and general affairs: (1) Management planning, (2) Control of corporate duties and general affairs
	Investment Planning Division	Overall coordination for equipment/facilities investment: (1) Construction budget, (2) Expenses for repair services
Administration/Personnel Dept.	General Affairs Division	Control of corporate duties, general affairs, public relations and legal affairs: (1) Control/general affairs on corporate

			duties, (2) Public relations, (3) Legal affairs, (4) Secretary duties
	Personnel/Labor Division		Employment planning, personnel affairs and reward/punishment: (1)Employment planning/adoption, (2) Personnel affairs, (3) Reward/punishment, (4) Wage, (5) Labor unions
	Education/Training Division		Education planning for employees, training center
	Welfare Division		Welfare of employees: (1) Welfare, (2) Health control
Finance/Procurement Dept.	Finance Division		Control of budget and corporate duties, general affairs: (1) Budget control (2) Control of corporate duties and general affairs
	Accounting Division		Accounting treatment, account settlement: (1) Account settlement, (2) Tax, (3) Accounting system
	Procurement Division		Materials services: (1) Planning, (2) Purchase
Sales/Marketing Dept.	Management Division		Control of corporate duties, general affairs
	Station duties/Service Division		Station duties, passenger services and guidance
	Marketing Division		Merchandise planning, ticket selling
	Affiliated Business Division		Affiliated businesses
Railway Operations Headquarters	Management Division		Control of corporate duties, general affairs
	Transport/ Crew & Rolling Stock Scheduling Dept.	Train Division	Train operation planning
		Train Crew Division	Scheduling and guidance of train drivers and conductors
		Rolling Stock Rotation Division	Scheduling of rolling stock and action against failures during rotation
	Rolling Stock Dept.	Workshop Division	Management of rolling stock workshops
		Rolling Stock Maintenance Division	Inspection/maintenance of rolling stock
		Rolling Stock Quality Division	Quality and technical development for rolling stock
	Tracks/Structure Dept.	Track Maintenance	Maintenance and technical development for rails/tracks

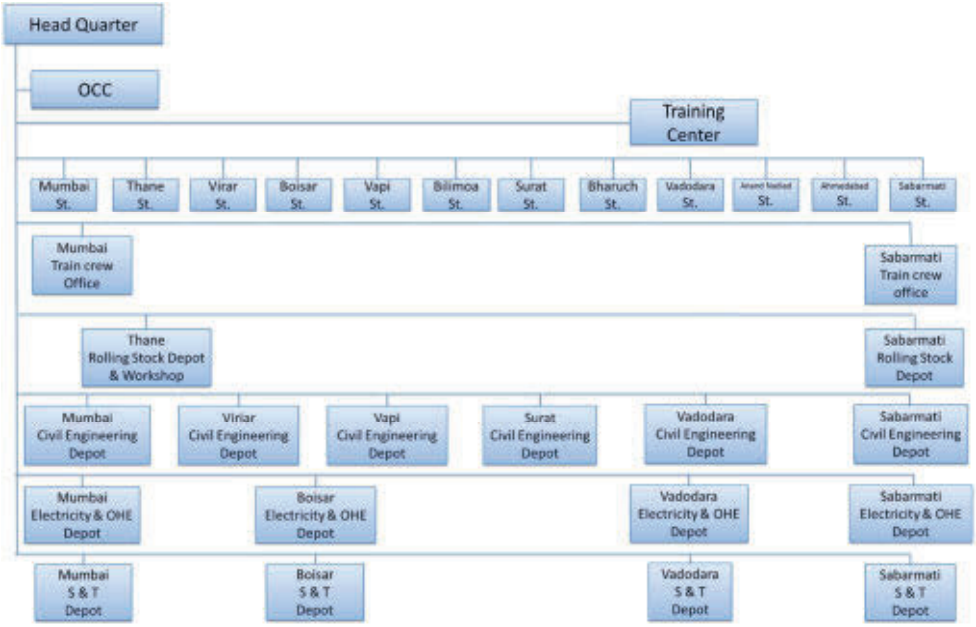
		Division	
		Railway Structure Division	Maintenance and technical development for railway structures
		Architecture /Machine Division	Maintenance and technical development for architectures/machines
	Electrical Engineering Dept.	Power Division	Maintenance and technical development for power supply/substation equipment/facilities
		Signal Division	Maintenance and technical development for signal equipment/facilities
		Telecommunication Division	Maintenance and technical development for telecommunication equipment/facilities
IT System Office			Maintenance/introduction of IT systems and guidance for relevant employees
Security Management Office			Security measures at stations, for rolling stock and in HSR wayside areas

[Organization affiliated to Head Office]

Name	Principal assignments	Remarks
OCC	Dispatching duties for HSR	
Education/training center	Education/training of employees in different divisions	

11.2.4 Structure of Operation and Maintenance

Figure 11.2-14 shows the management, upkeep and control structure of HSR operation and maintenance organization.



Source: Study Team

Figure 11.2-14 Management, Upkeep and Control Organization

(1) Station

- Based on the routing plan, 12 stations shall be set in major cities.
- Each station is assigned with a station master, deputy station master, assistant station master and other workers on duties for platforms, ticket windows and security measures
- As in the current Indian Railways and Delhi Metro, passengers are subject to security inspection before boarding a train by the Railway Protection Force (RPF) belonging to the railway business promoter and the Government Railway Police (GRP) belonging to the government.

(2) OCC

- A chief operation center officer, an assistant chief operation center officer and an instructor are assigned all for day services.
- A leader, deputy dispatching leader, transport dispatcher, ABC rotation, passenger dispatcher, equipment/facilities (track maintenance, power, signal and telecommunication) dispatcher and rolling stock base control members are also assigned on duties in shifts.

(3) Rolling Stock Depot & Work Shop

- Rolling stock depots should be instituted at Thane and Sabarmati for daily inspection and regular inspection.
- The Thane depots will have the function of workshop for general inspection

(4) Civil Engineering Depot (Truck and Structures)

- Six civil engineering depots should be instituted for this project by referring to the maintenance organization in Japan (approx. at 95 km intervals).

- Engineering depot staffs do the regular inspection of permanent way, make the plan of the repairing, direct the repairing work, and do the inspection of completion.
- Repairing works are outsourced.

(5) Signalling & Telecommunication (S&T) Depot

- Four signaling depots should be instituted for this project by referring to the maintenance organizations in Japan (approx. at 130 km intervals).
- S&T depot staffs do the regular inspection of signaling and telecommunication equipment, make the plan of the repairing, direct the repairing work, and do the inspection of completion.
- Repairing works are outsourced.

(6) Electric & OHE Depot

- Four signaling depots should be instituted for this project by referring to the maintenance organizations in Japan (approx. at 130 km intervals).
- -Electric & OHE depot staffs do the regular inspection of OHE, substations and other electrical equipment, make the plan of the repairing, direct the repairing work, and do the inspection of completion.
- Repairing works are outsourced.

11.2.5 Offices and Staff for Operation and Maintenance

Table 11.2-2 lists the number of offices and staff required for HSR's operation and maintenance.

Table 11.2-2 Number of Offices and Staff unit: persons

Department		Number of Office	Number of all staff (No. of outsourced staff)			
			2023	2033	2043	2053
Head Quarter		1	240	240	240	240
OCC		1	49	49	49	49
Training Center		1	20	20	20	20
Station		12	1,093 (385)	1,253 (465)	1,505 (591)	1,845 (761)
Train Crew Depot		2	278	422	631	992
Rolling Stock Depot and Workshop		2	498	713	1,199	1,929
Maintenance Depot	Civil Engineering (Track, Structures)	6	1,090 (838)	1,090 (838)	1,090 (838)	1,090 (838)
	Electricity & OHE	4	740 (420)	740 (420)	740 (420)	740 (420)
	S & T	4				
Total			4,008 (1,643)	4,527 (1,723)	5,474 (1,849)	6,905 (2,019)

Source: Study Team

11.2.6 Major Systems and Machines Required for Maintenance

(1) Electric and Track Inspection Cars

To implement high-speed railway maintenance, track maintenance, including the dynamic inspection to be done while the car in running shall be performed in accordance with the implementation standards adopted by each railway companies. Japan now inspects tracks and electric systems on a regular basis (once per 10 days) by using Shinkansen electric and track inspection car (Doctor Yellow, East-i's). The East-i composed of six cars runs at a maximum

speed of 275 km/h to measure track displacements, ride comfort and wear of trolley wires and check the function of signal equipment/facilities. See Figure11-15 and Table 11.2-3.

Source: Study Team

Figure 11.2-15 Shinkansen Electric and Track Inspection Car (East-i)

Table 11.2-3 Items Measured by the Electric and Track Inspection Car

Category	Measurement item	Measuring interval	Measuring environment
Track measurement equipment	Level (left/right), alignment (left/right), track distortion, track level, track-gauge, car body rolling acceleration, axle box acceleration, noise	0.25 m	Day/night measurement All-weather type Measurement during operating hours
Electric system measurement equipment	Wear of trolley wire, deviation of trolley wire, height of trolley wire, contact break, crossover, obstacle, hard point, shock on pantograph, position of electricity post, no-voltage time in changeover, total changeover time, contact wire voltage, distance between contact wires	0.05 m	Day/night measurement Hot-line measurement Measurement during operating hours

(2) Facility Management System

It is possible to maintain tracks efficiently and vigorously through the integration of facility data, track inspection data and track maintenance work data. Therefore, study team introduces a facility management system into this project. The facility management system has the following merits.

- Display of track top view, yard layouts and the comprehensive track status enables visual assessment of track structure, track alignment and analysis of track conditions.
- The database to integrate dimensions of facilities, results of inspection, records of work, planning data and other information owned by the facilities control organization, a field organization to control facilities, can freely be retrieved and used for data summarization by the head office and field organizations or in the field.
- The track control system reads inspection data through various inspection devices or portable terminals, automatically judges, sums up and grasps the status of the

implementation of inspection plan.
- Adoption of electronic approval function enables responsible personnel to read through necessary data to make it complete.

(3) Maintenance Cars

Maintenance cars required for the maintenance of tracks and electric systems to maintenance depots are shown in Table 11.2-4.

Table 11.2-4 List of Maintenance Cars

NO.	Maintenance car	Number
1	Confirmation car	18
2	Motor car	27
3	Rail flaw detect car	1
4	Rail grinding machine	1
5	Multi Maintenance Wagon (MMW)	4
6	Trolley Wagon (TW)	8

Source: Study Team

11.2.7 Operation and Maintenance Costs

The operation and maintenance costs include those for track maintenance, trolley wire maintenance, rolling stock maintenance, power, management and personnel affairs. Study team will estimate the costs of these items and the total amount of management and maintenance costs. Study team appropriate a sum of approx. Rs 407,500 per year for labor costs. (Reference: Indian Railway Annual Report 2010-2011)

(1) Maintenance Cost for Civil Engineering

The track maintenance costs include (1) the ordinary costs required to repair and maintain the fixed assets excluding contact wires, rolling stock (excluding track maintenance cars) and automatic ticket selling/cancelling machines and other machines for revenue services and (2) the labor cost for employees engaged in maintenance services.
Study team appropriated an amount of approx. 6.5 Mil Rs/km/year by taking into account the fact the structures in this project are mostly earth structures and by referring to the track maintenance cost of railway promoters in Japan (excluding labor costs). The number of employees engaged in maintenance services is estimated by referring to the maintenance organizations in Japan, while adding the number of maintenance workers in outsourced maintenance services in Japan.

(2) Maintenance Costs for Electricity and Signalling & Telecommunication

Maintenance costs for electricity and signaling and telecommunication include the costs required to maintain and repair contact wires, substation machines, telecommunication machines and special cars to maintain contact wires and the labor cost for employees engaged in the maintenance of contact wires.
Study team appropriated a sum of approx. 3.8 Mil Rs/km/year as the contact wire maintenance costs based on the track maintenance costs (excluding labor costs) of high speed rail operator in Japan. Study team estimated the number of employees engaged in maintenance services by referring to the maintenance organizations in Japan, while adding the number of maintenance workers in outsourced maintenance services in Japan.

(3) Rolling Stock Maintenance Cost

The rolling stock costs include the costs required to maintain and repair rolling stock (excluding those for the maintenance of tracks and contact wires) and the labor cost for employees engaged in maintenance services.
Study team estimated the rolling stock maintenance costs as 14 Rs/car/kilometers/year in this project by referring to the rolling stock maintenance costs (excluding the labor cost) of high speed rail operator in Japan. The number of employees are estimated by referring to the maintenance organizations in Japan, while discounting the labor cost in outsourced services in Japan.

(4) Power Cost

Study team appropriated an amount of 2.93~2.99 kWh/car/kilometers/year for power costs based on the records of Shinkansen in Japan considering the operating speed of 320km/h. As the power unit cost, Study team used that of Indian Railways, 4.73 INR/kwh. (Source: Indian Railways Annual Statistical Statement 2010-11)

(5) Operating Cost

The operating costs include the station management costs and the labor costs of the train crews and employees at stations, head office, OCC and training center.
Study team appropriated a sum of approx. 124.3 Mil Rs/station/year for station management costs (excluding the labor cost) based on Japanese Shinkansen station management cost. In the number of the employees at stations, Study team included a station master, deputy station master, assistant station master and employees at ticket office, those on duties on platforms and security personnel. The number of ticket windows is estimated from the demand forecasting with the ratio of window users set at 50%. Study team assumed one driver required for each train, two conductors for a 10-car train-set and three for a 16-car train-set.

(6) Operation and Maintenance Cost

Figure 11.2-16 summarizes the operation and maintenance costs for 30 years after inauguration.

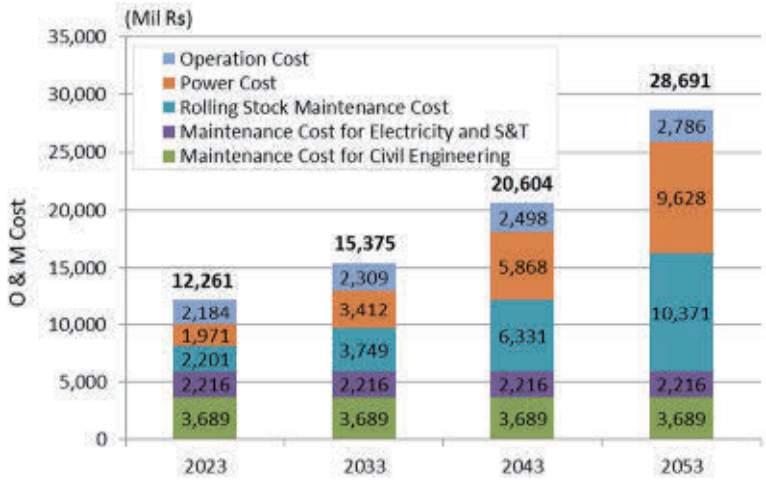


Figure 11.2-16 Operation and Maintenance Cost

11.2.8 Investment after Starting Operation

(1) Additional Investment Plan

Additional investment plan of rolling stocks and depots for meeting demand after starting operation are shown in Table11.2-5 and Table11.2-6.

Table 11.2-5 Additional Investment Plan for Rolling Stocks

Year		2023	2033	2043	2053
Number of operating trains (trains/way/day)		35	51	64	105
Required number of trains (trains)	10 cars train	24	24	24	-
	16 cars train	-	11	44	71
Required number of cars (cars)		240	416	704	1136
Additional investment for rolling stocks (cars)		246	176	288	432

Table 11.2-6 Additional Investment Plan for Depots

Year	2023	2033	2043	2053
Thane Depot	11	11	20	33
Sabarmati Depot	9	9	19	33
Total	20	20	39	66
Additional investment for Depots (lines)	20	0	19	27

(2) Renewal Period of Equipment/Facilities

Investments for renewal are in consideration according to the Replacement cycle Table11.2-7.

Table 11.2-7 Replacement Cycle of Equipment/ Facilities

Classification		Details	Replacement cycle (year)
Civil engineering structure		Embankment, cutting, viaduct, bridge, tunnel ROB, RUB, RFO	100
Track		Rails, fastener, turnout	30
		Reinforced concrete track bed, track slab, sleeper	50
Station main building		Elevator, escalator, etc.	25
Rolling stock			20*
equipment/facilities at rolling stock base			30
Power supply equipment/ facilities	Substation	Transformer	30
		Other than transformer (switch gear, distributing board)	20
		Diverter switch (2023-2043)	20
		Diverter switch (2044 and after)	10
	OHE	Other than trolley wire (other wires, support)	40
Signal and telecommunication		Electronic interlocking system, ATP ground equipment (units, relays)	10
		Electric point machine	10
		Train radio system (units)	10
		Optical carrier equipment (units)	10
		Distribution board for signal	20

System	OCC system	17
	P-SCADA	20
	F-SCADA	10
	Disaster prevention system	15
	Equipment/facilities control system	10
Machines for maintenance	Electric system/track inspection car	20
	Other cars for maintenance	30

* Important components of electric machines/devices partly subject to replacement in the 13th years after inauguration

(3) Investment after Starting Operation

Table 11.2-8 shows the investment cost after starting operation. It includes additional investment of rolling stocks and depots, and equipment/facilities renewal costs during the project period of 30 years. It is not adjusted for the effects of inflation.

Table 11.2-8 Renewal Costs by Year

Year	2033	2036	2038	2040	2043	2045	2046	2050	2053
Additional investment cost	61,253	959	965	1,622	138,244	616	1,797	154	136,415

Units: Million Rs

Chapter 16 Legal Systems and Technical Standard

16.1 High Speed Railway Line Construction Procedure in Japan

16.1.1 Japanese Institute and Procedure for Public Work (Council System)

In Japan, the procedure to decide and implement an important project is laid down by the law. The Minister consults the council which is composed of person's concerned and acknowledged scholars of erudition and experience to summarize the opinions. Under the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) are Land Council, Development of social Infrastructure Council and Transport Policy Council.

(1) Land Council

Minister of MLIT consults Land Council about comprehensive and fundamental policy of land use, development and maintenance. The Council consists of 6 members of the House of Representatives, 4 members of Representatives of the House of Councilors and less than 20 acknowledged scholars of erudition and experience (professors, governors, businessmen and concerning persons of mass media).

(2) Development of Social Infrastructure Council (Ex. Urban Planning Central Council)

Minister of MLIT consults Development of Social Infrastructure Council about the important matters concerning real estate business, land for housing, architecture, qualified architect and public facilities. The Council is composed of acknowledged scholars of erudition and experience (professors, businessmen, commentators and persons from media).

(3) Transport Policy Council

Minister of MLIT consults Transport Policy Council about the important matters concerning transport policy. The Council is composed of acknowledged scholars of erudition and experience (professors, businessmen, consultants, representatives of labor unions and persons from media). Transport Policy Council has 8 branch councils. (transport system, technology, tourism, over land transport, maritime affairs, port, aviation and weather)
The land transport branch of Transport Policy Council has a task force for Railway. The discussion about every high speed railway line is held at the subcommittee under the Railway task force.

16.1.2 Japanese High Speed Railway Construction Procedure

There is Nationwide Shinkansen Railway Development Act in Japan. The Minister of MLIT should decide the Master Plan for constructing high speed railway lines considering the demand of railway transport, main direction of land development and effective development of high speed railways. Basis the Master Plan, the Minister orders the study of constructing high speed railway line. The Minister nominates a construction corporation and an operating corporation for the construction line. Since railways do not achieve its goal only by being built, operations of the railways is the key point which matters. thus having enough discussion with the management of operating corporation is indispensable before the construction begins. The Minister is supposed to negotiate with the operating corporation and get an agreement before nominating a construction corporation. The Minister has to determine the construction plan for a new line defined by the master plan. When it is done, the Minister has to instruct the construction corporation to start the construction. The construction corporation is required to submit the construction work implementation plan which indicates a route name, the section of construction work, construction method, and the matter defined in MLIT ordinance and to get the approval of the Minister. For the purpose of securing the land of Shinkansen construction

site, action restricted area may be specified. In this area, the character of land must not be changed, and it is not allowed to rebuild or extend or newly build a building.
The flow of Shinkansen construction in Japan is shown in Figure 16.1-1 and Example of Central Shinkansen construction procedures shown in Figure 16.1-2.

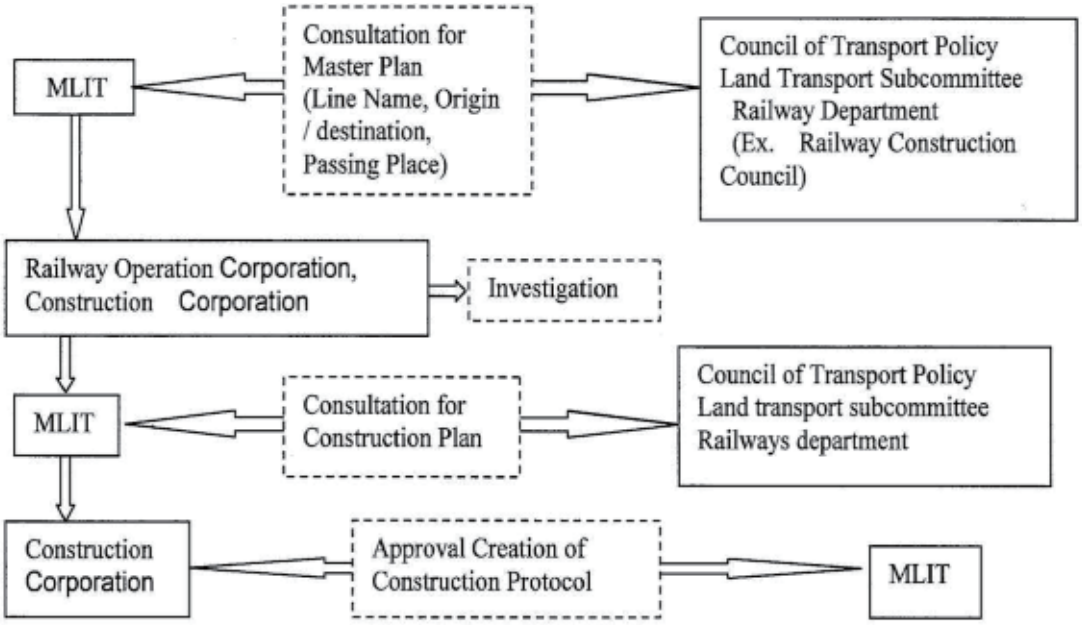


Figure 16.1-1 Flow of Shinkansen Construction
Source: JICA Study Team

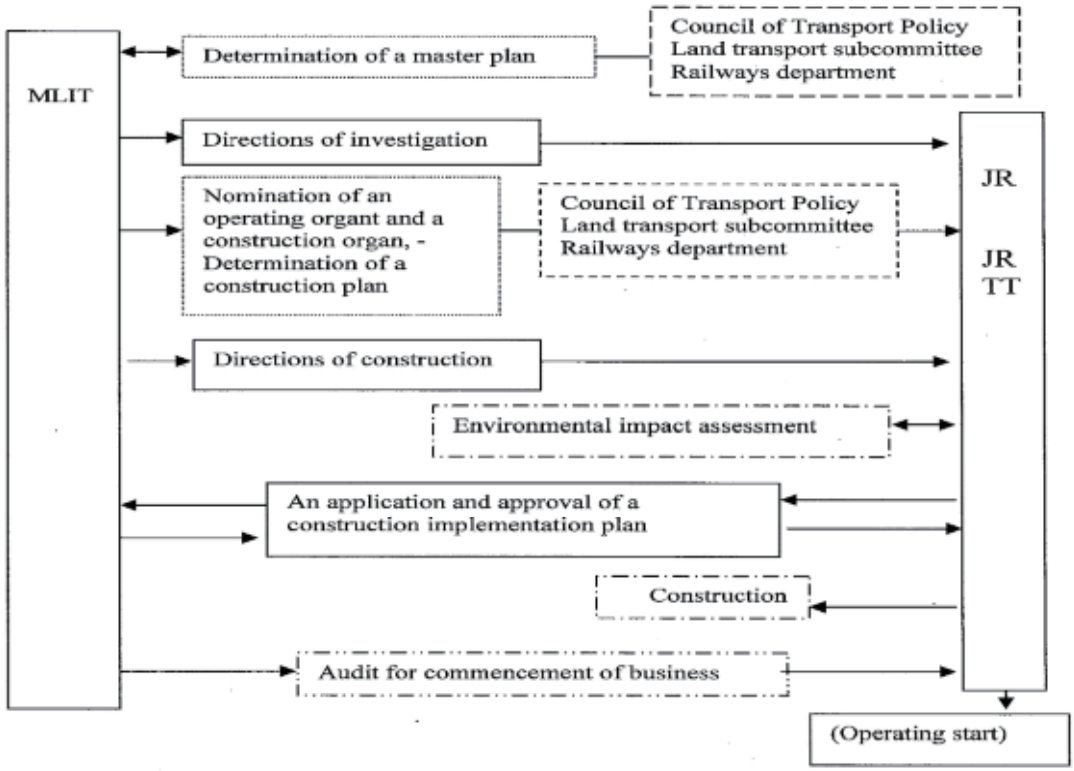


Figure 16.1-2 Example of Central Shinkansen Construction Procedure

Source: JICA Study Team

Japanese high speed railway lines (Shinkansen) are constructed according to the following procedure.

a) Enactment of Nationwide Shinkansen Railway Development Act
b) MLIT consults the Council of Transport Policy about the Master Plan of Nationwide Shinkansen.
c) The Council of Transport Policy suggests that Railway Department of Land Transport Subcommittee discuss the Shinkansen Master Plan.
d) Governmental Decision of Nationwide Shinkansen network development
e) MLIT consults the Council of Transport Policy about the individual Shinkansen line construction.
f) MLIT nominates the construction corporation and operating corporation after negotiating with them.
g) MLIT gives the instruction of investigation of the Shinkansen construction line to the construction corporation.
h) MLIT consults the Council of Transport Policy about the construction plan.
i) MLIT gives the instruction of construction of the Shinkansen to the construction corporation
j) The construction corporation makes a detail design and makes an environmental impact assessment
k) The construction corporation submits the construction implementation plan to MLIT and gets the approval.
l) The construction corporation signs contracts of the construction work with construction companies.
m) The construction corporation supervises and tests the Shinkansen construction work.
n) The construction companies hand over the finished products to the construction corporation.
o) Inspection of the construction work by the construction corporation and operating corporation.
p) Shinkansen facilities are transferred from construction corporation to operating corporation.
q) MLIT makes an assessment of safety of the Shinkansen operation.
r) Start the operation by operating corporation.

16.1.3 Land Acquisition Procedure and the Role of Local Government

After the plan of the construction route of the Shinkansen is determined through Governmental Council of Transport Policy, if needed action on restricted area will be prepared so that the present condition of the land may not be changed. Furthermore, in a city planning area, it is officially announced as a supplementary plan to have been incorporated in town planning decision adjusted with other plans including various kinds of public projects.

People are required to get permission to build new buildings thus it needs to adhere and conforms to city planning other than construction standards. The planned public works investment plan site can be prevented from construction of a building which becomes an obstacle. A public-works lot needs to determine, authorize and announce a plan beforehand officially.

In Japan, the development of station squares and side road of railway lines are carried out according to the city plan funded by local government. Every prefecture has its own city plan for urban area control. The City Plan is authorized after discussed at City Plan Council. All the development plans are discussed at City Plan Council attended by the office staff concerned and acknowledged scholars of erudition and experience. Information of the authorized projects on the City Plan is all available to the public. Any building construction requires an approval from Architecture Authority. The building plan should meet the condition of Architecture Act and the

City Plan. Construction in the sites for a public project is restricted to such buildings that will not disturb the public project implementation.

An acquisition of public-works sites, such as the Shinkansen site, is normally done through negotiations between the project owner and the land owner, but in case the negotiation cannot reach an agreement, an arbitrary purchase based on Land Expropriation Law becomes the rule of law as solution.

When a dispute arises about acquisition of a public-works site, Land Expropriation Committee judges the proper compensation price. Land Expropriation Committee is composed of a third party members including governmental officers who have experience and knowledge about law, economy and land price and they are required to obtain the consent of the Parliament for the nomination. They are believed to be capable of making a fair judgment about public welfare. The Land Expropriate Committee makes decisions about a land acquisition or land surrender, and the amount of compensation and time of surrender. Project owner and land owner should accept the decision of Land Expropriation Committee.

"Project authorization" and "expropriation decision" are the needed procedures prescribed in Land Expropriation Law. The Minister of MLIT or a governor of the prefecture judges the project authorization to see if the project is necessary for the benefit of public interest and is worth the expropriation of the private land.

The compensation land price is worked out based on the date of the notification of authorization of the project, and not affected by the increased price after the project commencement.

16.2 Japanese Legislation for High Speed Railway Construction and Operation

16.2.1 Laws Related High Speed Railway Construction and Operation

There are many Laws and Regulations related High speed railway construction and operation. The lists of laws and Regulations are shown in Table 16.2-1 and Table 16.2-2.

