Chapter 8

Detailed Study of Route Alignment

Chapter 8 Detailed Study on Route Planning

8.1 Route planning

On the basis of the result of Chapter 4, Route Selection, a detailed study was conducted on the route between Jakarta – Bandung/Gedebage. For the railway alignment, the relationship with the topography and aboveground structures is important, so that the study has been done using the results of satellite photographic survey (1/10,000 scale) conducted along the planned route in this study. The development project data, etc. made available to us in the course of on-the-spot study are to be taken into account. For particularly important points, discussion/negotiation was held with relevant authorities to achieve consensus building concerning alignment.

8.1.1 Route planning

(1) Plan conditions

a) Alignment conditions

This route assumes high-speed operation at 300 km/h or more, so that the alignment conditions are as summarized in the table below.

Table 8.1-1 Alignment Conditions of the High-Speed Railway

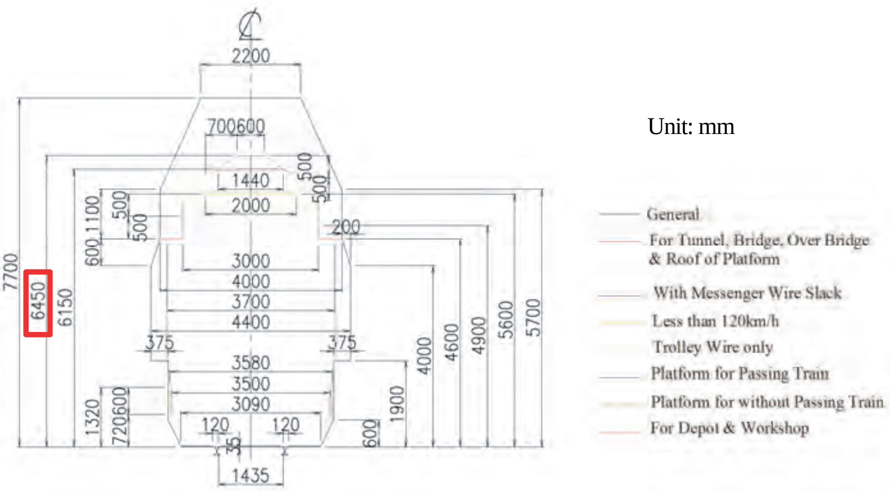
Parameters		Data
Gauge		1,435 mm
Radius of curve	Main line (high-speed section)	6,000 m or more
	Main line (other than the high-speed section)	1,000 m or more
Configuration of transition curve		Transition curve diminishing sine half-wave length
Straight line between curves	Main line	100 m
	For cases with 120 km/h or less	50 m
	For unavoidable cases	Direct connection of both transition curves (limited only to those in the opposite direction)
Length of circular curve	Main line	100 m
	For cases with 120 km/h or less	50 m
	For unavoidable cases	Direct connection of both transition curves
Maximum gradient	General	25 / 1,000
	For topographically unavoidable cases	35 / 1,000
	Area for stopping, siding, uncoupling	3 / 1,000
Vertical curve	Main line	25,000 m
	For cases with 120 km/h or less	5,000 m
Concurrence of causes	Vertical curve with the radius of 15,000 m or less must not be inserted into the transition curve.	
	No turnout should be provided in the transition curve and the vertical curve section.	
	No turnout should be provided in the grade section of 3/1000 or more.	

Source: Study team (refer to the Shinkansen Standard)

b) Construction gauge

The construction gauge of the high-speed railway relative to flyovers such as roads and existing railroad lines is 6.45 m from Figure 8.1-1.

The construction gauge of roads is planned as 5.50 m (including the allowance height of 0.5 m).

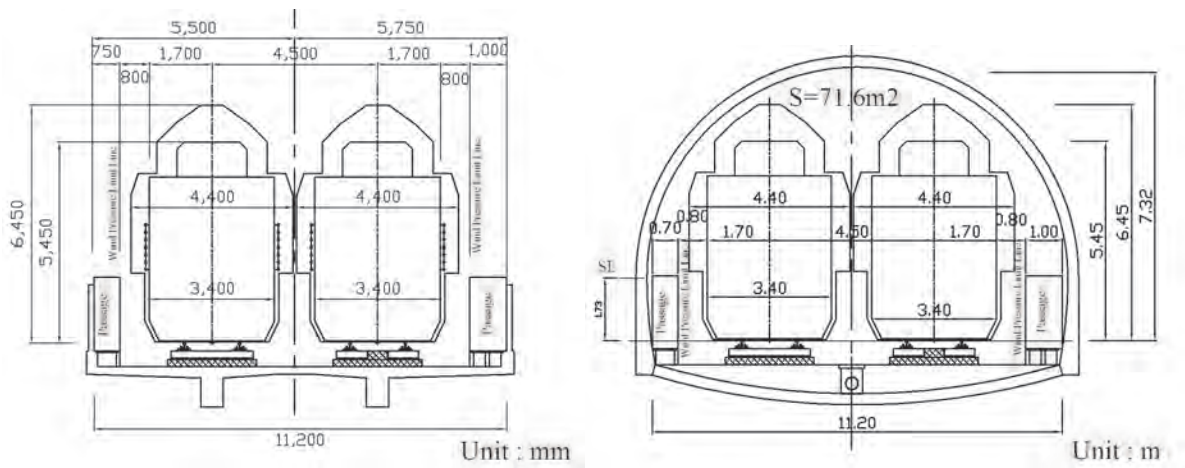


Source: “Explanation: Technical Standards concerning Railway” (Civil Engineering)

Figure 8.1-1 Construction Gauge Diagram of High Speed Railway

c) Formation level width

The standard formation level width of high-speed railway is shown in Figure 8.1-2.



Source: Study Team

Figure 8.1-2 Formation Level Width of Viaduct and Tunnel Sections (straight track)

(2) Facilities and structures to be considered, and the development project (Control point)

In principle, the high-speed railway route is planned by connecting stations with the shortest distance. However, the route may have to be diverted or adjusted by necessity due to taking into account the topographical factors (rivers and geological conditions), the locations of large structures and important facilities (historical structures, military installations, etc.), and their impact on the existing development projects.

For this route, the plan was further deepened through discussion with the related authorities while focusing on the control points shown below.

Table 8.1-2 Results of Coordination of Opinions on the Route Plan and the Response Guideline

Area		Opinions and requests of related authorities	Response guideline
a	Jakarta central area (Dukuh Atas)	The aboveground space is already oversaturated, so that construction of viaducts, etc. are difficult.	Use of underground space
b	BKT Canal area (Banjir Kanal Timur)	A plan exists to construct a four-lane road to the south of canal. The area above the canal quayside and the road is available.	Use of space above the four-lane road
c	Toll road area (Jakarta-Cikampek toll road)	The vacant land to the south of expressway can be used, except that the interchange addition plan and underground utilities must be taken into account.	Planning along the south side of toll road
d	Karawang industrial area	In addition to a new airport construction project, there are more than 10 development projects already approved.	Adjustment requested to the developer side
e	Mountainous area	Landslides have occurred frequently along the existing railroad lines and toll road.	Route to avoid the areas with high risks on the basis of the results of geological survey
f	Airport neighboring areas	High-speed railway structures must not present hindrance to landing and takeoff of planes.	Structure height to be limited to 45 m or less above ground
g	Bandung area (Existing railroad lines)	The project of elevating the existing railroad line in sections before and after the Bandung Station is under way.	Efforts for effective utilization of the limited right-of-way
h	Gedebage area	Projects concerning toll road, monorail system, and urban development are under way.	Adjustment to be made with the developer side concerning the location and elevation of the station

Source: Study Team

a) Jakarta central area (Dukuh Atas)

Jakarta central area (Dukuh Atas) is expected to develop in the future as a node of existing railroad lines and MRT as well as road traffic. The area around the Dukuh Atas Station of the existing railroad line is already overcrowded above and under the ground by projects related to the toll road and new traffic and railroad lines, as shown in Figure 8.1-2. The terminal station of high-speed railway will be planned under the green belt along the small canal in the north. The depth of underground tunnel will basically be 10 m or more under the ground of the land for public use and 30 m or more under the ground of private land according to the legal guideline for utilization of the underground space.

Source: Study Team

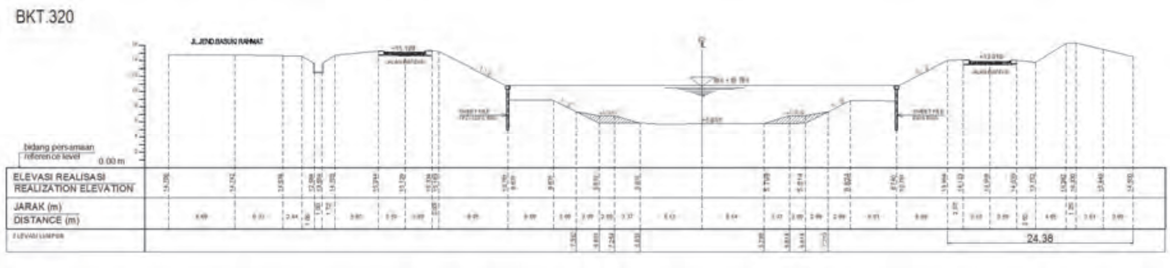
Figure 8.1-3 Current Condition of the Planned Site for HSR Dukuh Atas Station

Source: Study Team

Figure 8.1-4 Development Project of the Area Neighboring the Dukuh Atas Station of Existing Railroad Line

b) BKT Canal area (Banjir Kanal Timur)

BKT Canal is an important waterway (width: about 50 m) to control floods inside Jakarta City.



Source: DINAS PU

Figure 8.1-5 Typical Cross Section of the BKT Canal

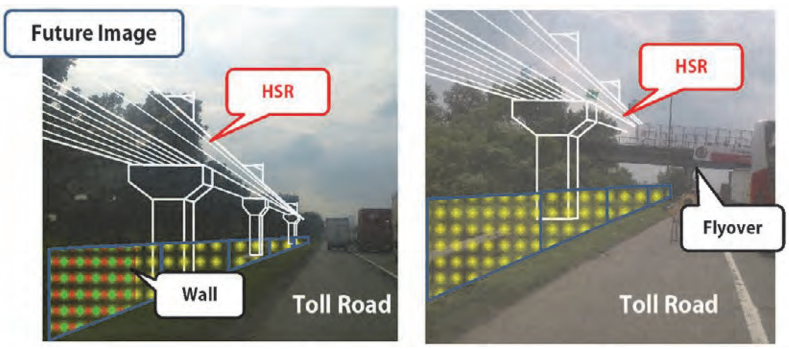
As the area to the north of the BKT Canal has heavy road traffic and is densely packed with residential housing, the high-speed railway is planned along the south side of the Canal. The Canal administrator acknowledged the necessity of this project by saying "though there is a project for new road construction on the south side of the Canal, there would be no problem if the high-speed railway passes over the riverbed and road."

Source: JICA Study Team

Figure 8.1-6 Alignment Plan View in the BKT Canal Area

c) Toll road area (Jakarta-Cikampek toll road)

A part of the green belt parallel to (south side) of the toll road is utilized as the right-of-way for high-speed railway. For the Bekasi – Cikarang section, there is no toll road widening project and the road administrators (BPJT and Jasamarga) present no objection.

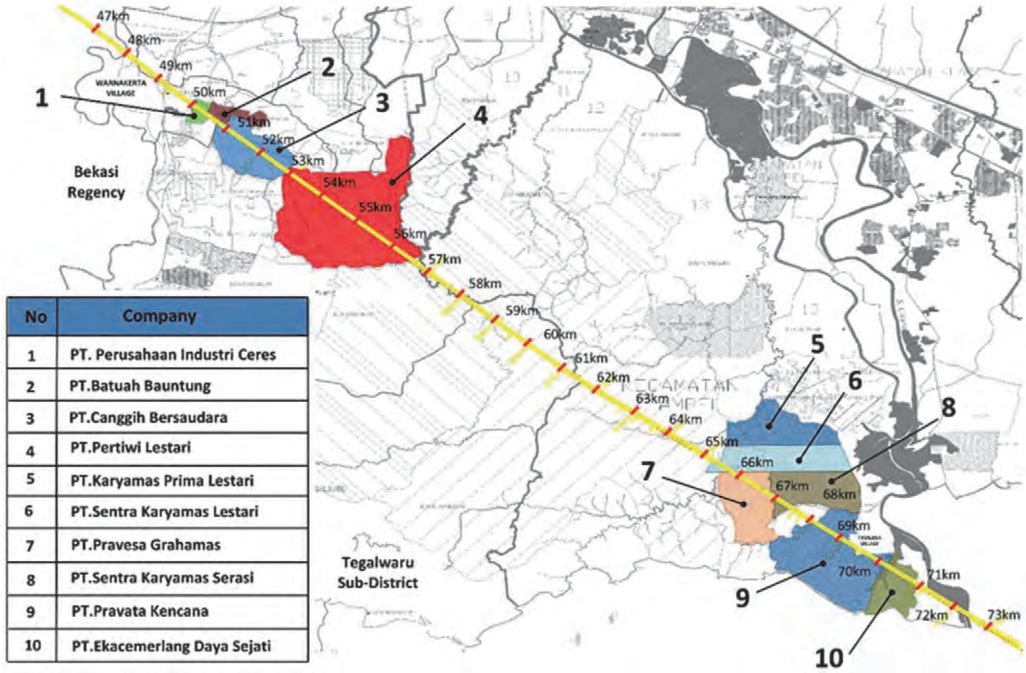


Source: Study Team

Figure 8.1-7 Image of Utilization along the Toll Road

d) Karawang industrial area

In Karawang, substantial industrial development is planned. Diverting the high-speed railway around all of development areas currently approved will worsen the quick-deliverability and cost effectiveness of the project. The planned route of high-speed railway was presented to the local government and request was made for cooperation to adjust the industrial development project.



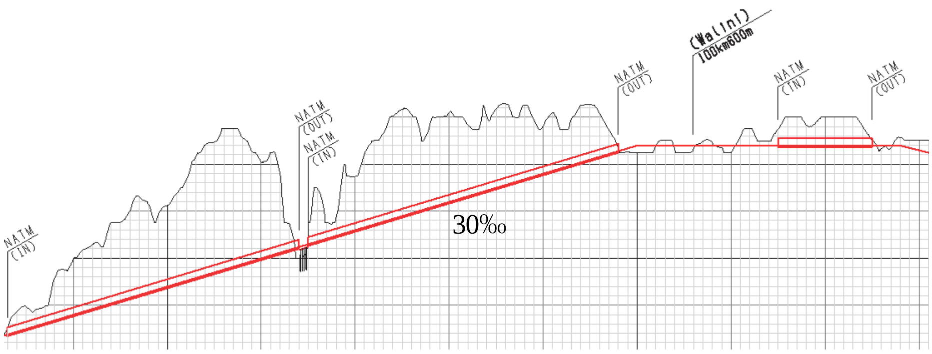
Source: Study Team

Figure 8.1-8 Relationship between the Development Area and the High-speed Railway Route

e) Mountainous area

In the mountainous area, tunnels will be used to shorten the route length. As a result of planning the route while avoiding the landslide-prone sections and those with poor ground conditions as identified from the geological survey, the maximum gradient for this section is set to 30‰, which is equivalent to that of Nagano Shinkansen.

The straight and flat section will be secured for the Walini area and locations where a new station is planned.



Source: Study Team

Figure 8.1-9 Review of the Tunnel Profile in the Mountainous Area

f) Airport neighboring areas

In the airport neighboring areas, the structure height is limited to 45 m or less, so that the landing and take-off of planes are not hindered. There would be no particular problem with the high-speed railway structures because their height is actually limited to around 30 m if they straddle over the elevated road.

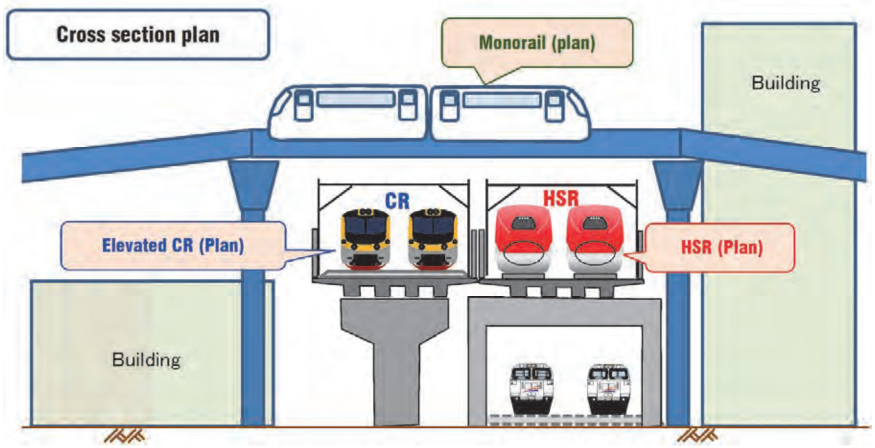
g) Bandung area

The Bandung area is packed with residential housing and has no large public space including toll road and canals leading to the center of the city. Accordingly, the alignment will be planned by utilizing the existing right-of-way. For this section, part of existing railroad lines is planned to be elevated as shown in Fig. 8.1-10. The high-speed railway will all be elevated to ensure safety.

For Merdeka Street to the east of the Bandung Station, the monorail intersecting with the existing railroad line is planned. Though the vertical alignment of this plan is not known, it is planned to reduce the entire cost by allowing the monorail superior in hill-climbing performance to override the existing railroad line and high-speed railway as shown in Figure 8.1-11,

Source: Study Team

Figure 8.1-10 Plan of Railways Running through the Bandung Area



Source: Study Team

Figure 8.1-11 Proposed Monorail – Railway Intersection Plan (Merdeka Street)

h) Gedebage area

The Gedebage area has been developed as a sub-center located to the east of Bandung, where coordination of working space must be attempted relative to the toll road and monorail plans. As a result of coordination with Bandung City, agreement was reached to use the first tier (ground surface) for the existing railroad line, the second tier for the toll road, and the third tier for the high-speed railway and monorail.

(3) Alignment data

Table 8.1-3 shows the relationship between the alignment data and the design speed determined from this survey. And the alignment plan is shown in Figures 8.1-12 - 8.1-20.

Table 8.1-3 List of Alignment Data (Jakarta - Bandung)

Station	Kirometerage (m)	L/R	Curve(m)		Gradient		Design speed (km/h)
			Radius	Distance	(‰)	Distance (m)	
Jakarta	0			354	0.0	1,100	
	354	L	800	622			140
	977			363			
	1,100				−3.0	1,900	
	1,339	R	1,500	451			140
	1,790			844			
	2,634	R	1,000	759			140
	3,000				3.0	3,586	
(Manggarai)	3,392			548			
	3,940			1,920			
	4,143	L	1,500				180
	5,860			358			
	6,218	R	1,500	1,090			180
	6,586				25.0	1,250	
	7,308			158			
	7,466	L	1,500	1,016			180
	7,836				0.0	5,264	
	8,482			146			
	8,628	L	5,000	590			180
	9,218			250			
	9,467	R	8,000	331			180
	9,798			494			
	10,293	L	2,000	862			180
	11,154			106			
	11,260	R	1,500	807			180
	12,067			128			
	12,195	L	2,600	648			180
	12,843			247			
	13,090	R	1,500	1,120			180
	13,100				−25.0	1,377	
	14,210			1,474			
	14,477				−3.0	1,523	
	15,684	R	10,000	1,549			350
	16,000				3.0	4,200	
	17,233			949			
	18,181	L	6,000	1,833			350
	20,014			3,712			
	20,200				25.0	1,520	
	21,720				0.0	13,580	
	23,726	R	10,000	1,091			350
	24,817			963			
Bekasi	25,780			1,012			
	26,792	L	6,000	1,521			350
	28,313			875			
	29,188	R	12,000	1,107			350
	30,295			1,308			
	31,603	R	6,000	1,948			350
	33,552			1,829			
	35,300				10.0	1,250	
	35,381	L	25,000	484			350
	35,864			789			
	36,550				0.0	1,650	
	36,653	R	25,000	495			350
	37,148			2,612			
	38,200				−10.0	1,100	
	39,300				10.0	900	
	39,760	R	30,000	442			350
	40,200				0.0	5,370	
	40,202			4,935			
Cikarang	42,000						
	45,138	R	10,000	2,599			350
	45,570				−15.0	1,630	
	47,200				0.0	800	

Station	Kirometerage (m)	L/R	Curve(m)		Gradient		Design speed (km/h)
			Radius	Distance	(‰)	Distance (m)	
	47,737			1,107			
	48,000				10.0	1,478	
	48,844	L	11,000	1,103			350
	49,478				5.0	6,267	
	49,947			10,868			
	55,745				−3.0	3,555	
(Karawang)	59,300				3.0	2,633	
	60,815	L	10,000	1,261			350
	61,933				−3.0	4,967	
	62,076			11,176			
	66,900				−10.0	1,500	
	68,400				0.0	5,459	
	73,253	R	6,500	7,694			350
	73,859				9.6	3,841	
	77,700				0.0	1,051	
	78,751				9.6	1,349	
	80,100				0.0	920	
	80,946			1,058			
	81,020				25.0	4,280	
	82,004	L	6,000	2,190			350
	84,194			16,880			
	85,300				30.0	6,400	
	91,700				20.0	1,100	
	92,800				30.0	7,200	
	100,000				0.0	2,800	
(Walini)	100,600						
	101,074	L	6,000	3,776			350
	102,800				−25.0	1,133	
	103,933				20.0	1,867	
	104,850			9,141			
	105,800				10.0	4,100	
	109,900				5.0	2,300	
	112,200				30.0	1,900	
	113,991	R	2,000	1,128			200
	114,100				0.0	850	
	114,950				−17.8	1,200	
	115,119			2,074			
	116,150				0.0	1,400	
	117,192	L	2,000	1,934			200
	117,550				20.0	1,550	
	119,100				0.0	5,620	
	119,126			606			
	119,732	R	1,200	632			170
	120,364			96			
	120,461	L	1,000	870			140
	121,331			755			
	122,086	R	2,000	542			200
	122,628			442			
	123,070	R	2,000	453			200
	123,523			3,168			
	124,720				−5.0	1,180	
	125,900				−10.0	1,810	
	126,692	L	1,000	721			140
	127,413			1,265			
	127,710				0.0	1,390	
Bandung	128,527						
	128,678	R	3,000	253			270
	128,932			690			
	129,100				−15.0	1,000	
	129,622	R	3,000	457			270
	130,079			1,557			
	130,100				−5.0	4,533	
	131,636	R	7,500	1,483			350
	133,120			6,480			
	134,633				−2.0	3,667	
	138,300				0.0	1,300	
Gedebage	139,600				0.0		

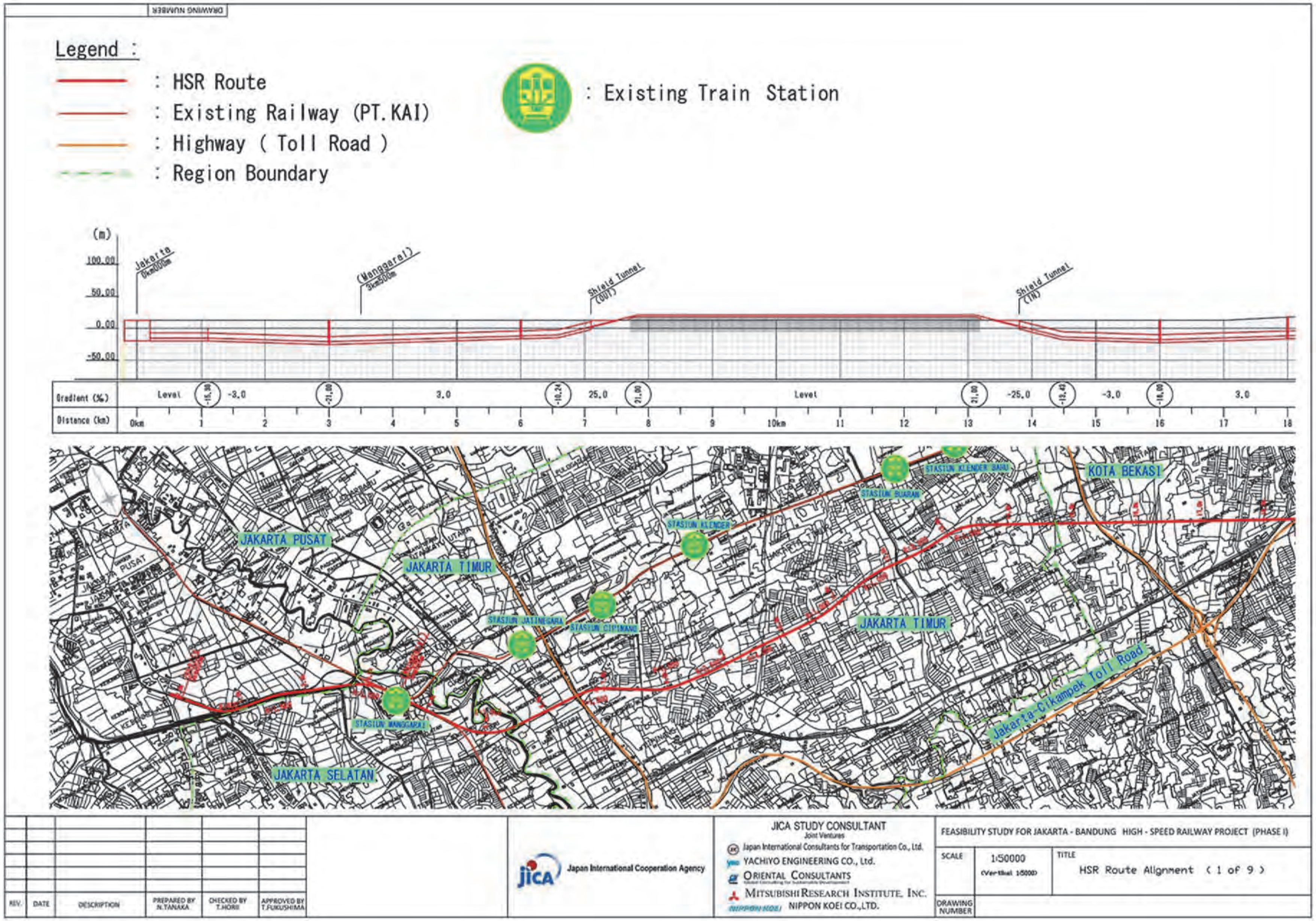
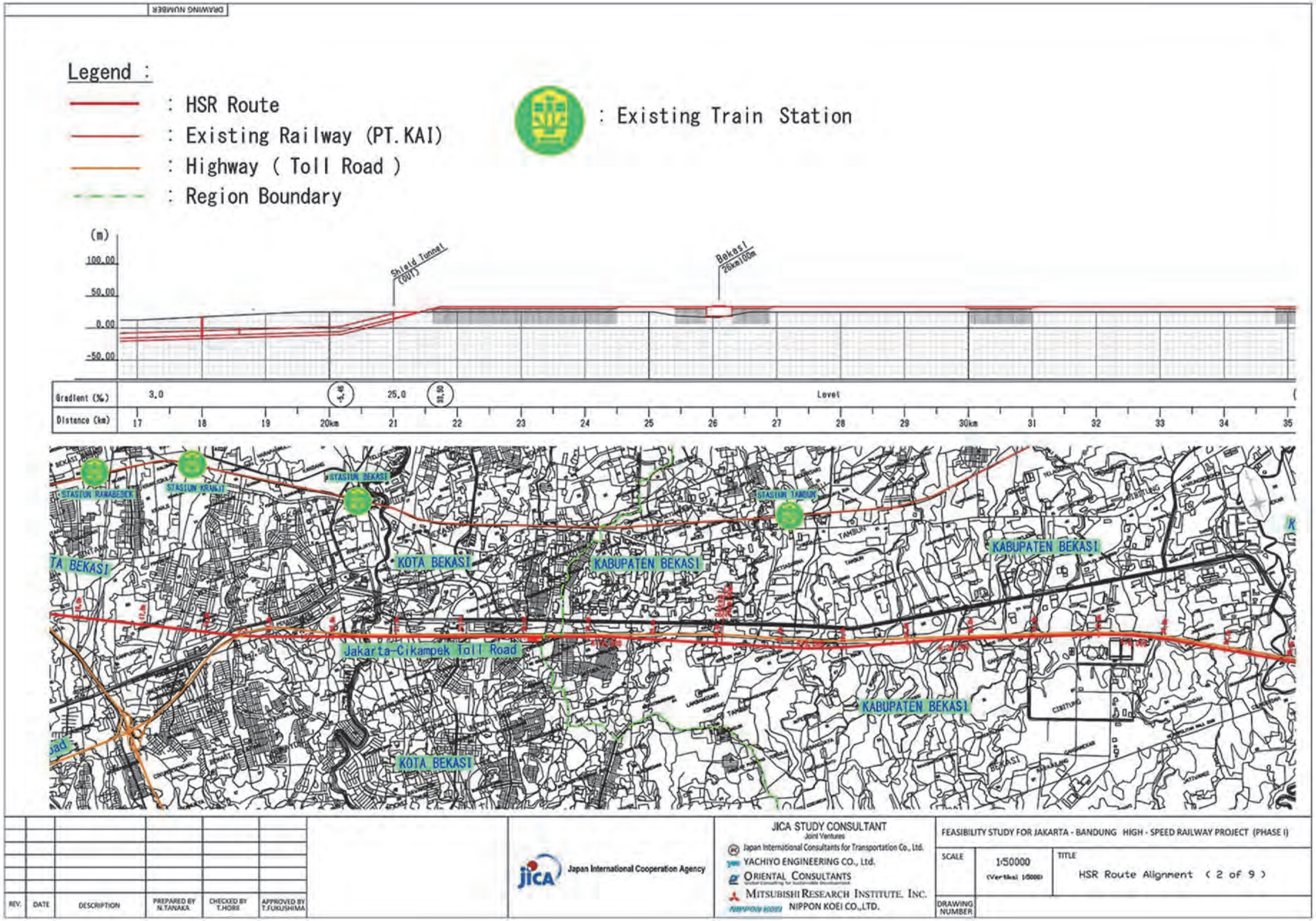


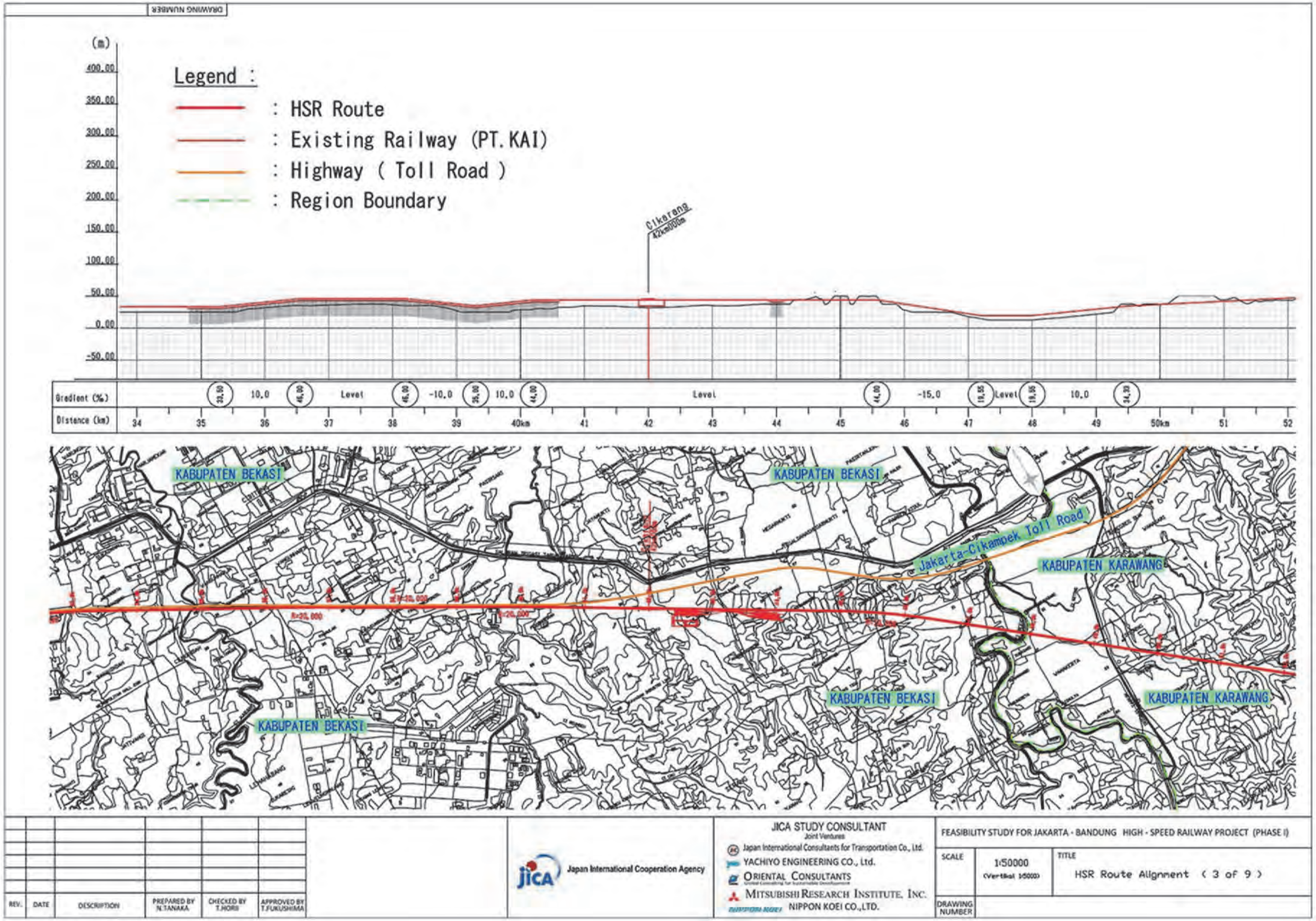
Figure 8.1-12 Alignment Plan (1/9)

Source: Study Team



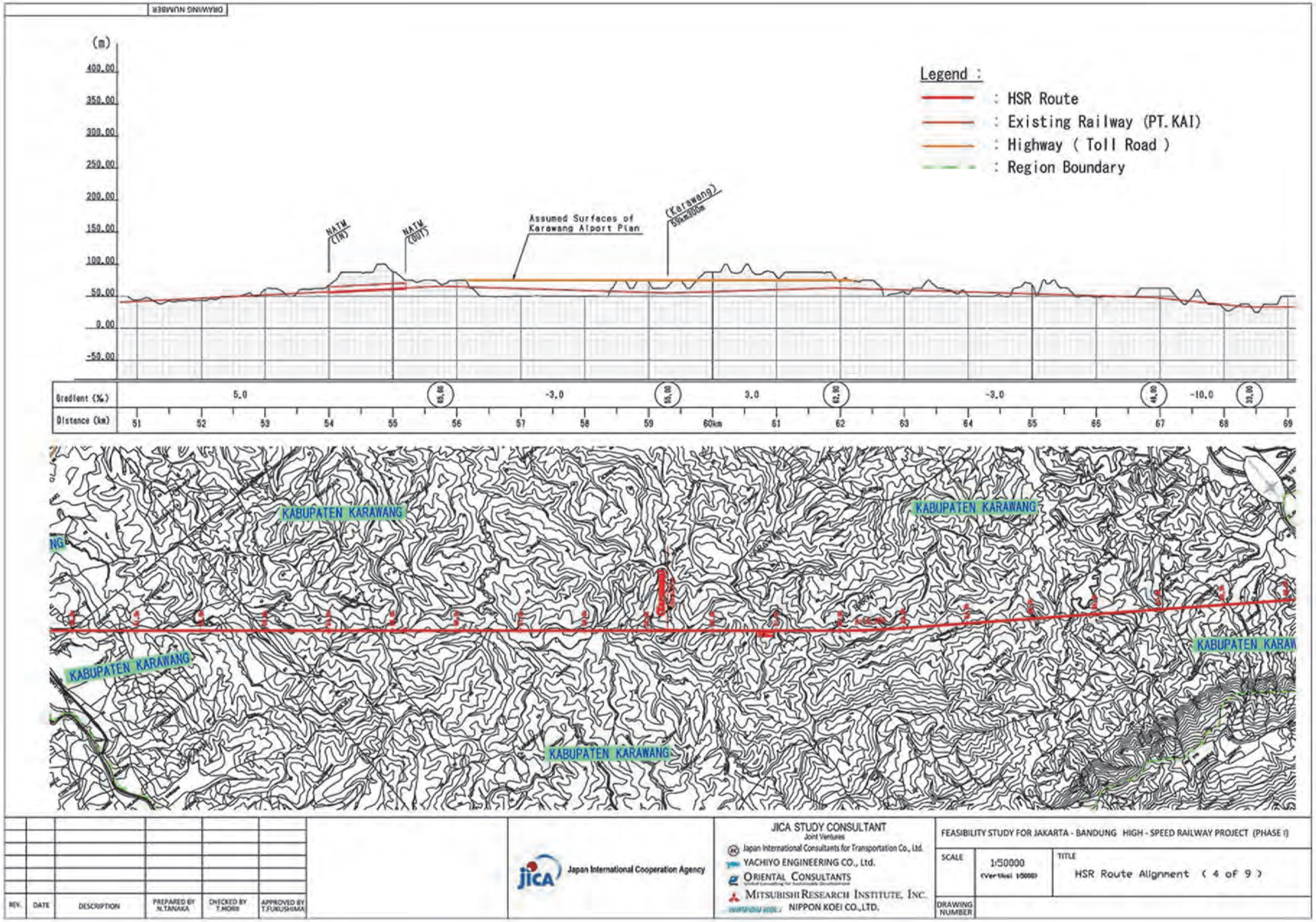
Source: Study Team

Figure 8.1-13 Alignment Plan (2/9)