Table 16.2-1 List of Law related High Speed Railway Construction and Operation

1	Ministry of land, infrastructure and transport establish Act (No.100, 16/7/1999)
2	Nationwide Shinkansen Railway Development Act (No.71, 18/5/1970)
3	Railway Business Act (No.92, 4/12/1986)
4	Railway Operation Act (No.65,16/3/1900)
5	Act on Special Provisions Concerning the Punishment for Conduct Impending the Safety of the Train Operation on the Shinkansen Railway (No.111, 22/6/1964)
6	Basic Environment Law (No.91, 19/11/1993)
7	Act for Assessment of Environmental Impact (No.81, 13/6/1997)

Source: JICA Study Team

Table 16.2-2 List of Regulation related High Speed Railway

1	Order for Enforcement of the Nationwide Shinkansen Railway Development Act
2	Ordinance for Enforcement of the Nationwide Shinkansen Railway Development Act
3	Ministerial Ordinance for Transport policy Council
4	Ministerial Ordinance for Transport Council
5	Regulation for enforcement of Railway business Act
6	Ministerial Ordinance to Provide the Technical Standard on Railway
7	Notice concerning to periodical inspection for facilities and rolling stocks
8	Ministerial Ordinance to ensure the safety of operation
9	Ministerial Ordinance concerning to operator license of driving car
10	Regulation for railway transport
11	Regulation for facilities inspection
12	Regulation for report of railway accident
13	Regulation for management and report of railway driver's quality
14	Regulation for audit of railway enterprise
15	Public notice concerning the regular inspection of facilities and rolling stock
16	Public notice on setting technical standard for special railway
17	Public notice on setting environmental standard for Shinkansen railway noise

Source: JICA Study Team

1) Nationwide Shinkansen Railway Development Act (Act No. 71 of May 18, 1970)

This Act was enacted for the purpose of developing the nationwide Shinkansen railway network considering the significance of the functions of established high-speed transportation network across the nation, thereby contributing to the development of the national economy, expansion of the living sphere of the citizens, and regional development.
The Minister of MLIT should determine the master plan which defines the route of the Shinkansen construction that is appointed by the government ordinance in consideration of the demand of railway traffic and the other major concerns of national land development, in order to achieve an effective use of the Shinkansen line.
The Minister can nominate the construction corporation and operating corporation which performs the construction of the line.
The Minister has to get an agreement from the operating corporation and construction corporation beforehand.
The Minister has to decide the development plan of high speed railway construction defined by

the master plan along the area appointed by the government ordinance based on the result of investigation.
The Minister has to talk to an operating corporation and has to get consent before making a decision about the development plan.
The construction corporation must draw up a construction implementation plan of the construction line which includes a route name, the section of construction, and construction method based on the development plan, and must get the approval of the Minister.
The construction corporation has to talk to the operating corporation before a construction implementation plan is drawn up.
The Minister can designate the action in restricted area in order to make the high speed railway construction carried out smoothly. The action restricted area should be presented to general inspection with the drawing and displays which announces the act restricted area publicly. In the action restricted area specified by the Minister, the character of land must not be changed, and it is not allowed to rebuild or extend any building. In case any party suffers a loss because of this restriction, the construction corporation must compensate for the loss which is due to the party. The construction corporation and the sufferer discuss the compensation of the loss. When the two parties cannot reach an agreement, they may request arbitration to the Expropriation Commission under Land Expropriation Law.
The construction corporation or its consignee may enter the restricted area when they are obliged to do so for the purpose of investigation or survey for the construction of high speed railway. Those who step into the land occupied by others have to notify the occupant of the land concerned beforehand.
The Minister has to consult the Council of Transport Policy about the following matters;
The determination and changes regarding the high speed railway master plan.
The nomination of the operating corporation or a construction corporation
The determination and changes regarding the high speed railway development plans

2) Order for Enforcement of the Nationwide Shinkansen Railway Development Act (Cabinet Order No. 272 of September 25, 1970)

The Basic Plan under the Nationwide Shinkansen Railway Development Act shall stipulate the name of the railway, origin, terminus, and major way points of the Construction Line under the said paragraph.
In the case where the Minister of MLIT intends to make decision on the Basic Plan pursuant to the provisions of the Act, the Minister of Land, Infrastructure, Transport and Tourism shall act based on the results of the research on the matters set forth hereunder.

i) Prospect for the volume of the transportation demand for the Shinkansen Railway
ii) Economic effect to be brought about by the reduced transportation time required and increased transportation capability by the development of the Shinkansen Railway
iii) Prospect for revenue and expenditure and the impacts imposed by the development of the Shinkansen Railway on the revenue and expenditure of the other railways.

The Development Plan under the Act shall stipulate the matters set forth hereunder for each Construction Line.

i) Propulsion method
ii) Maximum design speed
iii) Estimated total costs required for the construction
iv) Any other matters required

The Development Plan in the preceding paragraph may be determined for each section of the Construction Line in accordance with the time to implement the construction thereof.

3) Ordinance for Enforcement of Nationwide Shinkansen Railway Development Act (Ordinance of the Ministry of Transport No. 86 of October 1, 1970)

The instruction to research the Construction Line pursuant to the provision of the Nationwide Shinkansen Railway Development Act (Act No. 71 of 1970) shall be implemented with respect to the matters listed hereunder with determined date where a report on the research is to be submitted.

i) Matters related to the transportation capacity to be supplied to accommodate with the demand in the transportation volume and the like.
ii) Matters related to geographical and geological features and the like.
iii) Matters related to the development of the technologies for the facilities and train vehicles
iv) Matters related to the costs required for construction
v) Any other matters required

4) Act on Special Provisions Concerning the Punishment for Conduct Impeding the Safety of the Train Operation on the Shinkansen Railway (Act No. 111 of June 22, 1964)

This Act shall provide for the special provisions and other provisions to the Railway Operation Act (Act No. 65 of 1900) concerning the punishments for such conducts that impede the safety of the train operation on the Shinkansen Railway (any such Shinkansen Railway pursuant to the Act No. 71 of 1970) considering that such train on the Shinkansen Railway that is capable of operating at the speed of two hundred kilometers per hour (200km/h) or more in its predominating section.

5) Ordinance for Enforcement of the Act on Special Provisions Concerning the Punishment for Conduct Impeding the Safety of the Train Operation on the Shinkansen Railway (Ordinance of the Ministry of Transport No. 66 of September 15, 1964)

The facilities that are provided for under the Ordinance of the Ministry of MLIT as the facility for the purpose of ensuring the safety of the train operation as is stipulated under Article 2 Paragraph 1 of the Act on Special Provisions Concerning the Punishment for Conduct Impeding the Safety of the Train Operation on the Shinkansen Railway (Act No. 111 of June 22, 1964) shall comprise the following items.

6) Railway Business Act (Act No. 92 of December 4, 1986)

The purpose of this Act is to secure the safety of transportation and protect the benefit of users of railways, etc. as well as to ensure the sound advancement of railway business, etc. by making the operation of railway business, etc. appropriate and reasonable, and thus to advance the public welfare.

7) Railway Operation Act (Act No. 65 of March 16, 1900)

The construction of a railway, the structure and operation of rolling stocks shall be in accordance with the regulations stipulated under the Ordinance of the Ministry of MLIT. In addition to what is provided for under this Act and other specific laws and regulations, the specific matters of railway transportation shall be in accordance with the regulations stipulated under the Railway Transportation Ordinance. The Railway Transportation Ordinance shall be provided for by means of the Ordinance of the Ministry of MLIT.

16.2.2 Laws for Land Control and Land Acquisition

Shinkansen work site acquisition procedure begins after the plan of the construction route of the Shinkansen line is determined through governmental Council of Transport Policy. A restraining area will be announced so that the present land condition may not be changed according to necessity of the Shinkansen Plan.
Furthermore, in a city area, it is officially announced as a comprehensive plan adjusted with other various kinds of local government's projects and national projects in City Plan Council of each prefecture. Private building construction are required to get the local governmental approve before the construction. Local government checks according to the City Plan and Building Standard Act not to violate the public plan.
Laws for land control are shown in Table 16.2-3

Table 16.2-3 Land control Law

1	National Spatial Planning Act (No.205, 26/5/1950)
2	National Land Use Planning Act (No.92, 25/6/1974)
3	City Planning Act (No.100, 15/6/1968)
4	Building Standard Act (No.201, 24/5/1950)
5	Land Expropriation Act (No.219, 9/6/1951)
6	Land Readjustment Act (No.119, 20/5/1954)
7	Urban Redevelopment Act (No.38, 3/6/1969)
8	Promotion of integrated land development in metropolitan areas and railway line Special measures Act (No.61, 28/6/1989)

Source: JICA Study Team

1) National Spatial Planning Act (Act No.205, May 26, 1950)

The purpose of this Act is to promote the use, improvement and conservation of national land, from a comprehensive viewpoint of policies for the economy, society, culture with consideration for natural conditions of national land, by formulating National Spatial Strategies and taking other measures, in combination with measures by the National Land Use Planning Act (Act No. 92 of 1974), and thereby contributing to the realization of the economy and society in which present and future citizens can live rich lives with peace of mind. The term "National Spatial Strategies" as used in this Act shall mean the comprehensive and basic plans to promote the use, improvement and conservation of national land.

2) National Land Use Planning Act (Act No.92, Jun 25, 1974)

The purpose of this Act is to effect the comprehensive and systematic use of national land by providing for the necessary matters concerning the formulation of national land use plans, preparing land use master plans, and taking measures concerning the control of land transactions and other measures for the sake of coordinating land use, in combination with measures by the National Spatial Planning Act
Considering that national land is a finite resource for citizens both present and future, and that such land is a common foundation for various activities related to living and production, national land shall be used based on the basic principles of ensuring a healthy and culturally-rich living environment and the balanced development of national land, while giving a priority to the public welfare and the conservation of the natural environment, and while paying due attention to the natural, social, economic, and cultural conditions of the area.
National land use plans shall specify basic matters concerning the use of national land, and the national government shall formulate the National Plan for national areas, prefectures may formulate Prefectural Plans for their prefectural areas, and municipalities may formulate Municipal Plans for their municipal areas. The national government's plans other than the National Plan shall be based on the National Plan so far as the use of national land is concerned.

Prefectures shall develop their land use master plans based on the national land use plan; shall specify five areas: urban area, agricultural area, forest area, natural park area, and natural conservation area; and shall specify matters relating to the adjustment of land use. The heads of the relevant administrative agencies and relevant municipalities shall take measures relating to restrictions on the land use so that proper and reasonable land use is ensured in accordance with land use master plans.
For the purpose of eliminating the adverse effects that speculative land transactions and steep rises in land prices have on citizens' lives, and to ensure the proper and reasonable use of land, the following measures shall be taken relating to restrictions on land transactions:
At the nationwide level, if a contract for a large-scale land transfer is made or a large-scale ownership right to land is established, the person who acquires the right is required to notify the prefectural governor or the [mayor] of designated cities (hereinafter referred to as the "prefectural governor, etc.") of the purpose of use, the transaction price of the land, etc. The prefectural governor, etc. may recommend that the purpose of use be changed if the purpose of use in question does not conform to various land use plans.
According to the degree of increase in land prices, etc., the prefectural governor, etc. may make it mandatory to notify him/her prior to land transactions and may specify areas where the purpose of use and transaction price of the land is to be subject to examination and recommendation (monitored areas or supervised areas). Also, the prefectural governor may specify areas where all land transactions are subject to permission (regulated areas).
The prefectural governor, etc. shall issue a notification on idle land if land pertaining to permission under Article 14 or notification under the provisions of Article 23 etc. is in a state of under use or disuse for two years and when it is specifically necessary to do so to promote the effective and proper use of such land in light of the various land use plans. A person who receives such notification is required to submit a plan concerning the use or disposition of the land. The prefectural governor, etc. may recommend that the plan in question should be changed, etc.

3) City Planning Act (Act No. 100 of June 15, 1968)

This Act was enacted for the purpose of promoting the sound development and orderly improvement of cities by stipulating the details of city planning and decision procedures thereof, city planning restrictions, city planning projects and any other necessary matters concerning city planning, thereby contributing to well-balanced national development and the promotion of public welfare.
City plans shall be established based on the fundamental principle that healthy, cultural urban lifestyles and functional urban activities should be secured while maintaining a healthy balance with the agriculture, forestry and fishery industries, and that reasonable land use under due regulation should be promoted for this reason.

i) National and local governments are obliged to endeavor to adequately implement improvement, development and other plans for cities.
ii) City residents shall cooperate with measures that national and local governments enact to achieve the purpose of this Act and are obliged to make efforts to develop a good urban environment.
iii) National and local governments are obliged to endeavor to propagate knowledge and provide information on city planning to the residents of cities.

4) The Building Standard Act (Act No.201, May 24, 1950)

In order to carry out the construction of the building much to the governmental restriction for safety and land use policy, construction of building cannot be started unless it receives the check of a specification check inspection body.
The minimum standard of the building which the Building Standard Law defines can be classified into what is called "simple substance regulation" and "group regulation" from the

contents.
Simple substance regulation is a general standard about the site of each building for securing safety.
An administrative agency has the authority that can issue against a dangerous building or illegal architecture to order the command to cease, or correct the construction, or exclude the building.

5) Land Expropriation Act (Act 219, Jun9, 1951)

Article 29 of the Constitution of Japan provides that private property may be used for public project under the proper compensation. Land Expropriation Act provides the condition and procedure to expropriate and use the private land for public interest. It is determined compensation of the loss for using the land required is public interest. When a dispute arises about acquisition of a public-works lot, Land Expropriation Committee judges the dispute. Land Expropriation Committee is composed of independent members who have excellent experience and knowledge about law, economy, or administration. The governor of the prefecture nominates 7 Committee members with agreement of the Parliament. Both project owner and land owner are obliged to follow the decision of Land Expropriation Committee.

6) Land Readjustment Act (Act No.119, May 20, 1954)

A land readjustment project is planned to improve public facilities, such as road, park, and river and adjust the housing land for the better use of housing site.
The land owner offers his land portion for the portion (land area decrease), which is utilized for public use such as road and park, and some portions acquired are sold to increase the fund.
The project fund consists of disposal income of reserved land and the budget for public facilities improvement (a part of land value is included).
Construction of public facilities, housing site improvement, the compensation for moving of houses, etc. is funded by this.
As for a landowner, the area of the land after a land readjustment project becomes small compared to before, but public facilities such as road, park are improved and the shape of land is arranged, therefore the high land utility value is obtained.

7) Urban Redevelopment Act (Act No.38, Jun 30, 1969)

Under redevelopment project middle-to-high-rise institution building (which is called “a redevelopment building”) is constructed, giving the floors (which is called “landholder space”) of the building and the land shared to the right holders of land, building, etc. corresponding to the rights before the redevelopment project starts from the entrepreneur.
This is called right conversion. Those who do not wish right conversion receive the equivalent amount of money to the right from the entrepreneur. The extra floor (reserved space) is built in addition to landholder space, and usually working expenses are covered by selling off the reserved space.

8) Promotion of integrated land development in metropolitan areas and railway line Special measures Act（Land & Railway Act) No.61, 28/6/1989

The railway project owner can request to relocate his lands to the appointed place where railway facilities shall be constructed under the land readjustment project.

16.2.3 Technical Standards for Railway

The list of Technical Standards is shown in Table 16.2-4.

Table 16.2-4 List of Standard related High Speed Railway

1	Technical Standard for Japanese Railway
2	Explanation of Fire Prevention Standards for Underground Stations
3	Environmental Quality Standards for Shinkansen Super express Railway Noise
4	JR East Standard for Shinkansen drive treatment
5	JR East Standard for Shinkansen safety driving facilities
6	JR East Standard for Shinkansen work execution under closure of track
7	JR East Standard for Shinkansen using of vehicle for maintenance work
8	JR East Standard for Shinkansen Railway fundamental structure
9	JR East Standard for Shinkansen track structure
10	JR East Standard for Shinkansen track work treatment

Source: JICA Study Team

(1) Ministerial Ordinance to Provide the Technical Standard on Railway

This Ministerial Ordinance is set forth to secure the safe and stable transport and thereby to contribute to the promotion of public welfare, by establishing the necessary technical standards for facilities to be used for rail transportation, and rolling stock structure and handling. This Ordinance was overall revised on 2001 from method (numerical) standard to performance standard so as to correspond the new technologies. The Approved Model Specification is also announced. The Approved Model Specification is specifically indicated using numerical values, but it is not compulsory. Railway operators are required to make implementation standards for actual use.
The items of Technical Standards of Japanese Railway are shown in Table 16.2-5.

Table 16.2-5 List of Ministerial Ordinance to Provide the Technical Standard on Railway

Item	Page
Chapter 1 General Rule	
Objective	1
Definitions	2
Implementation Standard	4
Submission of Documents	6
Prevention of Danger	6
Prevention of Extreme Noise	6
Emergency restoration setup	8
Chapter 2 Staff	
Safety Assurance of Train Operation	8
Education and Training of Staff	8
Duties of Crew to Operate a Motive Power Unit	9
Chapter 3 Guide Way	
Gauge 10	
Guide way Alignment	11
Radius of curvature	11
Cant 12	
Gauge widening	14
Transition Curve	15
Gradient 17	
Vertical Curve	19

Relationship between Railway Signal and Train Operation	210
Indicated stop aspect by signal	210
Inaccuracy of Signal Display	210
Prohibition of Dual Use of Signal	211
Conditions of Signal Aspect to Indicate to Other Items Concerning Signal Display	211
Action to be Taken for Indication to Proceed Sign and Display	222
Special Railway	224

Source: JICA Study Team

(2) Explanation of Fire Prevention Standards for Underground Stations

Explanation of Fire Prevention Standards for Underground Stations after the subway fire accident in Deagu, Korea in February 2003, a "Study Group for Fire Prevention of Underground Railways" was established to examine the current status of subway fire prevention equipment and the circumstances of the accident, in order to promote a comprehensive study on preventing fires in underground railways in Japan, and a report was issued in March 2004.Based upon this report, the Ministry of MLIT reviewed. Approved specification for Ministerial Ordinance Article No. 29 (Facilities of Underground Stations), which is the so-called "Fire Prevention Standards". Overview of Explanation: The structure and main points are shown below.

i) Scope of Application

- This standard applies to underground stations and tunnels connected to underground stations.
- Underground stations include cases where the starting and terminal stations in urban areas are underground, stations built due to crossing with roads overhead, and cases where railway tracks are underground.
- The standard does not apply to cut and fill sections and stations in tunnels in mountain regions. However, these shall be studied separately depending upon the structure and facility.

ii) Main Points - Fireproofing of structures, etc.

- Fireproofing of structural materials and interior dressing
- Maximum fireproofing of floors of rooms of train dispatch stations to ensure habitability
- Maximum fireproofing of fittings (desks, lockers, etc.)
- Stores are classified into two types:
  →Convenience station store: Passengers can enter a store.
  →Simple concession stand: This is a simple, face-to-face, small store which passengers cannot enter.
- Convenience station stores require compartmentalization to prevent fire and smoke, and the installation of automatic fire alarm equipment and sprinkler equipment.
- As compartmentalization is difficult for simple concession stands due to their structure, the structural materials, interior and fittings such as bookshelves must be non-flammable.
- Compartmentalization of underground substations for fire prevention.

(3) Environmental Quality Standards for Shinkansen Super express Railway Noise

In accordance with the provisions of Article 16 of the Basic Environment Law (Law No. 91 of 1993), the environmental conditions relating to Shinkansen Super Express Railway noise standards are notified as follows.

The standards for regulating the environmental conditions of Shinkansen Super Express Railway noise are established as follows according to Article 9 of the Basic Law for Environmental Quality Standards and the target dates for achievement thereof. The maintenance of the standards is desirable to preserve the living environment and to contribute to protecting people's health.

The values of the environmental quality standards are established for each category of area

shown in Table 16.2-6. Prefectural governors shall designate the category of area.

Table 16.2-6 Standard value of Shinkansen noise restriction

Category of area	Standard value [in dB]
I II	70 or less 75 or less

Note: Area category I refer to areas used mainly for residential purpose and area category II refers to other areas, including commercial and industrial areas, where the normal living conditions shall be preserved.
(1) Measurements shall be carried out by recording the peak noise level of each of the Shinkansen trains passing in both directions, in principle, for 20 successive trains.
(2) Measurements shall be carried out outdoors and in principle at the height of 1.2 meters above the ground.

Source: JICA Study Team

16.3 Organization of Indian Government and railways-related institutions

16.3.1 Organization of Indian Government

After becoming a colony under direct control of the British Empire in 1858, India established the status of an empire concurrently crowned by Queen of England in 1877, with the Parliament instituted simultaneously, though the reins of the government were still in the hands of Viceroy. After World War II, India separated from Pakistan in 1947 to become independent, that was much earlier than Japan under the US occupation. As a federal republic state led by President as the head of the nation, each State has an independent bicameral legislature, administration (Cabinet) and judiciary (courts). Although political functions are centralized in the capital city, economic activities including those of Reserve Bank of India, a Central Bank of the nation, are all concentrated in Mumbai, a hub of commercial activities in India.
After the adoption of a new constitution in 1949, there had been some laws enacted in the colonial era and still effective for a while, with administrative and judiciary institutions surviving on their extension. As the Governor-General in the colonial era had great power for administration in the Central Government, Ministry of Railways and other central government organizations still follow suit even at present.
India has put in force a number of decrees such as Acts, Codes (guides), Rules (specifications to be followed) and Manuals (broad procedures).
In India, railway businesses have been promoted by Indian Railways under the Ministry of Railways, with urban railways alone exceptionally constructed by organizations independent thereof, in that the Kolkata (Calcutta) subway was constructed by the Metro Railway Calcutta Project Unit organized in the Ministry of Railways, with provisions made for operation/management by Metro Railway Calcutta (MRC), a public organization having of independent character. Due to political interference, technical problems and red-tapism, however, completion of the construction work was delayed approx. nine years to increase the construction cost to approx. 12 times the initially expected amount. Learning from this bitter experience in launching construction of Delhi Subway in October 1998, India set up a subway company with funds divided into halves by the Central and Delhi State Governments, made efforts to secure excellent human resources from the Ministries of Railways and Urban Development (MoUD) and recruited 80% of the rank-and-file from the public, thereby aiming at efficient construction and management of the subway. These efforts led to favorable evaluation by stakeholders as a result. The Ministry of Urban Development, a governmental organization in

charge of urban metros, flexibly modifies road and city planning in constructing subways in cities in order to facilitate efficient urban railway construction. To smoothly execute land acquisition and construction work in inter-city railway construction projects as well, it is expected that local governments anticipatorily review land utilization plans.

16.3.2 Railway-related Institutions

(1) Legislation

Regarding the railway-related legislation in India, Indian Railways has been the sole railway business promoter for more than 100 years since the advent of the first railway in the country, to set for the inner technical stipulations primarily on broad-gauge railways and compile manuals on special procedures for train operation at stations and maintenance procedures for facilities, equipment and rolling stock.

The Railway Act specifies a broad framework for railway business promotion, excluding rules to govern practical affairs. To supplement this drawback, therefore, inner technical regulations have been instituted as the decision or directive by the Minister of Railways (Ministerial Ordinance) after the institution of technical norms/codes.

The Railway Act and existing technical regulations, which are primarily for conventional railways, don't necessarily cope with electrification or high-frequency high-speed operation in urban or high-speed railways. The provisions on the qualification of train drivers, which assume the assistant driver system in the steam locomotive age, are unbecoming to the training of drivers for modern power cars. Therefore, a new system is now inforce to qualify EMU drivers at the Unbar Railway Bureau, Delhi Metro. As railway businesses are promoted in accordance with the Railway Act, it is thought that railways are immune against the differences in the decrees of different states and that new legislation isn't necessary in particular for operation of high-speed railways, with technical codes therefore to be drafted by RDSO and implemented by MOR. New manuals and rules will be required for high-speed operation and train control technologies.

See Table 16.3-1 for important railway-related decrees and Appendix for those regarded as Bare Acts in India.

Table 16.3-1 Railway-related Decrees

	Name	Promulgation
1	Railway Act	1989
2	Railway Property (Unlawful Possession) Act	1966
3	Railway Protection Force (RPF) Act	1957
4	Consumer Protection Act	1986
5	Public Premises (Eviction of Unauthorized Occupants) Act	1971
6	Arbitration and Conciliation Act	1996
7	Administrative Tribunals Act	1985
8	Factories Act	1948
9	Payment of Wages Act	1936
10	Employees' Compensation Act	1923
11	Industrial Dispute Act	1947
12	Indian Contract Act	1872
13	Information Technology Act	2000
14	Right to Information Act	2005
15	Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement (New Land Acquisition) Act	2013
16	Patent Act	2005
17	Environment (Protection) Act	1986
18	Wildlife Protection Act	1972

19	Forest Conservation Act	1980
20	General Rules of Indian Railways	1976
21	Rules for opening of a Railway or a section of Railway for the public carriage of passengers	1933
22	Indian Railway Schedule of Dimensions	1922
23	National Policy on Resettlement and Rehabilitation	2007
24	Policy Circular No.7 for "Opening of Sections and Sanction of Sectional Speed on Indian Railways"	2012

Source: Indian Railways

1) The Railways Act, 1989

The function of Indian Railway system was formerly regulated and legally controlled by the Indian Railway Act -1890. But this Act could not keep pace with the economic, political and law & order changes happening in the country. Hence a new Railway Act was enacted in 1989. The Act was amended in 2003, by Government Railway Police (GRP) has been divested with some powers and officer authorized has been given power to arrest, investigate and prosecute in all the offences under the Railways Act except the offences mentioned under some sections. The power to arrest, investigate and launch prosecution under the sections of Railway Act was left with GRP likewise earlier. The Act was amended in 2008 for land acquisition procedures. There are 16 chapters in the Railways Act.
Following matters are provided for in the Act.

- Commissioners of Railway Safety

Article 5.Appointment of Chief Commissioner of Railway Safety and Commissioners of Railway Safety.
The Central Government may appoint a person to be the Chief Commissioner of Railway Safety and such other person as it may consider necessary to be the Commissioners of Railway Safety.
Article 6.Duties of Commissioner. The Commissioner shall--
- inspect any railway with a view to determine whether it is fit to be opened for the public carriage of passengers and report thereon to the Central Government as required by or under this Act;
- make such periodical or other inspections of any railway or of any rolling stock used thereon as the Central Government may direct;
Article 7. Powers of Commissioner.-Subject to the control of the Central Government, the Commissioner, whenever it is necessary so to do for any of the purposes of this Act, may--
- enter upon and inspect any railway or any rolling stock used thereon;
-by order in writing addressed to a railway administration, require the attendance before him of any railway servant and to require answers or returns to such inquiries as he thinks fit to make from such railway servant or from the railway administration; and
- require the production of any book, document or material object belonging to or in the possession or control of any railway administration which appears to him to be necessary to inspect.

- Construction and Maintenance of Works

Article 11. Power of railway administrations to execute all necessary works.-
Notwithstanding anything contained in any other law for the time being in force, but subject to the provisions of this Act and the provisions of any law for the acquisition of land for a public purpose or for companies, and subject also, in the case of a non-government railway, to the provisions of any contract between the non-Government railway and the Central Government, a railway administration may, for the purposes of constructing or maintaining a railway-- (a) make or construct in or upon, across, under or over any lands, or any streets, hills, valleys, roads, railway, tramways, or any rivers, canals, brooks, streams or other waters, or any drains,

water-pipes, gas-pipes, oil-pipes, sewers, electric supply lines, or telegraph lines, such temporary or permanent inclined-planes, bridges, tunnels, culverts, embankments, viaducts, bridges, roads, lines of rail, ways, passages, conduits, drains, piers, cuttings and fences, in-take wells, tube wells, dams, river training and protection works as it thinks proper; (b) alter the course of any rivers, brooks, streams or other water courses, for the purpose of constructing and maintaining tunnels, bridges, passages or other works over or under them and divert or alter either temporarily or permanently, the course of any rivers, brooks, streams or other water courses or any roads, streets or ways, or raise or sink the level thereof, in order to carry them more conveniently over or under or by the side of the railway; (c) make drains or conduits into, through or under any lands adjoining the railway for the purpose of conveying water from or to the railway; (d) erect and construct such houses, warehouses, offices and other buildings, and such yards, stations, wharves, engines, machinery apparatus and other works and conveniences as the railway administration thinks proper; (e) alter, repair or discontinue such buildings, works and conveniences as aforesaid or any of them and substitute others in their stead; (f) erect, operate, maintain or repair any telegraph and telephone lines in connection with the working of the railway; (g) erect, operate, maintain or repair any electric traction equipment, power supply and distribution installation in connection with the working of the railway; and (h) do all other acts necessary for making, maintaining, altering or repairing and using the railway.

Article 12. Power to alter the position of pipe, electric supply line, drain or sewer, etc.-

-A railway administration may, for the purpose of exercising the powers conferred on it by this Act, alter the position of any pipe for the supply of gas, water, oil or compressed air, or the position of any electric supply line, drain or sewer:

Provided that before altering the position of any such pipe, electric supply line, drain or sewer, the railway administration shall give a notice indicating the time at which the work of such alteration shall commence, to the local authority or other person having control over the pipe, electric supply line, drain or sewer.

The railway administration shall execute the work referred to in sub-section (1) to the reasonable satisfaction of the local authority or the person receiving the notice under the proviso to sub- section.

Article 13. Protection for Government property.-

Nothing in sections 11 and 12 shall authorize--

- a railway administration of the Government railway to do anything on or to any works, lands or buildings vested in, or in the possession of, a State Government without the consent of that Government; and
- a railway administration of a non-Government railway to do anything on or to any works, lands or buildings vested in, or in the possession of, the Central Government or a State Government, without the consent of the Government concerned.

Article 14.Temporary entry, upon land to remove obstruction, to repair or to prevent accident-.

- Where in the opinion of a railway administration-- (a) there is imminent danger that any tree, post or structure may fall on the railway so as to obstruct the movement of rolling stock; or (b) any tree, post, structure or light obstructs the view of any signal provided for movement of rolling stock; or (c) any tree, post or structure obstructs any telephone or telegraph line maintained by it, it may take such steps as may be necessary to avert such danger or remove such obstruction and submit a report thereof to the Central Government in such manner and within such time as may be prescribed.
- Where in the opinion of a railway administration-- (a) a slip or accident has occurred; or (b) there is apprehension of any slip or accident to any cutting, embankment or other work on a railway, it may enter upon any lands adjoining the railway and do all such works as may be necessary for the purpose of repairing or preventing such slip or accident and submit a report thereof to the Central Government in such manner and within such time as may be prescribed.

-The Central Government may, after considering the report in the interest of public safety, by order, direct the railway administration that further action shall be stopped or the same shall be subject to such conditions as may be specified in that order.

Article 19. Over-bridges and under-bridges.-
- Where a railway administration has constructed lines of rails across a public road at the same level, the State Government or the local authority maintaining the road, may, at any time, in the interest of public safety, require the railway administration to take the road either under or over the railway by means of a bridge or arch with convenient ascents and descents and other convenient approaches, instead of crossing the road on the level, or to execute such other works as may, in the circumstances of the case, appear to the State Government or the local authority maintaining the road to be best adapted for removing or diminishing the danger arising from the level crossing.
-The railway administration may require the State Government or the local authority, as the case may be, as a condition of executing any work under sub-section, to undertake to pay the whole of the cost of the work and the expense of maintaining the work, to the railway administration or such proportion of the cost and expenses as the Central Government considers just and reasonable.
- In the case of any difference of opinion between the railway administration and the State Government or the local authority, as the case may be, over any of the matters mentioned in sub-section, it shall be referred to the Central Government, whose decision thereon shall be final.
Article 20. Power of Central Government to give directions for safety.-
Notwithstanding anything contained in any other law, the Central Government may, if it is of the opinion that any work undertaken or may be undertaken, is likely to alter or impede the natural course of water flow or cause an increase in the volume of such flow endangering any cutting, embankment or other work on a railway, issue directions in writing to any person, officer or authority responsible for such work to close, regulate or prohibit that work.

- Opening of Railways

Article 21. Sanction of the Central Government to the opening of railway.
No railway shall be opened for the public carriage of passengers until the Central Government has, by order, sanctioned the opening thereof for that purpose.
Article 22. Formalities to be complied with before giving sanction to the opening of a railway.-
-The Central Government shall, before giving its sanction to the opening of a railway under section 21, obtain a report from the Commissioner that-- (a) he has made a careful inspection of the railway and the rolling stock that may be used thereon; (b) the moving and fixed dimensions as laid down by the Central Government have not been infringed; (c) the structure of lines of rails, strength of bridges, general structural character of the works and the size of, and maximum gross load upon, the axles of any rolling stock, comply with the requirements laid down by the Central Government; and (d) in his opinion, the railway can be opened for the public carriage of passengers without any danger to the public using it.
- If the Commissioner is of the opinion that the railway cannot be opened without any danger to the public using it, he shall, in his report, state the grounds therefor, as also the requirements which, in his opinion, are to be complied with before sanction is given by the Central Government.
- The Central Government, after considering the report of the Commissioner, may sanction the opening of a railway under section 21 as such or subject to such conditions as may be considered necessary by it for the safety of the public.
Article 27. Use of rolling stock.-
A railway administration may use such rolling stock as it may consider necessary for the construction, operation and working of a railway: Provided that before using any rolling stock of a design or type different from that already running on any section of the railway, the previous sanction of the Central Government shall be obtained for such use: Provided further that before giving any such sanction, the Central Government shall obtain a report from the Commissioner that he has made a careful inspection of the rolling stock and, in his opinion, such rolling stock can be used.

2) The Railways (Amendment) Act, 2008

An Act further to amend the Railways Act, 1989. After Chapter IV of the principal Act, the following Chapter was inserted, namely:-

Article20A.Power to Acquire Land, etc. –

- Where the Central Government is satisfied that for a public purpose any land is required for execution of a special railway project, it may, by notification, declare its intention to acquire such land.
- Every notification under sub-section (1), shall give a brief description of the land and of the special railway project for which the land is intended to be acquired.
- The State Government or the Union territory, as the case may be, shall for the purposes of this section, provide the details of the land records to the competent authority, whenever required.
- The competent authority shall cause the substance of the notification to be published in two local newspapers, one of which shall be in a vernacular language.

Article20B. Power to enter for survey, etc –

On the issue of a notification under sub-section (1) of section 20A, it shall be lawful for any person, authorized by the competent authority in this behalf, to- (a) make any inspection, survey, measurement, valuation or enquiry; (b) take levels; (c) dig or bore into sub-soil; (d) set out boundaries and intended lines of work; (e) mark such levels, boundaries and lines placing marks and cutting trenches; or (f) do such other acts or things as may be considered necessary by the competent authority.

Article20C. Evaluation of damages during survey, measurement, etc.

Article20D. Hearing of objections, etc.

Article20E.Declaration of acquisition.

- Where in respect of any land, a notification has been published under sub-section (1) of section 20A for its acquisition, but no declaration under sub-section (1) of this section has been published within a period of one year from the date of publication of that notification, the said notification shall cease to have any effect, Provided that in computing the said period of one year, the period during which any action or proceedings to be taken in pursuance of the notification issued under sub-section (1) of section 20A is stayed by an order of a court shall be excluded.
-A declaration made by the Central Government under sub-section (1) shall not be called in question in any court or by any other authority.

Article20F.Determination of amount payable as compensation.

-Where any land is acquired under this Act, there shall be paid an amount which shall be determined by an order of the competent authority.
-The competent authority shall make an award under this section within a period of one year from the date of the publication of the declaration and if no award is made within that period, the entire proceedings for the acquisition of the land shall lapse: Provided that the competent authority may, after the expiry of the period of limitation, if he is satisfied that the delay has been caused due to unavoidable circumstances, and for the reasons to be recorded in writing, he may make the award within an extended period of six months: Provided further that where an award is made within the extended period, the entitled person shall, in the interest of justice, be paid an additional compensation for the delay in making of the award, every month for the period so extended, at the rate of not less than five percent of the value of the award, for each month of such delay.
- Where the right of user or any right in the nature of an easement on, any land is acquired under this Act, there shall be paid an amount to the owner and any other person whose right of enjoyment in that land has been affected in any manner whatsoever by reason of such acquisition, an amount calculated at ten percent of the amount determined under sub-section, for that land.

- If the amount determined by the competent authority under sub-section or as the case may be, sub-section is not acceptable to either of the parties, the amount shall, on an application by either of the parties, be determined by the arbitrator to be appointed by the Central Government in such manner as may be prescribed.
-In addition to the market-value of the land as above provided, the competent authority or the arbitrator, as the case may be, shall in every case award a sum of sixty percent on such market-value, in consideration of the compulsory nature of the acquisition.
Article20G. Criterion for determination of market-value of land.
Article20H. Deposit and payment of amount. –
Article20-I. Power to take possession.
- Where any land has vested in the Central Government under sub-section (2) of section 20E, and the amount determined by the competent authority under section 20F with respect to such land has been deposited under sub-section of section 20H with the competent authority by the Central Government, the competent authority may, by notice in writing, direct the owner as well as any other person who may be in possession of such land to surrender or deliver possession thereof to the competent authority or any person duly authorized by it in this behalf within a period of sixty days of the service of the notice.
-If any person refuses or fails to comply with any direction made under sub-section (1), the competent authority shall apply- (a) in case of any land situated in any area falling within the metropolitan area, to the Commissioner of Police; (b) in case of any land situated in any area other than the area referred to in clause (a), to the Collector of a district, and such Commissioner or Collector, as the case may be, shall enforce the surrender of the land, to the competent authority or to the person duly authorized by it.
Article20J.Right to enter into land where land has vested in Central Government. –
Where the land has vested in the Central Government under section 20E, it shall be lawful for any person authorized by the Central Government in this behalf, to enter and do other act necessary upon the land for carrying out the building, maintenance, management or operation of the special railway project or part thereof or any other work connected therewith.
Article20K.Competent authority to have certain powers of civil court. –
Article20L. Utilization of land for the purpose it is acquired. –
-The land acquired under this Act shall not be transferred to any other purpose except for a public purpose, and after obtaining the prior approval of the Central Government.
- When any land or part thereof, acquired under this Act remains not utilized for a period of five years from the date of taking over the possession, the same shall return to the Central Government by reversion.
Article20M. Sharing with landowners the difference in price of a land when transferred for a higher consideration. –
Article20N. Land Acquisition Act 1 of 1894 not to apply. –
Nothing in the Land Acquisition Act, 1894 shall apply to an acquisition under this Act.
Article20-O. Application of the National Rehabilitation and Resettlement Policy, 2007 to persons affected due to land acquisition. –
The provisions of the National Rehabilitation and Resettlement Policy, 2007 for project affected families, notified by the Government of India in the Ministry of Rural Development vide number F.26011/4/2007-LRD, dated the 31st October, 2007, shall apply in respect of acquisition of land by the Central Government under this Act.

3) The Railway Protection Force Act, 1957

The Railway Protection Force enables the personnel of the Force to be brought under a special set of disciplinary rules and confers on them, under certain conditions powers of arrest and search without warrant. Moreover, the Railway Protection Force could provide, in times of need, suitable assistance to the Railway Police who are charged mainly with the responsibility for overall maintenance of law and order in railway premises.

Every Indian States have own police Act. For example, Railway Police is provided for in the Assam police act as follows.

Assam Police Act, Article 16. Railway Police.

- The State Government may, by notification in the official Gazette, create one or more special police districts embracing such railway areas in the State as it may specify, and appoint a Superintendent of Police, one or more Assistant and Deputy Superintendent and such other police officers for each such special district as it may deem fit. The State Government may also appoint for the whole State an officer not below the rank of Deputy Inspector General of Police to supervise the functions of the railway Police.
- Subject to the control of the Director General of Police, such police officers shall discharge police functions connected with the administration of railways situated within their respective charges, such other functions as the State Government may from time to time assign to them.

4) The Railway Property (Unlawful Possession) Act, 1966

Penalty for theft, dishonest misappropriation or unlawful possession of railway property. Whoever commits theft, or dishonestly misappropriates or is found, or is proved to have been, in possession of any railway property reasonably suspected of having been stolen or unlawful obtained shall, unless he proves that the railway property came into s possession lawfully, be punishable—

5) General Rules of Indian Railways, 1976

These rules may be called the Indian Railways (Open Lines) General Rules, 1976.

Table 16.3-2 General Rules, 1986

Chapter	Item
1	Preliminary
2	Rules Applying to Railway Servants Generally
3	Signals
4	Working of Trains Generally
5	Control and Working of Stations
6	Accidents and Unusual Occurrences
7	System of Working
8	The Absolute Block System
9	The Automatic Block System
10	The Following Trains System
11	The Pilot Guard System
12	The Train-Staff and Ticket System
13	The One Train Only System
14	Block Working
15	Permanent Way and Works
16	Level Crossing
17	Working of Trains on Electrified Sections of Railways
18	Miscellaneous

Source: Indian Railways

6) The Right to Fair and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 (New Land Acquisition Act)

An Act to ensure, in consultation with institutions of local self-government and informed and transparent process for land acquisition for industrialization, development of essential infrastructural facilities and urbanization with the least disturbance to the owners of land and

other affected families and provide just and fair compensation to the affected families whose land has been acquired or proposed to be acquired or are affected by such acquisition and make adequate provisions for such affected persons for their rehabilitation and resettlement and for ensuring that the cumulative outcome of compulsory acquisition should be that affected persons become partners in development leading to an improvement in their post acquisition social and economic status and for matters connected therewith or incidental thereto.
Land acquisition in India is currently governed by The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013, which came into force from 1 January 2014.Till 2013, land acquisition in India was governed by Land Acquisition Act of 1894.
Land Acquisition in India refers to the process of land acquisition by the central or state government of India for various infrastructure and economic growth initiatives. Several controversies have arisen with claims that land owners have not been adequately compensated.
The process of land acquisition in Indiahas proven unpopular with the citizens. The amount reimbursed is fairly low with regard to the current index of prices prevailing in the economy. Furthermore, due to the low level of human capital of the displaced people, they often fail to find adequate employment.

The 2013 Act focuses on providing not only compensation to the land owners, but also extend rehabilitation and resettlement benefits to livelihood looser from the land, which shall be in addition to the minimum compensation. The minimum compensation to be paid to the land owners is based on a multiple of market value and other factors laid down in the Act. The Act forbids or regulates land acquisition when such acquisition would include multi-crop irrigated area. The Act changed the norms for acquisition of land for use by private companies or in case of public-private partnerships, including compulsory approval of 80% of the landowners. The Act also introduced changes in the land acquisition process, including a compulsory social-impact study, which need to be conducted before an acquisition in made.

The compensation for the acquired land was based on the value of the agricultural land, however increased price have been ignored. The land value would increase many times, which the current buyer would not benefit from. Secondly, if the prices are left for the market to determine, the small peasants could never influence the big corporate tycoons.

Delayed projects due to mass unrest have caused a damaging effect to the growth and development of companies and the economy as a whole.

The new Land Acquisition Act, enacted by Parliament to provide just and fair compensation to those whose land is taken away for constructing roads, buildings or factories, came into force replacing 120-year-old legislation. The Act, meant for bringing transparency to the process of acquisition of land, provides for generous compensation and rehabilitation of those affected by the takeover. The new law — Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act — stipulates mandatory consent of at least 70% of affected people for acquiring land for Public Private Partnership (PPP) projects and 80% for acquiring land for private companies.

The state governments will have to set up at least six bodies, including the state-level Land Acquisition Rehabilitation and Resettlement Authority, to hear disputes arising out of projects where land acquisition has been initiated by the state or its agencies. As per rules made by the ministry, the state governments should take immediate steps to create and establish the State Social Impact Assessment Unit, the office of the Commissioner Rehabilitation and Resettlement and the State Level Monitoring Committee.

Under the new legislation, compensation for the owners of the acquired land will be four times

the market value in rural areas and twice in urban areas. It also stipulates that the land cannot be vacated until the entire compensation is awarded to the affected parties. The law has the provision that the companies can lease the land instead of purchasing it. Besides, the private companies will have to provide for rehabilitation and resettlement if land acquired through private negotiations is more than 50 acres and 100 acres in urban and rural areas, respectively.

7) Environment Protection Act, 1986

The Environment (Protection) Act was enacted in 1986 with the objective of providing for the protection and improvement of the environment. It empowers the Central Government to establish authorities charged with the mandate of preventing environmental pollution in all its forms and to tackle specific environmental problems that are peculiar to different parts of the country. The Act was last amended in 1991.
Environment Protection Rules, 1986, Environmental Impact Assessment Notification, 2006 and Noise Pollution Rules, 2000 were promulgated.
Ambient Air Quality Standards in respect of Noise as follows,

Table 13.3-3 Air Quality Standards in Respect of Noise

Area Code	Category of Area/Zone	Limits in dB(A) Leq	
		Day Time	Night Time
(A)	Industrial area	75	70
(B)	Commercial area	65	55
(C)	Residential area	55	45
(D)	Silence Zone	50	40

Source: Indian Noise Pollution Rules, 2000
Schedule Ambient Air Quality Standards in respect of Noise

(2) Procedure for railway projects

Regarding proposed railway projects, surveys corresponding to the request by inhabitants or their representative, are implemented by the Ministry of Railways. The survey may be executed by RITES (former Rail India Technical and Economic Service) or other organizations.
In case a draft project is judged as effective from the social, economic and financial viewpoint based on the survey results, it will be adopted as a formal project in MOR. For a draft project entailing a budget exceeding 300Crores, a committee with enlarged membership will be held covering other ministries and agencies. After approved by the committee, the project will be registered in the Pink Book, subject to approval by a Cabinet meeting and are solution by the Parliament.
As of July 2014, there are 156 projects for railway construction, some of which have not been completed for more than 30 years. As a lump sum budget is granted in principle for MOR projects as a whole, MOR determines the amount to be appropriated for respective projects. For national projects, however, the Cabinet may direct MOR to allocate particular amounts for particular projects.

(3) Land purchase

Methods of land purchase largely differ depending on the land utilization style and social situations. The land acquisition for railway projects is sometimes required to execute with local governments. . The former Land Acquisition Act, which was instituted way back in 1894, necessitated drastic amendments to correspond to the nationwide opposition campaigns against factory construction due to troubles in land buying/ selling trades. Therefore, a new Land Acquisition Act was enacted in 2013, which specifies details of indemnification for inhabitants to be paid by the governments or enterprises in purchasing lands. The Act requires four-time payment in trading to guarantee the life of the land seller thereafter.

In contrast, as the former Act was studded with a number of ambiguities in the stipulations on compensation, land owners tended to repel them eager amount of indemnification and frequently cast themselves in opposition campaigns. Although consent of land owners isn't required for national projects promoted by the government in designated economic areas, the government shall pay "a due indemnity allowance" to each land owner under the new Land Acquisition Act. Regarding the amount of compensation, the Act specifies concrete figures as an amount maximum twice the land price in urban areas and four times that in local areas. The Act also stipulates that, in case the land purchaser has resold the land to a third party at an amount higher than the acquisition cost, he/ she shall pay 40% of the difference (profit) to the former land owner. Furthermore, the Act prescribes that the would-be land purchaser ought to survey social impact and environmental influence to be caused by the land transaction prior to negotiation and release the survey results to the opponent land owner. Regarding other terms as well, the Act is stringent as a whole for industrial circles, in that it shall apply retrogressively for five years to land expropriation cases in which the compensation amount hasn't been paid yet at the time of enactment. While insisting the necessity to amend the Land Acquisition Act, a leading member of the Association of Industries in India remarks that it is apprehended for enterprises to bear soaring land acquisition costs, possibly 3 to 3.5 times that before the enactment of the new Land Acquisition Act, and shows apprehensions that enterprise activities would be stagnant in the future.

As per the current regulations of Government of India, railway projects do not require conducting Environmental Impact Assessment (EIA) studies and obtaining Environmental Clearance (EC) from the Ministry of Environment and Forests (MOEF). Approval of 70% or 80% of the landowners for land acquisition on new Land Acquisition Act is also not required for Special Railway Projects.
Despite that lands for railway use can be purchased in accordance with the Railway Act, we shall pay attention to the implementation status of the new Land Acquisition Act from now on, as the spirit of the new Act shall duly be observed in view of the meaning of the enactment and as a policy to wrestle with related issues.
The report of "A case study of land acquisition for DFC project under CPM/DFCC" provided as follows. Land acquisition has been an integral part of any infrastructure project and has also proved to be a major bottleneck in execution of projects. The delay in land acquisition resulted in timely completion of the projects thereby causing cost over runs and delay in deriving benefits of the projects. The Railways Act was amended to included land acquisition provisions with liberal compensation package including rehabilitation and resettlement benefits to the persons whose land is to be acquired.

Acquisition of land was seen as major hurdle because alignment traversed nine states. Earlier land acquisition for all Railway project was being done under the Land Acquisition Act 1894 by the respective State Government. As railway project normally cover more than one state, sometimes there were delays in land acquisition as different state have different set of norms and rules for land acquisition. In order to expedite land acquisition for important Railway project declared as special Railway projects. The Railway (Amendment) Act 2008 was enacted and it was deemed to have come into force from 31.01.2008. The amended act ensured better deal for those whose land was being acquired by incorporating benefits under National Rehabilitation and Resettlement Policy 2007 and at the same time ensuring early acquisition. Under this act land is acquired by the Central Government.

The act is applicable only to the Railway Project declared as "Special Railway Projects" by the Central Government through Gazette notification under clause 37 (A) of Section 2 of Railway Act 1989.

Table 16.3-4 Basic differences between RAA- 2008 and Land Acquisition Act-1894

Description	RAA – 2008	LAA – 1894
Competent Authority for land acquisition	Competent authority is nominated by Central Government through Gazette notification	Collector or nominated persons by State Government are competent authority
Solatium	60%	30%
NRRP – 2007	Applicable	Not applicable
Compensation Dispute redressal	Through Arbitrator appointed under the Act by Central Government.	By respective Principal Court under whose jurisdiction the land in dispute lies
Challenge of declaration in court	Not permitted	Can be challenged in respective principal court
Criteria for determining Market rate for land	Defined. Does not take into account local regulation	Collector determines the rate taking into consideration the local regulations
Compensation for period from initial notification to date of award	No compensation	Interest 12% p. a. from date of publication of notice under section 4 and declaration of award.
Urgent acquisition	No provision	Section 17 provides for acquisition in urgency
Disposal of undisbursed amount	Not specified	Specified. To be deposited in respective principal court

Source: Indian Railways

Land acquisition is a sensitive issue so humane, systematic and transparent approach need to be adopted for early and peaceful acquisition. Land acquisition must take place in a manner that fully protects the interests of land-owners and also of those whose livelihoods depend on the land being acquired. So an adequate compensation package which shall include reasonable compensation for land and resettlement and rehabilitation measures to assuage the sufferings of the affected persons.
Source: http://wiki.iricen.gov.in/doku/doku.php

16.3.3 Railway Safety Commissioner

Clause3 of Railway Act prescribes the Committee on Railway Safety. The Railway Safety Commissioner, who is under the umbrella of the Ministry of Civil Aviation, is independent of the Ministry of Railways and assigned with final judgment on the safety of the inauguration of passenger railways. The Central Government may appoint a person to be the Chief Commissioner of Railway Safety and such other person as it may consider necessary to be the Commissioners of Railway Safety.

The Commissioner shall--

(a) inspect any railway with a view to determine whether it is fit to be opened for the public carriage of passengers and report thereon to the Central Government as required by or under the Railway Act;

(b) make such periodical or other inspections of any railway or of any rolling stock used thereon as the Central Government may direct;

The responsibilities, duties, functions and powers of Commissioner of Railway Safety are laid down under the Railways Act, 1989. A careful perusal of these sections of Railways Act indicates that, the role of Commissioner of Railway Safety is very narrow and is limited to specifically three areas- inspection and certification of new works if the new lines are to be opened for public carriage of passengers, certification of new rolling stock and enquiry into railway accidents.

In a railway line already opened and functional, the role of Commissioner of Railway Safety if any is very marginal. Even the power of CRS to make periodical inspections of any railway or of any rolling stock used therein has to be directed by the central government. Therefore its autonomy from Indian Railway administration is rather elusive. Railway Board can still over-ride and do over-ride the Commissioner of Railway Safety, and such a prevalent scenario makes the functioning of Commissioner Railway Safety for all practical purpose, as one that is subordinated to the Railway Board. An Architecture of Safety organization is detailed later in this chapter to overcome these weaknesses.

Source: Report of high level safety review committee, MOR, Feb. 2012

16.4 Railway Technical Standards in India

16.4.1 Authentication of Technologies

The Ministry of Railways adopts the schedule of dimensions for railway technologies for conventional lines and release to the public, with the contents discussed at RDSO. The scale of dimensions (SOD) is also determined by RDSO. The establishment or amendment of technical standards for conventional lines of Indian Railways is conducted by RDSO. This covers all aspects of technical standards for conventional lines of Indian Railways, such as design criteria, construction standards, material specifications, and standard design drawings.

Regarding urban railways, technical plans and safety of the Metro system are authenticated by RDSO, Ministry of Railways, in accordance with the Amended Metro Railway (Operation and Maintenance) Act 2009. The technical schedule of dimensions for Delhi Metro was drafted by Delhi Metro (DMRC) and approved by the Ministry of Railways.

An eligibility certificate issued by India is required for the technologies to be adopted for the first time in India. According to MOR, it still belongs to anybody's guess at the moment whether new decrees or a technical schedule of dimensions is necessary for high-speed railways.

16.4.2 Railway Technical Standard

The establishment or amendment of technical standards for Indian Railways is conducted by RDSO.
This covers all aspects of technical standards of Indian Railways, such as design criteria, construction standards, material specifications, and standard design drawings.

Table 16.4-1 List of Example of Manual of Indian Railways

Commercial Manual Vol.1, Vol.2
Track Manual Vol.1, Vol.2
Manual for reconditioning of Medium Manganese(MM) Steel Point and Crossings, Switch Expansion Joints(SEJ's) and Cast Manganese Steel(CMS) Crossing
Manual for flash bat welding of rails
Manual for Fusion Welding of Rails by the Alumino-thermic Process
Manual of instructions on Long Welded Rails
Manual for Ultrasonic Testing of Rails & Welds
Manual Glued insulated rail joints
Small track machine Manual
Track machine Manual
Railway works Manual
Bridge Manual1) Bridge Rules 2) Concrete Bridge Code 3) Steel Bridge Code4) Bridge Sub-structure & Foundation Code5) Welded Bridge Code 6) Well & Pile Foundation Code (Revised Edition-)
Manual of AC Traction maintenance and operation Vol.1, Vol.2 Part1, Part2, Vol.3
Operating Manual-traffic
Permanent way Manual
Railways establishment Manual Vol.1, Vol.2
Signal engineering Manual part1, part2
Telecommunication Manual
Manual of AC Traction Maintenance and Operation Vol.1, Vol.2
Indian Railways Code for the Engineering Department (Third Reprint)
Guidelines for Earthwork in Railway Projects (Guideline No.GE:G-1,)
Indian Railway Schedule of Dimensions BG
Specification for Mechanically Produced Blanketing Material for Railway
Formations Including Guidelines for Laying (Specification No.GE:IRS-2,)

Source:Indian Railways

Table 16.4-2 Example of Indian Railway Standard Code, Regulation

Name of document	**Amendment no./ Correction slip no./ Revision no.**
Bridge Rules (IN SI UNITS): Rules specifying the loads for design of super-structure and sub-structure of bridges and for assessment of the strength of existing bridges, Adopted – 1941, First Revision -1964 First Reprinting – 1989, Second Reprinting – 2008 (Incorporating Correction Slip Up to 39)	A&C slip No.42 Dt.20.10.2009
Indian Railway Standard code of Practice For Plain, Reinforced and Prestressed Concrete for General Bridge Construction (Concrete Bridge Code) First Adopted -1936, First Revision – 1962Second Revision – 1997	A&C slip No.13 Dt.25.11.2010
Indian Railway Standard Code of Practice for the Design of Sub-Structures and Foundations of Bridges (Bridge Sub-Structures & Foundation Code) Adopted -1936, Revised - 1985	A&C slip No.29 Dt.28.07.2009
Indian Railway Standard Code of practice for the Design of steel or wrought Iron bridges carrying rail, Road or pedestrian traffic (Steel Bridge code)Adopted – 1941, Revised – 1962 (Reprinted Incorporating Addendum & Corrigendum Slip No. 1 to 10)	A&C slip No.18 Dt.14.06.2012
Indian railway Standard Code of Practice for Metal ARC Welding in structural steel bridges carrying rail, rail- cum- road or pedestrian traffic (Welded Bridge Code)Adopted – 1972, Revised - 2001	Nil.
Indian railway Standard Specification for fabrication and erection of steel girder bridges and locomotives turn tables 2001(Fabrication specification SERIAL NO. B-1/2001, Adopted – 1934, Last Revision – 2001, Re-Printed-2008, (INCORPORATING A&C SILP UPTO 4)	A&C slip No.4 Dt. 31.07.2008
Indian railway Standard Code of practice for the design and construction of masonry and plain concrete arch bridges (Arch Bridge Code) 1962 (Second Revision-2004) Incorporating Correction Slips Nos. 1to 6)1982, Adopted – 1941, Revised - 1962	A&C slip No.7 Dt.25.9.2000
Indian railway Standard Code of practice for the structural design of Microwave towers of self Supporting type –1982 (Self supporting microwave tower code) Adopted – 1974, Revised - 1982	A&C Slip No. 1 Dt. 25.09.2000
Indian railway Standard Code of practice for the Fabrication and erection of steel work of microwave Towers - Self-supporting Type Adopted 1979	A&C Slip No. 1 Dt. 25.09.2000
Manual on the design and Construction of well and pile Foundations-1985	A&C Slip No.2 Dt.09.03.2010
Indian Railway Standard Code of Practice for Precast Concrete Products and Structural Members	1958
Welding Code Indian Railway Standard Code of Practice for Electric Arc Welding of Mild Steel Structures	1945
Regulations for Electrical Crossings of Railway Tracks	1973

Source: Indian Railways

16.4.3 Existing Schedule of Dimensions

(1) Schedule of dimensions for broad-gauge railways

The schedule of dimensions for broad-gauge railways is prescribed in the Revised 2004 Indian Railways Schedule of dimensions 1,676mm-gauge (BG).
Recommended Dimensions to be observed on all 1676mm gauge Railways in India. In that Schedule, certain dimensions of the previous schedule of the year 1913 were modified with the

object of permitting the use of enlarged rolling stock.
The Schedule of Dimensions of 1922 contained two distinct sections, namely, a schedule of "Maximum and Minimum Dimensions" which was considered to enable the proposed larger vehicles to run with about the same degree of safety as that which was previously obtained on the older Railways with existing stock, and a schedule of "Recommended Dimensions" intended to provide approximately the same clearances from fixed structures for the future larger vehicles as the 1913 schedule gave for existing vehicles.
Among the more important changes introduced in the 1929 Schedule, were an increase in the minimum height above rail level for overhead structures to 5410mm and increase to 2360mm in the horizontal distance to a fixed structure up to 3355mm above rail level, a reduction in this distance to 2135mm at 4420mm above rail level, and a reduction also in the clearance to fixed structures from rail level to 1065mm above rail level on bridges and in tunnels. The last three changes were intended to allow for a reduction in tunnel sections and an improvement in the disposition of bracing of bridge girders without sacrificing safety.
In 1936, however, the financial stringency on Railways brought to the front the urgent necessity for restricting capital expenditure to a minimum. The falling off in Railway traffic generally and the increasing demand for light fast units to compete with motor bus transport also made the introduction of heavier engines and 3660mm wide stock on Railways improbable.

(2) Schedule of dimensions for Metro systems

The Ministry of Urban Development has jurisdiction over urban railways, while RDSO under the umbrella of the Ministry of Railways authenticates the schedule of dimensions for railway technologies.
”January 2013, Procedure for Safety Certification and Technical Clearance of Metro Systems by RDSO describes the authentication of Metro technologies”

(3) Schedule of dimensions for environmental technologies

In India, Euro4 equivalent Bharat Stage IV schedule of dimensions for environmental technologies is applied to 11 large cities, Delhi, Mumbai, Kolkata, Chennai, Bangalore, Ahmedabad, Hyderabad, Kanpur, Pune, Suratand Agra, while one-rank lower Euro3 equivalent Bharat stage III to other cities. As modification of decrees is not thoroughly known among construction contracting enterprises, confusion is seen some times at the execution stage in the field.

16.4.4 Policy Circular

Revision of Policy Circular No.6 Para 6 and Appendix 1 & 2.Sanction of speed of nominated trains on specific routes.
Para 6.1. (a) For speed up to 110km/h on BG describing about maintenance of track conditions and rolling stock.

16.4.5 Standards of Construction

Standards of Construction for Broad Gauge (BG) of Indian Railways are as follows:
The BG lines have been classified into five groups “A” to “E” on the basis of the future maximum permitted speed.
Group A Speed up to 160 km/h, Group B Speed up to 130 km/h, Group C Suburban sections of Mumbai, Delhi, Kolkata, Group D Sections where the sanctioned speed is 100 km/h at present, Group E Sectional and branch line with the traffic density is very high or likely to grow substantially in future and the sanctioned speed is less than 100 km/h.
Along DFC route, East Corridor (Delhi - Kanpur – Allahabad – Varanasi – Khanna – Howrah) and West Corridor (Delhi – Mathura – Ratlam – Vadodara – Mumbai) are classified as Group A, and East Corridor (Ludhiana – Ambala - Delhi) is classified as Group B.

Table 16.4-3 Standards of Construction of Existing IR

1	1676mm
Max. Permissive Speed	Group A : 160 km/h, Group B : 130 km/h
Max. Gradient	In plane country : 1 in 150, In hilly terrain : 1 in 100
Max. degree of curves	10 degree (R=175 m)
Max. Cant	165 mm
Max. Cant Deficiency	100 mm
Max. Cant Excess	75 mm
Type of Transition Curve	Cubic Parabola
Min. radius of Vertical Curve	Group A : 4,000 m, Group B : 3,000 m
Type of Turnout	1 in 8.5 or 1 in 12
Axle load	22.9 ton
Type of Track Structure	Ballast Track or Ballast less Track (in the station)
Rail	52 kg/m or 60 kg/m
Sleeper	Pre-Stressed Concrete (PSC) Sleeper
Sleeper Density	Nos.1550 /km or Nos. 1660/km
Min. Thickness of Ballast	250, 300 mm or 200 mm over 150 mm sub ballast (in case of PSC Sleeper) under sleeper

Reference
(1) *"Indian Railway Permanent Way Manual Second Reprint 2004" (05 Mar 2004)*
(2) *"Indian Railway Track"(M.M. AGARWAL, 2004)*

Source:Indian Railways

16.4.6 Current Situation of Bridge Design Process

Bridge design process in India, in principle, is carried out by RDSO. RDSO prepares the standard drawings according to the standard design, and distributes it to Zonal Railway for their new bridge construction.
Generally, Manuals and Specifications are prepared adequately. The standard drawings are prepared for every Axle Load and Span length. Accordingly, the positive attitude to economization due to standardization will be understood easily.
Codes and Manuals are shown on Table 16.4.2. The standard drawing for specified load which does not exist will be prepared by RDSO. As the study for maintenance, rehabilitation and research works are also carried out by RDSO, potential high technique of Indian railway will be appreciated.

16.4.7 Electrical Facilities

The centralised computer aided SCADA system is used widely for exclusive supervision as well as control for traction power on Indian railways. The main switchgear on the traction power circuits is also locally made. The majority of the power circuit breakers are of vacuum interrupter type. Railways are apt to become the major source of disturbances to signalling as well as communication systems. As for the basis of countermeasure against the disturbance by the electromagnetic induction and harmonic waves, Indian Railways have already established the regulations (Harmonic wave's regulation) for the suppression against such interference.
Telecommunication systems have an essential and important role in railway operations such as train control, operation, safety, etc. In order to meet operational demands, Indian Railways is in the process of improving and expanding their telecommunication systems. The following information describes the current situation and trends in telecommunications development within Indian Railways. Optical fibre communications (OFC) systems have been selected as the next generation fixed telecommunication system. A 150 MHz band press-to-talk mobile radio

system is provided for the purpose of making emergency calls. All the Zonal and Divisional exchanges of Indian Railways are being integrated under a uniform standard via 2 MBPS connectivity. Currently, the Zonal Railways are introducing automatic signalling and blocking system in rural area, where 4 aspects multiple colours signal is provided. And electronic interlocking system integrating signals, switch machines, level crossing gates etc. are in process, however, many old types of manually operated equipment are still functional.