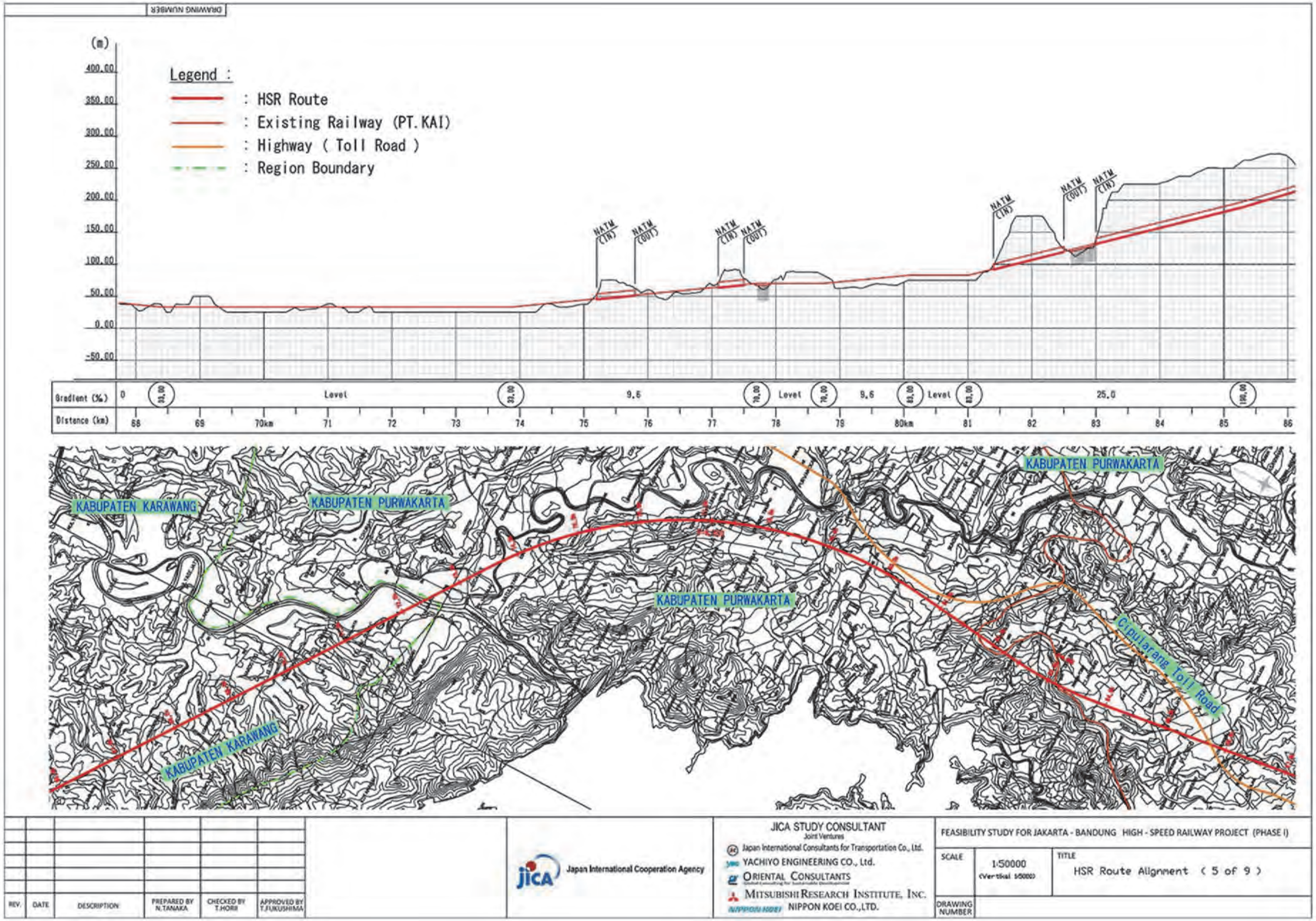
Source: Study Team

Figure 8.1-14 Alignment Plan (3/9)



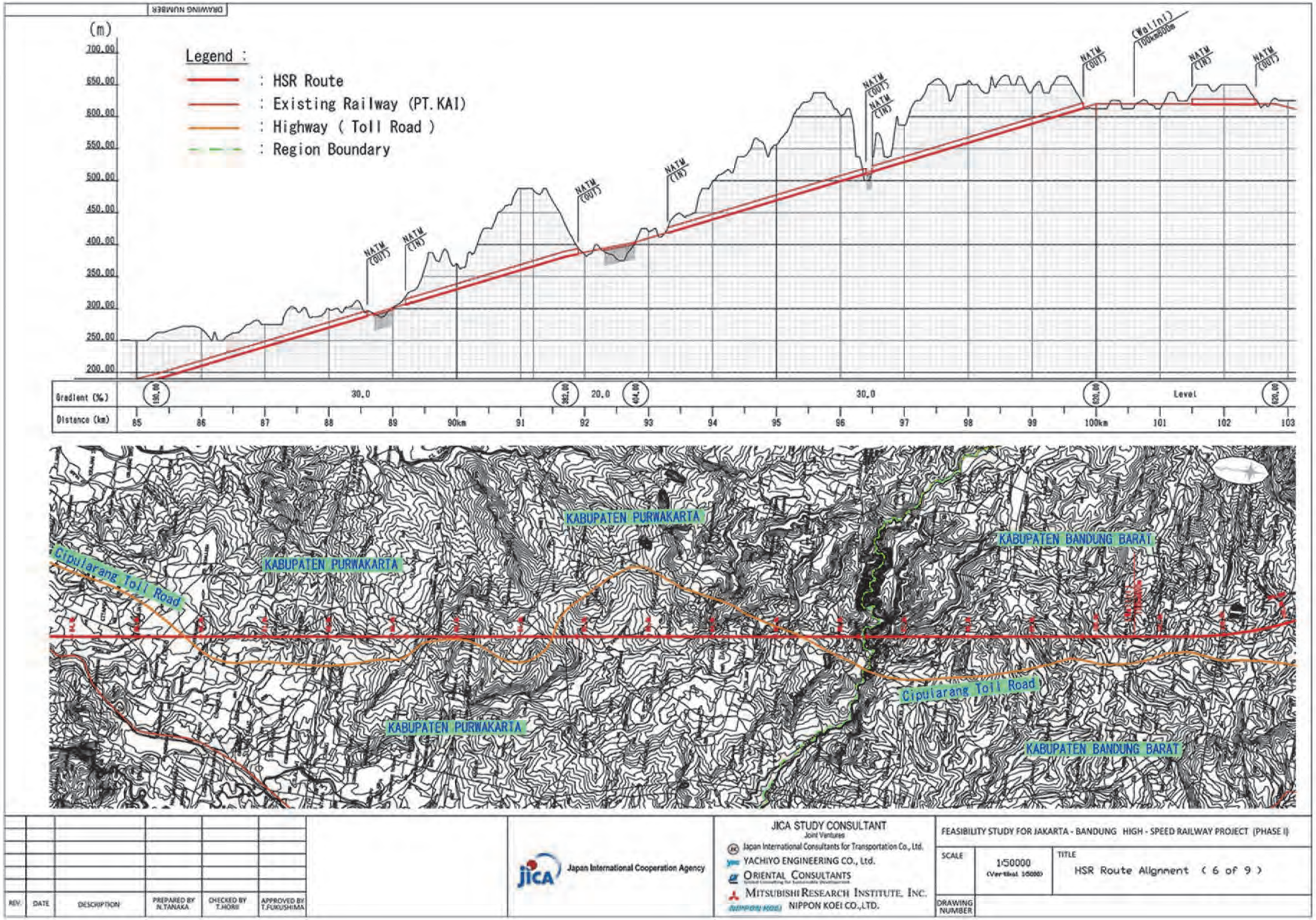
Source: Study Team

Figure 8.1-15 Alignment Plan (4/9)



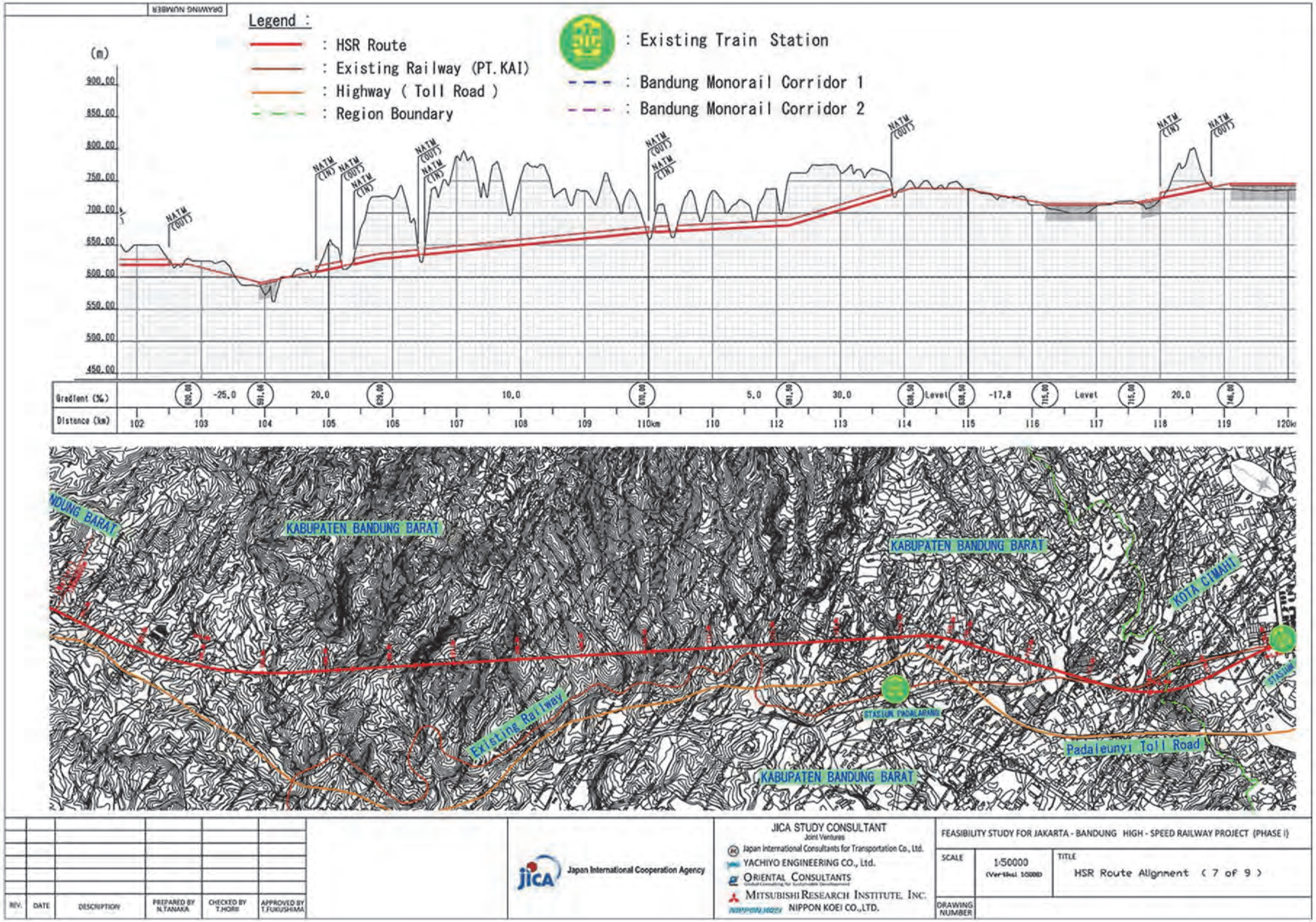
Source: Study Team

Figure 8.1-16 Alignment Plan (5/9)



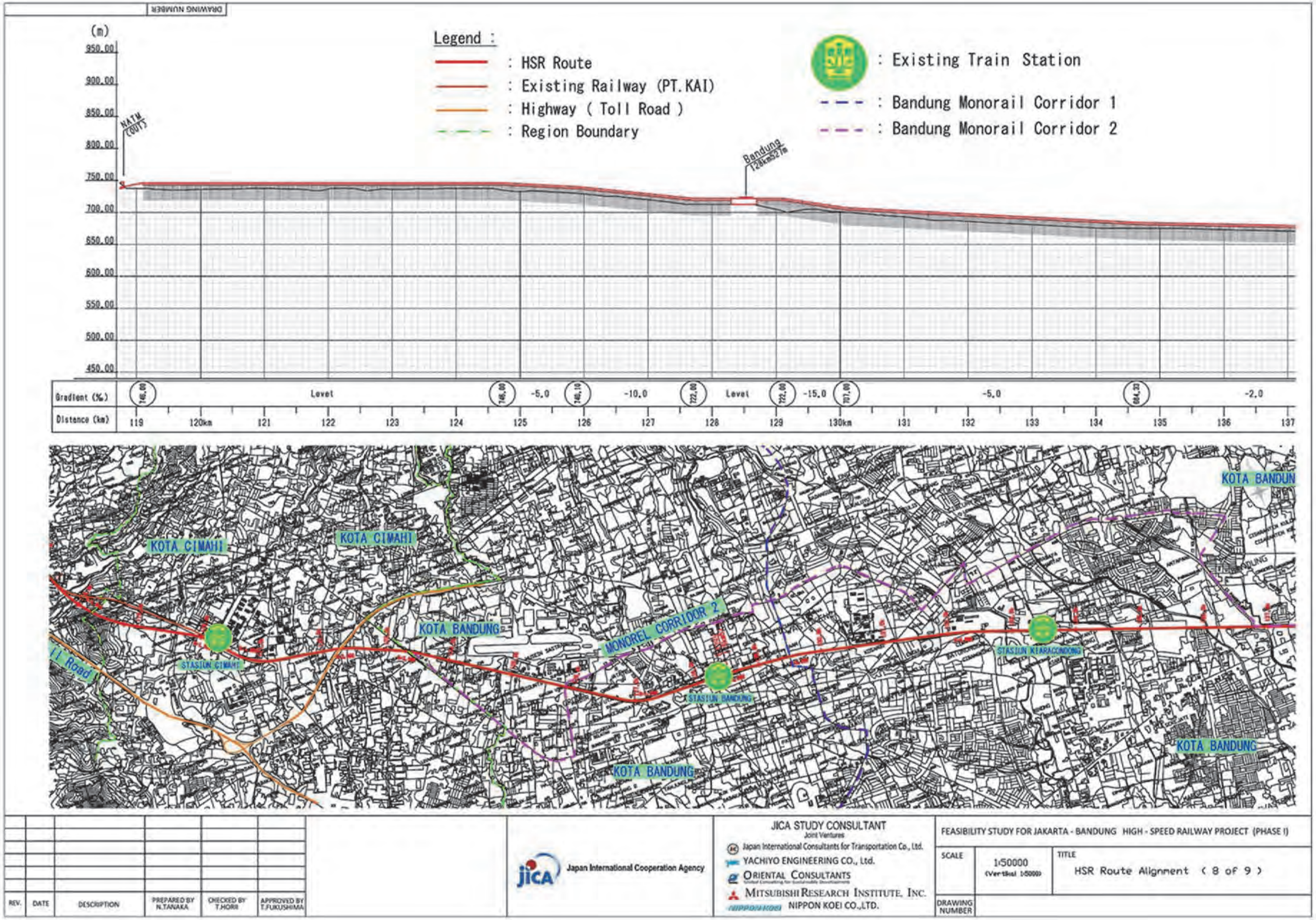
Source: Study Team

Figure 8.1-17 Alignment Plan (6/9)



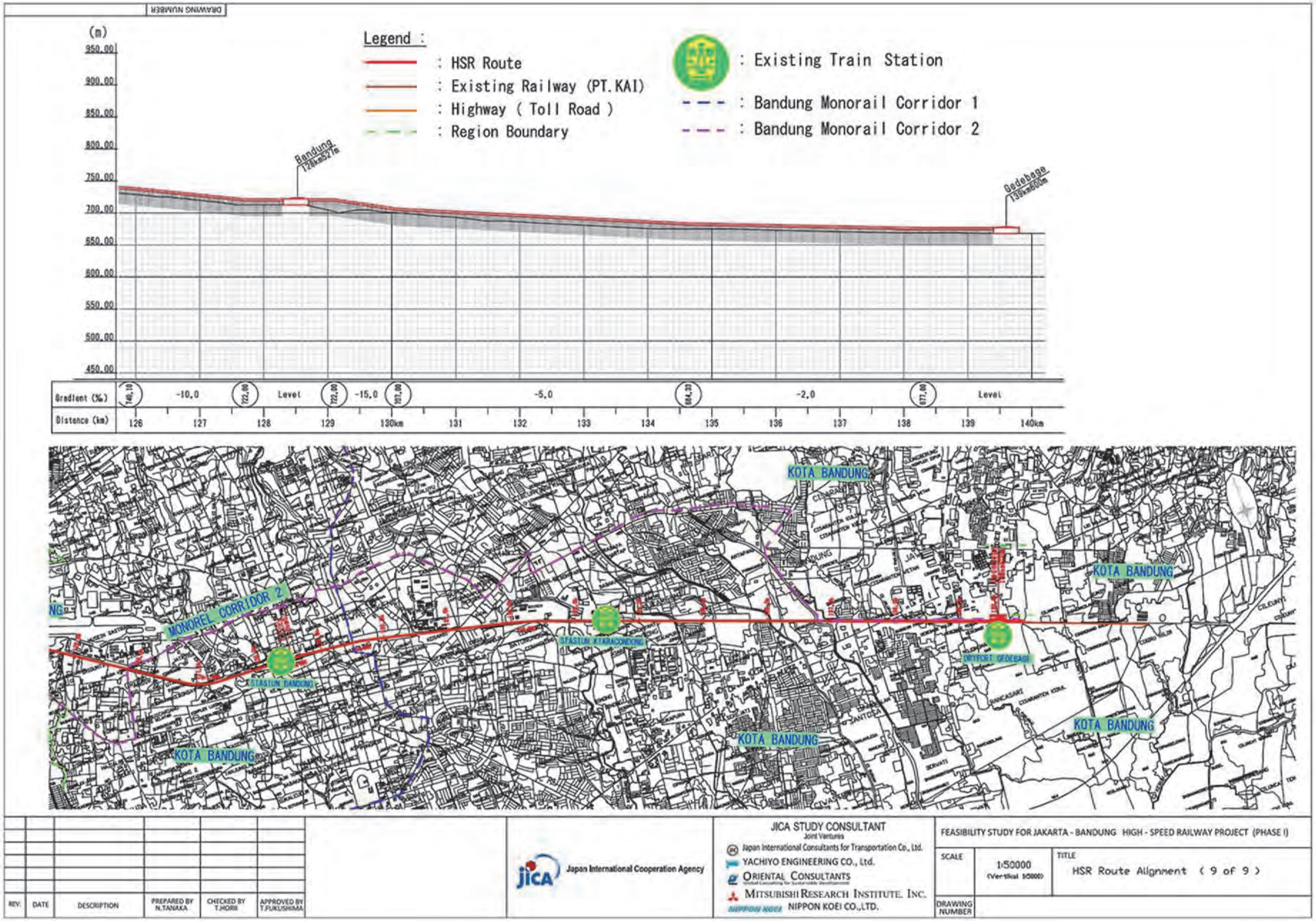
Source: Study Team

Figure 8.1-18 Alignment Plan (7/9)



Source: Study Team

Figure 8.1-19 Alignment Plan (8/9)



Source: Study Team

Figure 8.1-20 Alignment Plan (9/9)

8.1.2 Station Plan

(1) Plan conditions

The basic conditions required for the high-speed railway station are summarized below.

Table 8.1-4 List of Station Plan Conditions

Parameters		Data
Platform length		310 m (300 m+ 10m)
Deviation from the track center	All trains stop	1,760 mm
	Some passing trains	1,800 mm
Platform width	Both sides used	10.0 m
	One side used	6.0 m
Platform fence location	All trains stopped	680 mm from the end of platform
	Some passing trains	2,000 mm from the end of platform
Minimum radius of curve within the station yard		R=1,000 m
Gradient of platform		Level (0‰), in principle
Turnout used	Main line	Simple turnout 18# (1:18), 16# (1:16)
	Siding	Simple turnout 12# (1:12)

Source: Study Team

(2) Station data and plan overall view

When opened for service, this route will have five stations: Jakarta, Bekasi, Cikarang, Bandung, and Gedebage. The high-speed railway station will be planned as a ground station, except for the metropolitan area where the land acquisition is difficult and the airport where there are large ground obstacles. The platform is determined to be of a type sufficiently compatible with the future growth of users while referring to the assumed number of station users and the operation plan.

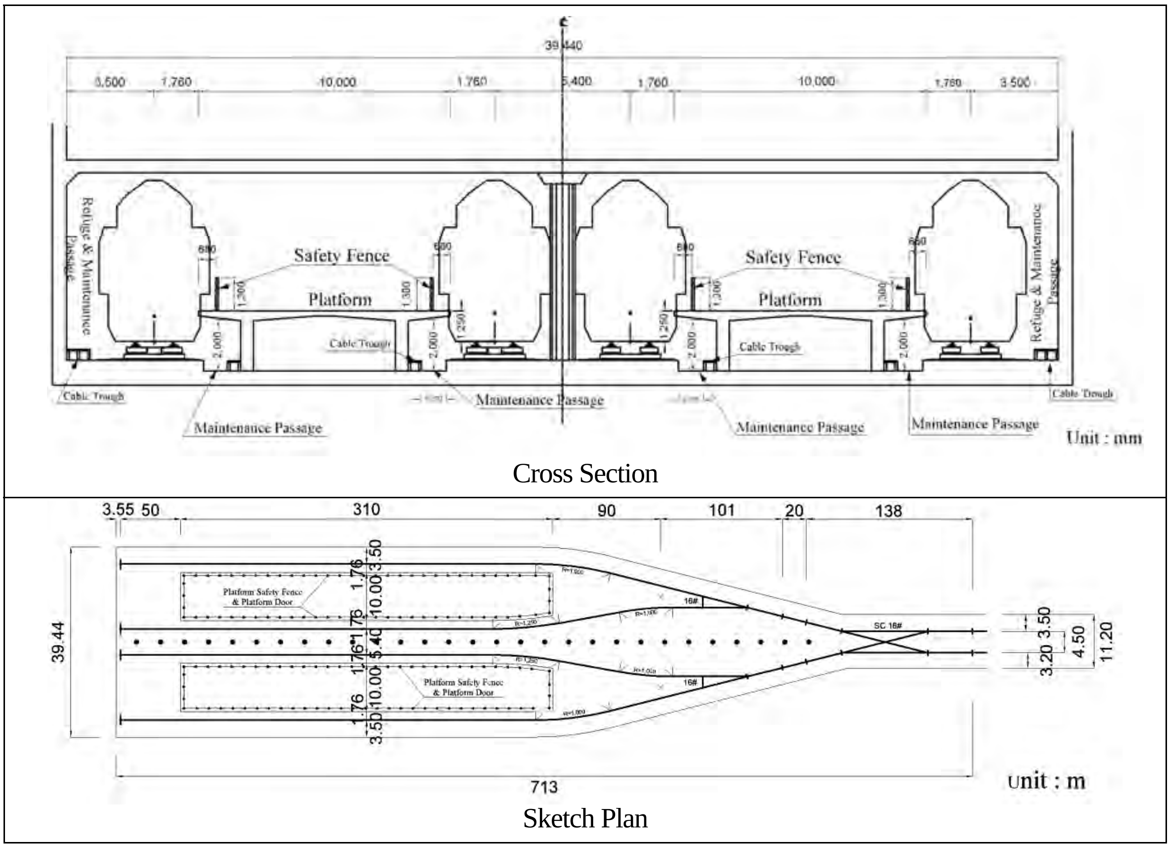
The candidates for future addition include Manggarai, the terminal of existing railroad lines of the metropolitan area, Karawang where industrial development is underway, which is also a candidate for construction of a new airport, and Walini to which the provincial capital of West Java Province is planned to be relocated.

Table 8.1-5 List of Station Data

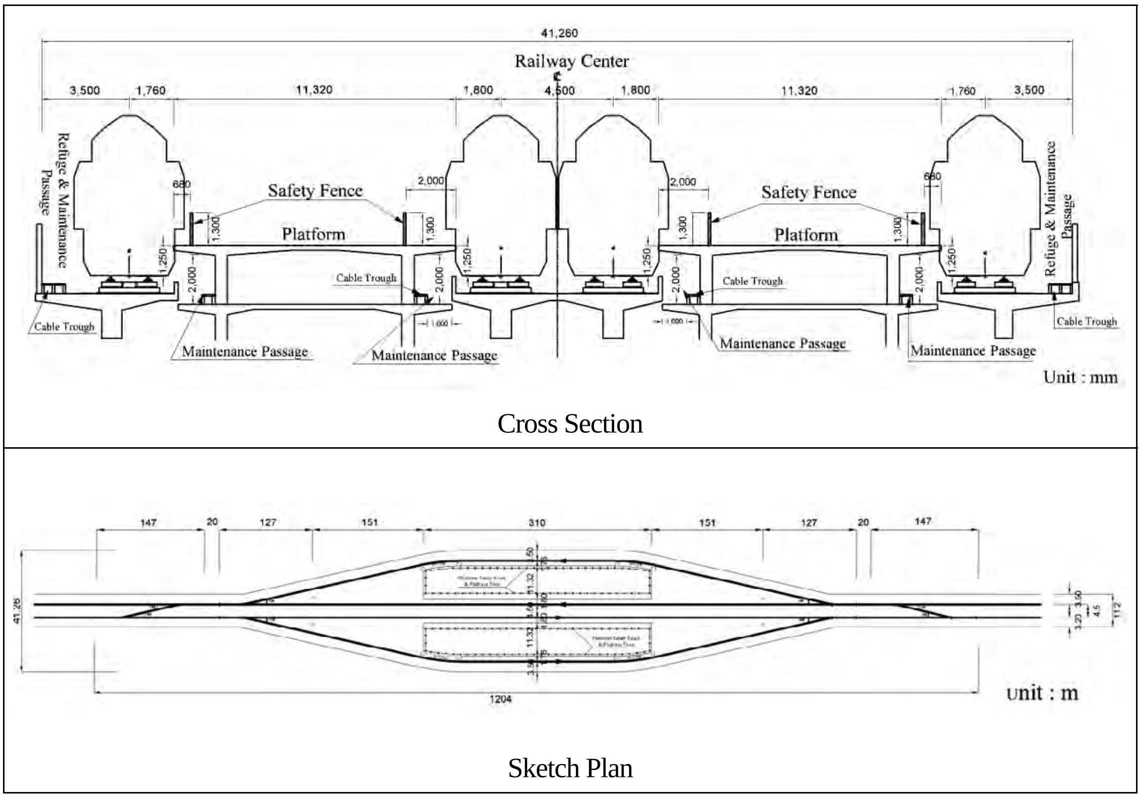
Station	Distance	Station type/platform	Remarks
Jakarta	0.0 km	Underground station/two end transverse platforms and four tracks	All trains stop/shuttle
Bekasi	26.1 km	Elevated station/two island platforms and four tracks	Some trains passing on the main line/stop on the subsidiary main track
Cikarang	42.0 km	Elevated station/two island platforms and four tracks	Some trains passing on the main line/stop on the subsidiary main track
Bandung	128.5 km	Elevated station/two island platforms and four tracks	All trains stop/some trains shuttling
Gedebage	139.6 km	Elevated station/an island platform and two tracks	Some trains shuttling
(Manggarai)	3.5 km	Underground station/two island platforms and four tracks	Some trains passing on the main line/stop on the subsidiary main track
(Karawang)	59.3 km	Underground station/two island platforms and four tracks	Some trains passing on the main line/stop on the subsidiary main track
(Walini)	100.6 km	Elevated station/a pair of separate platforms serving two tracks between them	Some trains passing on the main line/stop on the main track

Source: Study Team

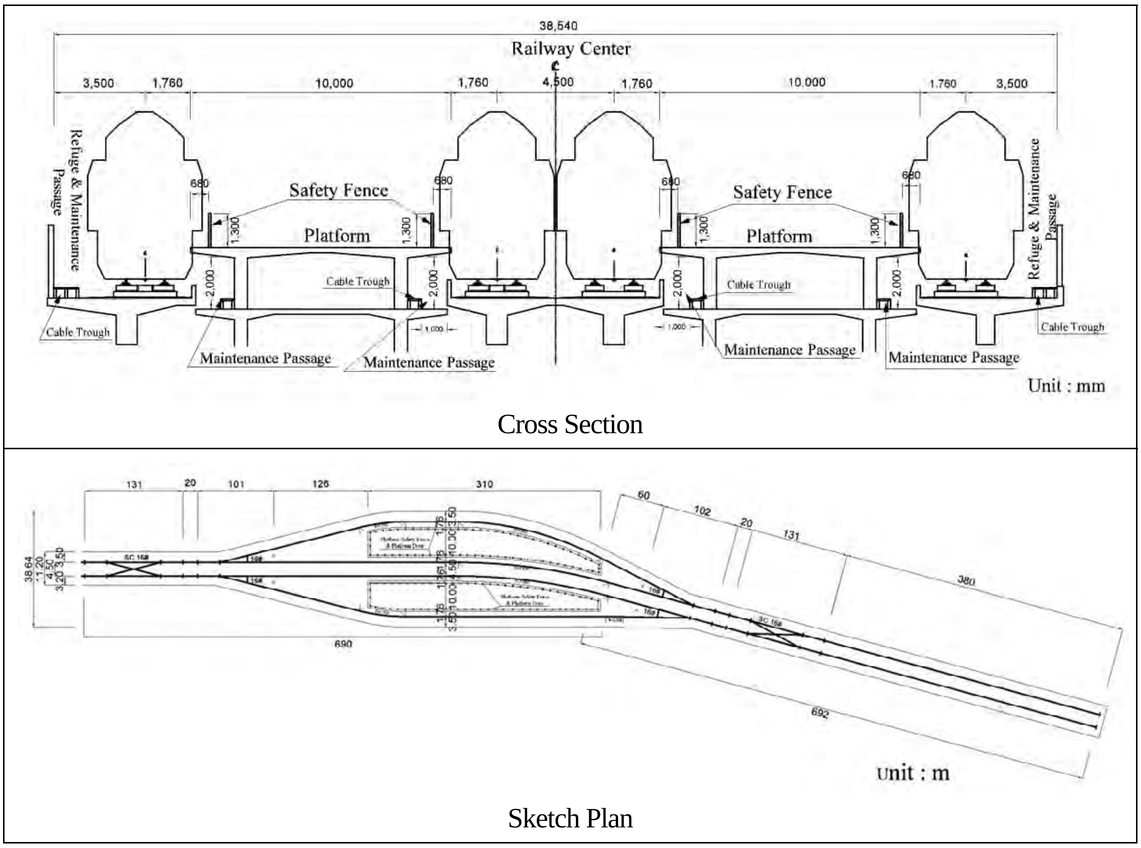
Central sectional view and plan overall view of stations are shown in Figures 8.1-21 to 8.1-24.



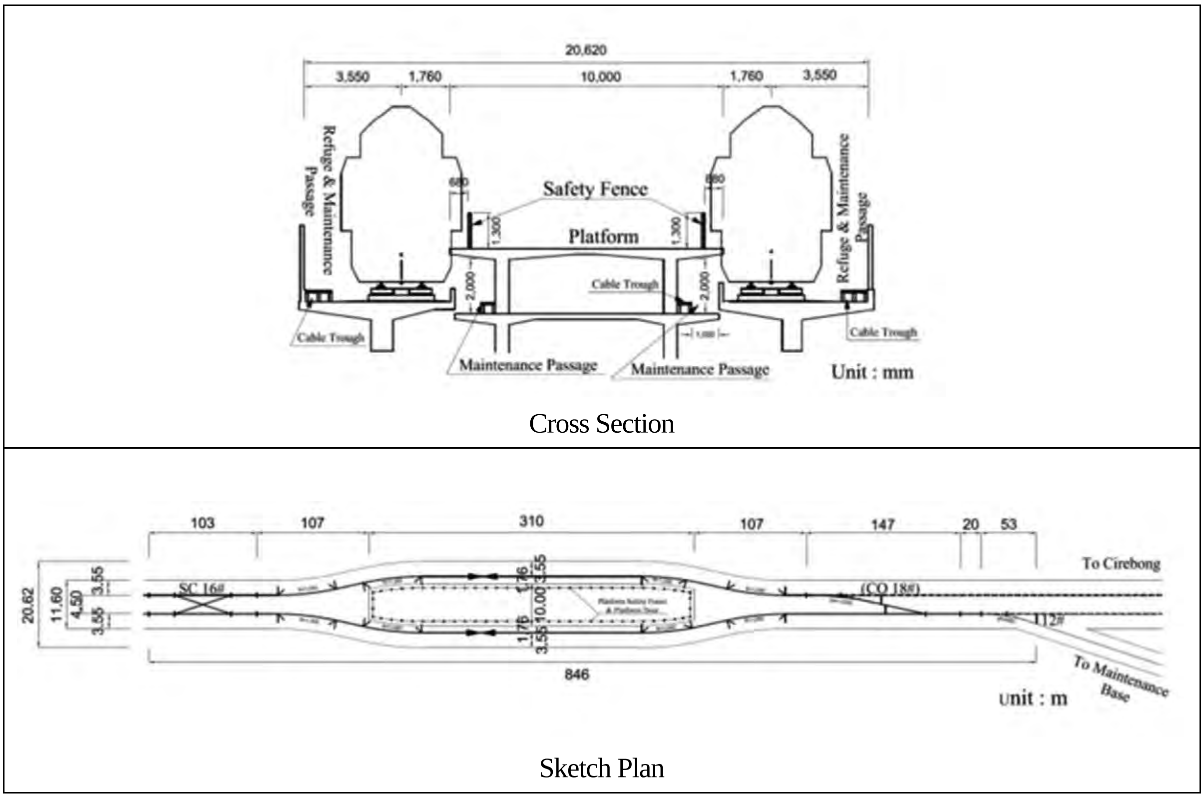
Source: Study Team Figure 8.1-21 Jakarta Station



Source: Study Team Figure 8.1-22 Bekasi and Cikarang Station



Source: Study Team Figure 8.1-23 Bandung Station



Source: Study Team Figure 8.1-24 Gedebage Station

8.1.3 Depot Plan

(1) Plan conditions

The basic conditions required for the depot of this route on the basis of demand forecast results are summarized below.

Table 8.1-6 List of Depot Plan Conditions

Contents		Specification
Length of one train / Train set capacity		300m (12 vehicles) / 18 trains
Required area		About 47ha (470,000 m^2)
Gradient		Level (0‰), in principle
Environmental conditions	Above- or underground	Aboveground in principle (due to fire risk during maintenance)
	Ground conditions	No possible settlement

Source: Study Team

(2) Location selection of the depot

For the convenience of operating vehicles, the depot should be located at both ends of the route. Because of advancement of urbanization in areas around Jakarta and Bandung, however, it is difficult to secure large areas of land in the neighborhood of the planned route.

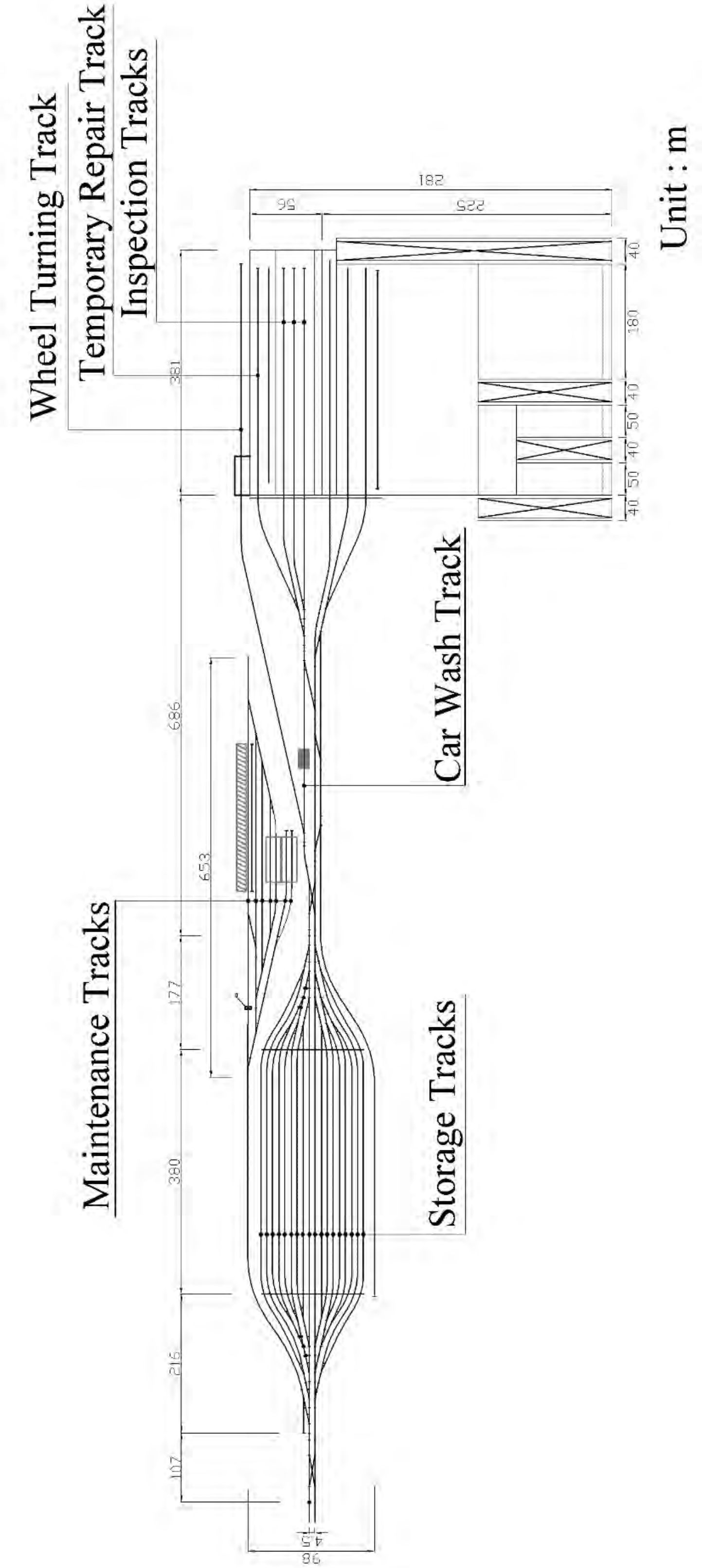
On the other hand, large-scale utilization of agricultural land is difficult in the suburban areas with low density of residential housings. Namely, development of agricultural land, including paddy fields, has been advanced in these areas, so that their acquisition requires securing of the multi-fold substitute land from the viewpoint of food security.

As a result of candidate selection mainly in the wasteland around the planned route, it was determined that construction of a depot and workshop in the Cikarang – Karawang area is the best. The area is located at about a halfway point of the planned route, but presents no particular problem for operation of vehicles for the time being. Because of its closeness to the site planned for industrial development, the materials are readily procurable and the replacement parts can be locally manufactured, which may produce synergetic effects with surrounding businesses.

Figure 8.1-25 Planned Location of the Depot

(3) Plan overall view of depot

The plan overall view of depot is shown below. Details of specifications, etc. are dealt with in “10.7, Depot for Infrastructure Maintenance.”



Source: Study Team

Figure 8.1-26 Cikarang Depot Plan

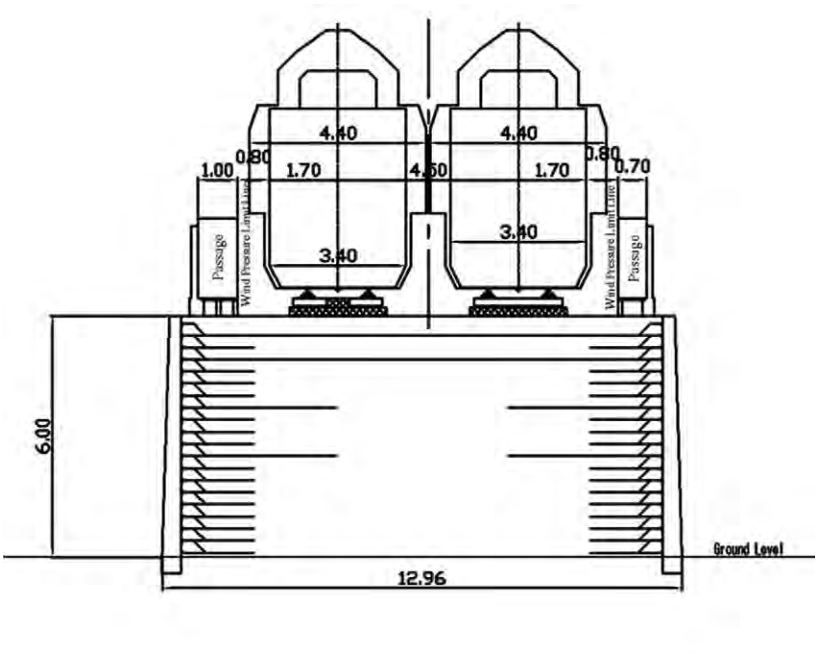
8.2 Structure Design

8.2.1 Outline of the Structure Design

The construction costs of civil engineering structures account for more than half of the total project cost of the high-speed railway project. In addition, expectations of improvement in local labor skills and the expansion of domestic demand in Indonesia are high. Therefore, it is considered that materials and equipment that can be procured locally should be utilized as much as possible. In addition, proven construction methods and structure types in Indonesia should be adopted. The following is an overview of the structures to be erected on the route.