16.5 Efforts and Procedures Required for Introduction of High-Speed Railways in the Future

16.5.1 Establishment of Legal System and Technical Standard for HSR in India

To ensure safety and realize total design management aiming at overall optimization, establishment of such legal system structure is required for design, construction and operation The confirmation of the technical level is necessary for engineers to perform steady construction and supervision based on this legal system and technical standards.
HSR is different system from conventional line. Its implementation structure is considered to be a different organization from Indian Railways as mentioned in Chapter 11. Therefore, study team recommends establishing independent legal system for HSR apart from the one for conventional lines. For example of similar case, the legal system for Metro railway in India is established apart from conventional line. The legal system recommended for HSR is as follows. The structure of Legal system for HSR is shown in Figure 16-5-1.

1) Ministry Level

① Act
Act for HSR's construction, operation and maintenance is required corresponds to the Railways Act (1989) for conventional lines or the Metro Railways (Operation and Maintenance) Act for Metros. It should include the basic article for establishing organization for HSR operation and maintenance.

② Regulation
In Regulation level, MOR control the safety, inspection and certification of new line, certification of new rolling stocks, and certification of driver license for HSR.

③ Notification
In notification level, the technical specifications are announced to Railway organization. The technical specification should be performance standard for HSR Organization to be able to introduce new technology.

2) Railway Organization Level

① Standards
Standards are prepared by HSR organization according to the Acts, Regulations, and Notice from MOR. It should be submitted to MOR for approval. It includes technical standards for construction, operation and maintenance.

②) Manuals
Manuals are prepared by HSR organization according to ministerial regulations and internal standards. It includes the specific procedure for construction, operation and maintenance.

Figure 16-5-1 Structure of Legal System and Technical Standard for HSR in India

Enactor	Classification	Contents
Ministry Level (Supervision, Regulator)	Act	• Structure Organization • Finance • Station Area Development
	Regulation	• Safety (Enquiry into Railway Accidents) • Inspection and Certification of new line • Certification of New Rolling Stock • Certification of Driver License for HSR
	Notification	• Technical Specifications for HSR
Railway Organization(Construction, Operation)	Standard	• Technical Standard for Construction, Operation and Maintenance for HSR
	Manual	• Specific Procedure for Construction, Operation and Maintenance for HSR

Source: Study Team

16.5.2 Reinforcement of the Institute of High Speed Railway Project Implementation

India is sort of a railway empire featuring along history, with railway-related decrees already prepared in outline including those indispensable for construction of high-speed railways. The schedule of dimensions for high-speed railways alone shall be established in the future, however. Regarding land acquisition, as the new Land Acquisition Act has just been enacted, India shall see through the situation of land acquisition for other public projects in the country for the time being. In any event, however, land acquisition in an easy manner tends to become increasingly difficult in urban areas. Therefore, a multi-level land re-plotting system exchanging a land with a package of land plus building floors as a unit) shall desirably be instituted, as seen in the urban area re-development law in Japan.

HSR Authority which is responsible for legal system and technical standards for HSR should be established earlier, and it should start making legal systems as soon as possible. In this context, it is expected that timely presentation of the high-speed railway technologies of Japan facilitate smooth institution of the schedule of dimensions in India.

For successful HSR project execution, the operation administration of HSR has important role. Establish of responsible administration of HSR is the urgent matter. In Japan, Nationwide Shinkansen Railway Development Act (Act No. 71 of May 18, 1970) provides that the Minister has to talk to an operating corporation and has to get consent before making a decision about the development plan. It means the operation is the most important matter of railway projects. Without rational and efficient operation, railway project cannot continue successful business. The discussion among construction organ and operation organ to reflect the operation and maintenance plan to construction plan is indispensable for railway construction.

16.5.3 Necessity of the Regulation Enactment in the Future

(1) Procedure for Safety Certification and Technical Clearance

The Study Team recommends making the performance standards for HSR so as to correspond the new technologies flexibly. The construction organization of HSR will be required to present the technical standards to do the planning of HSR project. Ministry of Railways has to do certification of the presented technical standards. It is recommended to gather in advance the information of new high speed railway technologies.

The technical planning and safety of HSR System in India should be studied quickly. Since a considering the fact that some technical and safety related issues can best be dealt with at the

planning stage itself, a comprehensive document shall be prepared giving the details of procedure for Safety Certification and Technical clearance.
After deliberations in the Inter-Ministerial Committee on HSR issues, it shall decide with general consensus, that Ministry of Railways should confine its role to according in principle approvals of broad technology as chosen and proposed by HSR Authority in the following areas:
Schedule of Dimensions, Design Basis Report, Track Structure, Issue of Speed Certificate, Technology for signaling, Technology for electrification, Technology for rolling stock, Rules for opening of the HSR railway and General Rules
Overview of the Procedure
The complete exercise of safety certification and technical clearance for commissioning HSR System is broadly divided into the following parts:
(i) Submission and Scrutiny of Schedule of Dimensions(SOD)
(ii) Submission and Scrutiny of technical documents like specifications, design and test certificates.
(iii) Tests of selected sub-systems.
(iv) Oscillation trials and issue of speed certificates.
For maintenance and other manuals, before commencement of the commercial services, the HSR Authority should ensure that all the following manual are in place:
(i) Operation Manual
(ii) Safety Manual
(iii) Disaster Management Manual
(iv) Maintenance Manual of various sub-systems

(2) Enactment of land-related laws on readjustment/ urban redevelopment

(a) Urban Planning
In Japan legal force is given to the Urban Planning Law to realize the urban planning, by applying necessary restriction to construction of buildings based on the Building Standard Law. The urban planning is formulated on an all-prefectures level and a cities, towns and villages level. Whenever planning a new project or changing some existing plans, the urban council is to be referred to, and the newest urban planning map is created. All project plans are woven into city planning.
All constructors should make buildings according to the urban plan and the building standard law. For this purpose, the urban plan should be decided under the agreement of people concerned at the opened council. Impartial scholars should join the discussion at the council to decide/amend the urban plan.
The modern urban plan is required TOD (Transport Oriented Development) or Railway Station Oriented Development. Because human contact is the indispensable matter for economic and technology activity. Railway connection is the key point of urban plan.

(b) Introduction of land readjustment/ multi-level replotting
It is pointed out by mass media that there are problems in the cost and period of the public facilities construction work in India. Land acquisition is now under severe conditions, in particular. This requires a system to authorize the evaluation and fair amounts of indemnification.
Regarding the land purchase for road construction in the past, there was reportedly a case where the cost of the lands remained unsold near the completed road skyrocketed when compared with the cost at which a land had been purchased. This caused the land seller a feeling of intolerable unfairness and dissatisfaction. Similar problems have been experienced in Japan as well. As a means to solve this problem, reduced land replotting by readjustment or multi-level replotting in urban development is conceivable like in Japan. India is expected to adopt a system to produce public lands through readjustment when railways or roads are constructed in cities and make the

gains from the development be enjoyed among the stakeholders in the related areas. Land readjustment is a method to promote development of regional areas when roads, parks, railways or stations are constructed, with the lands required therefor appropriated in pieces by those living in the area. Multi-level replotting is a technique to construct a large-scale building by appropriating the whole of the sites of small-scale buildings and distribute the floors of the completed buildings in proportion to the right of land and house. If the concept of Promotion of integrated land development in metropolitan areas and railway line special measure Act in Japan is introduced, collective replotting to the lands for public projects through land readjustment scheme will become possible. Furthermore, internalization of developmental gains will smoothly accelerate the projects for railway construction and development of residential areas.
In introducing these systems, India shall accomplish consciousness innovation of the nation to the effect that lands are public assets so public projects should get land allocation priority and people should cooperate it.

16.5.4 Schedule of Institute Preparation

Legal items required to implement public projects are all specified in relevant laws in India. However, their implementation lacks smoothness in actuality. This implies that there may be problems in the provisions of existing laws. Nevertheless, it is more important than anything else that government officials in charge shall acquire a habit to address their services with a vision and induce basic concepts of public opinions and policies.
As the laws required before the inauguration of the high-speed railway project, India shall enact a law on the procedure to construct high-speed railways by referring to the nation-wide Shinkansen network construction law in Japan and adopt the rules on the railway construction by referring to the deliberating councils for building social capitals and for transport policies in Japan in order to formulate fair and square plans to construct high-speed railways and perform verification of their sustainability.
Besides the laws on the construction of high-speed railways, the laws/provisions that are immediately required include the Land Readjustment Act, multi-level replotting on Urban Redevelopment Act and provisions on the method to evaluate the fair amounts of indemnification of the compulsory expropriation procedure in the Land Law. As a measure required other than the above, India shall desirably reinforce the control of the development/ utilization of land and newly built architectures in accordance with city planning schemes and discuss the measure for fairness of the evaluation of land purchasing prices to guarantee the impartiality between the transferred and remained land owners and a taxation system for the beneficiaries of developmental gains.

16.5.5 Decrees Instituting Process

In India, Railway related Decrees needs to be outlined at this stage including those indispensable for construction of HSR. As MOR prepares Performance Standards for Indian Railways, HSR Authority should make HSR standards including schedule of dimensions and submit to MOR to get certification and approval.
In case the HSR project is executed outside the purview of Indian Railways, following items should be made before the project start.
-Establishment Act of HSR Authority
-Act or Ordinance of definition of High Speed Railway (Construction Administration, Property owner Administration, Facilities maintenance responsibility, Funding and operation cost Sponsor)
-Other regulation imitated by Metro Railway.

India is required to institute railway-related decrees while considering the whole process of the projects for high-speed railway construction in the future, in order to keep a breast there of all the time. The process therefor conceivable at the moment is as follows.

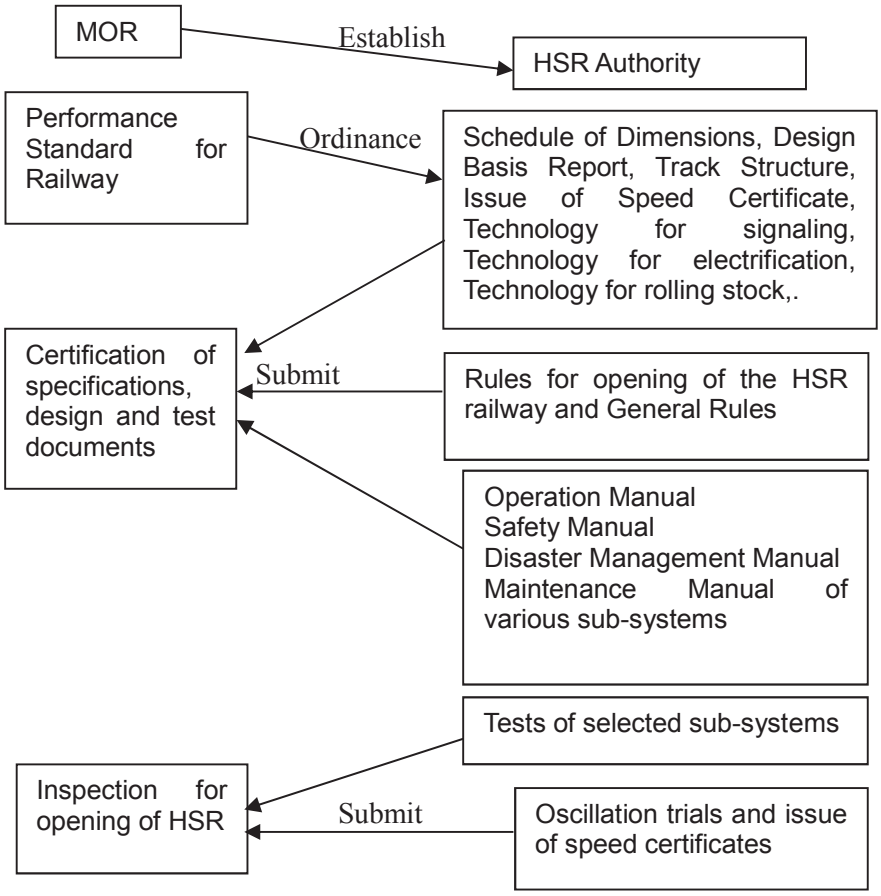


Figure 16.5-2 Institute Schedule

Necessary period to prepare the regulations and standards for high speed railway is shown in Table 16.5-1 and Figure 16.5-3.

Table 16.5.1 Desirable Period of Institution preparation

Year	Construction	Regulators Action	Institutional Arrangement
2015	Detail design	Establish of HSR Authorization Announcement of Performance Standard for HSR	Detailed Project Report Schedule of Dimension
2016		Certification of HSR standard and design HSR finance set-up	Track Structure, rolling stock, train control system, Design standard for HSR Design Basis Report
2017			HSR construction bidding documents
2018	Construction start		Test line design
2019		Certification of Speed test documents HSR driver license rule	Regulation on HSR operation, safety, management
2020	Test line open	Certification of Regulation on HSR operation, safety,	Regulation on HSR maintenance, Inspection,

		management Validation of rolling stock	Disaster management
2021	Construction work finish Test line operation	Certification of Regulation of HSR maintenance, Inspection, Disaster management Inspection upon completion of works and safety	
2022			Driver training and license
2023	Operation Start		

Source: JICA Study Team

Item	15	16	17	18	19	20	21	22	23	24	25
Detailed Project Report											
Schedule of Dimension Document											
Design Basis Report											
Establish of High Speed Rail Co.											
Design standard of high speed rail											
Regulation on High speed rail operation											
Regulation of high speed rail maintenance, Inspection											
Test Run											
HSR Open											

Figure 16.5-3 Working Schedule

Source: JICA Study Team

16.6 Recommendation

- Indian Railway has rich experience and execution capability of legal systems and technical standards in conventional line.
- HSR system is quite different from conventional line. Technical standards for HSR should be developed.
- The role of Ministry and HSR organization for construction and operation should be clarified.
- Ministry will be responsible for regulator and supervisor, including safety issues for HSR.
- HSR Railway organizations will be responsible to construct and operate, maintain HSR by technical standards, rules and manual etc.
- As the establishing Legal system and technical standard are quite important for HSR system, Technical cooperation of India and Japan in this field would be vitally necessary.
- MOR should make the performance standards for HSR so as to correspond to the new technology flexibly.
- MOR to do certification of the new presented technical standards from HSR Authority.
- The information should be gathered in advance for the new high speed railway technologies.
- HSR technical standardization would be important for HSR network, and cost-effectiveness of spare equipment.
- The special railway projects are exempted from environmental clearance and land acquisition Act. HSR Authority should be careful about negative impact of HSR especially on environment.

Appendix 16.1 Indian Railway Bare Act

A
THE ADMINISTRATIVE TRIBUNALS ACT, 1985
THE ADVOCATES ACT, 1961
THE AIR (PREVENTION AND CONTROL OF POLLUTION) ACT, 1981
THE AJMER TENANCY AND LAND RECORDS ACT, 1950
THE ALL INDIA COUNCIL FOR TECHNICAL EDUCATION ACT, 1987
THE ALL-INDIA SERVICES ACT, 1951
THE ALL-INDIA SERVICES REGULATIONS (INDEMNITY) ACT, 1975
THE ANAND MARRIAGE ACT 1909
THE ANCIENT MONUMENTS AND ARCHAEOLOGICAL SITES & REMAINS ACT, 1958
THE ANCIENT MONUMENTS PRESERVATION ACT, 1904
THE ANTI-APARTHEID (UNITED NATIONS CONVENTION) ACT, 1981
THE ANTI-HIJACKING ACT, 1982
THE ANTIQUITIES AND ART TREASURES ACT, 1972
THE APPRENTICES ACT, 1961
THE ARBITRATION (PROTOCOL AND CON V ENTION) ACT, 1937
THE ARBITRATION ACT, 1940
THE ARBITRATION AND CONCILIATION ACT, 1996
THE ARMS ACT, 1959
THE ARMY ACT, 1950
THE ARMY AND AIR FORCE (DISPOSAL OF PRIVATE PROPERTY) ACT, 1950
THE ARYA MARRIAGE VALIDATION ACT, 1937
THE ALL INDIA COUNCIL FOR TECHNICAL EDUCATION ACT, 1987
B
THE BUILDING AND OTHER CONSTRUCTION WORKERS (REGULATION OF EMPLOYMENT AND CONDITIONS OFSERVICE) ACT, 1996
THE BUILDING AND OTHER CONSTRUCTION WORKERS' WELFARE CESS ACT, 1996
THE BOMBAY HIGH COURT (LETTERS PATENT) ACT, 1866
THE BIRTHS, DEATHS AND MARRIAGES REGISTRATION ACT, 1886
THE BANKERS BOOK EVIDENCE ACT, 1891
THE BONDED LABOUR SYSTEM (ABOLITION) ACT, 1976
THE BONDED LABOUR SYSTEM (ABOLITION) RULE, 1976
THE BHOPAL GAS LEAK DISASTER (PROCESSING OF CLAIMS) ACT, 1985
THE BUREAU OF INDIAN STANDARDS ACT, 1986
THE BUREAU INDIAN STANDARDS (CERTIFICATION) REGULATION, 1988
THE BUREAU OF INDIAN STANDARDS RULES 1987
THE BENAMI TRANSACTIONS (PROHIBITION) ACT, 1988
C
THE CABLE TELEVISION NETWORKS (REGULATION) ACT, 1995
THE CALCUTTA HIGH COURT (EXTENSION OF JURISDICTION) ACT, 1953
THE CALCUTTA HIGH COURT (JURISDICTIONAL LIMITS) ACT, 1919
THE CALCUTTA METRO RAILWAY (OPERATION AND MAINTENANCE) TEMPORARY PROVISIONS ACT, 1985
THECANTONMENTS (EXTENSION OF RENT CONTROL LAWS) ACT, 1957
THE CANTONMENTS (HOUSE-ACCOMMODATION) ACT, 1923
THE CASTE DISABILITIES REMOVAL ACT, 1850
THE CATTLE-TRESPASS ACT, 1871
THE CENSUS ACT, 1948
THE CENTRAL ADMINISTRATIVE TRIBUNAL (PROCEDURE) RULES, 1987
THE CENTRAL BOARD OF DIRECT TAXES (VALIDATION OF PROCEEDINGS) ACT,

1971
THE CENTRAL BOARDS OF REVENUE ACT, 1963
THE CENTRAL INDUSTRIAL SECURITY FORCE ACT, 1968
THE CENTRAL LABOUR LAWS (EXTENSION TO JAMMU AND KASHMIR) ACT, 1970
THE CHAPARUMUKH-SILGHAT RAILWAY LINE AND THE KATAKHAL LALA BAZAR RAILWAY LINE (NATIONALISATION) ACT, 1982
THE CHARTERED ACCOUNTANTS ACT, 1949
THE CHILD LABOUR (PROHIBITION AND REGULATION) ACT, 1986
THE CHILDREN ACT, 1960
THE CIGARETTES (REGULATION OF PRODUCTION, SUPPLY AND DISTRIBUTION) ACT, 1975
THE CINE- WORKERS WELFARE FUND ACT, 1981
THE CITIZENSHIP ACT, 1955
THE CODE OF CIVIL PROCEDURE (AMENDMENT) ACT, 1999
THE CODE OF CIVIL PROCEDURE, 1908
THE COLLECTION OF STATISTICS ACT, 1953
THE COMMISSIONS OF INQUIRY ACT, 1952
THE COMMISSIONS OF SATI (PREVENTION) ACT, 1987
THE COMPANIES (DONATIONS TO NATIONAL FUNDS) ACT, 1951
THE CONSTITUTION OF INDIA, 1950
THE CONSUMER PROTECTION ACT, 1986
THE CONSUMER PROTECTION RULES, 1987
THE CONTEMPT OF COURTS ACT, 1971
THE CONTEMPT OF COURTS (CAT) RULES, 1992
THE CONTRACT ACT, 1872
THE CONTRACT LABOUR (REGULATION AND ABOLITION) ACT, 1970
THE COPYRIGHT (AMENDMENT) BILL 1999
THE COPYRIGHT ACT, 1957
THE COPYRIGHT RULES, 1958
THE COST AND WORKS ACCOUNTANTS ACT, 1959
THE COURT-FEES ACT, 1850
THE CRIMINAL PROCEDURE CODE
D
THE DAKSHINA BHARAT HINDI PRACHAR SABHA ACT, 1964
THE DANGEROUS MACHINES (REGULATION) ACT, 1983
THE DECREES AND ORDERS VALIDATING ACT 1936
THE DELHI (URBAN AREAS) TENANTS' RELIEF ACT, 1961
THE DELHI AND AJMER RENT CONTROL (NASIRABAD CANTONMENT REPEL) ACT, 1968
THE DELHI AND AJMER RENT CONTROL ACT, 1952
THE DELHI APARTMENT OWNERSHIP ACT, 1986
THE DELHI CO-OPERATIVE SOCIETIES ACT, 1972
THE DELHI FIRE PREVENTION AND FIRE SAFETY ACT, 1986
THE DELHI HIGH COURT ACT, 1966
THE DELHI LAND HOLDINGS (CEILING) ACT, 1960
THE DELHI LAND REFORMS ACT, 1954
THE DELHI LAND REVENUE ACT, 1954
THE DELHI LANDS (RESTRICTIONS ON TRANSFER) ACT, 1972
THE DELHI PROHIBITION OF SMOKING AND NON -SMOKERS HEALTH PROTECTION ACT, 1996
THE DELHI RENT ACT, 1995
THE DELIVERY OF BOOKS AND NEWS PAPER (PUBLIC LIBRARIES) ACT, 1954
THE DEPARTMENTAL INQUIRIES (ENFORCEMENT OF ATTENDANCE OF

WITNESSES AND PRODUCTION OF
DOCUMENTS) ACT, 1972
THE DOWRY PROHIBITION ACT, 1961
THE DRUGS AND COSMETICS ACT, 1940
E
THE ECONOMIC OFFENCES (INAPPLICABILITY OF LIMITATION) ACT, 1974
THE ELECTRICITY REGULATORY COMMISSION 1998
THE EMIGRATION ACT, 1983
THE EMIGRATION RULES, 1983
THE EMPLOYEES PROVIDENT FUNDS AND MISCELLANEOUS PROVISIONS ACT, 1952
THE EMPLOYEES' STATE INSURANCE ACT, 1948
THE EMPLOYERS' LIABILITY ACT, 1 938
THE EMPLOYMENT EXCHANGE (COMPU L SORY NOTIFICATION OF VACANCIES) ACT, 1959
THE ENVIRONMENT (PROTECTION) ACT, 1986
THE ENVIRONMENT ACT
THE EQUAL REMUNERATION ACT, 1976
THE ESSENTIAL COMMODITIES ACT, 1955
THE EXPENDITURE TAX ACT, 1987
F
THE FOREIGN MARRIAGE RULES, 1970
THE FAMILY COURTS ACT, 1984
THE FATAL ACCIDENTS ACT, 1855
THE FACTORIES ACT 1948
THE FOREIGN CONTRIBUTION (REGULATION) ACT, 1976
THE FOREIGN EXCHANGE & REGULATION ACT, 1973
THE FOREIGN EXCHANGE MAINTENANCE ACT, 1999
THE FOREIGN EXCHANGE MANAGEMENT BILL, 1999
THE FOREIGN EXCHANGE REGULATION ACT, 1973
THE FOREIGN EXCHANGE REGULATION ACTS (FERA)
THE FOREIGN MARRIAGE ACT, 1969
THE FOREIGN TRADE (DEVELOPMENT AND REGULATION) ACT, 1992
THE FOREST CONSERVATION ACT, 1980
THE FOREST (CONSERVATION) RULES, 1981
G
THE GENERAL CLAUSES ACT, 1897
THE GIFT TAX ACT, 1958
THE GLANDERS AND FARCY ACT, 1899
THE GOVERNMENT OF NATIONAL CAPITAL TERRITORY OF DELHI ACT, 1991
THE GUARDIANS AND WARDS ACT, 1890
H
THE HINDU ADOPTIONS AND MAINTENANCE ACT 1956
THE HINDU DISPOSITION OF PROPERTY ACT, 1916
THE HINDU MARRIAGE ACT, 1955
THE HINDU MINORITY AND GUARDIANSHIP ACT, 1956
THE HINDU SUCCESSION ACT, 1956
THE HIRE-PURCHASE ACT, 1972
I
THE ILLEGAL MIGRANTS (DETERMINATION BY TRIBUNALS) ACT, 1983
THE IMMIGRANTS (EXPULSION FROM ASSAM) ACT, 1950
THE INCOME TAX ACT, 1961
THE INDECENT REPRESENTATION OF WOMEN (PROHIBITION) ACT, 1986

THE INDIAN BOILERS ACT, 1923
THE INDIAN DESIGN ACT
THE INDIAN CHRISTIAN MARRIAGE ACT 1872
THE INDIAN CONTRACT ACT, 1872
THE INDIAN DIVORCE ACT, 1869
THE INDIAN DOCK LABOURERS ACT, 1934
THE INDIAN FOREST ACT, 1927
THE INDIAN EVIDENCE ACT, 1872
THE INDIAN PARTNERSHIP ACT, 1932
THE INDIAN PATENTS ACT 1970
THE INDIAN PENAL CODE 1860
THE INDIAN RIFLES ACT, 1920
THE INDIAN STAMP ACT, 1899
THE INDIAN SUCCESSION ACT, 1925
THE INDIAN TELEGRAPH ACT 1885
THE INDIAN TRUSTS ACT, 1882
THE INDUSTRIAL DISPUTES ACT 1947
THE INDUSTRIAL DISPUTE ACT, 1955
THE INDUSTRIAL DISPUTES (BANKING COMPANIES) DECISION ACT, 1955
THE INDUSTRIAL EMPLOYMENT (STANDING ORDERS) ACT, 1946
THE INDUSTRIES (DEVELOPMENT AND REGULATION) ACT, 1951
THE INFORMATION TECHNOLOGY ACT, 2000
THE INSURANCE REGULATORY AUTHORITY BILL, 1999
THE INTEREST ACT, 1978
THE INTEREST TAX ACT, 1974
THE IPC
J
THE JUDGES (INQUIRY) ACT, 1968
THE JUDGES (PROTECTION) ACT, 1985
THE JUDICIAL COMMISSIONERS' COURTS (DECLARATION AS HIGH COURT) ACT, 1950
THE JUTE COMPANIES (NATIONALISATION) ACT, 1980
THE JUTE MANUFACTURES CESS ACT, 1983
THE JUTE PACKAGING MATERIALS (COMPULSORY USE IN PACKING COMMODITIES) ACT, 1987
THE JUVENILE JUSTICE ACT, 1986
K
THE KAZIS ACT, 1880
THE KHADI AND VILLAGE INDUSTRIES COMMISSION ACT, 1956
L
THE LABOUR LAW (EXEMPTION FROM FURNISHING RETURNS AND MAINTAINING REGISTERS BY CERTAIN ESTABLISHMENTS) ACT, 1988
THE LALIT KALA AKADAMI (TAKING OVER OF MANAGEMENT) ACT, 1997
THE LAND ACQUISITION (MINES) ACT, 1885
THE LAND ACQUISITION ACT, 1894
THE LAND IMPROVEMENT LOANS ACT, 1883
THE LAWS LOCAL EXTENT ACT, 1874
THE LEGAL REPRESENTATIVES SUITS ACT, 1855
THE LEGAL SERVICES AUTHORITIES ACT, 1987
THE LIFE INSURANCE (EMERGENCY PROVISIONS) ACT, 1956
THE LIFE INSURANCE CORPORATION (MODIFICATION OF SETTLEMENT) ACT, 1976
THE LIFE INSURANCE CORPORATION ACT, 1956
THE LIMITATION ACT, 1963

THE LIMITATION ACT, 1963 - PERIOD OF LIMITATION - FIRST DIVISION - SUITS
THE LIVE-STOCK IMPORTATION ACT, 1898
THE LOTTERIES (REGULATION) ACT, 1998
M
THE MADHYA BHARAT TAXES ON INCOME (VALIDATION) ACT, 1954
THE MAHARASHTRA MATHADI, HAMAL AND OTHER MANUAL WORKERS (REGULATION OF EMPLOYMENT ANDWELFARE) ACT, 1969
THE MAHARASHTRA RECOGNITION OF TRADE UNION AND PREVENTION OF UNFAIR LABOUR PRACTICES ACT, 1971
THE MAJOR PORT TRUSTS ACT, 1963
THE MARRIED WOMEN'S PROPERTY (EXTENSION) ACT, 1959
THE MARRIED WOMEN'S PROPERTY ACT, 1959
THE MATERNITY BENEFIT ACT, 1961
THE MATERNITY BENEFITS ACT, 1961
THE MEDIA LAW
THE MEDICAL TERMINATION OF PREGNANCY ACT, 1971
THE MENTAL HEALTH ACT, 1987
THE METRO RAILWAYS (CONSTRUCTION OF WORKS) ACT, 1978
THE MINIMUM WAGE ACT, 1948
THE MONOPOLIES AND RESTRICTIVE TRADE PRACTICE ACT, 1969
THE MOTOR TRANSPORT WORKERS ACT, 1961
THE MOTOR VEHICLE ACT, 1988
THE MRTP ACT, 1969
THE MUNICIPAL TAXATION ACT, 1881
THE MUSLIM PERSONAL LAW (SHARIAT) APPLICATION ACT, 1937
THE MUSLIM WOMEN (PROTECTION OF RIGHTS ON DIVORCE) ACT, 1986
THE MUSSALMAN WAKF VALIDATING ACT 1930
THE MUSSALMAN WAKF VALIDATING ACT, 1913
N
THE NARCOTIC DRUGS AND PSYCHOTROPIC SUBSTANCES ACT, 1985
THE NATIONAL COMMISSION FOR BACKWARD CLASSES
THE NATIONAL COMMISSION FOR MINORITIES ACT, 1992
THE NATIONAL COMMISSION FOR SAFE KARAMCHARIS ACT, 1993
THE NATIONAL COMMISSION FOR WOMEN ACT, 1990
THE NATIONAL CO-OPERATIVE DEVELOPMENT CORPORATION ACT, 1962
THE NATIONAL COUNCIL FOR TEACHER EDUCATION ACT, 1993
THE NATIONAL ENVIRONMENT APPELLATE AUTHORITY ACT, 1997
THE NATIONAL HOUSING BANK ACT, 1987
THE NATIONAL SECURITY ACT, 1980
THE NATIONAL SERVICE ACT, 1972
THE NEGOTIABLE INSTRUMENTS ACT, 1881
THE NEW DELHI MUNICIPAL CORPORATION ACT, 1994
THE NEWSPAPER (PRICE AND PAGE) ACT, 1956
THE NEWSPAPER (PRICE CONTROL) ACT, 1972
THE NORTH-EASTERN COUNCIL ACT, 1971
THE NOTARIES ACT, 1952
THE NOTARIES RULES, 1956
O
THE OATHS ACT, 1969
THE OFFICIAL LANGUAGES ACT, 1963
THE OFFICIAL SECRETS ACT, 1923
P
THE PARLIAMENTARY PROCEEDINGS (PROTECTION OF PUBLICATION) REPEAL