(1) Embankment

- Embanking is a method to create level ground by filling low ground or slopes with soil.
- This method is applied to sections with substantial topographic undulations where the present ground level is lower than the designed vertical alignment.
- In soft ground sections, in order to prevent subsidence due to the weight of the embankment in the future, ground improvement will be included in the structure plan.
- In addition, high embankment is expensive because it requires a vast amount of land and large amounts of soil. Therefore, reinforced soil retaining walls will be adopted if the embankment height is 3 m or more. The maximum height of reinforced soil retaining walls is 6 m. It should be noted that embankments that extend a long distance have an impact on the ecosystem and division of the community. The structure plan may include installation of RC box culverts at 500 m intervals in order to allow lifelines or vehicles to cross the HSR tracks.

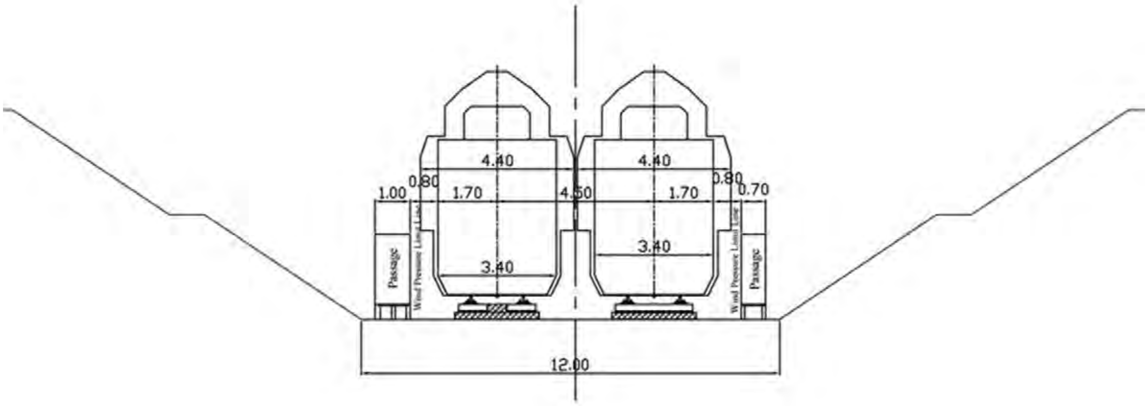


Source: JICA Study Team

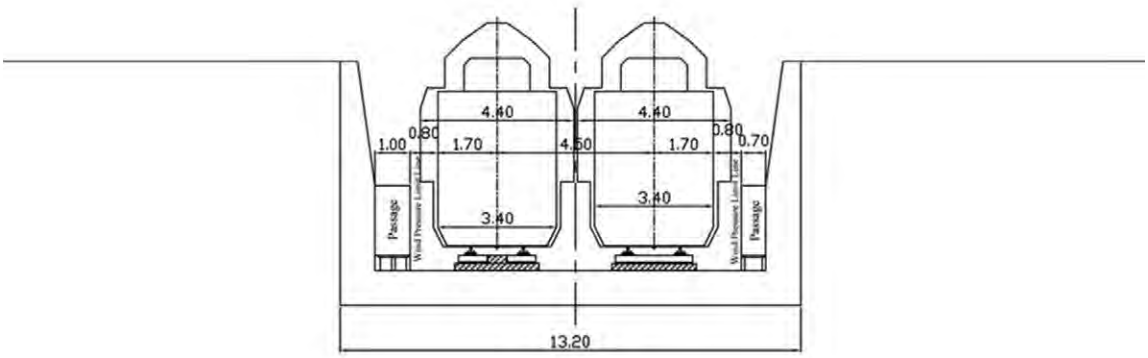
Figure 8.2-1 Cross Section of Embankment

(2) Cutting

- Cutting is a method to create level ground on a mountainside or hill slope by excavating soil from the existing ground.
- This method is applied to sections with substantial topographic undulations where the present ground level is higher than the designed vertical alignment.
- If the ground conditions are poor, reinforcing measures such as inserting anchor reinforcements or relaxation low slopes will be adopted to ensure the stability of the slope.
- If the percentage of resettlement compensation and land acquisition cost increases in dense residential areas, U-shaped retaining walls will be adopted.
- It should be noted that cuttings that extend a long distance have an impact on the ecosystem and division of the community. The structure plan may include construction of bridges with an appropriate capacity at 500 m intervals in order to allow lifelines or vehicles to cross the HSR tracks.



Cutting



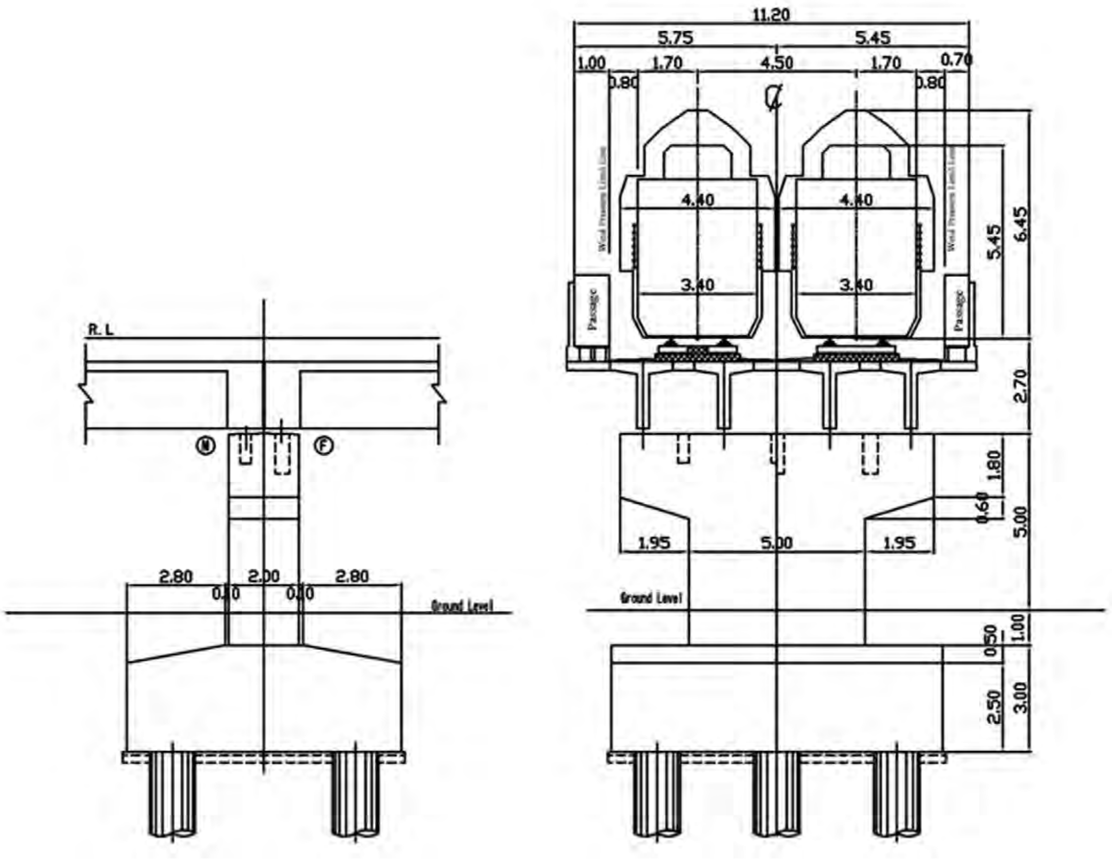
U-Shaped Retaining Wall

Source: JICA Study Team

Figure 8.2-2 Cross Section of Cutting

(3) Viaduct

- The use of viaducts can eliminate crossings in sections with consecutive intersections with road traffic in urban areas. PC rigid frame viaducts commonly found in Japan are the most reasonable structure. However, there are few cases in Indonesia. Therefore, the girder type viaduct will be adopted as the standard type.
- The viaduct consists of a superstructure and substructure. A PC or RC girder is adopted as the superstructure, while a wall type pier is adopted for the substructure.
- The optimum span length of the superstructure is determined by the arrangement of the substructure. If the substructure costs are excessive due to poor ground conditions, it is economic to adopt a superstructure with a long span.
- In this study, the RC girder with a span length of 20 m and the PC girder with a span length of 30m will be adopted as the standard method, based on the expected ground conditions.



Source: JICA Study Team

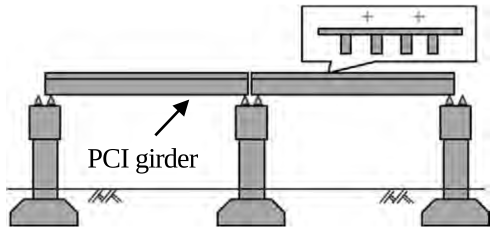
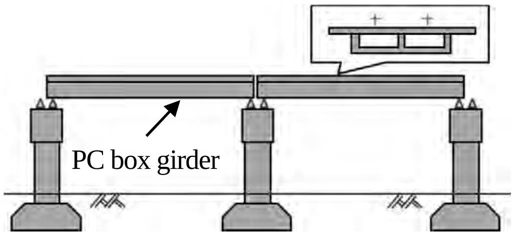
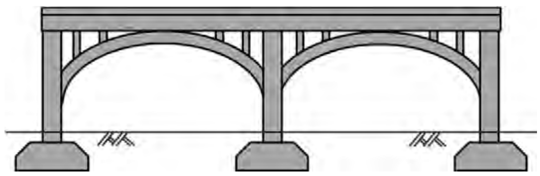
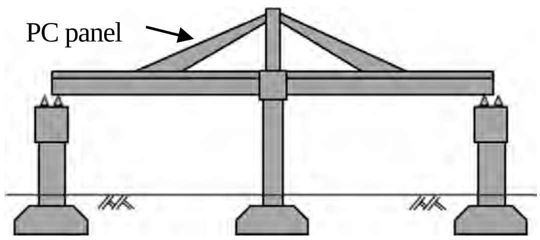
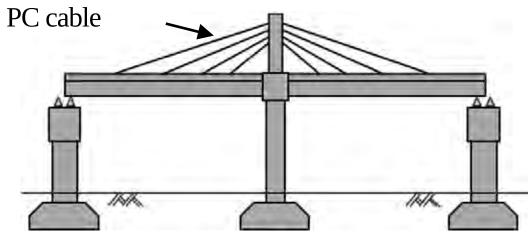
Figure 8.2-3 Cross Section of Viaduct

Generally, cranes that shorten the work time are used for construction of the superstructure. However, if any obstacle makes the use of a crane not viable, another construction method such as erection girder will be considered.

(4) Bridge

- For bridges with a span of 50 m or longer, various types are available, such as PC box girder bridges, depending on the installation conditions. This type is applied where the railway passes over major rivers or toll roads.
- Steel bridges will not be adopted for the HSR due to the high noise level.
- From the fact that the planned route of this project does not interfere with structures or large rivers, PC box girders with a length of about 50 m will be mainly adopted in this study.

Table 8.2-1 Types of Bridges and Spans

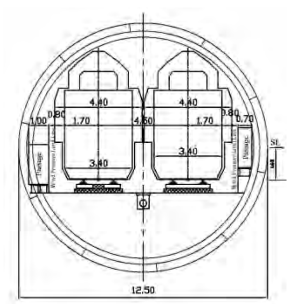
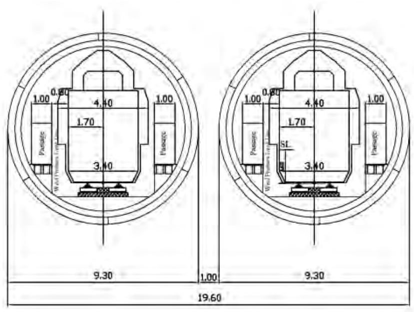
No	Type of bridge	Span	Reference
1	PPC I girder bridge	25 m - 50 m	
2	PPC box girder bridge	30 m - 60 m	
3	Arch bridge	60 m - 120 m	
4	Panel-stayed bridge	About 100 m	
5	Extradosed bridge	Over 100 m	

Source: JICA Study Team

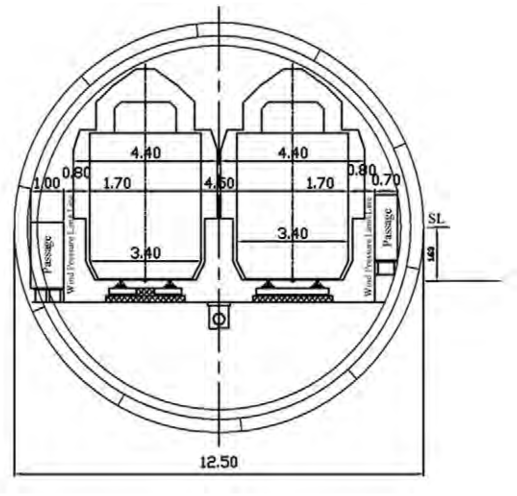
(5) Shield Tunnel

- Shield tunnel is a method to construct tunnels by inserting concrete or steel segments into the ground. As for high-speed rail, there are proven results in Ueno Station for the Tohoku Shinkansen in Japan.
- This is applicable to soft ground in urban areas and is used in densely-populated areas where construction of structures on the ground is impossible. The specific rules on land acquisition when using underground space in Indonesia are still unclear. The double track shield will be adopted in this plan. There is a possibility that the construction cost can be reduced further by adopting the multi-face type or rectangle type shield method because the track record of this method is increasing in recent years in Japan.

Table 8.2-2 Comparison of Shield Tunnel Types

Item	Double Track Tunnel	Single Track Tunnel
Cross Section		
Diameter (Area)	12.5 m (123 m^2)	9.3 m x 2 (67.9 x 2 = 136 m^2)
Workability	The surrounding ground is liable to subsidence.	The proximity may mutually affect the construction works.
Total Width	14.5 m	21.6 m (Special method)
Evaluation	○	-

Source: JICA Study Team



Source: JICA Study Team

Figure 8.2-4 Cross Section of Shield Tunnel

(6) Mountain Tunnel

Mountain tunnel is a tunneling method using rock bolts and shot concrete as the principal materials.

It is easy to cope with obstacles and changes in geology because the ground conditions can be always checked during the drilling works.

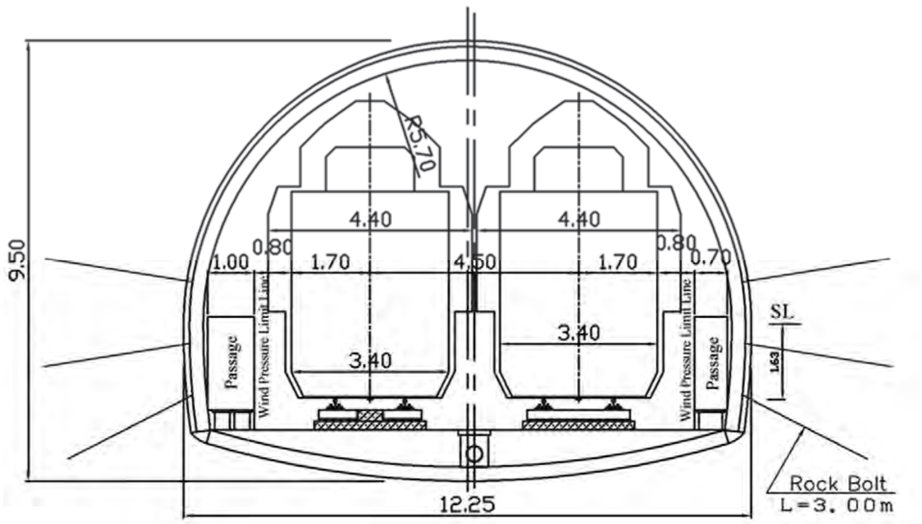
This will be applied in mountainous areas where viaducts are difficult to construct and where sufficient overburden is secured.

For railway tunnels, for which the standard section has been established, the standard design can be applied, except for the case under special conditions. The reasonable standard support pattern of this section is determined to be IN-1P for the mudstone, and ISP for others on the basis of ground classification from the geological survey.

Table 8.2-3 List of Support Patterns for HSR Tunnels

Standard support pattern	Rock bolt			Shotcrete(cm)		Iron beam
	Place	Length × number (m) (nos)	Interval (m)	Arch, wall	Invert	Type
$Ⅳ_{NP}$	—	—	—	5(Average)	—	—
$Ⅲ_{NP}$	Arch	2 × 0～5	(Optional)	10(Average)	—	—
$Ⅱ_{NP}$	Arch	3 × 10	1.5	10(Average)	—	—
$Ⅰ_{N-2P}$	Arch, wall	3 × 10	1.2	12.5(min)	—	125H(upper)
$Ⅰ_{N-1P}$	Arch, wall	3 × 14	1.0	15(min)	—	125H
$Ⅰ_{SP}$	Arch, wall (Invert)	3 × 14 (3 × 4)	1.0	15(min)	15(min)	150H
$Ⅰ_{LP}$	Arch, wall	3 × 12	1.0	20(min)	—	125H

Source: Japan Railway Construction, Transport and Technology Agency (JRTT)

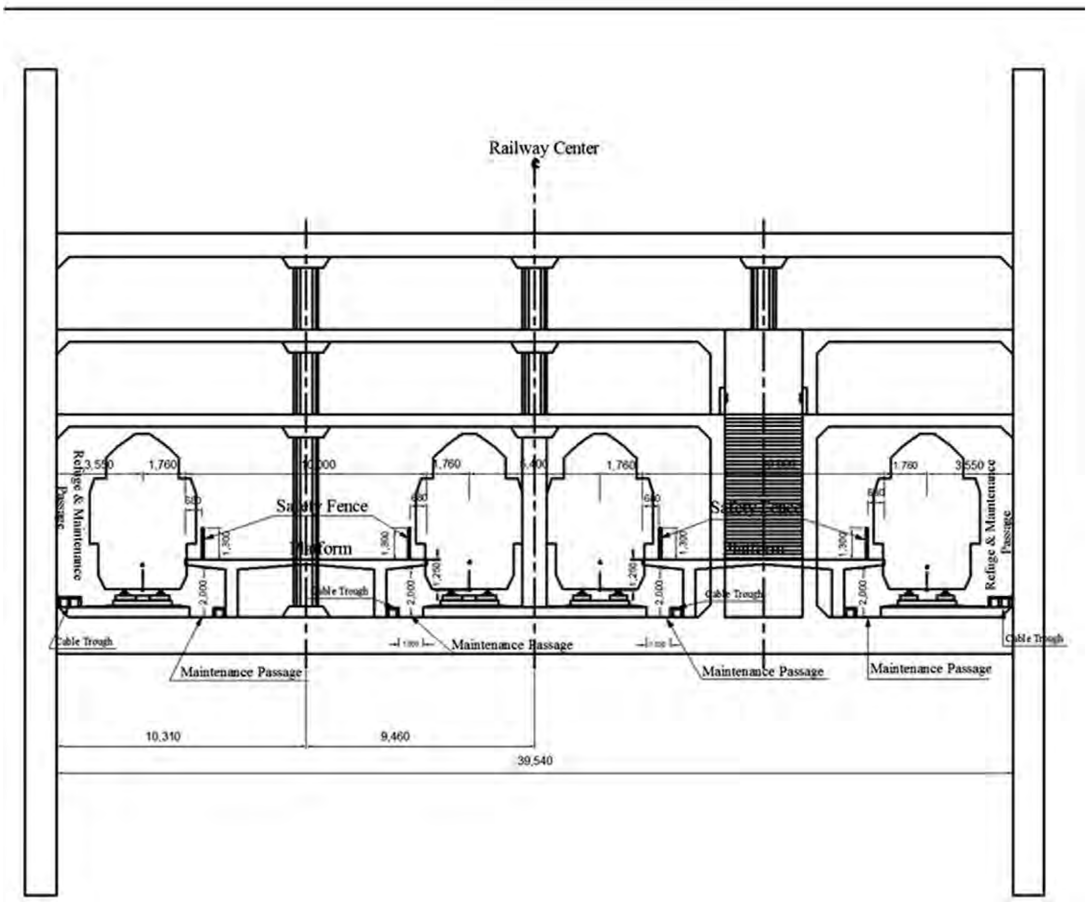


Source: JICA Study Team

Figure 8.2-5 Cross Section of Mountain Tunnel (NATM)

(7) Cut and Cover Tunnel

- Cut and cover tunnel is a method of excavating the ground safely using steel beams and RC diaphragm walls to build an underground station.
- This method has also been applied to the MRT project in Jakarta.
- The structure of the underground station will be 4 spans and three layers, considering the placement of the elevator equipment and platform width in Jakarta Station.
- The backfilled space can be used as underground facilities such as a parking area because the backfilling cost is almost the same as the construction cost of an upper layer.
- For underground utilities near the surface and small rivers, either their transfer or diversion of the route by pump-up should be considered before the work.



Source: JICA Study Team

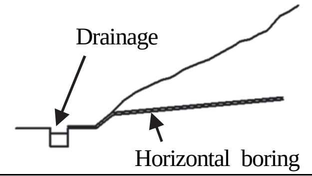
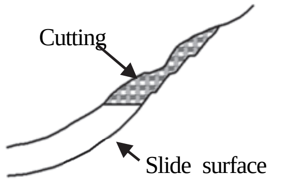
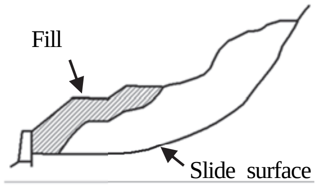
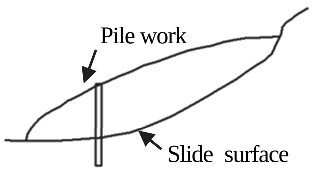
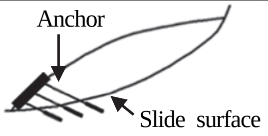
Figure 8.2-6 Cross Section of Cut & Cover Tunnel (Jakarta Station)

(8) Application of Special Construction Methods

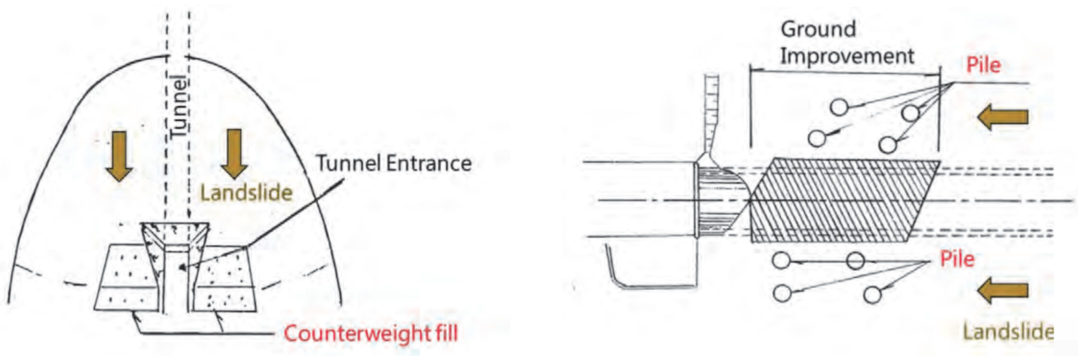
(a) Measures against Landslides

- Measures against landslides will be applied at the entrance to tunnels where landslides could occur.
- The appropriate measures must be selected in consideration of the geology and topography. In general, a suppression method such as earth removal work is applied, but the pile work and groundwater exclusion that have been applied in the local neighborhood will be applied in this project.

Table 8.2-4 Overview of Measures against Landslides

Control work	Groundwater exclusion	Method of reducing the pore pressure acting on the sliding surface by planting a collecting well and waterway	
	Earth removal work	Method of reducing the landslide slide force by removing the load of the head of the clod	
	Counterweight fill	Method of increasing the resistance to landslide slide force by applying fill at the end of the clod	
Prevention work	Pile work	Method of adding bending resistance and shear resistance to make the ground immovable by inserting piles	
	Anchor work	Method of suppressing the slide by using the tensile strength of steel fixed to stationary ground.	

Source: JICA Study Team



Source: JICA Study Team

Figure 8.2-7 Measures against Landslides at Tunnel Entrance

(b) Side Roads

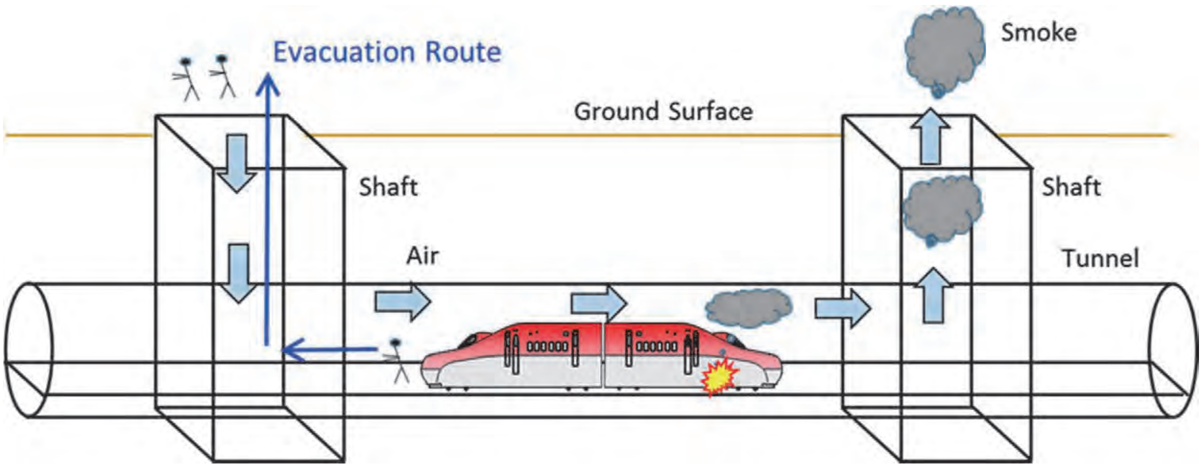
- Roads with a width of 4.0 m will be developed at the side of the viaducts in order to ensure the workability and carrying of equipment during the construction works. The roads will be used for management after completion of the construction works.
- There is no need to consider the right of sunlight in Indonesia. However, since the roads may not function sufficiently as buffer space to reduce the vibration and noise of the trains, soundproof walls will be installed in dense residential areas to reduce the environmental impact and properly maintain the viaducts.

Source: JICA Study Team

Figure 8.2-8 Side Roads

(c) Vertical Shaft

- In the shield tunnel sections, vertical shafts will be installed to enable maintenance of the drill bits and starting of the shield machine every 3 km. After the construction, these shafts will play an important role for the power supply, ventilation, drainage pump and as an escape route in an emergency.
- The size of the vertical shaft depends on the loading and assembly of the shield machine, and the cut and cover method is used for the construction.



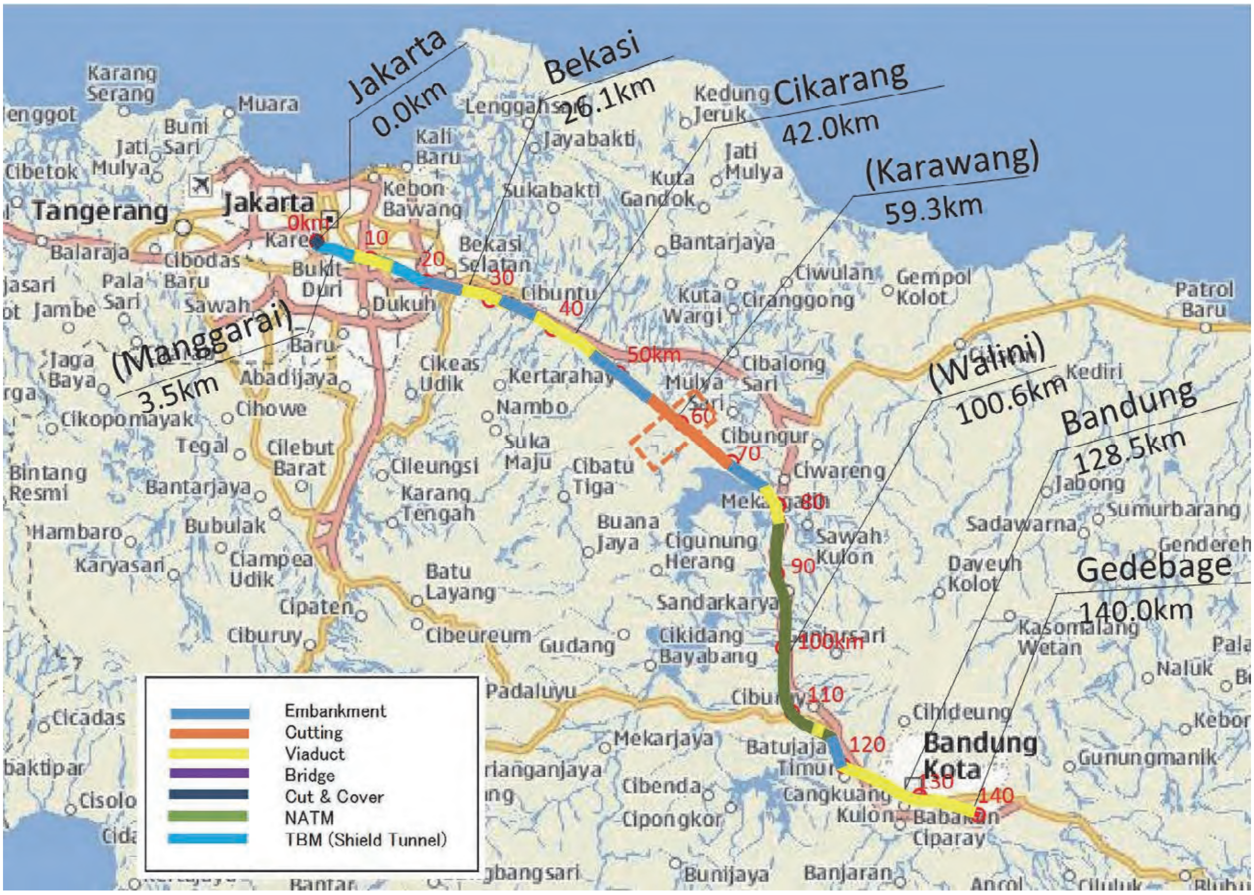
Source: JICA Study Team

Figure 8.2-9 Function of Vertical Shaft

8.2.2 Structural Arrangement Plan

(1) Structural Arrangement Plan

The structural arrangement between Jakarta and Gedebage was planned as shown in Figure 8.2-10, based on mainly terrain information and the alignment plan of the high-speed railway.



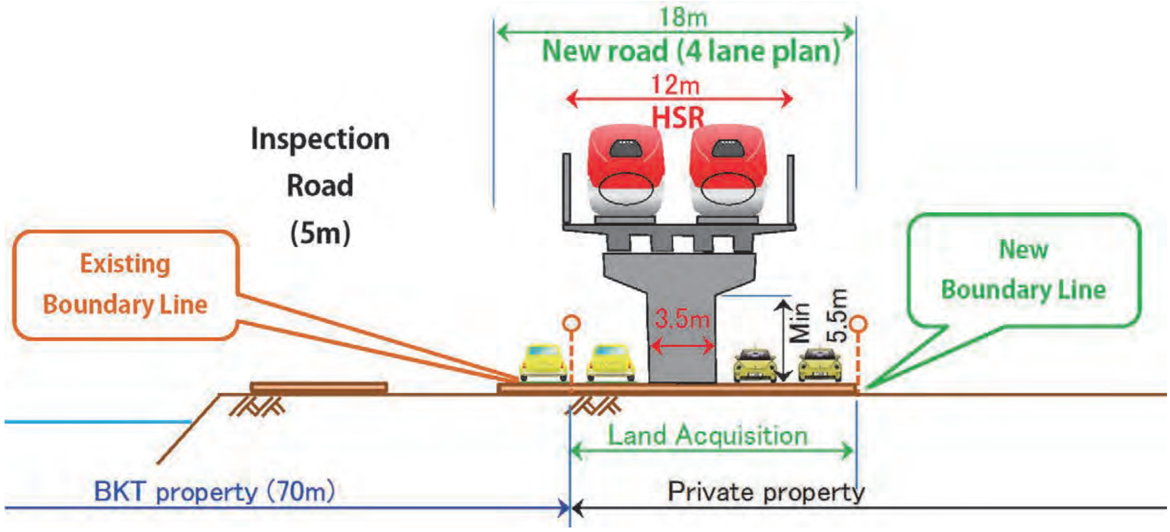
Source: Study Team

Figure 8.2-10 Civil Structure Layout

a) Jakarta area (Urban area, BKT Canal)

The prerequisite for the Jakarta area is utilization of the underground space. Since a station has to accommodate efficiently the railroad, platform, service office and electric and mechanical equipment, open cut tunneling will be employed which can cope with any intricate configuration.

For the section between stations, shield tunneling will basically be employed, which has limited impacts on the traffic above the ground and is appropriate for the geological conditions of the plain. A viaduct will also be employed to reduce costs for the area along the canal where the aboveground space density is low.

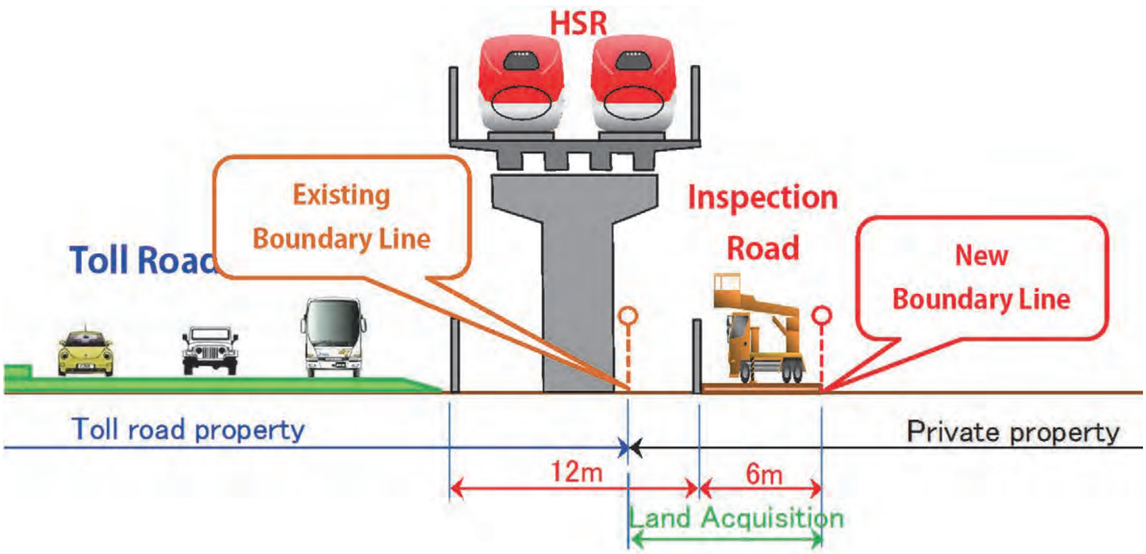


Source: Study Team

Figure 8.2-11 Layout Plan of Structures along the BKT Channel

b) Bekasi – Cikarang area (along the toll road)

The green belt along the toll road is utilized to the maximum degree for construction of a viaduct or reinforced earth retaining walls. The inspection road for construction and inspection will also be developed. In the section where sufficient land for an inspection road cannot be secured, the understanding of the administrator, Jasa Marga, has been obtained to allow partial use of the toll road with due care on the safety and traffic volume.



Source: Study Team

Figure 8.2-12 Layout Plan of Structures along the Toll Road

c) Karawang area (hilly area)

The Karawang area is a relatively gentle hilly area, consisting mainly of undeveloped portions. Cutting and embankment structures are used mainly to reduce the costs.

d) Walini area (mountainous area)

Economically-superior mountain tunneling is employed for the mountainous area with highly consolidated ground.

Japan has extensive experience of constructing long tunnels of 20 km or more, such as the Hakkoda Tunnel of Tohoku Shinkansen. However, Indonesia has only limited experience of tunneling itself, so that the maximum tunnel length is to be limited to 10 km or less. The number of mountain tunnels to be constructed between Jakarta and Bandung is planned to be 14. The tunnel layout plan is shown in Table 8.2-15.

Table 8.2-5 List of Tunnels

Section	Tunnel location		Length	MAX Length	Number
	In	Out	(km)	(km)	
Cikarang to Karawang	54.0 km	55.2 km	1.20	1.20	1
Karawang to Walini	75.2 km	75.8 km	0.60	5.60	7
	77.1 km	77.5 km	0.40		
	81.4 km	82.5 km	1.10		
	83.0 km	88.6 km	5.60		
	89.1 km	91.9 km	2.80		
	93.3 km	96.4 km	3.10		
	96.5 km	99.8 km	3.30		
Walini to Bandung	101.7 km	102.5 km	0.80	3.70	6
	104.8 km	105.2 km	0.40		
	105.4 km	106.4 km	1.00		
	106.5 km	110.0 km	3.50		
	110.1 km	113.8 km	3.70		
	118.2 km	118.8 km	0.60		

Source: Study Team

e) Bandung area (along the existing railroad line)

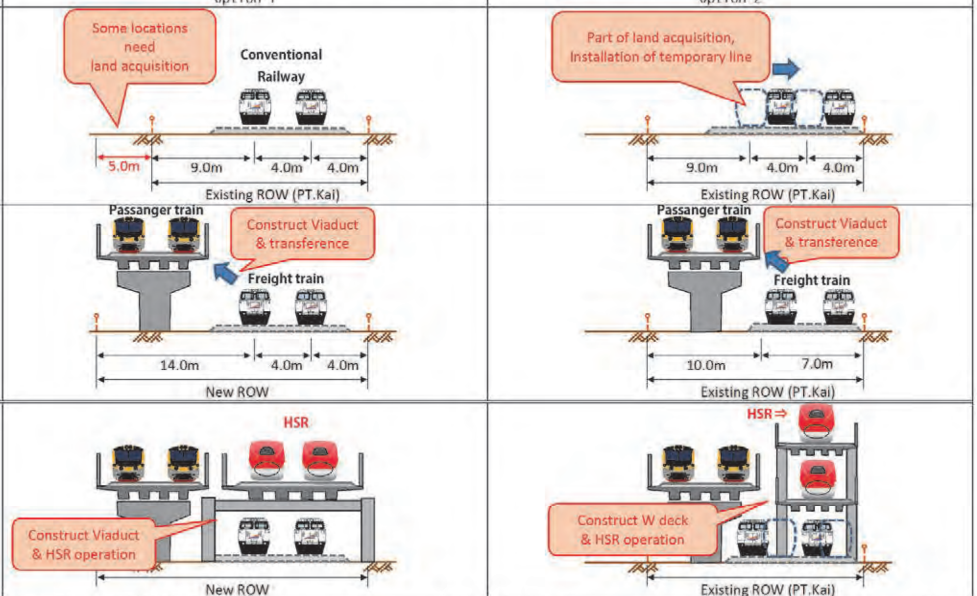
In the highly-urbanized Bandung area, where the traffic is heavy, the high-speed railway will intersect with many roads. Accordingly, a viaduct will be constructed by utilizing the existing right-of-way. Basically, the separate line method will be employed, in which the viaduct will be newly constructed lateral to the existing railroad line. Where the land is insufficient or the distance between high-speed railway and the existing railroad line is excessively large, the temporary line method will be employed, in which the positon of the existing railroad line is adjusted beforehand.