ACT, 1977
THE PASSPORTS ACT, 1967
THE PATENTS ACT, 1970
THE PAYMENT OF BONUS ACT, 1965
THE PAYMENT OF WAGES ACT, 1936
THE PAYMENT OF GRATUITY (AMENDMENT) ACT, 1998
THE PAYMENT OF GRATUITY ACT, 1972
THE PERSONAL INJURIES (COMPENSATION INSURANCE) ACT, 1963
THE PERSONAL INJURIES (EMERGENCY PROVISIONS) ACT, 1962
THE PERSONS WITH DISABILITIES (EQUAL OPPORTUNITIES, PROTECTION OF RIGHTS AND FULLPARTICIPATION) ACT, 1995
THE PLACES OF WORSHIP (SPECIAL PROVISIONS) ACT, 1991
THE PLANTATIONS LABOUR ACT, 1951
THE POLICE-FORCES (RESTRICTION OF RIGHTS) ACT, 1966
THE POWERS OF ATTORNEY ACT 1882
THE PRESS AND REGISTRATION OF BOOKS ACT, 1867
THE PRESS COUNCIL ACT, 1965
THE PRESS COUNCIL ACT, 1978
THE PREVENTION OF FOOD ADULTERATION ACT, 1954
THE PREVENTION OF MONEY-LAUNDERING BILL, 1999
THE PROBATION OF OFFENDERS ACT, 1958
THE PUBLIC LIABILITY INSURANCE ACT, 1991
THE PUBLIC PREMISES (EVICTION OF UNAUTHORISED OCCUPANTS) ACT, 1971
THE PUBLIC PROVIDENT FUND ACT, 1968
THE PUBLIC RECORDS ACT, 1993
THE PUBLIC SERVANTS (INQUIRIES) ACT, 1850
THE PUBLIC WAKFS (EXTENSION OF LIMITATION) ACT, 1959
R
THE RAILWAY CLAIMS TRIBUNAL ACT, 1987
THE RAILWAY COMPANIES (EMERGENCY PROVISIONS) ACT, 1951
THE RAILWAY PROPERTY (UNLAWFUL POSSESSION) ACT, 1966
THE RAILWAY PROTECTION FORCE ACT, 1957
THE RAILWAYS (EMPLOYMENT OF MEMBERS OF ARMED FORCES) ACT, 1965
THE RAILWAYS ACT, 1989
THE REGISTRATION ACT, 1908
THE REGISTRATION OF BIRTHS AND DEATHS ACT, 1969
THE RELIGIOUS INSTITUTIONS (PREVENTION OF MISUSE) ACT, 1988
THE REPRESENTATION OF THE PEOPLE (AMENDMENT) ACT, 1989
THE REPRESENTATION OF THE PEOPLE (MISCELLANEOUS PROVISIONS) ACT, 1956
THE REPRESENTATION OF THE PEOPLE ACT, 1951
THE RESERVE BANK OF INDIA ACT, 1934
S
THE SALE OF GOODS ACT, 1930
THE SALES-TAX LAWS VALIDATION ACT, 1956
THE SCHEDULED CASTES AND THE SCHEDULED TRIBES (PREVENTION OF ATROCITIES) ACT, 1989
THE SLUM AREAS (IMPROVEMENT AND CLEARANCE) ACT, 1956
THE SMALL COINS (OFFENCES) ACT, 1971
THE SMUGGLERS AND FOREIGN EXCHANGE MANIPULATORS (FORFEITURE OF PROPERTY) ACT, 1976
THE SOCIETIES REGISTRATION ACT, 1860
THE SPECIAL CRIMINAL COURTS (JURISDICTION) ACT, 1950
THE SPECIAL MARRIAGE ACT, 1954

THE SPECIFIC RELIEF ACT, 1963
THE ST. JOHN AMBULANCE ASSOCIATION (INDIA) TRANSFER OF FUNDS ACT, 1956
THE STANDARDS OF WEIGHTS AND MEASURES (ENFORCEMENT) ACT, 1985
THE STANDARDS OF WEIGHTS AND MEASURES ACT, 1976
THE STATE RE-ORGANISATION BILL, 1956
THE SUITS VALUATIONS ACT, 1887
THE SUPPRESSION OF IMMORAL TRAFFIC IN WOMEN AND GIRLS ACT, 1956
THE SUPPRESSION OF UNLAWFUL ACTS AGAINST SAFETY OF CIVIL AVIATION ACT, 1982
THE SUPREME COURT (ENLARGEMENT OF CRIMINAL APPELLATE JURISDICTION) ACT, 1970
THE SUPREME COURT (NUMBER OF JUDGES) ACT, 1956
THE SUPREME COURT JUDGES (CONDITIONS OF SERVICE) ACT, 1958
T
THE TAXATION LAWS (CONTINUATION AND VALIDATION OF RECOVERY PROCEEDINGS) ACT, 1964
THE TAXATION LAWS (EXTENSION TO JAMMU AND KASHMIR) ACT, 1954
THE TECHNOLOGY DEVELOPMENT BOARD ACT, 1995
THE TERMINAL TAX ON RAILWAY PASSENGERS ACT, 1956
THE TERRITORIAL ARMY ACT, 1948
THE TRADE UNIONS ACT, 1926
THE TRANSFER OF PROPERTY ACT, 1882
THE TRANSPLANTATION OF HUMAN ORGANS ACT, 1994
U
THE UNLAWFUL ACTIVITIES (PREVENTION) ACT, 1967
THE UNTOUCHABILITY (OFFENCES) ACT, 1955
V
THE VOLUNTARY DEPOSITS (IMMUNITIES AND EXEMPTIONS) ACT, 1991
THE VOLUNTARY DISCLOSURE OF INCOME AND WEALTH ACT, 1976
W
THE WEALTH-TAX ACT, 1957 INCOMPLETE
THE WEEKLY HOLIDAYS ACT, 1942
THE WORKMEN'S COMPENSATION ACT, 1923 INCOMPLETE
THE WILD LIFE (PROTECTION)
Y
THE YOUNG PERSONS (HARMFUL PUBLICATIONS) ACT, 1956

Source Indian Railways Internet Home Page

Appendix 16.2 Example of Indian rule , manual, standard

List of Manuals:

Sl. No.	Description	Issued	Correction Slip No.
1.	Track Manual Volume-I	1994	1 of 2001
2.	Track Manual Volume-I I	1989	Nil
3.	Manual for Flash Butt Welding of rails.	1996 (Re-printed 2004)	7 of 2007
4.	Manual for fusion welding of rails by the Alumino-Thermic Process.	1998	5 of 2006
5.	Manual of instructions on Long Welded Rails.	1996	10 of 2006
6.	Manual for Ultrasonic Testing of Rails & Welds.	1998	17 of 2006
7.	Manual for Glued Insulated Rail Joints	1998	4 of 2001
8.	Manual for reconditioning of Medium Manganese (MM) Steel Points and Crossings, Switch Expansion Joints (SEJ's) and Cast Manganese Steel (CMS) Crossing 1996	1996	Under revision

Source Indian Railways

List of Indian Railway Standard Specifications

Sl. No.	Description	Specification No.	Corrigendum No.
1	Dog spikes	IRS. T-2 - 66	3 of May,73
2	Round spikes	IRS. T-4 - 66	3 of May,73
3	Rectangular M.S. Bearing plates	IRS. T-5 - 65	2 of Sept.,86.
4	C.I. Sleeper plates bearing plates and chairs	IRS. T-7 - 83	4 of Oct. 1981
5	Tie bars, gibs, cotters and keys	IRS. T-8 - 66	8 of Sept.,91
6	Transverse track and turnout steel sleepers.	IRS. T-9 - 70	3 of Sept.,83
7	Fabricated Switches and crossings, welded/heat treated crossings and switch expansion joints (SEJ)	IRS. T-10-2000	Nil
8	Flat bottom railway rails	IRS. T-12- 2009	3 of June-2012
9	Fangs, bolts and nuts.	IRS. T-13- 66	1 of Sept.,67
10	Inspection trolleys, material trolleys or lorries and duplicated lorries	IRS. T-15- 67	Nil
11	Rail/plate screws	IRS. T-16- 81	2 of June,97
12	Loose jaws for steel trough sleepers.	IRS. T-17- 68	1 of April,76
13	Fusion welding of rails by Alumino-thermic process	IRS. T-19-1994	14 of Jan.11
14	Steel clamps for wooden sleepers	IRS. T-21- 72	Nil
15	Track bolts and nuts	IRS. T-23- 67	5 of Oct., 87
16	Rail Anchors	IRS. T-24- 65	4 of Sept.,91
17	B. G. Second quality transverse track steel sleepers	IRS. T-26- 67	Nil
18	Non-infringing track jacks of 5 tonnes capacity	IRS. T-27- 72	Nil
19	High tensile fish bolts and nuts.	IRS. T-28- 73	Nil
20	Cast Manganese Steel Crossings	IRS. T-29-2000	6 of Nov., 2007
21	Transverse track steel sleepers for use with M. S. welded plates and pandrol clips.	IRS. T-30- 75	Nil
22	Elastic Rail Clip	IRS. T-31-1992	2 of April, 1999
23	Modified loose Jaw	IRS. T-36-1981	1 of Aug. 1985
24	Grooved Rubber Sole Plates 4.5 mm thick	IRS. T-37-1982	2 of Aug. 1986
25	Steel rail pads and their electric welding on to steel sleepers	IRS. T-38- 82	1 of Jan-1990
26	Pretensioned Prestressed Concrete Sleeper for Broad gauge and meter gauge	IRS. T-39-85	4th revision Aug-2011
27	Special grade cement for use in concrete sleepers	IRS. T-40-1985	Nil
28	Single Coil Spring Washer	IRS. T-42-1988	1 of April, 2000
29	Glass Filled Nylon-66 insulating liner	IRS. T-44-1995	3 of Dec. 2010
30	Pretensioned Prestressed Concrete Sleeper for turnout for Broad Gauge and meter gauge.	IRS. T-45-1996	5 of Dec., 2002
31	Spheroidal Graphite Cast Iron inserts	IRS. T-46-1996	1 of Aug. 2008
32	Grooved rubber sole plates 6.0 mm thick	IRS. T-47-2006	1 of June 2007
33	Grooved rubber sole plates 10 mm thick	Provisional-1989	2 of Dec., 1993

34	ERC-J Clip	IRS- Specification for ERC-J (Provisional) Revised - 1994	Nil
35	Rail joints welded with mobile gas pressure welding equipment	Provisional-1995	Nil
36	Polyethylene dowel	Provisional-1997	Nil
37	Track Based Lubricators (Electronic & Hydraulic type)	Provisional-2003	Nil
38	Ultrasonic testing of rails/welds using vehicular systems.	Provisional-2009	2 of Feb,2010
39	Metal Liner	Provisional-2010	Nil
40	Retro-Reflective Engineering Indicators using high intensity grade sheeting (encapsulated lens type)	Provisional-2011	Nil
41	Fishplates	(Provisional) IRS T1 – 2012	Nil
42	Ultrasonic testing of rails/welds	Provisional-2012	Nil
43	Technical specification for Improved SEJ.	Provisional-2008	Nil
44	6.2 mm thick composite Grooved Rubber sole plates for placing beneath rails.	Provisional-2006*	Nil
45	10 mm thick composite Grooved Rubber sole plates for placing beneath rails.	Provisional-2007*	Nil

* Specification issued by M&C Directorate of RDSO.

Source Indian Railways

Chapter 17 Human Resource Development Plan

Mumbai-Ahmedabad HSR has an important meaning that it will be the first HSR in India and become the precedent in order to build a HSR network in India. In India, it is an urgent issue to get the related technology and to operate safely between Mumbai-Ahmedabad HSR.
However, as soon as possible, it is necessary that India has its own technology of HSR to be able to deploy HSR network by oneself in a country in the near future. To this end, transferring of core technology for HSR and training of personnel in charge are extremely important.
It is expected to provide training to field level railways staff for operation as well as maintenance with the assistance from Japanese HSR operators and authorities. Support for establishing a legal framework and technical specification, which is necessary before designing and construction of HSR, is also expected to be planned, and necessary assistance for the preparation of operation phases are also expected to be taken care of by building a training center and sending railway operators from Japan.

17.1 Basic Policy of Developing Human Resource

At first, when considering human resource development, characteristics of HSR should be noted. Farther than conventional lines, HSR has the strong characteristics of the system integrated with many technologies such as train operation & maintenance, rolling stocks, structures, roadbeds &tracks, power supply, telecommunication & signal devices and etc., which constitute railway. If we capture the HSR as a system, the following matters are significant.

(1) The subsystems to form the overall system should be highly reliable respectively.

(2) The subsystems should be integrated so as to organically function to constitute a stable system.

(3) The organization, rules, human resource and education system in order to ensure safety are developed.

Next, one more characteristic as mentioned in "Interim Report 2 Chapter11-Operation and Maintenance Plan", is that train drivers in the case of conventional railways can apply brakes when they have noticed an abnormality ahead, whereas HSR trains running at 300 km/h cannot stop until they run about 5 km after an emergency brake is activated. In other words, it is too late to take necessary actions after finding an abnormality or the situation is totally beyond the sensing ability of human beings. This is true not only for train drivers but also for those in charge of the tracks and electric facilities. This is because, when considering the speed and load applied to civil infrastructure/ electricity equipment of HSR, readiness system to promptly stop or repair the train is necessary if the failure occurs. Furthermore, even when disaster of strong winds or heavy rain occurs, rapid catch and quick/appropriate arrangements according to the situation become very important to take train operation regulations. In this way, in HSR, various techniques and systems are introduced, and their safety is secured
Based on these characteristics of HSR, in discussing human resource development for HSR, it is required to examine the following issues.

(1) The technology required for operation/maintenance of Indian HSR based on current Indian Railway technology, and the core technology to ensure the safety of HSR

(2) Set-up time of the Organization concerned / the O&M company for HSR and Schedule of Human Resource Development

(3) Specific program for human resource development

1) Support for HSR construction preparations

2) Technology transfer during construction period
3) Overseas training
4) Training in India

(4) Other issues of Human Resource Development

1) The education/training of safety to be most considered in order to ensure the safety in Indian HSR
2) Recruiting of massive human resource for operation/maintenance of HSR
3) Technical independence of India HSR
4) The others

(5) Set-up plan of training institute of HSR

17.2 The Technology Required for Operation/Maintenance of India HSR Based on Current Railway Technology Level in India and the Core Technology to Ensure Safety of HSR

17.2.1 Current State of Railway Technology Level in India

As mentioned at "Chapter 11-Organization for Management Indian HSR Line 1", Indian Railway has a fairly high technology comparing to Southeast Asian countries. Among them, Indian Railways (IR) is a huge organization of having about 65,000 operation km and about 1.3 million employees.
Since it is difficult to investigate all IR in this survey, we implemented mainly the survey about Western Railway having related area. In IR, electrification already has considerably advanced and various superior railway technologies are existing. The number of accidents is decreasing every year, however, since IR has vast operating area, it is also true that casualties by train collision or train or fire is happening. Therefore, IR is reinforcing safety measures mainly of improvement such as the signal equipment.
The Delhi Metro (DMRC), which was one of this survey, is small railway operators comparing to the IR, but DMRC incorporates quite a recent railway technology so that it is a newly built urban railway. Because Japanese Shinkansen has a process that was built based on Electric Multiple Unit(EMU), DMRC has many technologies to be useful for the Indian HSR Line 1. However, in both IR and DMRC, the technique of the high speed running more than 300km/H is unknown fields. If you look back at the history of the past world HSR, in France, Germany, Spain, China and South Korea, in each of the countries large accident have occurred unfortunately in the past. Over 50 years after the opening, As for the accident during a high-speed running of HSR, the accident in China and Spain are new in our memory. Particularly, in the case of accidents during high-speed running of HSR, the scale of the damage and casualties becomes miserable to the extent which cannot comparing with the conventional railway. In addition, train derailment and collisions in IR occur successively until now. In order to operate HSR, the establishment of the security system including hardware and software and the safety education for employees concerned are supremacy proposition.
It is only the Japanese Shinkansen not having caused the big accident of HSR. The reason is that the Japanese Shinkansen has been tackling as the greatest problem how not to cause accidents in the development, operation and maintenance of HSR. As below, transfer of technology and development of human resource are described, but the biggest challenge is still "safety assurance." in those issues.

17.2.2 The Technology Required for Operation/ Maintenance of HSR

As mentioned above, this survey was performed mainly about ①IR Western Railway and ② DMRC. Based its survey, items compared with basic techniques used in the Japanese

Shinkansen are described in Appendix 17-1. As can be seen in this table, it seems to be understood that there are quite a number of techniques required for the HSR, which are not in the current Indian railways, still. Among the techniques described above, early disaster detection system including the earthquake is a superior technology that Japanese Shinkansen can boasts to the world. It is considered that training regarding these technologies is necessary to be performed in Japan. For some others, it is conceivable to utilize DMRC or IR. In addition, the methods to acquire the technology at the construction stage and the training by the early construction of the Indian HSR training institute must be considered.
Furthermore, Information & Communication Technology for (ICT) was not introduced also in Japanese Shinkansen at early period, because such technology has not been developed at that time. However, when train number largely increased and various information of operation/maintenance must be dealt quickly with, it has become important and indispensable tool. In particular, ①Rolling stock management system, ②Track maintenance management system, ③Signaling maintenance management system, ④Materials procurement management system and so on are desirable to be introduced at early stage.

17.2.3 The Core Technology to Ensure Safety for Operation/Maintenance of HSR

The core technologies required for operation/maintenance of HSR are as follows.

(1) Civil Infrastructure and Track

①Slab track for HSR and its inspection/maintenance, ②Long rail and high speed turnout, ③ Automatic detecting system of rail temperature, ④Multiple inspection dedicated car for HSR and track maintenance management system, ⑤Management criterion value of track irregularity, ⑥Handling of maintenance work time zone, various maintenance cars and confirmation cars, ⑦Inspection system of Civil infrastructure(health monitoring system), ⑧Disaster detecting system

(2) Rolling stock

①Bolsterless Bogie for HSR, ②Wheel and bearing for HSR, ③Suspension structure for HSR (including air- Suspension, and etc.), ④Brake system /improving system of adhesion between rails and wheels, ⑤Current-collection device(pantograph, and etc.) for HSR, ⑥Door safety device and airtight structure of Car body, ⑦Axle flaw detect system and wheel Gliding for HSR, ⑧Riding comfort countermeasures(anti-roll damper between cars, active suspension), ⑨ATC characteristic inspection,⑩High speed testing of bogie after assembly ,⑪HSR maintenance system (Inspection cycle, Changing system of bogies, and etc.)

(3) Electric power facilities

①Automatic changeover section circuit, ②Compound catenary suspension system, ③High tensile catenary for HSR, ④Power SCADA, ⑤Multiple inspection dedicated car for HSR and Catenary maintenance management system, ⑥Handling of maintenance work time zone and various maintenance cars.

(4) Signaling and Telecommunication facilities

①Digital-ATC and CTC, ②Track circuit maintenance(non-insulated track circuit and etc.), ③ Electric point machine for HSR, ④LCX and Dedicated train radio, ⑤Multiple inspection dedicated car for HSR and Signaling facilities maintenance management system, ⑥device for clearance disorder alarm, ⑦Train protection radio (using by ground worker), ⑧Disaster detecting system

(5) OCC

①Transport planning system, ②Train operation system, ③Passenger information system, ④ Power SCADA, ④Facilities SCADA, ⑤Disaster detecting system

(6) ICT system

①Transport planning system, ②Train operation system, ③Passenger information system,③ Maintenance management system (Track ,Rolling stock, Catenary and Signaling), ④Materials procurement management system.

In addition, not only these individual technologies, but also Know-how regarding mutual cooperation of each technology is important. As mentioned above, since HSR has the strong color as the system and each technology is linking others , we should not forget the cooperation beyond each technology. In particular, they are the relationship between the contact wire and pantograph, between the wheel and rail, between information of operation/maintenance and Information & Communication Technology (ICT), and coordination among each works during maintenance time. Though Taiwan HSR, after opening also, is suffering the trouble of integration between rolling stock and rail &turnout, Indian HSR shall by all means avoid such a situation by coordination during construction period.

Other than the problem of safety, efficiency of operation and environmental issues also must be unforgettable matters. Especially regarding rolling stocks, energy efficiency of E5 rolling stocks are enhanced due to energy saving than other previous rolling stocks, by improving main circuit performance and reducing running resistance. In addition, also measures to prevent noise due to the lower body and the pantograph are taken, and environmental problems of noise by operation of HSR are considered. These are much superior to rolling stocks in other countries.
Furthermore, in introducing HSR, Life Cycle Cost (LCC) as well as construction costs also has to be taken into account. It can contribute significantly to the reduction of the LCC to adopt the core technology of these HSR developed by Japan.
To acquire the core technology to ensure safety of HSR, it is necessary that the Key person for that will be selected specially and receive overseas training in Japan, and they will spread the technique at the domestic training in India.

17.3 Set-up Time of the Organization Concerned / the O&M Company for HSR and Schedule of Human Resource Development

Set-up time of the Organization concerned/the O&M Company for HSR and Schedule of Human Resource Development are shown as Appendix 17-2.

17.3.1 Set-up time of the Organization concerned/the O&M Company for HSR

(1) The Organization concerned for HSR in India

When considering the schedule of human resource development, its schedule comes closely related to that the future organization concerned such as construction of HSR and Regulator and the O & M company in charge of future operation/maintenance of HSR will be established on what schedule. In particular, regarding how to proceed with construction work, it is necessary that the tight schedule until opening of operation shall be considered.]

Ministry of Railways(MOR),Government of India, was notified that RVNL / HSRC is responsible for development and implementation of high speed rail projects by letter dated 12th November 2014 from MOR (Appendix 17-2). High Speed Rail Corporation of India Limited (HSRC) has been

formed on the directions of Ministry of Railways, for development and implementation of high speed rail projects. This Special Purpose Vehicle has been incorporated in 2012 as a subsidiary of Rail Vikas Nigam Limited which is a Mini-Ratna public sector enterprise of Government of India.
After this, the development of laws/regulations and technical standards related to HSR construction is necessary first. MOR, Regulator of HSR or RVNL/HSRC related to HSR will be mainly in charge of these, but the organization of this Regulator or the positioning of the organization in MOR has not been necessarily clear at present. However, even if it becomes what, it is necessary to develop the related laws/ regulations and technical standards by the time of making basic design.

In addition, if the construction work has been started, its management and integration of component/interface will be left to the GC, but RVNL/SRC or the following company will be in charge of supervision as the Indian government. For the purpose, it is desirable that the staffs related to supervise the construction work shall get the technology of HSR in advance.
After all, regarding the HSR technology required to preparations until this construction and during the construction work, it would be necessary that Japan having the HSR technology support them. Specifically, the overseas training in Japan of the RVNL/HSRC persons concerned and the dispatch of the Japanese experts to RVNL/HSRC are considered

(2) The HSR Authority (HSRA) as a Public Sector Regulator and Supervisor on HSR

Whatever the system is introduced for the HSR projects, the public sector shall assume the ultimate responsibilities in providing public transportation service such as HSR. It would an recommendable option to create a separate entity, called, for example, as the HSR Authority ("HSRA") with a view to keep HSR independent from the existing railway operations due to the fact that HSR runs on a dedicated network, requires very specific and highly advanced technology, demands HSR specific regulations to assure the high level of safety.

Within this framework, HSRA shall play three key roles;

- HSR Regulator and Supervisor
- Coordinator with Regional and Local Governments
- Facilitator for HSR Industry Development

The overall planning, regulating and supervising role for HSR projects can continue to be trusted to the ministry responsible for railway transportation as long as it has good capacity in HSR operations. It is, however, suggested that the HSRA is the most suited entity to play those roles, due mainly to its highly advanced technological system particularly focusing on the safety and so on.
The relevant public sector entity, HSRA, shall have an advanced planning, managing, establishing, granting, and monitoring, supervising and evaluating capacity on HSR standards and rules to be observed by the HSR operators.
HSRA shall provide the key principles of regulations, rule, standards and certifications, most of which maybe common among the HSR network. It is recommended that the public sector agency shall be able set up rules, regulations, standards or certifications on such as procurement, engineering, technical, safety, operational, driving and maintenance matters particularly applied for HSR operations.

(3) Set-up time of the O&M Company for HSR

Particularly, it is the O&M company in charge of operation/maintenance after construction completion of HSR to be most closely related to the schedule of Human Resource Development. It is one of big discussion issues when this O&M Company will be set up. Though it is a matter of course that early set-up of the O&M company is better to prepare for it, it is required that the O&M company have to bear the costs including personnel expenses. Because the O&M Company has no income before opening of HSR, it is necessary to ascertain the timing of

setting up it.

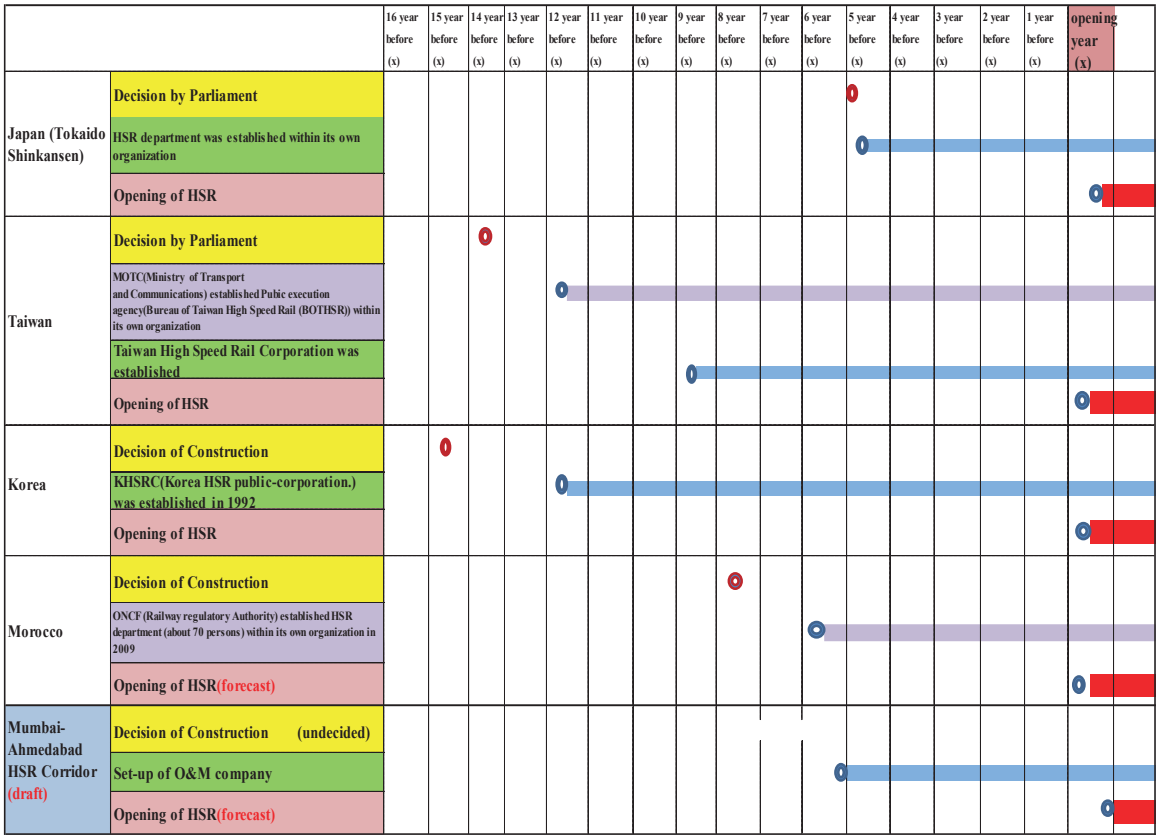


Figure 17.3-1 The Examples of Preparation until Opening in Some Countries which Introduced HSR

The example of some countries which introduced HSR until now is shown in Figure 17.3-1. In some examples of countries except Japan, the related organization or the O&M company of HSR were set up before 7~12 year of opening. The related organization of the Japanese Tokaido Shinkansen was set up about five years before its opening and the shortest period as an example. However, in the case of Japanese Tokaido Shinkansen, the employees of HSR were recruited from inner organization of Japanese National Railway, therefore there was no need of recruitment as in other countries.

In addition, regarding this set-up time of the O&M Company, we have to examine to start the education of employees from what time, considering opening time of HSR. As mentioned later in detail, it is considered that training of about 4,000 employees (including the stuffs of outsourced work) should be started at least 4 years before opening of HSR. In that case, if taking into consideration of recruiting period of employee, it means that the O&M Company should be set up 6 years before opening of HSR at the latest.
From some examples of foreign Countries and period of recruiting/bringing up, also in the case of Indian HSR, the O&M Company of HSR should be set up 6 years before the opening of HSR at the latest.

17.3.2 Technology Transfer during Construction Period

About the organization of the India side which is orderer (owner) at the time of the construction, at present, it is difficult to identify it since it is closely related to ordering system of construction

etc.. However, the technology transfer at the time of the construction is one of the important issues, even if the organization of the Indian side at the time of the construction becomes what kind of form. As the construction technology of HSR, the matter have to be taken note are as follows.

(1) Civil Infrastructure

①Viaduct for HSR, ②Embankment for Slab track, ③Long bridge and Long tunnel (partly undersea tunnel)

(2) Track

①Slab track for HSR, ②High speed turnout

(3) Station facilities

①Station facilities layout and structure(hybrid structures, etc.), ②Passenger guidance at Station system

(4) Rolling stock depot and work shop facilities

①Rolling stock maintenance devices for HSR, ②ATC characteristic inspection device, ③ High speed testing machine of bogie

(5) Power facilities

①Automatic changeover section circuit, ②Compound catenary, ③High tensile catenary and etc.

(6) Signaling and telecommunication

①ATC, ②Non-insulated track circuit, ③LCX, Digital train radio, and etc.

(7) ICT system

①Transport planning system, ②Train operation management system, ③Passenger information system, ④Maintenance management system of facilities(Track ,Rolling stock, Catenary and Signaling), ⑤Materials procurement management system,

In India, IR and also DMRC, of course, have the experience of construction such as structures (tunnel, viaduct, and embankment), track and electrification facilities and so on. However, it must be noted that these structures and electric facilities are not for HSR required for quality and stability at high speed. In particular, when introducing the first digital ATC, LCX and other new technology in India, it is desirable to aim for getting these technologies during construction time.

If Indian engineers concerned can join the related works from the stage of design, construction and its management, it is serving not only as the technology for subsequent construction of HSR, but also helpful to maintenance technology after construction. Though the organization during construction is described as above. Regardless of becoming any organization, it is desirable to deploy the staffs selected beforehand, who will become the key persons of the O&M Company after opening of HSR, to the organization concerned from the stage of design and construction.

Road map regarding set-up time of the Organization concerned/the O&M Company for HSR, which are described above, is shown as “Figure 17.3-2”.

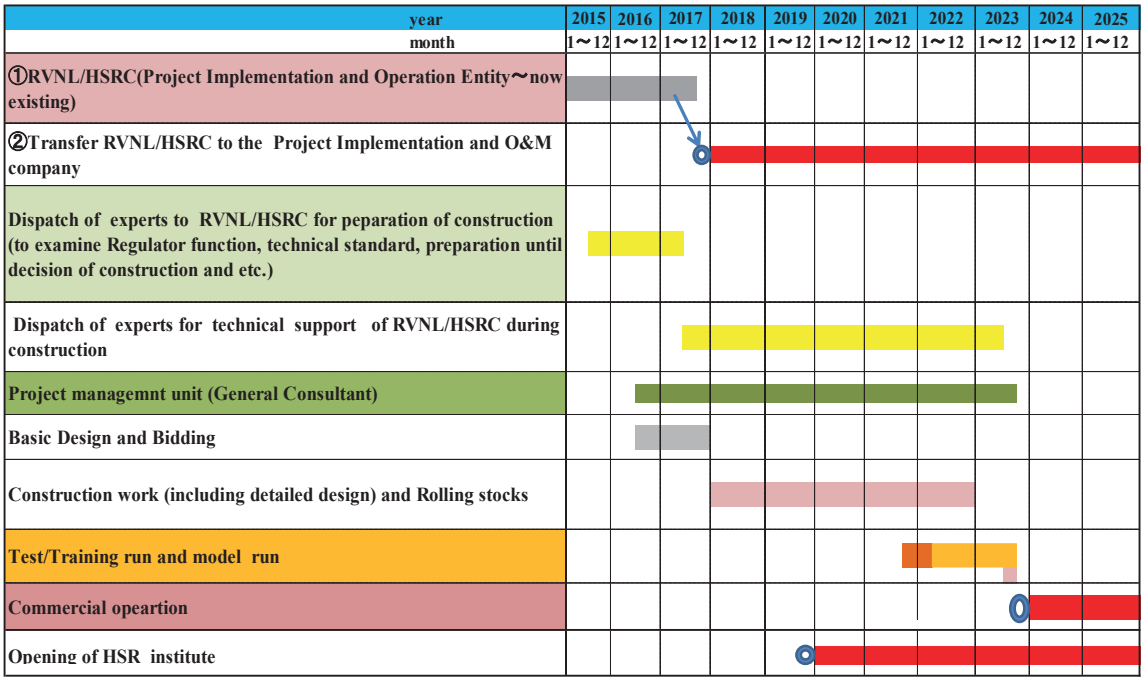


Figure17.3-2 Set-up Time of the Organization Concerned/the O&M Company for HSR

17.4 Specific Program for Human Resource Development

17.4.1 Human Resource Development for Operation/Maintenance

Main matters that are required to develop human resource for construction and operation/maintenance of Indian HSR are as described above. It should be considered that, in particular, the target personnel number for the human resource development becomes large-scale of about 4,000 including the staffs of outsourced works, and the education/training system that India will be able to construct HSR by oneself early in the future are formulated. To this end, not only overseas training, it is necessary to develop human resource, mainly on the domestic training in India, by set-up of India HSR institute.

To do this, specific program such as overseas training of the person to be training leader in the future, technology transfer during construction period, utilizing of the India HSR training institute and Practical training at training line will be important. Besides, follow-up education/training during one year after opening will be also considered. Further, appropriate Indian counterpart to the Japanese expert dispatched in India shall be deployed by all means, it is necessary to consider so that they can become the future leaders of HSR in India.
Repeatedly described, certainly Indian railway has a fairly high technology comparing to Southeast Asia country, however, Indian railway have no experience the following technologies needed for HSR of 320km/H speed and it is also true that there are many necessary technologies to be acquired newly.

(1) Running parts of Rolling stock(Bogie, Wheel, Brake system)

(2) Current-collection device by Rolling stock and Power facilities (pantograph, contact wire)

(3) Track and Rail

(4) Signaling system and Operation control (ATC, CTC)

(5) Disaster countermeasures

Table 17.4-1 No. of Employees at Opening of HSR
(Including the Staffs of Outsourced Work)

Department		Number of Office	Number of staff			
			2023	2033	2043	2053
Head Quarter		1	240	240	240	240
OCC		1	49	49	49	49
Training Center		1	20	20	20	20
Station		12	1,093	1,253	1,505	1,845
Train Crew Depot		2	278	422	631	992
Rolling Stock Depot and Workshop		2	498	713	1,199	1,929
Maintenance Depot	Civil Engineering (Track, Structures)	6	1,090	1,090	1,090	1,090
	Electricity & OHE	4	740	740	740	740
	S & T	4				
Total			4,008	4,527	5,474	6,905

Source: Study Team

17.4.2 Object Trainees and Training Methods for Human Resource Development

To promote human resource development, the object employees and the method of education/training shall be specified first. Therefore, the training methods were examined by classifying target persons according to job ranking, or purpose, and by adopting overseas training or domestic training in India. We adopt the following levels of object trainees as below.

(1) The members of India HSR concerned and Executive members of the O&M Company (head of division or over)

(2) Managers (chief of head office section and worksite organization)

(3) Lecturers of HSR training institute and training leader of training line

(4) Staff of head office and training leaders at worksite

(5) Skill engineer in charge of core technology for operation/ maintenance of HSR

(6) Drivers, conductors and OCC members

(7) Worksite workers for operation/ maintenance of each department

In this, the largest number of object trainees will be maintenance workers of each department at work-site. For this level, “staff of head office and training leader of worksite” are educated / trained as its instructors in advance.

17.4.3 Overseas Training

After the company was established, it becomes necessary to examine concretely to proceed education / training of human resource recruited, by any way or in any schedule. Of course, overseas training in the country operating HSR shall be considered, but when considering the expenses required for it, the number of trainees will be limited to a part of object trainees. The Specific program of overseas training is as Table 17.4-2

Table 17.4-2 Overseas Training Program

No	Object trainees	Number and period	Remarks
1. Study Tour of Indian party concerned/Executive members of O&M company to comprehend Japanese Shinkansen		30 persons×2 weeks	
2. Overseas training of each level of O&M company in Japan			
(1)	Managers (chief of head office section and worksite organization)	About 60 persons×3 weeks	All managers
(2)	Staff of head office and training leaders at worksite	About 140 persons×1.5 months	(core staffs)
(3)	Lecturers of HSR training institute and training leaders of training line	40 persons ×6 months	All lecturers and training leaders
(4)	Skill engineer in charge of core technology for operation/ maintenance of HSR	25 persons ×6 months	(core staffs)
(5)	Drivers, conductors and OCC members	About 30 persons ×4-6 months	(core staffs)
Total		About 330 persons × (2 weeks -6 months)	

In the above Table 17.4-2, "1,Overseas training of Indian party concerned/Executive members of O&M Company will be planned mainly as study tour to comprehend Japanese Shinkansen. "2(2) Staff of head office and training leaders at worksite" are cornerstones of human resource development for Indian HSR. It is assumed that "2(3) Lecturers of training institute and training leader of training line" will become lecturers of training institute or training leader of training line with Japanese experts after overseas training of six months. Further, overseas training period of" 2(4) Skill engineer in charge of core technology for operation/ maintenance of HSR" which India not have, is expected 6 months.

Drivers, conductors, station staffs and OCC members (core staffs)" are members to become training leader of training institute or of training line after overseas training, therefore, since it is necessary to acquire professional knowledge for each job, overseas training period of them are expected to be 4-6 months.

When considering the capacity of receiving side, etc. it expected to take at least three years to finish.

17.4.4 Training in India

(1) Education/training in the HSR Training Institute

When developing human resource of HSR in India, it is necessary to educate/train about 4,000 employees including the stuffs of outsourced works before its opening. To this end, it is a wise policy after all to establish training institute for dedicated HSR. In this HSR Training Institute, prior to Practical training in the training line before opening, it is important to keep the desk education/training by simulators finished beforehand.

Further, Practical training in training line after completion of construction is also very important. Not only the training of drivers in the Practical training, the training of each department are carried out at the same time, After worksite workers for operation/maintenance of each department will finish desk education in training institute of HSR, they will attend practical training in training line. However, it is difficult to train all members of them in training line, the other trainees not to be able to train in training line shall be trained by on-the-job training at worksite. The specific training program of the HSR Training Institute in India is as Table 17.4-3.

Table 17.4-3 Training Program of the HSR Training Institute in India

No.	Object trainees	Number and period
1. Education/training in HSR training institute		
(1)	Managers (chief of head office section and worksite organization)	About 60 persons×3 months
(2)	Staff of head office and training leaders at worksite	About 500 persons×4 months
(3)	Skill engineer in charge of core technology for operation/ maintenance of HSR	80 persons×6 months
(4)	Drivers and OCC staffs	About 130 persons×6～7 months
(5)	Conductors and station staffs A	About 900 persons×3 months
(6)	station staffs B(Security)	About 300 persons×1 months
(7)	Rolling stock maintenance employees	About 400 persons×4 months
(8)	Maintenance staffs of civil engineering and track	About 1,000 persons×4 months
(9)	Maintenance staffs of Power supply	About 300 persons×4 months
(10)	Maintenance staffs of signaling &telecommunication	About 300 persons×4 months
Total		About 4,000 persons×(1 month-7 months)
2. Other on-the-job training and practical training at work-site		whenever necessary

(2) Practical training in training line and others

1) Practical training in training line

When test run will be finished after the completion of construction, the O&M company can use the facilities concerned. At that time, the Practical training mainly of drivers training will be started by using the training line. Here, of course, not only drivers, Practical training of conductors, dispatchers and maintenance engineer of rolling stock/ facilities will be performed. In addition, there is a possibility to need checking/reviewing manuals related and In this way, since the Practical training of many technology section are carried out in this training line at the same time, it is necessary to set up a practical training center in training line in order to

coordinate them. It is desirable to be located near the training institute of HSR, by placing that this practical training center in training line is a branch school of the HSR Training Institute. Practical training in training line are considered as the followings

① Operation training of drivers, Practical training of conductors, station staffs and dispatchers of OCC.
② Practical training of operation/maintenance staffs for rolling stocks and facilities
③ Checking/reviewing of various regulations, manuals and so on for operation/maintenance
④ Trial run after assembly of rolling stocks and testing items related to special characteristics of India.
⑤ Training of assuming various abnormality and derailment recovery

2) The organization and the personnel (Draft)

Because the Practical training in this training line cannot support only by lecturers of the Indian HSR Training Institute established beforehand, it is desirable that Japanese experts shall be increased. In addition, we must deal with these training items in the limited time until opening of HSR after the construction completion. For this reason, because the practical training contents of each department are congested mutually, the establishment of the safe system during the training period and the adjustment of the work schedule become important. Organization and command instruction system in order to coordinate these various training items must be established.

It is desirable to establish the organization which Japanese experts are in charge of this practical training center in training line with the counter part of Indian experts. It is assumed that Japanese experts cooperate with Indian counterparts and bring up Indian HSR engineers concerned. In addition, after completion of the construction, cooperation of GC/Contractor is necessary in the maintenance or handling of such as HSR-related facilities, equipment and rolling stocks, and it is assumed that the support of GC/contractor will be implemented. .

For buildings of practical training center in training line, not to establish it separately, measures such as utilizing a part of rolling stock depot before opening should be considered.

The plan of organization and the personnel for this practical training center in training line required are as the following

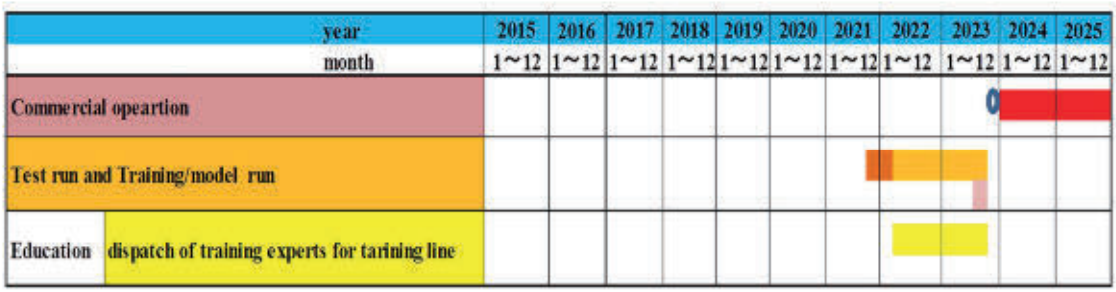


Figure 17.4-1 Schedule of Practical Training in Training Line

Table 17.4-4 The Organization and the Personnel of Practical Training Center in Training Line (Draft)

In charge	Japanese expert	Indian counterpart	(GC/Contractor)	Remarks
Manager	1	—	—	
Assistant manager	—	1	—	
General Affairs Section	2	2	—	Including materials procurement
Planning and Safety Section	1	1	—	
Station duties and sales Section	3	3	(2)	
Train Operation Section	4	4	(2)	
Rolling Stock Section	4	4	(3)	
Civil engineering Section	5	5	(4)	
Electricity Section	7	7	(5)	Including ICT
OCC	7	7	(3)	
Driver	7	7		
Conductor	5	5		
Total	46	46	(19)	

3) Examination of the training line candidate sites

Training line is basically desirable as the same of all operating line, however, in many cases, all operating line often may not necessarily used when considering progress of the construction work.
On the other hand, since training of drivers take much time, it is advantageous to train them by using the section completed even if it is a part of operating line. In this case, training line is desirable to meet the following conditions.

① It has the section more than a certain distance to be able to run at the maximum speed
② It has the rolling stock depot or work shop
③ At least, 1~ 2 station and work-site of each department are included.
④ Viaduct and embankment section are included.
⑤ Handling of maintenance work time zone and training of using various large maintenance machines can be implemented.

Table 17.4-5 The Training Line Candidate Sites

	Work-site/Infrastructure	Sabarmati-Surat (about 240km)	Sabarmati-Vadodara (about 108km)	Remarks
1	Rolling stock depot or work shop	1 & 1	1 & 1	Sabarmati
2	station	6	4	
3	Crew Depot	1	1	
4	civil engineering/track Depot	2	2	
5	Power supply Depot	2	2	
6	Signaling & Telecommunication Depot	2	2	
7	Viaduct	98.6km	30.4km	
8	Embankment	142.3km	78.1km	

Table 17.4-6 Example of Training Line in Japan (Reference)

No.	Railway Operator	Section (Distance)	Start of Training Line (Approximately)
1	JR EAST(HSR)	Sendai -Kitakami (135.7km, 4 stations) Omiya-Morioka (505.0km,14 stations)	28months before opening
		Sendai -Morioka (183.5 km,5 stations) Omiya-Morioka(505.0km,14 stations)	18months before opening
2	Tsukuba Express (Conventional line)	Moriya-Midorino (0.9km,3 stations) All line(58.3km,20 stations)	16 months before opening

4) Test-ride event utilizing a part of training line

Though the construction of HSR has severe schedule, in order to perform outsider PR of deepening the understanding for HSR, it is necessary to examine test-ride event in model operation line utilizing a part of training line about three months before opening. In addition, it has also the advantage that trouble etc. in the passenger service can be checked beforehand actually by having passengers using HSR. Perhaps, since this model operating line will use a part of training line, it may be necessary to consider precedent construction of this relevant section.

17.4.5 Follow-up Education/Training during One Year after Opening

Even though looking at the past example of other new line opening, we are used to watch early failures or troubles which are normally not expected to occur beforehand. As subsequent to practical training center in training line, it is desirable that support system for follow-up training will be conducted for one year after opening as mentioned below, by Japanese experts, Indian counterpart and GC/Contractor.

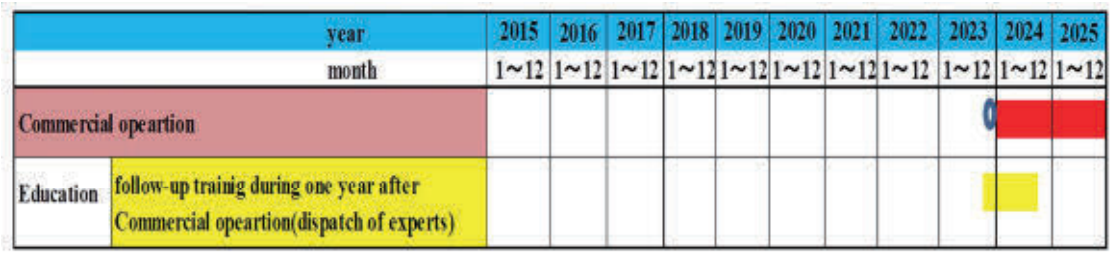


Figure 17.4-2 Schedule of Follow-up Education/Training

Table 17.4-7 The Organization and Personnel of Follow-up Education/Training (Draft)

Position	Japanese expert	Indian counterpart	(GC/Contractor)	Remarks
Manager	1	—	—	
Assistant manager	—	1	—	
General Affairs Section	1	2	—	Including materials procurement
Planning and Safety Section	1	1	—	
Station duties and sales Section	2	3	(2)	
Train Operation Section	3	3	(2)	Including dispatcher
Rolling Stock Section	2	3	(2)	
Civil engineering Section	2	3	(3)	
Electricity Section	3	4	(4)	Including ICT
Total	15	20	(13)	

17.5 Other Issues of Human Resource Development

17.5.1 The Education/Training of Safety to Ensure the Safety in Indian HSR

To ensure safety is the most important issue for operation/maintenance of HSR. Naturally, infrastructures, equipment, rolling stocks and so on for operation/maintenance of HSR are important to ensure safety, it should not be forgotten that there is also the human issues dealing with it. To do this, measures such as to increase the motivation of employees to work on safety are required. Therefore, the organization to deal with safety problem are described in "Interim Report 2 Chapter11 Operation and Maintenance Plan", it becomes also the big problem how education/training of safety are incorporated in human resource development.

In the education at the HSR Training Institute and other places, what is common among different department is the education of safety. The system to ensure safety shall be established for the whole of the railway company as already explained above. In this context, The Japanese Shinkansen has been operated without an accident for many years, and the big contribution to them can be considered as follows. Firstly, it is because of adopting the concept of "fail-safe system" which is the policy of always taking safe side measures, if error occurs in the facilities/ equipment related. Next, various abnormality detection system is incorporated and will stop HSR train by detecting this early when the abnormality occurs.

In addition to this concept, there are more important missions for railway operators, in that they shall make their employees thoroughly understand the importance of safety. At the HSR managing company, all members from the top to the rank-and-file workers shall tackle to promote organization-wide safety measures. For this purpose, it is extremely important for railway operators how to address safety as a management policy. Just at the incorporation of the company, therefore, the Indian HSR shall establish the basic management policies, with the stance against safety clarified therein, which shall thoroughly be disseminated among its employees. If possible, it is recommended that the basic policies on safety (general principles of safety, etc.) be adopted and exhibited before the employees.

17.5.2 Recruiting of Human Resource for Operation/Maintenance of HSR

Regardless of India HSR, the methods of recruiting a lot of employees needed for HSR are not always same, when watching the example of some countries which have already opened until now. Besides, all of them are not necessarily successful. As mentioned above, it is very big problem how to keep human resource to ensure safety of HSR

At the opening of commercial operation, 4,000 employees (including the staffs of outsourced work) are required to operation/maintenance of HSR between Mumbai-Ahmedabad. How to recruit these members is a big challenge. In the case of Taiwan Shinkansen, about 2,500 staff was recruited, however, almost of them had little railway experience. For this reason, technical support by overseas experts mainly from Japan and France has been continued for a long time, and currently its part remains.

Even if the India government/ HSR Company would decide how to recruit the staff for HSR, we will recommend that management members and major key person should be having experience of railway such as IR/DMRC at least. If management members and major key person in charge of railway operation/maintenance have no experience of railway, then its risk is too big. We think that only the person who has experienced in railway job for several years at least and know the fear of the railway accident can be in charge of HSR. Fortunately, Indian railway has a fairly high technology comparing to Southeast Asia country. By recruiting the appropriate human resource, Indian HSR should be able to perform independently its operation and maintenance at early time.

17.5.3 Technical Independence of India HSR

Though it is the urgent issue to get the related technology to operate safely Mumbai-Ahmedabad HSR, as soon as possible, it is necessary that India has the own technology of HSR to be able to deploy HSR network by oneself in a country in the future. To this end, in the first, transferring of technology during construction work and acquiring of core technology to ensure safety of HSR are necessary.

Besides, by establishing of the Indian HSR training institute, it is also important to keep expanding the horizons of domestic related engineers. These are just as what mentioned above, however, it is desirable to pay attention also for the following matters.

(1) Independence from manufactures

In case parts or components such as those of rolling stock have failed, railway staffs concerned shall often rely on the technologies of manufactures for trouble shooting or repair of defective parts/components. Of course, it is important for railways to make efforts to acquire information on various technologies from manufactures, in order to improve their technological level. However, they shall not depend all on manufacturers. This is also the case in the railways in the southeastern Asian countries. With such an attitude, they will not become technologically self-reliant forever as a result.

(2) In the future, promoting the way for the India HSR to achieve its own development

In the future, it is advised that the long-term basic research is also necessary in university or institute other than transfer of HSR core technology, in order that the Indian HSR will promote the way to achieve its own development. Regarding these, the cooperation or assistance from Japan already carried out as follows, in addition, there are some plans examined further in the future.

1) Coordination with universities in Japan

Tokyo University in Japan is having coordination with MOR in India, and has been accepting about two overseas students from MOR mainly in infrastructures every year. In addition, Tokyo University has been developing the human resource by joint research and by accepting master's and doctor`s overseas student based on academic cooperation agreement with the leading universities such as IIT. Besides, in 2014 year-end, three engineering faculties from the University of Tokyo for this Institute has made a special lecture, in opening of the high-speed railway institute of IIT-Kharagpur established by the budget of the Ministry of Railways.

In the future, at the stage when construction of HSR was decided, to Tokyo University, MOR in India shows the intention to increase the number of overseas students of the executive candidates engineer from MOR up to 10-20 persons a year. Thereby, in 10 years of the future, it is possible to cultivate about 100-200 persons of human resource. And from now on, not only infrastructure engineering, it is required to expand also the specialized field of mechanical engineering, electrical engineering, signaling, information and communication system and etc. Furthermore, since safety measures are important issues, if any educational program suitable for this, to send persons in this field are considered.

Regarding this, in addition to the conventional international scholarship students system, Ministry of Education, Culture, Sports, Science and Technology (MEXT) in Japan is examining to expand its number of accepting scholarship students, by implementing "scheme of deploying study abroad coordinator" and setting "frame of scholarship students from India". These are the Japanese University Union, by around eight universities including the Tokyo University, is trying to accept India scholarship students.

If this scheme of accepting Indian scholarship students will be used effectively, it is considered to contribute significantly to develop the technical independence for India HSR in the future.

2) Coordination with Railway Technical Research Institute (RTRI) in Japan

In February 2014, the persons concerned including the vice-minister of the Indian Ministry of Railways visited RTRI in Japan, and exchanged opinions about the cooperation system for the railway technology of India, to ensure safety and develop human resource.

RTRI in Japan had become the backbone in the technical aspect when constructing the Japanese Shinkansen. Testing equipment of rolling stock installed in this Institute, plays a major role to develop high-speed rolling stock of the Shinkansen

In addition, the general roadbed testing device and tunnel micro-pressure wave model testing device are also installed, it is extremely significant for India to coordinate with RTRI in Japan, in order that India will develop the independence technique in the future.

However, until the opening of HSR, it is a top priority that Indian HSR shall acquire the current HSR technology. After opening of HSR, if there is the demand from India HSR, RTRI will prepare to dispatch the lecturers or accept trainees of HSR technology, with the assistance of JICA or relevant authorities.

Figure 17.5-1
Testing Equipment for High-speed Rolling Stock

Figure 17.5-2
The First Testing Bogie of Shinkansen

Figure 17.5-3
Large-scale Testing Machine of Air Suspension

17.5.4 Other Considerations

(1) The issues of developing human resource of executive members

In developing countries, one of the problems in the upbringing of railway engineers is the education/training of executive members. Once graduated from high-level university enter a railway company, they will become the executives of the company after hardly experiencing the services at worksites. That means that they will be assigned with the duties of executive members without acquiring the knowledge of worksite organizations that support train operation. As this is also the case in India, efforts shall be made by all means to avoid such a situation. To ensure the safety which is most important for HSR, the scheme to be able to reflect the voices of work-site is essential, including utilizing of “Kaizen” and “On-the-job training” as the following mentioned. In addition, for safety measures of HSR, all members from the top to the rank-and-file workers shall tackle it together. To do so, company executives must always strive to grasp actual conditions in work-sites. For this purpose, India shall adopt an executive member upbringing system to make graduates experience worksite services for a certain period of time in the same way as in Japan.

(2) Utilizing of “KAIZEN” and On-the-job training and so on

In Japan, not only railway operators, mainly in general companies, various mechanisms to maximize the ability of the employees are incorporated. They are “Kaizen”, “Teian(suggestion scheme)” and “QC activity”. These are one element that Japanese automobile industry can occupy a major position. These are contributing to the human resource development at the point of enhancing the ability of employees. .
However, since railway business has the strong characteristic that what was decided by rules should be implemented properly, there are some difficult points to be introduced in railway business. It is difficult to raise motivation of employees, only in a way that what was decided by rules should be implemented properly. However, depending on the content of the work, there are many works to be able to increase self‐reliance of employees by introducing "Kaizen" and so on. Actually, each Japanese railway company takes in this mechanism.
In addition, in Japan, even more than education in training institute, the emphasis of training is lay upon "On-the-job training" at work-site. Education/training in training institute has likely tendency to become absolutely uniform. Considering the daily progress of technology and measures to increase the motivation of the employee to prevent accidents, "On-the-job training" suitable to special characteristics of the work-site become important. Though "On-the-job training" is introduced in India also, we would like to recommend that Indian HSR shall utilize “KAIZEN” and "On-the-job training" more than before in future.

(3) Organization and Human Resource of materials procurement to keep appropriate spare parts

The materials to be used by HSR in the future will mostly be related to new technologies. To ensure the safety of high-speed HSR train operation, therefore, the quality control for materials is essential. Furthermore, these materials are hardly available in the market and require long periods for manufacture. To avoid hindrances on train operation just after inauguration, therefore, it is essential to procure required materials in required quantities. As often seen in the railways in Southeast Asian countries, in case a part of a car has failed, a corresponding part is frequently appropriated from other cars for replacement as it cannot be obtained just in time or cannot be procured for budgetary reasons. As a result, the number of active cars decreases to make impossible to turn trains as scheduled. Even recently, Bangkok Airport Line in Thailand had to suspend a part of train for this problem. Indian HSR shall by all means avoid such a situation and keep in mind to ensure the organization and human resource related to materials procurement.

17.6 Set-up Plan of the HSR Training Institute in India

In India, IR and DMRC together have superior training facilities as shown in "Appendix-17.3 Examples of Railway institutes in India". IR has training facilities more than 270, from this number, it can be guessed that IR lay emphasis on the education of the employee. In addition, DMRC has one, but it has splendid training facilities which included the latest technique. In Japan, JR East, and other JR has each training facilities. In the case of Japan, it is noteworthy that the affiliated companies of railway operator, which are entrusted with the maintenance business, has excellent training facilities respectively, while railway operator also each training facilities. To establish the dedicated training institute for Indian HSR gathering superior points of training facilities in India and in Japan must be the big power, when India will extend the HSR network in the whole country. When setting up this training institute, even if the support of the experts from Japan would be necessary at first, the persons concerned with Indian HSR should build the scheme so as to educate/train the trainees by themselves early in the future. Therefore, in Japan, it is desirable to educate/train the Indian engineer to be lecturer of the HSR Training Institute.

Further, when considering the facility capacity, establishment time of this training institute is considered as follows. If assuming that the capacity of the training institute is 300 trainees per one day and the average training period (1~7 months by training contents) is 3.5 months, maximum of trainees per year are 1,200. This is the number of cases obtained by running 100%, but 1,000 trainees per year will be reasonable when considering the operating losses.

Though showing the detailed education/training schedules of the training institute separately, when considering the assumption of 1,000 trainees per year, it is reasonable to think that establishment time of training institute would be 4 years before opening thus. it is necessary to undertake the preparation of 7 years before the opening of HSR, as showing the procedure to construct the HSR Training Institute at Figure 17.5-4.

In addition, when considering the training of rolling stock, the training institute will also be appropriate to be located near the depot or work shop of rolling stock.

Regarding organization of the training institute, building & facilities, training materials and training curriculum & schedule, we want to speak separately next.

Furthermore, as the long-term prospects, it is assumed that the India HSR Training Institute will be utilized as training institute for the related countries, when India will extend HSR technology to the third country, such as Asia, after acquiring the own HSR technology of India.

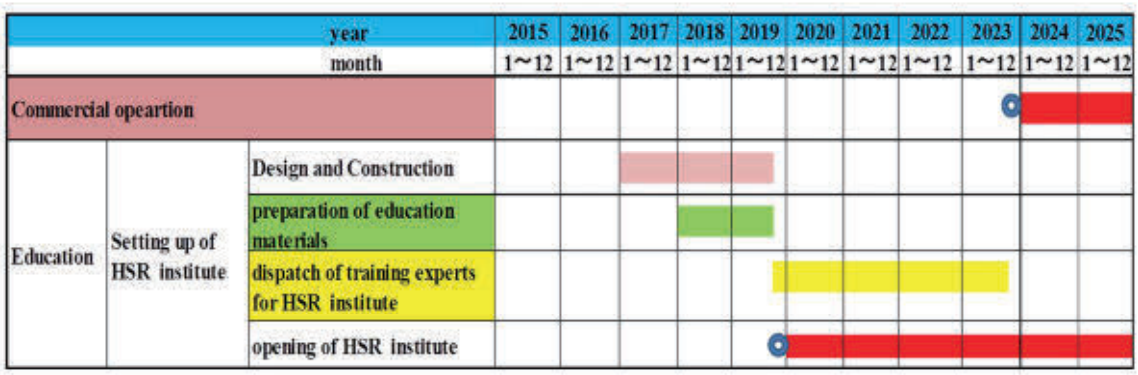


Figure 17.5-4 Set-up Schedule of the HSR Training Institute

17.6.1 Organization of the HSR Training Institute

Though some examples of organization of the training institute in India are introduced in "Appendix 17-3 Examples of Railway institutes in India", it is thought that the organization is not necessary to be so complicated. According to this, based on the special characteristics of India, the organization would be determined by Indian side. It is assumed that Japanese side will dispatch the expert of each technology section as following Table 17.6-1.
In addition, in this case, the people which are educated and trained in japan to be future lecturers of the training institute should be deployed as the counter part of Japanese expert.
But we think that, when the training line will be completed and Practical training will be started, it is necessary to establish the practical training center in training line as a branch school of the HSR Training Institute. In that case, the additional experts will be dispatched as mentioned at "17.4.4(2)Practical training in training line and others".