Source: Study Team

Figure 8.2-13 Construction Plan of Structures along the Existing Railroad Line (separate line method)

For the section with competition with the existing railroad line elevation project, reduction of the total cost has been proposed through tradeoff with the existing railroad line project from the viewpoint of introduction of high-speed railway as shown in Table 8.2-6.

Table 8.2-6 Proposed Coordination with the Existing Railroad Line Elevation Plan



Railway development plan in Bandung (Freight train remains on the grade)					
Option		Option 1		Option 2	
Construction STEP 1 (CR Project)					
Construction STEP 2 (CR Project)					
Construction STEP 3 (HSR Project)					
CR	Land acquisition (LA)	Some sections require LA for CR viaduct.	×	Very little.	△
	Level of difficulty	Easy to build on open space.	○	Easy to build on open space.	○
	Operation/Maintenance	Easy operation and maintenance.	○	CR turcks must be shifted.	△
	Duration Time	Very short. (After land acquisition)	○	Long. (Track work is required beforehand)	△
HSR	Level of difficulty	Difficult to build over the railway.	△	Very difficult to build on narrow site.	×
	Construction Cost	Fair. 150 million IDR/m	○	High. 200 million IDR/m	△
General Evaluation		○		△	

○ : Good. △ : Fair. × : Bad

(2) Quantity of structures

On the basis of above review and discussion results, the structures to be provided every 100 m section along the planned route were selected. The quantity aggregate result of structures is shown in Table 8.2-7.

Table 8.2-7 List of Number of Structures

Structure		Length	Number	Specification
Type	Mark	(km)	(no.)	
Embankment	A	3.100	-	Normal Embankment
	B	2.300	-	Reinforced soil retaining wall H = 3m
	C	29.200	-	Reinforced soil retaining wall H = 6m
Cut	A	18.000	-	Average depth 6 m
	B	4.400	-	Average depth 12 m
U-wall	-	1.200	-	Average depth 6m
Viaduct	A	29.700	-	H=8 m, Pile length 26 m
	B	6.300	-	H=16 m, Pile length 35 m
	C	1.200	-	Station (2 islands/4 tracks)
	C´	0.400	-	Station (1 island/2 tracks)
Bridge	A	1.100	-	Span 40 m
	B	0.500	-	Span 60 m
NATM	A	2.900	-	Tunnel entrance
	B	24.700	-	Standard section
	C	0.500	-	Special section (Low cover, soft soil etc.)
Shield Tunnel		14.000	-	Double track type
Cut & Cover	A	0.300	-	Box Culvert (3 layer)
	B	0.200	-	Box Culvert (1 layer)
Shaft	-	-	4	
Underpass	-	-	48	
Flyover	-	-	32	
Road	-	43.600	-	
Depot	-	-	1	476,851 m^2/no.
SS	-	-	4	20,000 m^2/no.
SP	-	-	4	3,600 m^2/no.
SSP	-	-	6	2,400 m^2/no.

Source: Study Team

Chapter 9

Superiority of High-Speed Railway and Technical Comparison

Chapter 9 Superiority of High-Speed Railway and Technical Comparison

9.1 Background of High-Speed Railway Introduction in Indonesia

9.1.1 Background and Related Plans of High-Speed Railway Introduction in Indonesia

In Java Island where the population is more than 100 million, the transportation infrastructure has not been developed sufficiently to cope with such a large-scale population. The railway service, in particular, is less competitive in terms of required time than passenger cars, so the ratio of car users is currently more than 80% as a means of transportation (Table 9.1-1). Therefore, since traffic congestion is serious due to the increasing number of cars mainly in urban areas, the necessity of an inter-city connection by railway has been identified.

Table 9.1-1 Share of Transportation by Passengers and Cargo (2005)

	Passengers		Cargo	
	Passengers (million)	Share (%)	Transportation (million tons)	Share (%)
1. Road	2,021.1	85.05	2,514.1	91.2
2. Railway	150.3	6.32	17.4	0.6
3. Ferry	116.0	4.88	27.4	1.0
4. Marine Transport	42.3	1.78	194.8	7.1
5. Air Transport	36.5	1.54	1.4	0.1
6. River Transport	10.3	0.43	0.3	0.0
Total	2,376.5	100.0	2,755.4	100.0

Source: HIGH SPEED TRAIN PROJECT IN INDONESIA (DGR, 2010)

According to the national development plan, the Master Plan for Acceleration and Expansion of Indonesia’s Economic Development (MP3EI), the development of the high-speed railway between Jakarta and Bandung and Jakarta and Surabaya is recognized as one of the corridor transportation infrastructures to support economic development. Moreover, the National Railway Master Plan (NRMP) also highlights the development of the Jakarta - Surabaya high-speed railway. Moreover, the high-speed railway between Jakarta and Bandung is designated as a priority project in the Master Plan for JABODETABEK Metropolitan Priority Area (MPA) which is jointly conducted by the Indonesian and Japanese governments.

Source: JICA Study Team

Figure 9.1-1 Related Plans to High-Speed Railway in Indonesia

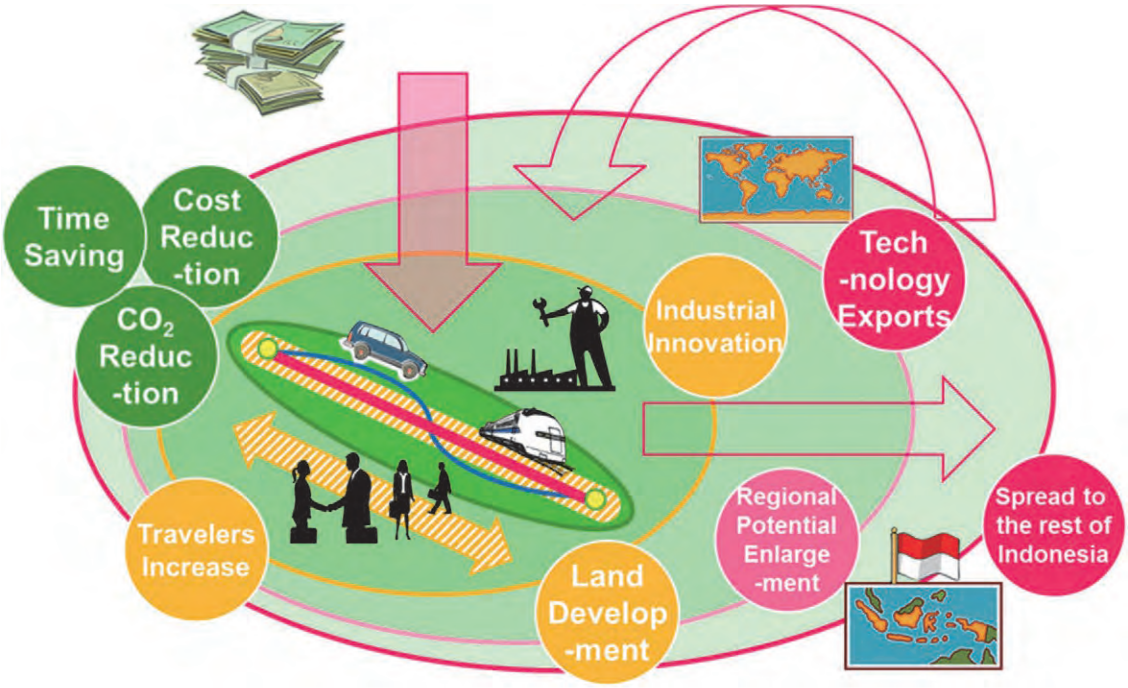
9.1.2 Necessity of Project Implementation

Railway transportation from Jakarta to Bandung using the North Line and diverting at Cikampek to the south takes around three hours by express train. In the past, the trains ran every one or two hours. However, after the development of the toll road in 2005 connecting the two cities in about two hours, the number of passengers tended to decline and the trains only run six or seven times per day.

Currently, because of the increase in the number of cars, traffic congestion on the toll road is serious; the traveling time by toll road might be longer than by rail in case of heavy traffic jams. Moreover, increased road length cannot meet the increasing number of cars, so it seems difficult to solve the traffic congestion by only road development. In addition, due to the further increase of vehicles in line with economic growth, it is considered that the development of an efficient transportation system including the high-speed railway is needed.

9.1.3 Effect and Impact of Project Implementation

The high-speed railway is expected to connect Jakarta and Bandung in less than 40 minutes, so the traveling time will be significantly shortened compared to that of vehicles (two hours for private cars and buses) and conventional railways (three hours). Moreover, due to the reduced travel time, several synergy effects are expected such as expansion of the economic area and mitigation of the overconcentration in the JABODETABEK area. Furthermore, the development and operation of the high-speed railway will provide the opportunity to revitalize related industries and to expand employment opportunities.



Source: METI Study

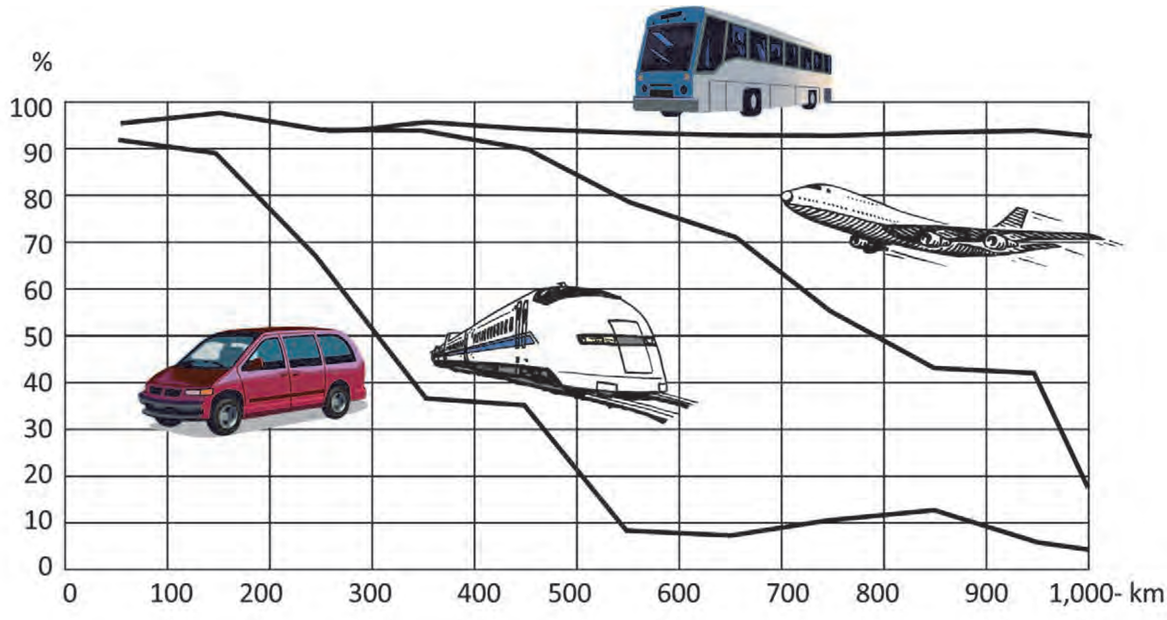
Figure 9.1-2 Effects related to High-Speed Railway Introduction

9.1.4 Comparison of Proposed Project and Other Alternatives

Currently, improvement of the North Line has been conducted by double tracking between Jakarta and Cirebon. The improvement of conventional railways is effective in increasing the transportation capacity and reducing the traveling time. On the other hand, since the railway route connection to Bandung at a high elevation of 700 m faces severe topographic restrictions, significant reduction in traveling time is not expected by improvement of the existing infrastructure. Therefore, it is appropriate in this section to introduce the high-speed railway with new tracks.

Moreover, a second Jakarta - Cikampek Road is planned to reduce the traffic congestion on the existing Jakarta - Cikampek Road as a highway project. However, highway projects tend to be frustrated because of the difficulty of land acquisition in Indonesia, and this project also has not made much advancement.

Figure 9.1-3 shows the transport mode selection rate by distance. The railway is suitable for 300 - 700 km trips while private cars and airplanes are suitable for trips of less than 300 km and more than 700 km respectively. Therefore, the railway is the most suitable for trips between Jakarta and Surabaya where the maximum distance is about 700 km.



Source: Ministry of Land, Infrastructure, Transport and Tourism (MLIT), Japan

Figure 9.1-3 Transport Mode Selection Tendency by Trip Distance

9.1.5 HSR Impact to Regional Growth

The operating distance in the Japanese Shinkansen is increasing since its inauguration of the section between Tokyo and Shin-osaka of the Tokaido Shinkansen, and it reaches over 5 times of the distance of the opening time. Such extension of the line not only contributed to increasing the national transport capacity but also strengthened the relationship between the cities along the corridor, thus accelerating economic development in those cities. Table 9.1-2 shows the HSR impact to regional growth in such as population, number of company and local government receipt, and HSR impact is outstanding in the cities with HSR stations.

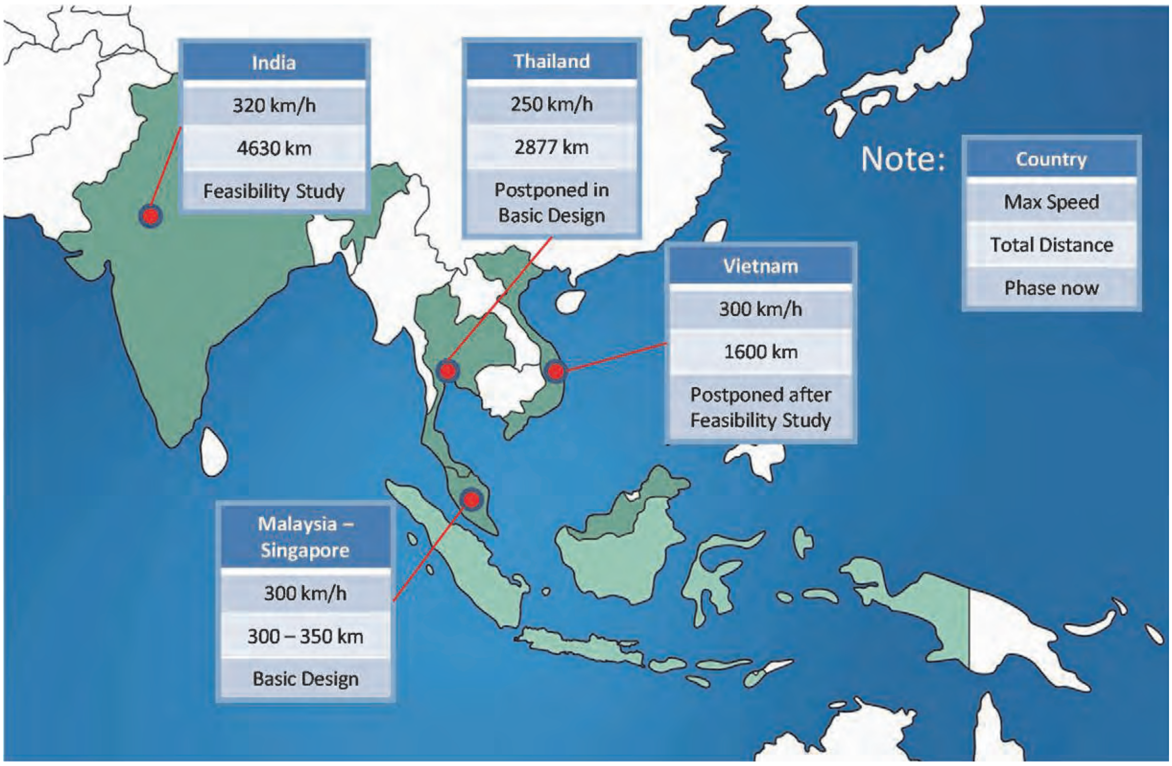
Table 9.1-2 HSR Impact to Regional Growth

	Cities with HSR Stations	National Average
Population Growth (1975-1995)	32%	12%
Company Number Growth (1975-1991)	46%	21%
Local Gov’t Receipt Growth (1980-1993)	155%	110%

Source: Shinkansen’s Local Impact, 2010, Christopher Hood, Oxford Univ.

9.2 High-Speed Railway Planning in Neighboring Countries

Currently, neighboring countries including India, Malaysia, Singapore, Thailand and Vietnam are planning the introduction of High-Speed Railways.



Source: Study Team

Figure 9.2-1 High-Speed Railway Planning in Neighboring Countries

(1) India

In India, the master plan of railway development named as "Indian Railway Vision 2020" was issued in 2009. According to this plan, at least 4 high-speed rail projects to provide bullet train services at 250-350 km/h are planned. Now they are planning 7 high-speed railway corridors as shown in Figure 9.2-2. Feasibility studies or more detailed studies have been proceeding in each project.

In order to promote these projects, the Ministry of Railways in India established the 'High Speed Rail Corporation of India Ltd.' as a special purpose vehicle in November 2013.

Source: Study Team

Figure 9.2-2 High-Speed Railway Planning in India

Table 9.2-1 High-Speed Railway Planning in India

No.	Section	Route length (Approx.)
1	Pune – Mumbai – Ahmedabad	680 km
2	Delhi – Amritsar	480 km
3	Delhi – Agra – Lucknow – Varanasi - Patna	1000 km
4	Howrah-Kolkata – Haldia	140 km
5	Hyderabad – Viajyawada – Chennai	720 km
6	Chennai – Bengaluru – Kochi-Ernakulam – Thiruvananthapuram	1080 km
7	Delhi – Jaipur – Jodhpur	530 km

Source: Study Team

(2) Thailand

2.2 trillion baht infrastructure project including 4 High Speed Railway Projects was announced by the Government of Thailand in March 2013. Step by step construction would be applied for some corridors which have long route distances. Feasibility studies, basic design and preparations for tender have been done. However, due to political change in May 2014, these projects are currently up in the air.