Table 17.6-1 The Organization and Personnel of HSR Training Institute (Draft)

Position	Japanese expert	Indian counterpart	(GC/Contractor)	Remarks
Manager		1		
Assistant manager	1			
Admin staff		4		
Planning and Safety	2	2	—	Including education materials duties
Station duties and sales	3	3	(2)	
Train Operation	3	3	(3)	Including dispatcher
Rolling Stock	3	3	(3)	
Civil engineering	4	4	(4)	
Electricity	5	5	(5)	Including ICT
Total	21	25	(17)	

17.6.2 Facilities/Equipment of the HSR Training Institute

(1) Building for training and hostel

Building for training and hostel is examined to have the capacity of 350 trainees, 150 lecturers in total for 500 persons. Specific contents are as the following Table 17.6-2.

Table 17.6-2 Facilities/Equipment of t the HSR Training Institute

Facilities	Number/m^2
1. Training Facility	
(1) Auditorium	1
(2) Teacher members room	1
(3) Outsider lecturers room	1
(4) Admin staff room	1
(5) Class room(Total=20)	
①Large (450 m^2 for 40 trainees)	18
②Small (250 m^2 for 24 trainees)	8
(6) Simulators	
①HSR Driving Simulator	1
②Trouble Shooting Train Simulator	1
(7) Training facilities	
①Rolling stock	1
②Track, rail and turnout	1
③Power supply	1
④Signal	1
⑤Telecommunication	1
⑥Outdoor training facilities of overhead wire & catenary	1
(8) Model Room of related equipment	1
(9) Computer Labs	1
(10) Library	1
Sub Total (Training Facility)	15,000m^2
2. Hostel	
(1) Room	
① Man (10 m^2 for 2 trainees)	145
② Woman (10 m^2 for 2 trainees)	30
③ Teacher & Lecturer (10 m^2 for 1person)	150
(2) Canteen	1
Sub Total (Hostel)	12,500 m^2
Total (Training Facility +Hostel)	27,500 m^2

(2) Education/training facilities in the HSR Training Institute in India

Education/training facilities in the HSR Training Institute of India are considered, including Simulator for crew, such as the following Table 17.6-3

Table 17.6-3 Education/Training Facilities in the HSR Training Institute in India

No.	Items	contents
1	Simulator for crew	Simulator for driver and conductor, Emergency trouble shooting simulator
2	Civil infrastructure and Track	Disaster detection/Inspection devices of Civil infrastructure, Rail, Turnout, Slab track, expansion joint and set-off device of maintenance car
3	Rolling stock	Bogie, Wheel, Brake system, pantograph, Door and Emergency ground switch and etc.
4	Electric power and catenary	Substation control panel, Disconnecting switch, Electric breaker, Catenary , Electrification pole and etc.
5	Signaling and telecommunication	Interlocking control panel, Electric point machine, Optical carrier device, Radio station and etc.
6	Others	Education system of CAI, Personal computer, Audio-visual equipment and etc.

Table 17.6-4 Comparison with JR East and DMRC Training Institute (Reference17-1)

Railway Operator	NO. of trainee using hostel (Approximately)	NO. of class room	Practical training rooms of each department	Total area of building (Approximately)	Remarks
JR East General Education Center (Shin-Shirakawa)	1.200	50	existing	58,000 m^2	
DMRC Training Institute	300	24	existing	23,500 m^2	
the HSR Training Institute in India	500	26	existing	27,500 m^2	350 are for trainees among 500

We show buildings and facilities of General Education Center of JR East and its affiliated companies below as reference.

◆JR East General Education Center
(Hostel; 558nrooms, Maximum 1224 trainees, Building total area; 59,000m^2)

・Front of General Education Center

・Overall view of General Education Center

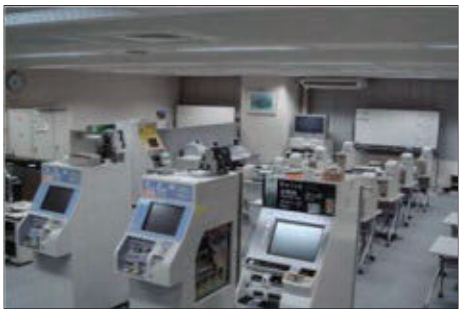
・Audio-visual room

・CP room

・Training room of rolling stock

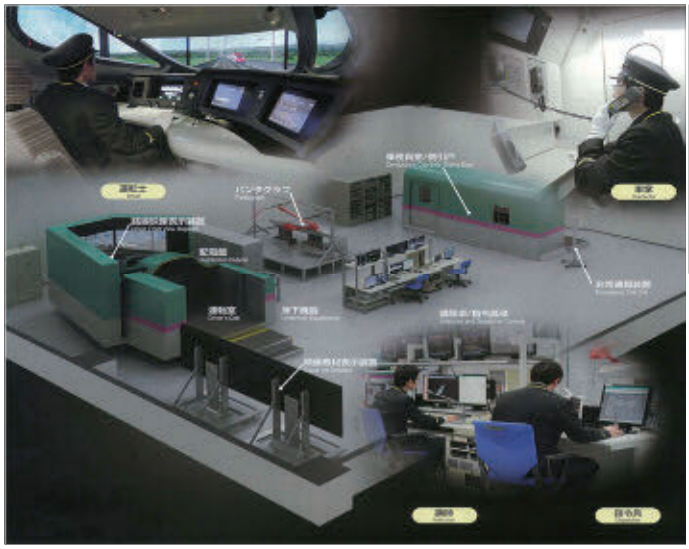
・Signaling training room

・Station equipment training room

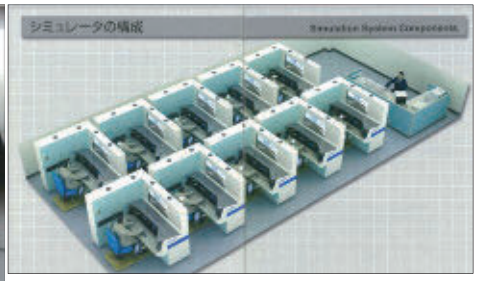


・Outdoor training facilities

・HSR simulator for driver



・simulator for group training



◆The affiliated company of Electric

・Outdoor training facilities

・Point

・Electronic interlocking training room

・Telecommunication training room

・CP room

・Library

・Hostel room

◆The affiliated company of civil engineering

・Track training equipment

・Point

・Position to the overhead wire

・Clearance gauge and rolling stock gauge

・Class room

・Training system aided by computer

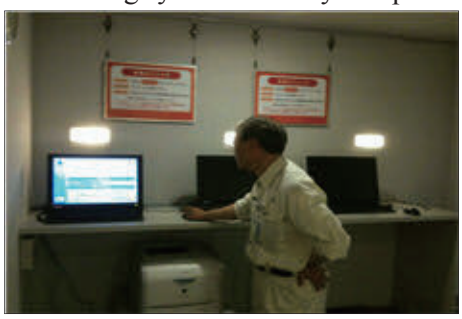


Figure 17.6-1 Building and Facilities of JR East General Education Center (Reference2)

17.6.3 Training Materials

As shown at Figure 17.6-1, training materials will be made by English version in Japan, based on the training materials of JR EAST, considering the infrastructure, facilities/equipment and rolling stock introduced into Indian HSR. The rules for the Shinkansen in Japan related to these are shown in Appendix-17-4, and further it is also required to prepare manuals based on these rules.

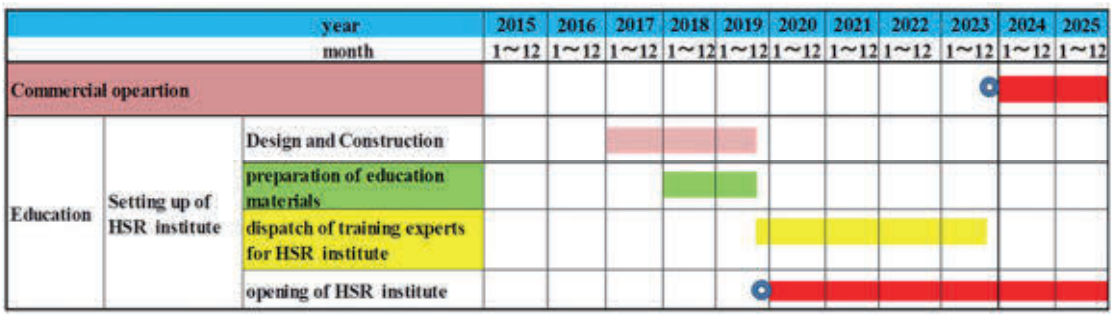


Figure 17.6-1 Schedule of Preparing Training Materials

17.6.4 Education/Training Curriculums and Training Period of Main Related Employees

Since education/training curriculums and training period of HSR related employees are different according to the job type, it is required to examine them according to the job type.
Education/training curriculums and training period of main related employees are described in Appendix 17-5.

17.7 Overall Roadmap of Human Resource Development

Overall roadmap of human resource development based on the previous study is as follows.
In this figure, technical assistance for construction preparation, technology transfer during the construction period, further, establishment of the O & M company and the HSR Training Institute in India most related to human resource development, as well as practical training in the training line, overseas training and domestic training in India, etc. these schedule is shown.
On the other hand, the amount of human resource development expenses, for having also many uncertainties, is estimated at the minimum in this case.
Training of management to field level of Indian Railways officials including train drivers and workers will be provided with assistance from Japanese high speed railway operator and authority. First of all, dispatch of experts by Japanese ODA grant assistance through JICA will be provided to support the Indian side to establish regulations and technical specification which

is necessary before design and construction of high speed railway. Necessary assistance during construction to preparation of operation phases can be taken care of by general consulting services, which will be funded by the Loan, including integration of component/interface into one high speed railway system with full support by Japanese high speed railway operator. Besides, necessary components can be supported through Japanese ODA in a form of Technical Cooperation by JICA which is a fully grant assistance aimed for capacity building and technical transfer from Japanese high speed rail operator and authority to the recipient country.

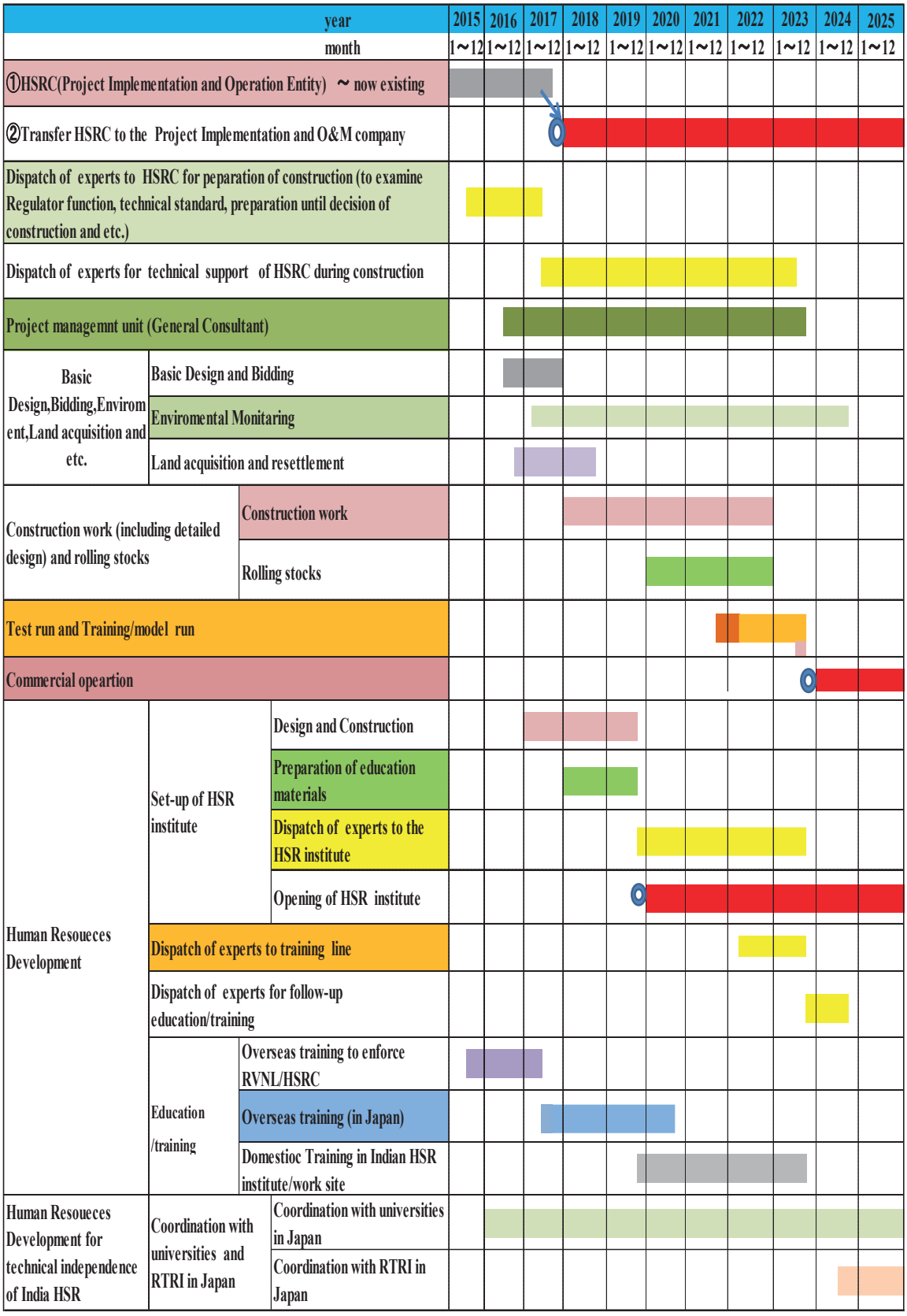


Figure 17.7-1 Overall Roadmap of Human Resource Development

Appendix 17.1 The Technology Required for Operation and Maintenance of HSR

(Remarks1) ◎=outstanding, ✓=having, △=partly having, ×=not having
(Remarks2) The target items of IR are investigated mainly between Ahmedabad – Mumbai.
(Remarks3) For disaster countermeasures, they are recorded with other departments in multiple.

No./ Department	Technical items	IR (having or not having)	DMRC (having or not having)	Remarks	Items to be considered for human resource development
1. Civil infrastructure and Track					
(1)	Inspection of Civil infrastructure				
	①Non Destructive Inspection of reinforced concrete structure	×	△(※2)	(※2) having but a part	Training in Japan
	② Inspection system of linig concrete in tunnel (inspection car and so on)	×	×		Training in Japan
	③Wireless monitoring of bridge health	△(※1)	×	(※1) recently developed	Training in Japan
(2)	Track				
	① Slab track for HSR and its maintenance	×	△(※2)	(※2) DMRC have Slab track for Urban railway, but not for HSR	Training in Japan
	② High speed turnout with movable nose crossing	×	×		Training in Japan
	③ Long rail and its maintenance	△(※1)	✓(※2)	(※1) IR uses usually 5~6km long rail, some are about 20km at maximum (※2) about 40km at maximum	Training in Japan
	④Automatic detecting system of rail temperature	△(※1)	△(※2)	(※1) (※2) detecting of rail temperature are not automatic system	Training in Japan
	⑤Rail flaw detecting car	△(※1)	△(※2)	(※1) (※2) The ultrasonic flaw detection have done, but they are almost according to human-powered trolley	Training in Japan
	⑥ Rail Gliding machine	✓	✓		
	⑦Multiple inspection dedicated car (electric equipment and	✓(※1)	×	(※1) not for HSR	Training in Japan

		track) for HSR				
	(3)	Maintenance work time and confirmation car	×	△(※2)	(※ 2) Early morning before the start of operation , the pilot train are running at a speed of about 40km / H.	Training in Japan
2.	**Rolling stock**					
	(1)	Bogie, Wheel				
		① Bolsterless Bogie for HSR	×(※)	×(※)	(※) having the one of conventional line, but not for HSR	Training in Japan
		② Wheel and bearing for HSR	×(※)	×(※)	(※) ditto	Training in Japan
		③ Suspension structure for HSR (including air-Suspension and so on)	△(※)	△(※)	(※) ditto	Training in Japan
	(2)	Brake system /improving system of adhesion between rails and wheels				
		① Brake system for HSR (both electric and air brake, Disk-brake)	△(※)	△(※)	(※) having the one of conventional line , but not for HSR	Training in Japan
		② Regenerative brake system	✓	✓		
		③ Ceramic jet device (improving adhesion)	×	×		Training in Japan
	(3)	Power control system				
		① VVVF control system(Variable Voltage and Variable Frequency)	✓	✓		
	(4)	Current-collection device(pantograph for HSR)	×(※)	×(※)	(※) having the one of conventional line, but not for HSR	Training in Japan
	(5)	Car body, door				
		① Door safety device	×	✓ (※ 2)	(※2) having the one of conventional line , but not for HSR	Training in Japan
		② airtight structure of Car body,	×(※1)	×	(※1) Currently, examining it by some passenger cars	Training in Japan
	(6)	Monitoring the condition of HSR rolling stock				
		① Axle temperature and wheel lock detection system	△(※1)	△(※2)	(※ 1) (※ 2) having “wheel lock detection system”	Training in Japan

					(※ 2) having Axle temperature detection system but not automatically	
		② Some other Monitoring system	×(※)	×(※)	(※)Axle temperature, Brake air pressure, main circuit current and so on.	Training in Japan
	(7)	Fire preventive countermeasures				
		① Fire proofing and flame retardant	△(※1)	✓	(※ 1) It is thought that countermeasures are in progress	
		② Smoke or fire detector	×	✓		
	(8)	Riding comfort countermeasures				
		① Anti-roll damper between cars, active suspension	×	×		Training in Japan
		③ Riding comfort management system	×	×		Training in Japan
	(9)	HSR maintenance technology				
		① Inspection cycle, Changing system of bogies	×	×		Training in Japan
		② axle flaw detect system by ultrasonic	✓	✓		
		③ ATC characteristic inspection	×	×		Training in Japan
		④ Wheel Gliding machine under-floor type	✓(※1)	✓	(※ 1) having them, but the number of them are limited,	
3. Electric facilities						
	(1)	Facilities of electric power and substation				
		① AT(Auto Transformer) power supply system and Automatic changeover section circuit	△(※1)	△(※2)	(※ 1) (※ 2) having AT power supply system, but not having automatic changeover section circuit(dead section)	Training in Japan
		② Simple catenary or Compound catenary	△(※)	△(※)	(※) having the one of	・Compound Catenary

		suspension system and overhead contact wire for HSR			conventional line , but not for HSR	and Section changeover system shall be introduced due to large numbers of trains ・Training in Japan
		③multiple inspection dedicated car(electric equipment and track) for HSR — same as [1(2)⑦]				Training in Japan
		⑤ Stringing car of contact wire	✓	✓		
	(2)	Signaling system				
		① Digital-ATC (continuous speed control)	×	▵(※２)	(※2) CATC(ATP ,ATS & ATO) (注) CATC＝Centralized Automatic Train Control	Training in Japan
		② Track circuit to detect train (non-insulated track circuit and etc.)	▵(※1)	✓ (※2)	(※1) They are limited, but IR has automatic block system based on track circuit between Mumbai and Ahmedabad (※2) non-insulated AF track circuit, No. 8 line will adopt CBTC in the future.	Training in Japan
	(3)	telecommunication				
		① Dedicated train radio system(Digital type) using LCX	×(※1)	▵(※2)	(※1) The command to the crew are carried out through the station (※2) not having LCX	Training in Japan
		②Optical fibre	✓	✓		
4. ICT system						
	(1)	Ticket reservation system	✓	—(※2)	(※2) no need	
	(2)	AFC	×(※1)	✓	(※1) Ticket inspection of	

					Long-distance train are performed in the car	
	(3)	Transport planning system	×	✓		
	(4)	Rolling stock management system	×	✓		Training in Japan
	(5)	Crew allocation system	✓	✓		
	(6)	Track maintenance management system	△(※1)	✓	(※1) Since 2010, it has been tried in the six pilot area	Training in Japan
	(7)	Materials procurement management system	✓	✓		Training in Japan
	(8)	Other various system for administration/management	△(※1)	✓ (※2)	(※1) ① terminal management system and others (※2) ①human resource, ② maintenance, ③ accounts, ④ project execution, ⑤ property development activities and others	
5. OCC						
	(1)	Train operation system				
		① CTC (Centralized Traffic Control system)	△(※1)	✓ (※2)	(※1) be limited, but having the monitoring device of train operation management (※2) having CTC	・Autonomous and Decentralized System is recommended by survey team ・Training in Japan
		②Digital ATC		—	same as [3(2)①]	Training in Japan
		③Electronic interlocking system at the Station	✓ (※1)	✓ (※2)	(※1) electronic interlocking systems are installed in 535 stations (※2) all station	
	(2)	Power SCADA (Supervisory Control and Data Acquisition system)	△(※1)	✓	(※1) The number is still limited	

	(3)	Facility SCADA	△(※1)	✓	(※1) ditto	
	(4)	Disaster prevention information Disaster countermeasures]	—	same as [7,		Training in Japan
	(5)	ICT system of Train operation system (7)ICT system]	—	same as [4(1)～		
6. Preventing Concurrence accident						
	(1)	train protection radio (using by ground worker)	×	✓		Training in Japan
	(2)	device for clearance disorder alarm	×	✓		Training in Japan
	(3)	emergency ground switch (Rolling stock)	✓	✓		
7. Disaster countermeasures						
	(1)	Early earthquake detection system	×	×(※2)	(※ 2)having seismic sensor but not automatically	Training in Japan
	(2)	Heavy rainfall and water level of Bridge	× (※1)	✓	(※ 1) Disaster countermeasures are basically patrolled by human	Training in Japan
	(3)	Strong wind detection system	× (※1)	✓	(※1) ditto	Training in Japan
	(4)	Landslide detecting system of Slope	×	—(※2)	(※ 2) almost viaduct and underground	Training in Japan
	(5)	Automatic detecting system of rail temperature	—	same as [1(2)④]		Training in Japan
	(6)	Obstruction detecting device from the outside of railway	×	—(※2)	(※ 2) almost viaduct and underground	Training in Japan
8. Security						
	(1)	CCTV(closed-circuit television) for Security and Installation of Security Center	△(※1)	◎(※2)	(※1) CCTV are partly installed in the main station but not much progressed (※ 2) CCTV are installed at each station and more over surveillance camera in the train are installed	
	(2)	Deployment of the security staffs	◎(※)	◎(※)	(※) From its necessity, Security in India is reinforced more than in Japan	

Appendix 17.2 Entrusting HSR Projects to RVNL/HRSC for Execution

GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS
(RAILWAY BOARD)
*****

No.2014/PL/65/4 (Pt.) New Delhi, dated : 12.11.2014

The Chairman and Managing Director,
Rail Vikas Nigam Limited,
August Kranti Bhawan,
Bhikaji Cama Place,
New Delhi - 110022

Sub: Entrusting HSR projects to RVNL / HSRC for execution.

Ref: Compliance of Para XV (1. & 2.) of Budget announcement, 2014

Ministry of Railways has decided to entrust the work of implementation of High Speed Rail Projects (HSR) to Rail Vikas Nigam Limited (RVNL) / High Speed Rail Corporation of India Limited (HSRC). While approving the same, Hon'ble Minister of Railways has directed that the project needs to be prioritized and regular reports should be put up to him.

You are advised to take action on priority accordingly

(A.P.Dwivedi)
Executive Director (PSU & HS)
Telefax: 011-23386091

Copy to:-

1. PSO/Sr PPS/PPS ; for kind information of CRB, FC, ME, MT, MG, DL, IRSE.
2. General Managers all Indian Railways
3. DG/RDSO
4. Secretary, Railway Board

Appendix 17.3 Examples of Railway Institutes in India

1. Indian Railways (IR)

IR devotes a significant effort towards education of employees, and has institutes more than 270 to suite a variety of education. Therefore, it was not possible to investigate all of the Institute, among them, the following Institutes have especially excellent facilities and curriculum.

① National Academy of IR(NAIR) at Vadodara,
② Indian Railways Institute of Civil Engineering (IRICEN)at Pune,
③ Indian Railways Institute of Signal Engineering and Telecommunications(IRISET) at Secunderabad,
④ Indian Railway Institute of Electrical Engineering(IRIEEN) at Nasik,
⑤ Indian Railway Institute of Mechanical & Electrical Engineering(IRIMEE) at Jamalpur,
⑥ Indian Railway Institute of Transport Management(IRITM) at Lucknow

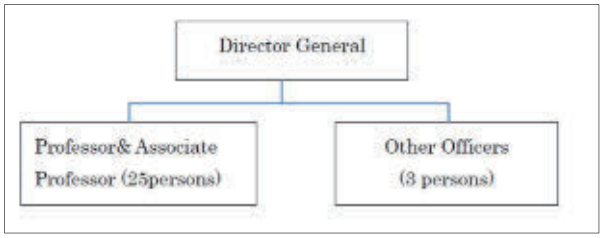
In addition, one of the features of IR training system is that such as related education materials or manuals of each department are maintained very well. However, the obsolescence of training equipment were seen partly, it was supposed probably because investment was late for local Institute.
We would like to introduce the following Institutes which were able to investigate this time.

(1) National Academy

The National Academy of Indian Railways is the alma mater for the Officers of the Indian Railways. Around 2500 officers participate in various training programs each year. The duration of programs varies from one week to ten weeks. Managers of a few Public Sector Undertakings, Other ministries of the Government and a few managers from railway systems abroad also attend training programs in this College.

1) Institute Building & Model Room

2) Organization



3) Learning Aids

The spacious rooms in the palace are used for formal learning, seminars, workshops, tutorials etc. All the rooms have been equipped with the necessary electronic audiovisual and other aids. Library complex houses the Library stocked with over 50,000 books, 15,000 journals, reports, 8,650 Hindi books and over 103 periodical magazines are procured.

4) Hostels

Two hostels, Pahune and Mehman, in the campus provide comfortable lodging upto 230 officers.

5) Training program

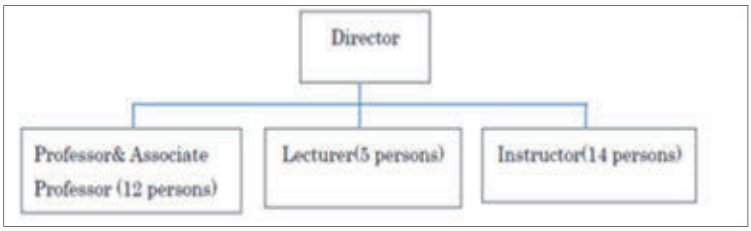
S.No.	Programmes Name	Eligibility/Level
1	Strategic Management Programmes	General Managers, Principal Head of Departments and Divisional Railway Managers
2	Advanced Management Programmes	Middle/ Senior Level Management
3	Management Development Programmes	Middle Level Management
	Group 'A' Foundation Programmes	Probationers of Group 'A' Railway Services
5	Group 'A' Induction Programmes	Probationers of Group 'A' Railway Services
6	Programmes forming part of Centralised Training of Probationers	Probationers of IRAS, IRPS and IRSS
7	Group 'B' Foundation Programmes	Group 'B' Officers
8	Group 'B' Induction Programmes	Group 'B' Officers
9	Function Related Programmes	Junior and Middle level managers of all disciplines
10	Information Technology	All levels
11	Advanced Information Technology	All Levels
12	Programmes for Foreign Railway Officers	Railway Officers of Foreign Countries
13	Programmes for Public Sector Undertakings/ Other Ministries	Specially designed training courses for Officers of Public Sector Undertakings & Other Ministries.

(2) Indian Railway Institute for Civil Engineering(IRICEN, Pune)

IRICEN had a modest beginning in 1959 when a "Permanent Way Training School" was set up at Pune to fulfil the long-felt need of providing in-house training to freshly recruited civil engineers of Indian Railways.

1) Institute Building

2) Organization



3) Facilities and Equipment

◆Lecture Room(1)

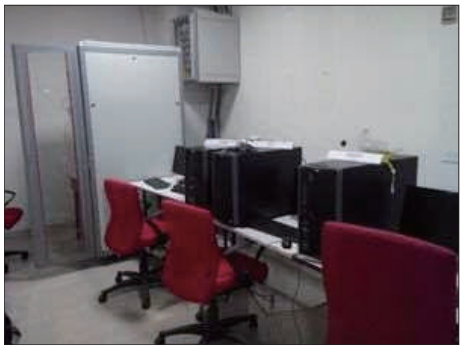
◆Lecture Room(2)

◆Rail flaw detecting equipment

◆Material Testing Lab

◆Training Line

◆Computer Center



◆Library(1)

◆Library(2)

◆Hostel

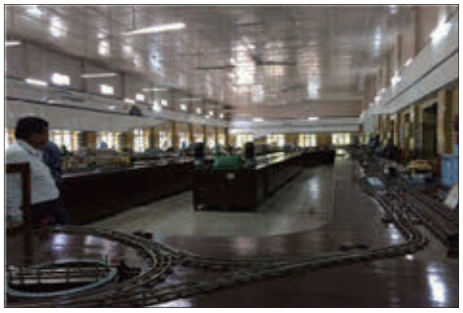
(3) Zonal Railway Training Institute (Udaipur)

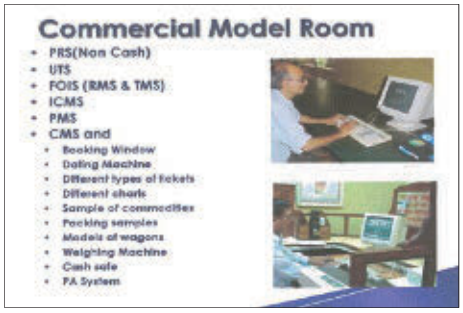
- The person targeted for education are all newly requited Group C and all of loco pilots in IR
- This institute are accepting civil engineering trainees of other companies or countries, such as DMRC, Bangladesh, Nigeria and so on.
- 63 Faculty members
- Class rooms- 32, Total seating capacity -1,000

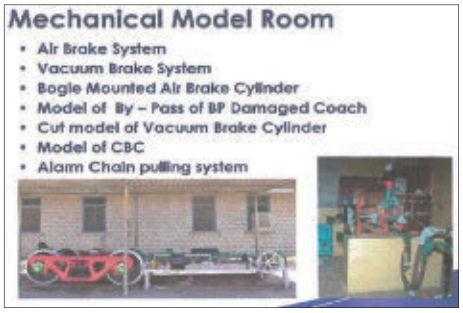
◆Institute Building

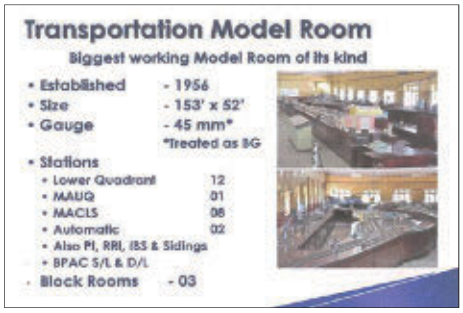
◆Lecture Room（with projector）

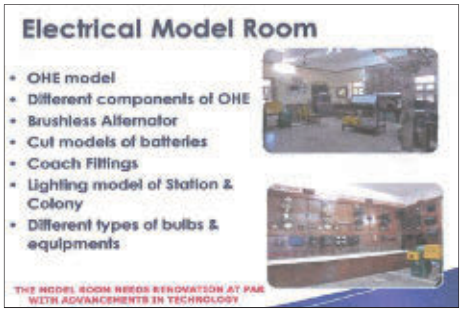
◆Model room

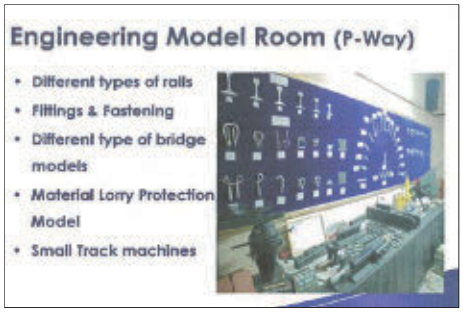


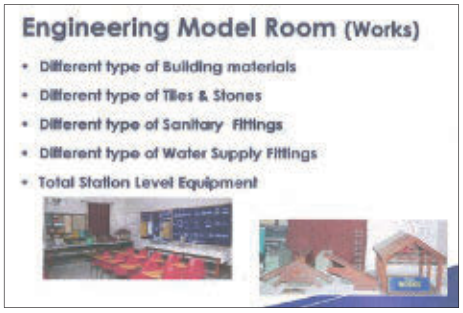


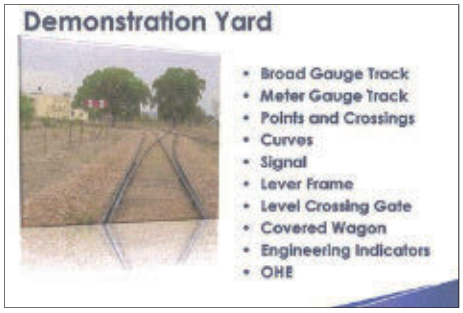

Mechanical Model Room
• Air Brake System
• Vacuum Brake System
• Bogie Mounted Air Brake Cylinder
• Model of By – Pass of BP Damaged Coach
• Cut model of Vacuum Brake Cylinder
• Model of CBC
• Alarm Chain pulling system


Transportation Model Room
Biggest working Model Room of its kind
• Established - 1956
• Size - 153' x 52'
• Gauge - 45 mm*
*Treated as BG
• Stations
• Lower Quadrant 12
• MAUQ 01
• MACLS 08
• Automatic 02
• Also PI, RRI, IBS & Sidings
• BPAC S/L & D/L
• Block Rooms - 03

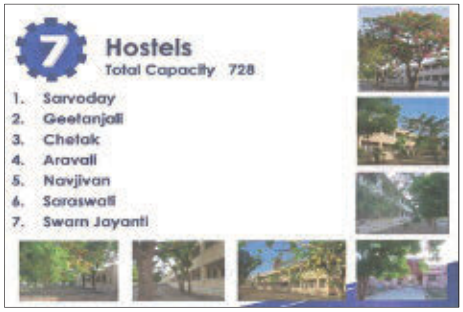

Electrical Model Room
• OHE model
• Different components of OHE
• Brushless Alternator
• Cut models of batteries
• Coach Fittings
• Lighting model of Station & Colony
• Different types of bulbs & equipments
THE MODEL ROOM NEEDS RENOVATION AT PAR WITH ADVANCEMENTS IN TECHNOLOGY

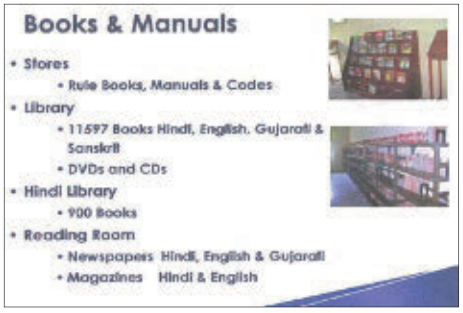

Engineering Model Room (P-Way)
• Different types of rails
• Fittings & Fastening
• Different type of bridge models
• Material Lorry Protection Model
• Small Track machines

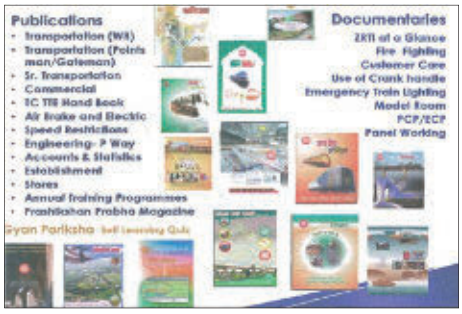

Engineering Model Room (Works)
• Different type of Building materials
• Different type of Tiles & Stones
• Different type of Sanitary Fittings
• Different type of Water Supply Fittings
• Total Station Level Equipment


Demonstration Yard
• Broad Gauge Track
• Meter Gauge Track
• Points and Crossings
• Curves
• Signal
• Lever Frame
• Level Crossing Gate
• Covered Wagon
• Engineering Indicators
• OHE


Computer Centre
• 20 Computers
• 03 Printers
• 01 Duplo Printer
• 01 Scanner
• Railnet - 2 Mbps
• LAN


7
Hostels
Total Capacity 728
1. Sarvoday
2. Geetanjali
3. Chetak
4. Aravali
5. Navjivan
6. Saraswati
7. Swarn Jayanti


Books & Manuals
• Stores
• Rule Books, Manuals & Codes
• Library
• 11597 Books Hindi, English, Gujarati & Sanskrit
• DVDs and CDs
• Hindi Library
• 900 Books
• Reading Room
• Newspapers Hindi, English & Gujarati
• Magazines Hindi & English


Publications
• Transportation (WR)
• Transportation (Points man/Gateman)
• Sr. Transportation
• Commercial
• IC TTE Hand Book
• Air Brake and Electric
• Speed Restrictions
• Engineering- P Way
• Accounts & Statistics
• Establishment
• Stores
• Annual training Programmes
• Prashikshan Prabha Magazine
Gyan Pariksha
Documentaries
ZRTI at a Glance
Fire Fighting
Customer Care
Use of Crank handle
Emergency Train Lighting
Model Room
PCP/ECP
Panel Working

(4) Electrical Training Center (Vadodara)

- This Training Center is the Zonal Training Center of Western Railway, and in charge of assistant loco pilots and power supply employees
- Electrical Department has the below 4 sections
  - ① Locomotive maintenance(Rolling stocks),
  - ② Locomotive operation
  - ③ General Services(Train Lightings, Building Lights, etc.)
  - ④ Tracting Distribution(Over Head Equipments)
- This Training Center has 33 trainers.

◆Simulator of locomotive

◆Driving seat of Simulator

◆Training of Loco Pilots

◆Emergency training of locomotive

◆Model room of rolling stock and power facilities

◆Manuals

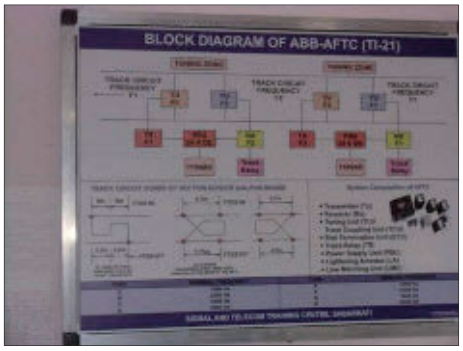
◆Training equipment of overhead catenary

5) Signaling & Telecommunication Training Center (Sabarmati)

- This Training Center is the Zonal Training Center of Western Railway, and has 1,200 trainees a year.
- Regular training course

Course	Category		Duration	Period
	Signal	Telecom		
Promotee	○	○	8~9 weeks	once
Initial	○	○	[8+9+8]~[8+9] weeks	Once during Apprentice period
Refresher	○	○	3 weeks	Every 4 years
Foundation	○	○	12 weeks	On promotion from helper to technician
Induction	○	○	4 weeks	Once after joining as helper

◆Block Diagram (1)



◆Block Diagram (2)

◆Relay device

◆Model of block system

◆axle counter

◆Telecommunication equipment

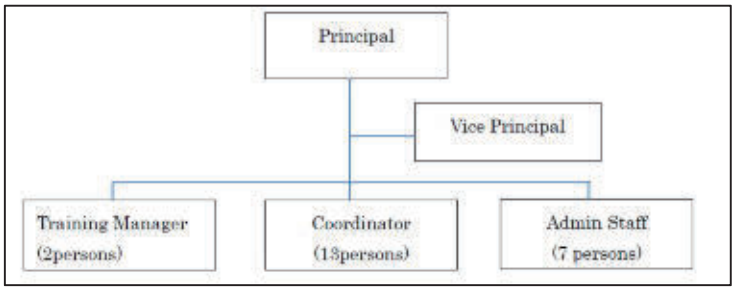
◆Training line

2. Delhi Metro (DMRC)

The education/training facilities of DMRC are are developed very well. They have many equipment including new technology such as machines, simulators and computer based training system to enhance education/training effect. When establishing Indian HSR training institute, it can be considered one of the reference.

(1) Institute Building

(2) Organization



(3) Class rooms

The Institute has 24 class rooms with a capacity of 864 trainees at a time.

(4) Computer Based Training

Computer-Based Training (CBT) is an interactive method of e-learning that provides a series of self-paced, hands-on courses. DMRC Training institute facilitates the trainees with two CBT Labs, well equipped to accommodate 42 trainees.

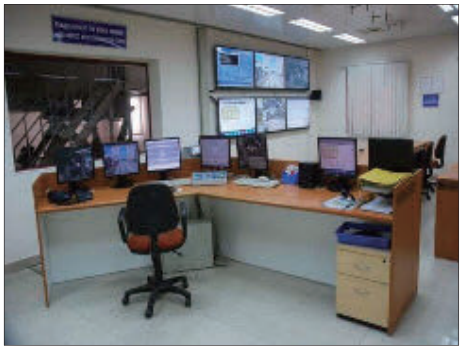
(5) Library

There are more than 4000 books related at present.

(6) equipment and facilities

◆Model equipment and facilities

◆Trouble Shooting and Maintenance Simulators



◆Train Simulator

(7) Hostel

Facility of accommodating the trainees is available in hostel. The boys hostel has 112 rooms with attached bathrooms. A total of 224 trainees can be accommodated in the boys hostel. The girls hostel can accommodate 50 trainees.

(8) Training program

① Executive Developement Programme
② Management Development Program
③ Induction Training
- Station Controller/Train Operator (Duration-30 weeks)
- Customer Relations Assistant (Duration-16 weeks)
- Junior Engineer:Electrical/Electronics/Mechanical/Civil (Duration varies from 07 weeks to 20 weeks)
- Maintainer:Electrical/Electronics/Mechanical/Civil (Duration varies from 06 weeks to 17 weeks)
- Traffic Controllers (Duration-3 weeks)

④ Refresher Training
⑤ Reshuffling Training
⑥ Training on Promotion
⑦ Special traini

Appendix 17.4 Formation of the Rules for Different Fields in the Shinkansen of Japan

(1) Safety

Laws and ministerial ordinances, etc.	Internal			Remarks
	Internal control rules and implementation criteria	Procedure and criteria, etc.	Standards and main points (manuals), etc.	
1. Railway operations law (1)Ministerial ordinance to specify the criteria on railway technologies (2)Ministerial ordinance on the security of train operation	• Control rules of implementation criteria • Train operation handing/implementation criteria • Norms on the safety of train operation	• Procedure to control train operation at disaster • Procedure to deal with the accidents in train operation • Procedure on the railway meteorological notification • Train operation handling Procedure for maintenance works • Procedure to inspect the appropriateness of railway-related services • Procedure to report and classify accidents in train operation	• Manuals in train operation of Shinkansen • Standards for the appropriateness of train Operation • Standards to report accidents in train operation	
2. Disaster Countermeasures Basic Act	• Rules of disaster prevention	• Disaster prevention plan	• Emergency actions manuals for disaster	
3. Industrial Safety and Health Law	• Health and Safety Operational Rules	• Handling procedure of Health and Safety duties	• Prevent manuals of train hitting accident for transportation and rolling stock staffs • Prevent manuals of train hitting accident for civil engineering staffs	

(2) Stations, Sales and Transportation

Laws and ministerial ordinances, etc.	Internal			Remarks
	Internal control rules and implementation criteria	Procedure and criteria, etc.	Standards and main points (manuals), etc.	
1. Railway operations law (1) Ministerial ordinance to specify the criteria on railway technologies	• Operation rules • Train operation handing/ implementation criteria	• Income from transport services and compiling/handling of relevant reports • Lost articles handling criteria • Rules on the discounts for physically handicapped persons and other charges • Procedure to control train operation at disaster • Procedure to deal with the accidents in train operation • Procedure on the railway meteorological notification • Procedure to inspect the appropriateness of railway-related services • Procedure to report and classify accidents in train operation	• Rules on the handling of IC card tickets	
(2) Ministerial ordinance on the security of train operation	• Norms on the safety of train operation			

(3) Rules on train crews

Laws and ministerial ordinances, etc.	Internal			Remarks
	Internal control rules and implementation criteria	Procedure and criteria, etc.	Standards and main points (manuals), etc.	
1. Railway operations law (1) Ministerial ordinance to specify the criteria on railway technologies	• Train operation handing/ implementation criteria • Norms on the safety of train operation	• Procedure to control train operation at disaster • Procedure to deal with the accidents in train operation • Procedure on the railway meteorological notification • Procedure to inspect the appropriateness of railway-related	• Main points in train operation • Standards for drivers (1) Criteria of driver duties (2) Standards on driver services (3) Guideline to train operation/handling in emergency) • Standards for conductors (1) Criteria on conductor duties	
(2) Ministerial ordinance on the security of train operation				

(3) Ministerial ordinance on the license for car drivers		services • Procedure to report and classify accidents in train operation • Standards on the upbringing of car drivers	(2) Standards on conductor services, (3) Guideline to train operation/handling in emergency) • Standards for the appropriateness of train Operation • Standards to report accidents in train operation	

(4) Rolling stock

Laws and ministerial ordinances, etc.	Internal			Remarks
	Internal control rules and implementation criteria	Procedure and criteria, etc.	Standards and main points (manuals), etc.	
1. Railway operation law (1) Ministerial ordinance to specify the criteria on railway technologies (Note 1) (2) Notice on the regular inspections for equipment/ facilities and rolling stock (Note 2) (3) Criteria on the interpretation of director directives (Note 3)	• Rules on the control of rolling stock • Criteria on the implementation of Shinkansen car services (Decretory specification of the criteria on service implementation) • Criteria on the implementation of the rolling stock structure (Prescription of the minimum specifications)	• Standards on the Shinkansen car services (Speculations) (Specification of the servicing system and standards on services) • Standards on the design of rolling stock structure and other structures (Prescription of design criteria, targeted numerical values and specifications)	• Standards of the detailed rules on the services for cars of different types	(Note 1) Rolling stock servicing, inspection of trains, duties of regular inspections, requirements for rolling stock performance, etc. (Note 2) Periodicals of regular inspections, exceptions thereof, etc. (Note 3) Concretized representation of the interpretation of ministerial ordinances and notice

(5) Civil engineering

Laws and ministerial ordinances, etc.	Internal			Remarks
	Internal control rules and implementation criteria	Procedure and criteria, etc.	Standards and main points (manuals), etc.	
1. Railway operation law (1) Ministerial ordinance to specify the criteria on railway technologies (Note 1) (2) Notice on the regular inspections for equipment/ facilities and rolling stock (Note 2)	• Rules to control implementation criteria • Shinkansen track equipment/facilities implementation criteria	• Rules on the Shinkansen track structure implementation criteria • Criteria on the implementation of the maintenance of Shinkansen civil engineering structures • Procedure to use maintenance cars (Speculations) • Procedure to spread track ballast while running (Speculations) • Standards on the guarding against disasters on tracks, etc. (Speculations)	• Working rules on the procedure for Shinkansen train operation related to maintenance work • Specifications on the security of construction work close to revenue service lines • Standards on the inspection of welded parts of rails • Main points in the train operation control against rainfall, etc.	

(6) Electricity

Laws and ministerial ordinances, etc.	Internal			Remarks
	Internal control rules and implementation criteria	Procedure and criteria, etc.	Standards and main points (manuals), etc.	
1. Railway operation law (1) Ministerial ordinance to specify the criteria on railway technologies (Note 1) (2) Notice on the regular inspections for equipment/ facilities and rolling stock (Note 2)	• Train operation handing/ • implementation criteria • Rules to control implementation criteria • Shinkansen track equipment/ • facilities implementation criteria • Criteria on the implementation of Shinkansen operation security equipment/facilities	• Procedure of trolley wire maintenance work under power shutdown (Speculations) • Procedure of maintenance work (Speculations) • Criteria on the control of the system of electric equipment/facilities (Speculations) • Criteria on the report of the statistics of electric telecommunication traffic (Speculations) • Criteria on the utilization of electric telecommunication (Speculations) • Criteria on the installation of wire electric telecommunication equipment/facilities (Speculations)	• Standards on the design of electric structures (Shinkansen substation equipment/facilities) • Standards on the design of electric structures (Shinkansen trolley wire system) • Standards on the Shinkansen signal/security equipment/facilities • Standards on the design and execution of the construction work of Shinkansen signal/security equipment/facilities	

1. Railway operations law (1) Rules on the report of railway accidents, etc. (ministerial ordinance) (2) Rules on the report of railway operation, etc.		• Criteria on the report of electricity accidents (Speculations) • Design specifications • Criteria on the report and statistics of electric equipment/facilities, etc. (Speculations)		
2. Electricity enterprises law (1) Detailed rules on the implementation of electricity enterprises law (2) Technological criteria on electric equipment/facilities	• Rules on security	• Criteria on power supply and demand (Speculations)	• Main points in the report and statistics of power supply and demand	

(7) Information and communication Technology (ICT)

Laws and ministerial ordinances, etc.	Internal			Remarks
	Internal control rules and implementation criteria	Procedure and criteria, etc.	Standards and main points (manuals), etc.	
1. Railway operations law (1)Rules on the report of railway accidents, etc. (ministerial ordinance) 2. Personal Information Protection Law 3. Control Law of Injustice Access	• Rules on the control of ICT system	• Criteria on the Control of developing/ operating ICT system(Speculations) • Criteria on thecontrol of ICT system (Speculations) • Handling criteria of transportation information (Speculations) • Handling criteria of integrated Office system(Speculations) • handling criteria of ICT system security(Speculations)	• Standards and manuals on the control of ICT system	

Appendix 17.5 Education/Training Curriculums and Training Period of Main Related Employees

1. Drivers

In particular, in the case of Japanese Shinkansen, it is the system that the person who holding driver's license of EMU or electric locomotive in the conventional line have the qualification to take the examination of driver's license for HSR. However, in India, we will recommend the system that the person who becoming HSR driver can directly take the examination of driver's license for HSR, and will consider education/training curriculums for the purpose. In this case, only rolling stock structure related directly to HSR is taught, and the main curriculums of them are as follows Table Appendix 17.5-1.

Table Appendix17.5-1 Education/Training Curriculums for HSR Drivers

Class division	Education/training curriculums	Period	Remarks
1. Desk education	(1) Over view of railway	4 months	
	(2) Railway Accident Prevention		
	(3) Job duties of drivers		
	(3)Rolling stock of HSR		
	(4) Train operation rules and regulations		
	(5) Signaling and tracks		
	(6) Railway electricity		
	(7) Train operation theory		
	(8) inspection and repair		
	(9) Safety in work		
	(10) Rules and manuals for drivers		
	(11) Emergency actions and Handling when accident occurred		
	(12) Training by simulator		
2. Practical training	(1) Basic training	3 months	Rolling stocks on the training line
	(2) driving training		
	(3) inspection before departure from depot		
	(4) Emergency actions and Handling when accident occurred		
Total		7 months	

2. Conductor

Conductors shall need a part of education/training for train operation including emergency training, but main duties are passenger service and ticket handling.

Table Appendix17.6-2 Education/Training Curriculums for HSR Conductors

Class division	Education/training curriculums	Period	Remarks
1. Desk education	(1) Over view of railway	2 months	
	(2) Railway Accident Prevention		
	(3) Job duties of Conductors （handling of ticket sales, passenger service, handling of cash）		
	(4) Rolling stock of HSR （cabin facilities）		

	(5) Train operation rules and regulations		
	(6)Facilities on the ground		
	(7) Safety in work		
	(8) Rules and manuals for conductors		
	(9) Handling when accident occurred		
	(10) Training by simulator		
2. Practical training	(1) Basic training	1 months	Rolling stocks on the training line
	(2) Crew training in driver`s cab		
	(3) Drive training		
	(4) Handling when accident occurred		
Total		3 months	

3. Station staffs

Station staffs, as well as the conductor, shall need a part of education/training for train operation including emergency and passenger service /sales matters including ticket handling. In addition to this, such as handling of station-related facilities and fire emergency are important for education/training of station staffs.

Table Appendix17.5-3 Education/Training Curriculums for Station Staffs

Class division	Education/training curriculums	Period	Remarks
1. Desk education	(1) Over view of railway	2 months	
	(2) Railway Accident Prevention		
	(3) Job duties of station staffs(handling of ticket sales, passenger service, handling of cash)		
	(4) Train operation rules and regulations		
	(5) Rolling stock of HSR		
	(6) Facilities on the ground (station premises Facilities)		
	(7) Safety in work		
	(8) rules and manuals for station		
	(9) Handling when accident occurred		
2. Practical training	(1) Basic training	1 months	Using the station by training line
	(2) Training of station job duties		
	(3) Handling when accident occurred		
	Total	3 months	

4. Dispatchers

Naturally, dispatchers of each department must have the basic knowledge of HSR in every field. Therefore, they must finish education/training curriculums of their field. In addition, it is necessary to be familiar with the handling of the related equipment. Duties of dispatchers are not particularly difficult in the normal conditions, if emergency does not occur. However, once when emergency occurs, the duties are not same and a great variety and it is necessary to take action in accordance with the conditions flexibly. Though basic manuals for dispatchers will are prepared, it is not always able to respond to all by this. Education /training required especially are those in the field of practice. Therefore, education/training in the training line will become very significant. Because it is necessary to take considerable time like a driver for the education /training of dispatchers, desk education of three months and practical training of three months in the training line are anticipated.

5. Engineer to acquire the core technology of operation/maintenance

In order to ensure the success of India HSR, it is important that technology transfer of the core technology for operation/maintenance of HSR is performed surely in each field. Therefore, other than the overseas training of key Person in Japan, domestic training in India also are required in order to spread the technology. The core technology of operation/maintenance for HSR to be acquire in each field are shown as below.

Therefore, even in Japan in addition to the overseas training of key Person, it is assumed that to perform the education of stakeholders in order to spread the technology. Education /training required especially are those in the field of practice also like dispatchers. Desk education of three months and practical training of three months in the training line are anticipated also like dispatchers.

(1) Rolling stock

①Bolsterless Bogie for HSR, ②Wheel and bearing for HSR, ③Suspension structure for HSR (including air- Suspension and so on), ④Brake system /improving system of adhesion ⑤ Current-collection device for HSR (pantograph) ⑥Door safety device and Airtight structure

of Car body, ⑦Axle flaw detect system and Wheel gliding, ⑧Riding comfort countermeasures (anti-roll damper between cars, active suspension), ⑨ATC characteristic inspection, ⑩High speed testing of bogie after assembly ⑪HSR maintenance technology (Inspection cycle, Changing system of bogies)

(2) Civil infrastructure and Track

①Slab track for HSR and its maintenance, ②Long rail and High speed turnout, ③Automatic detecting system of rail temperature, ④Multiple inspection dedicated car for HSR and Track maintenance system, ⑤Management criterion value of track irregularity ⑤Handling of Maintenance work time and confirmation car, ⑥Inspection of Civil infrastructure (health monitoring system), ⑦Disaster detection system

(3) Electric Facilities

①Automatic changeover section circuit, ②Compound catenary suspension system ③High tensile catenary for HSR ④Power SCADA (Supervisory Control And Data Acquisition system), ⑤Multiple inspection dedicated car for HSR and Overhead contact wire management system, ⑥Handling of maintenance work time zone and various maintenance cars

(4) Signaling & Telecommunication

①Digital-ATC and CTC, ②Track circuit maintenance(non-insulated track circuit and etc.) ③ Electric point machine for HSR, ④LCX and Dedicated train radio, ④Multiple inspection dedicated car for HSR and Signaling facilities maintenance management system, ⑤Device for clearance disorder alarm, ⑥train protection radio (using by ground worker), ⑦Disaster detection system

(5) OCC

①Transport planning system, ②Train operation system, ③Passenger information system, ④ Power SCADA, ⑤Facility SCADA, ④Disaster detection system

(6) ICT system

①Transport planning system, ②Train operation system, ③Passenger information system, ④ Maintenance management system (Rolling stock, Track, Overhead contact wire and Signaling), ⑤Material procurement system

6. Maintenance staffs of rolling stocks

Though maintenance of rolling stocks is different between Depot and Work shop, education/training of pre-opening are implemented with the same content. Education /training for different duties in each field shall are corresponded by on-the-job training at work site. In addition, since it is difficult that all of Practical training are implemented in training line, practical training, which are not able to be coped in training line, shall be corresponded by on-the-job training at work site.

Table Appendix17.5-4
Education/training Curriculums for Maintenance Staffs of Rolling Stock

Class division	Education/training curriculums	Period	Remarks
1. Desk education	(1) Over view of railway	2 months	
	(2) Railway Accident Prevention		
	(3) Job duties of rolling stock maintenance		
	(4) Rolling stock of HSR(Bogie, Brake system, Wheel and bearing)		
	(5) Rolling stock of HSR(ATC and TC characteristic inspection)		
	(6) Rolling stock of HSR(Current-collection device, main motors)		
	(7) Rolling stock of HSR(main circuit, control circuit)		
	(8) Rolling stock of HSR(Car body, door, Airtight structure, cabin facilities)		
	(9) inspection and repair method of HSR Rolling stock (related rules and manuals)		
	(10) machine and equipment for inspection and repair of HSR(handling method)		
	(11) Emergency actions for troubles		
	(12) Safety in work		
2. Practical training	(1) Basic training	2 months	Rolling stocks on the training line
	(2) Training of inspection and repair		
	(3) Emergency actions for troubles		
Total		4 months	

7. Maintenance staffs for Civil Engineering

Though maintenance of civil engineering include broad field such as maintenance of infrastructure, track& rail, other facilities and handling of various maintenance car and so on, education/training of pre-opening are implemented with the same content.

Education /training for different duties in each field shall are corresponded by on-the-job training at work site. In addition, since it is difficult that all of practical training is implemented in training line, practical training, which are not able to be coped in training line, shall be corresponded by on-the-job training at work site.

Table Appendix-17.5-5
Education/Training Curriculums for Maintenance Staffs of Civil Engineering

Class division	Education/training curriculums	Period	Remarks
1. Desk education	(1) Over view of railway	2 months	
	(2) Railway Accident Prevention		
	(3) Job duties of maintenance for civil engineering		
	(4) Train operation handling procedure for civil engineering (railway track closing, handling procedure of maintenance car, handling when disaster occurred)		
	(5) Maintenance of infrastructure (Viaduct, Embankment)		
	(3) Maintenance of track, rail and turnout (Slab track, long rail, turnout, rail temperature management)		
	(7) Maintenance work time and confirmation car		
	(8) Disaster detection system		
	(9) Multiple inspection dedicated car for HSR and Track maintenance system		
	(10) Facility SCADA and maintenance of various equipment		
	(10) Inspection and repair method of infrastructure and other facilities (related rules and manuals)		
	(11) machine and equipment for inspection and repair of infrastructure and other facilities (handling method)		
	(12) Emergency actions for troubles		
	(13) Safety in work		
2.Practical training	(1) Basic training	2 months	On the training line
	(2) Training of inspection and repair		
	(3) Emergency actions for troubles		
Total		4 months	

8. Maintenance staffs for Power supply

Though maintenance of power facilities are carried out enough in India, in the case of HSR, it should be considered how to cope with maintenance of 320km / H high speed in particular. For this purpose, it is to be carried out with maintenance that put an important point on the contact line.

In addition, since it is difficult that all of practical training are implemented in training line, practical training which are not able to be coped in training line, shall be corresponded by on-the-job training at work site.

Table Appendix-17.5-6
Education/Training Curriculums for Maintenance Staffs of Power Supply

Class division	Education/training curriculums	Period	Remarks
1. Desk education	(1) Over view of railway	2 months	
	(2) Railway Accident Prevention		
	(3) Job duties of maintenance for Power facilities		
	(4) Train operation handling procedure for Power supply(current stopping, railway track closing, handling procedure of maintenance car)		
	(5) Substation, Automatic changeover section circuit, high speed circuit breaker		
	(6) High tensile overhead catenary		
	(7) Power SCADA		
	(8) Distribution facilities		
	(9) Maintenance work time and maintenance car,		
	(10) Disaster detection system		
	(11) Multiple inspection dedicated car for HSR and Overhead contact wire management system		
	(12) Inspection and repair method of power supply facilities (related rules and manuals)		
	(13) Various maintenance cars and equipment for inspection and repair of power supply facilities (handling method)		
	(14) Emergency actions for troubles		
	(15) Safety in work		
2. Practical training	(1) Basic training	2 months	On the training line
	(2) Training of inspection and repair (training of overhead catenary)		
	(3) Voltage detection and earth connection		
	(4) Emergency actions for troubles		
Total		4 months	

9. Maintenance staffs for signaling &telecommunication

Though signaling &telecommunication are not necessarily in the same technical field, worksite organization is integrated to one in order to simplify the organization. Therefore, education/training of pre-opening is implemented with the same content. Education /training for different duties in each field shall are corresponded by on-the-job training at work site. In addition, since it is difficult that all of Practical training are implemented in training line, practical training which are not able to be coped in training line, shall be corresponded by on-the-job training at work site.

Table Appendix-17.5-7 Education/Training Curriculums for Maintenance Staffs of Signalling & Telecommunication

Class division	Education/training curriculums	Period	Remarks
1. Desk education	(1) Over view of railway	2 months	
	(2) Railway Accident Prevention		
	(3) Job duties of maintenance for signaling & telecommunication		
	(4) Train operation handling procedure for signaling &telecommunication （railway track closing, handling procedure of maintenance car）		
	(5) Signaling facilities (Digital ATC,CTC)		
	(6) Signaling facilities（Track circuit , Electronic interlocking devices of station）		
	(7) LCX, train radio and train protection radio		
	(8) Optical fiber, other carrier device		
	(9) Facility SCADA		
	(10) Maintenance work time and maintenance car		
	(11) Disaster detection system（Device for clearance disorder alarm）		
	(12) Multiple inspection dedicated car for HSR and Signaling management system		
	(14) Inspection and repair method of signaling &telecommunication facilities ()related rules and manuals		
	(15) Various maintenance cars and equipment for inspection and repair of signaling &telecommunication facilities (handling method)		
	(16) Emergency actions for troubles		
	(17) Safety in work		
2. Practical training	(1) Basic training	2 months	On the training line
	(2) Training of inspection and repair		
	(3) Emergency actions for troubles		
Total		4 months	