Source: Study Team

Figure 9.2-3 High-Speed Railway Planning in Thailand

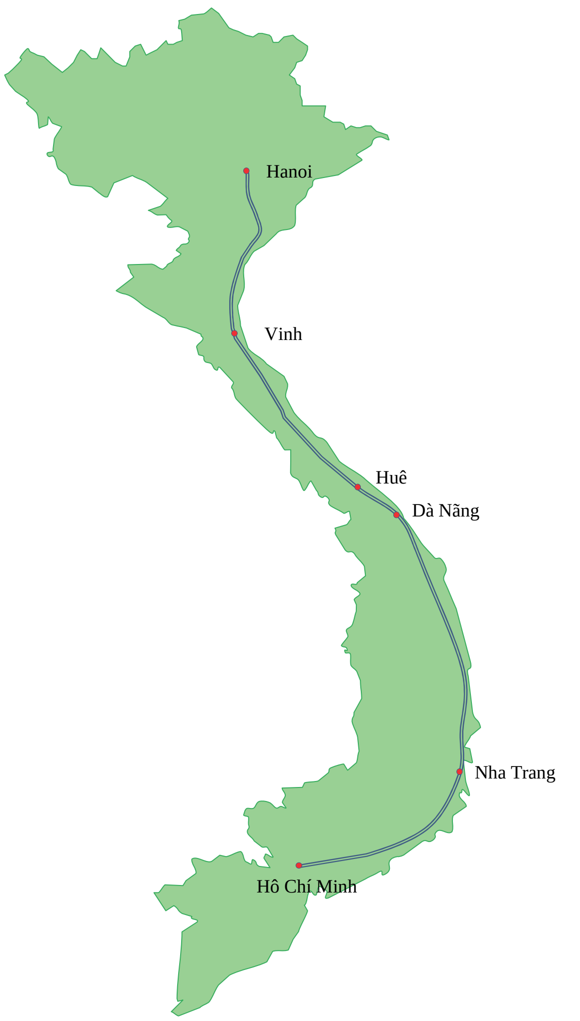
Table 9.2-2 High-Speed Railway Planning in Thailand

Line	1st Step Inauguration section	2nd Step Inauguration section	Route Length (Approx.)
North	Bangkok – Phitsanulok	Phitsanulok – Chiang Mai	730 km
North-East	Bangkok – Nakhon Ratchasima	Nakhon Ratchasima – Nong Khai	615 km
		Nakhon Ratchasima – Udon Ratchathani	315 km
South	Bang kok – Hua Hin	Hua Hin – Padang Besar	980 km
East	Bangkok – Rayong		220 km

Source: Study Team

(3) Vietnam

In Vietnam, a South-North High-Speed Railway connecting Hanoi and Hô Chí Minh had been planned. In 2008, a feasibility study was executed utilizing Vietnam Government budget. However, Vietnam National Railways declared the suspension of the High-Speed Railway Project in March 2013.



Source: Study Team

Figure 9.2-4 High-Speed Railway Planning in Vietnam

Table 9.2-3 High-Speed Railway Planning in Vietnam

Section	Route Length (Approx.)
Hanoi - Hô Chí Minh	1600 km

Source: Study Team

(4) Malaysia - Singapore

In February 2013, both the Malaysian government and Singaporean government declared that a high-speed railway would start operation by 2020 connecting the 300 km between Kuala Lumpur and Singapore, with a 90 minutes trip. Now they are in the detailed design phase. If there are no obstacles for the project, it could well be the first inauguration of a High-Speed Railway in East-South Asia.

Source: Study Team

Figure 9.2-5 High-Speed Railway Planning of Malaysia – Singapore

Table 9.2-4 High-Speed Railway Planning of Malaysia – Singapore

Section	Route Length (Approx.)
Kuala Lumpur – Johor Bahru – Singapore	300 km

Source: Study Team

9.3 Technical Comparison on High-Speed Railway System

9.3.1 Technical Comparison of Specification

Japan started high-speed rail operation in 1964. In the 1980s, European countries, such as France, Italy, Germany and Spain, launched operations one after another. After 2000, East Asian countries, such as South Korea, Taiwan and China, opened high-speed rail lines, and Turkey, the Netherlands and Russia also started operation in 2009.

Table 9.3-1 shows the characteristics of the main high-speed trains incorporating the latest technologies.

Table 9.3-1 Example of High-Speed Railways around the World

Country		Japan	France	Spain	China	South Korea
Inauguration Year		1964	1981	1992	2007	2004
Vehicle performance	Class	E5	TGV-POS	S112	CRH3C	KTX- Sancheon
	Type	EMU	Locomotive	Locomotive	EMU	Locomotive
	Train Configuration*1	8M2T	2L8T	2L12T	4M4T	2L8T
	Maximum Operation Speed	320 km/h	320 km/h	300 km/h	300 km/h	300 km/h
	Output/Capacity	13.1kW	26.0kW	22.0kW	15.8kW	24.2kW
	Weight/Capacity	0.62t	1.18t	0.89t	0.76t	1.11t
	Train Width	3350 mm	2904 mm	2960 mm	3265 mm	2970 mm
	Seat Configuration	2+3	2+2	2+2	2+3	2+2
	Seat Pitch	1040 mm	900 mm*2	1000 mm	Unknown (920 mm*3)	980 mm
Geography/Climate	Maximum Gradient	35‰	35‰	12.5‰	20‰	15‰
	Earthquake Frequency *4	29	0	0	5	0
	Earthquake Experience	Much	Little	Little	Little	Little
	Annual Rainfall	Kagoshima 2266mm	Paris 653mm	Madrid 437mm	Beijing 534mm	Seoul 1429mm
Features		Most efficient transportation network created Superior prevention of climatic disaster	Changed from locomotive type to EMU type	Supports various track gauges and non-electric operation	Rapid growth has created world's largest high-speed railway network	Only operated with locomotive type Slopes are not steep

*1 M: Motor car, T: Trailer car, L: Locomotive

*2 Seat pitch of TGV-R where passenger coach is used on TGV-POS is 900 mm.

*3 Seat pitch of ICE3 which is the base train for CRH3C is 920 mm.

*4 Frequency of earthquakes is the number of earthquakes with a magnitude of 7 or more that have occurred in the relevant country since 2000

[Reference] Annual Precipitation in Indonesia: 1480mm (Jakarta), 1656mm (Bandung)
Number of Earthquakes: 12
Annual Precipitation in Tokyo: 1529mm

Source: JICA Study Team

(1) Rolling Stock

The E5 series is a “multiple unit” train that operates on the Tohoku Shinkansen Line in Japan. Its maximum operation speed is 320 km/h. There are 3 types of cars in the E5 series: Grand Class (comparable to First Class on airplanes), Green Class (comparable to Business Class on airplanes) and Ordinary Class. The seat configuration in Ordinary Class is 5 seats per row, a seat configuration that makes mass transportation possible.

TGV-POS operates in France with a maximum operation speed of 320 km/h and is manufactured by ALSTOM. It is not a “multiple unit” train but a “locomotive-hauled train”. The advantages of the “locomotive-hauled train” are that there are fewer motor cars requiring a lot of maintenance and the quietness of the passenger area is maintained because the passenger cars are removed from the source of noise from the motor car. However, the disadvantages are that maintenance of the infrastructure and brake units is required because the axle loads are heavier and the intermediate trailer cars cannot use dynamic braking.

The S112 operates in Spain and is manufactured by Bombardier. The maximum design speed is 350 km/h. However, the maximum operation speed is 300 km/h. The S112 is also a “locomotive-hauled train”, the same as the TGV-POS.

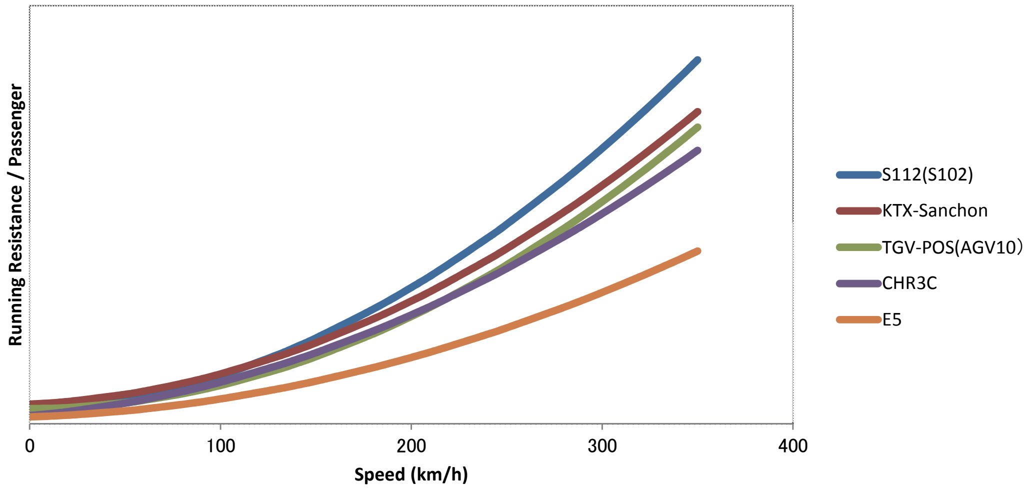
The CRH3C, which is based on SIEMENS Velaro platform car, operates in China with a maximum operation speed of 300 km/h. The Velaro is a “multiple unit” train and it is also operating in Germany as ICE3. However, the CRH3C’s width has been extended by 300 mm compared with ICE3 in order to achieve a seat configuration of 5 seats per row.

The KTX-Sanchon is under operation in South Korea and is based on the TGV.

As shown in Table 9.3-1 and the above description, high-speed trains have a lot of different characteristics. The “car weight per passenger capacity” which contributes to energy saving and “countermeasures for the environment in Indonesia” should be noted.

“Car weight per passenger”: A light “car weight per passenger” value means that the trains are able to perform energy-saving operation. Since Japanese trains are the lightest, the trains provide superior energy efficiency.

In terms of energy efficiency, the train resistance should be noted. The various train resistances are shown in Figure 9.3-1. The train resistance is the loss during train operation and it consists of the friction resistance between the rails and the wheels, mechanical resistance from the rotation parts of the train, and air resistance. This means that the lower the train resistance, the less energy is required for train operation. In particular, train resistance in high-speed areas is most important because high-speed trains operate at high velocities. The Japanese Shinkansen has the significantly lowest train resistance as shown in Figure 9.3-1, especially in high-speed areas, so the value at 300 km/h is half the train resistance value of the S112. In short, Japanese trains have superior energy efficiency in terms of train resistance.



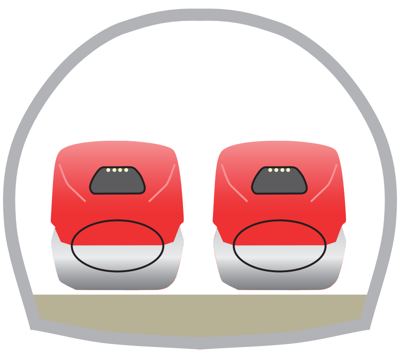
*1 The S112 value is calculated using the S102 running resistance (There is no difference in performance between the S112 and S102)

*2 The TGV-POS value is calculated using the AGV running resistance

Source: JICA Study Team

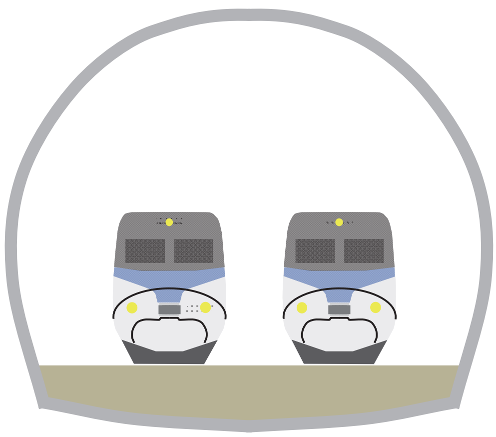
Figure 9.3-1 Running Resistance/Passenger in Other Countries

Besides the structure of Shinkansen has efficient shape against running resistance, it is also suitable for the infrastructure condition which has many tunnel sections. Entering a tunnel with high speed, large pressure difference is imposed to vehicles. Shinkansen structure has so adequate strength against pressure that it can run through a tunnel which has smaller cross section than other high speed railways's tunnels even though Shinkansen has a wider body than other high speed railways. In addition, thanks to superior ventilation system, passengers never feel uncomfortable by pressure difference when a train go into/out of a tunnel with high speed.



Japanese Shinkansen

Cross Sectcion $64m^2$



Other High Speed Railawy

Cross Section $100m^2$

Source: Study Team

Figure 9.3-2 Comparison of Tunnel cross-sectional area

“Countermeasures for the environment in Indonesia”: These are mainly countermeasures against steep gradients and earthquakes. They are described in the following.

Regarding steep gradient sections, since there are steep gradient areas and precipitous mountains in Indonesia, the service operation area between Jakarta and Bandung will have steep gradient sections. Japanese and French trains are superior in terms of countermeasures against steep gradients because they have experience in service operation on 35‰ gradient sections. In addition, Japanese trains can run stably on upward gradients due to the “multiple units” and safely on downward gradients due to the light vehicle weight.

Next, regarding earthquakes, Indonesia is a country of frequent earthquakes, therefore, high-speed trains must have countermeasures against earthquakes. There are no countries with frequent earthquakes besides Japan in Table 6.3-1, thus it is considered that Japanese trains have superior ability against earthquakes.

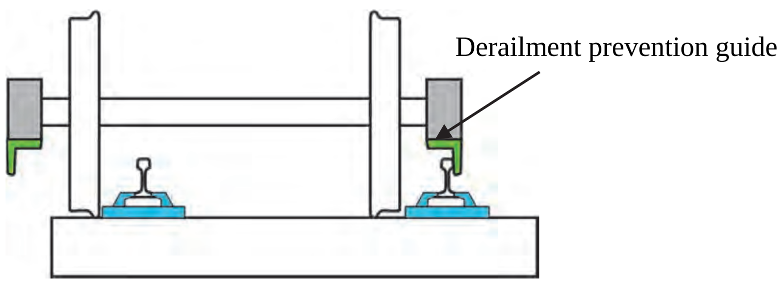
As countermeasures against earthquakes, the Early Earthquake Detection System can stop the train as soon as possible after earthquake generation and the Derailment Prevention Guides prevent the train from going off the rails in the case of derailment.

The Early Earthquake Detection System mechanism detects the P wave at the preliminary tremor stage and immediately stops the power supply from the electric power station. After that, the train’s emergency brake is engaged to reduce speed before the arrival of major motion (S wave).

The Derailment Prevention Guides are fitted on the underside of the axle box on the bogie (Figure 9.3-3) to prevent the train from going off the rails in the case of derailment, thereby avoiding major damage.

Source: East Japan Railway Company

Figure 9.3-3 Derailment Prevention Guide and Installation Image



Source: East Japan Railway Company

Figure 9.3-4 Derailment Image

(2) Power Supply and Catenary System

In this section, the differences in power supply and catenary system in each country are described as below. Power distribution is not mentioned as power distribution varies little from country to country.

1) Power Supply

An AC traction power supply includes equipment such as sectioning posts, sub sectioning posts and AT posts. The differences in AC equipment are the kinds of main transformers and sections.

(a) Power Supply Equipment

Typical power supply equipment is a circuit breaker, main transformer, control panel and AT transformer. The composition of the equipment and the protective devices differ little from country to country. In Japan, for protection against earthquakes, when the seismometer detects an earthquake, the circuit breaker is activated. The main purpose is to apply the emergency brake. Another purpose is the prevention of ground faults by wires touching the trains or buildings after being cut.

In Japan, a Scott-T transformer or roof-delta transformer is used. In other countries, a V-connection composed of two single-phase transformers is mainly used. The Scott-T transformer and roof-delta transformer produce less unbalanced voltage. The V-connection cannot reduce unbalanced voltage. Therefore, unbalanced voltage from the Scott-T transformer and roof-delta transformer is less than from the V-connection. The smaller the capacity of the transmission line, the larger the unbalanced voltage produced.

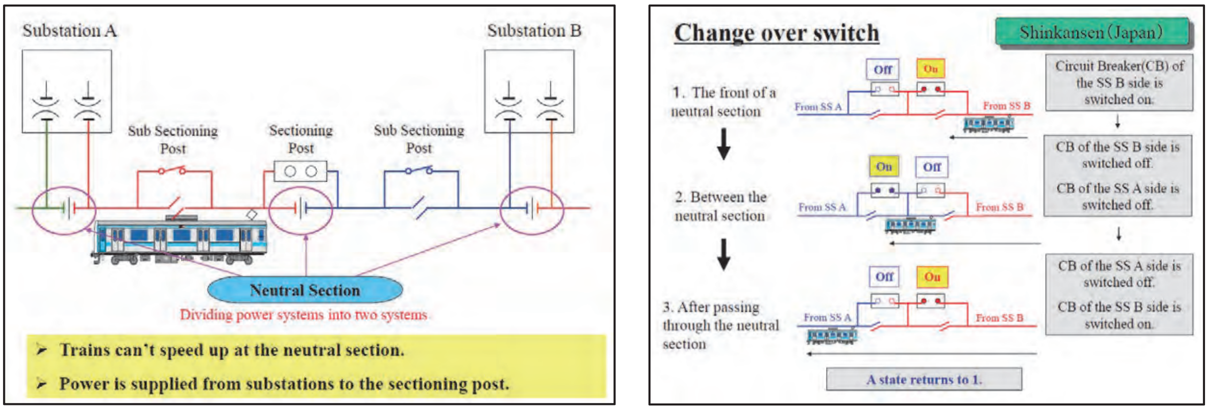
Unbalanced Voltage

Connecting a single-phase load to a three-phase line will create unbalanced voltage. Unbalanced voltage will propagate through the line, affecting all the other consumers connected to it. In addition, unbalanced voltage will cause an extra temperature rise in synchronous and asynchronous electrical motors. This effect is very profound as 1% unbalance will create an extra temperature rise. As quick variations in unbalance do not have a significant overheating effect, unbalance is measured, on average, every 10 minutes and limitations are based on the average values obtained during that time span. International standards recommend no more than 1% unbalance continuously and no more than 2% under abnormal conditions, but energy suppliers have their own guidelines for unbalance limitations according to their own code of practice.

The Japanese standard is no more than 3% unbalanced voltage during 2 hours. The reason is that the motor is not damaged by an extra temperature rise of less than 10% when 3% unbalanced voltage is created.

(b) Change-Over Section and Neutral Section

In Japan, a change-over switch is installed at substations and sectioning posts and trains can speed up at the change-over section. In Taiwan too, a change-over switch is installed.
On the other hand, a neutral section is installed in other countries. Trains cannot speed up when running through the neutral section, but can speed up after passing through the neutral section.
An early earthquake detection system cannot be adopted when a neutral section is installed, because the trains are not supplied with power when running through the neutral section.



Source: JICA Study Team

Figure 9.3-5 Change-Over Section

2) Catenary Systems

High-speed railways use pantographs and catenary systems which are highly efficient.

(a) Structure of Catenary System

The Japanese Tohoku Shinkansen and Joetsu Shinkansen high-speed railways used a heavy compound catenary system until 1982. Recently, the railways have adopted a simple catenary system. The system uses a high strength contact wire. The structure of the simple catenary system is simpler than the heavy compound catenary system.
High-speed railways in other countries mainly use the simple catenary system. In Spain, China and South Korea, the high-speed railways have adopted a stitched catenary system. In France, the high-speed railway uses the simple catenary system.
The equivalent spring coefficient is small when the stitched catenary system is installed. The stitched catenary system can supply power stably to the pantographs, but the contact wires and pantographs become more worn because the support point is hard. In addition to the above, it is difficult to fix the catenary and there is a strong upward force when the wind is strong. In France the TGV Southeast Line, the first high-speed railway, adopted the stitched catenary system. When the trains accelerated to 300 km/h, the contact wires frequently broke and the pantographs were damaged at the support point. Therefore, in France the stitched catenary system was changed to the simple catenary system on sections with speeds of more than 270 km/h.

(b) Contact Wires and Messenger Wires

The simple catenary system uses copper alloy messenger wires and copper alloy contact wire for sections with speeds of more than 300 km/h and hard copper contact wire for sections with speeds of less than 300 km/h. In Japan, copper clad steel (CS) contact wire made of hard copper and a steel core is used for some sections. Additionally, in Japan precipitation-hardened copper alloy (PHC) contact wire is used for the Tohoku Shinkansen between Shin-Hachinohe Station and Shin-Aomori Station and for the Kyushu Shinkansen between Hakata Station and Shin-Yachiyo Station.

PHC contact wire is the hardest of all the contact wires. The harder the contact wire, the less the abrasion of the contact wire by the pantograph. Therefore, PHC contact wire is the best because of its excellent wear resistance.

On the other hand, in France, Spain, China and South Korea, copper and magnesium contact wire is used. In France, China and South Korea, copper and tin contact wire is also used. Table 9.3-2 shows the conductivity and rupture strength of the contact wires. From the results of the comparison, the rupture strength of copper and silver contact wire is much the same as copper contact wire. The rupture strength of copper and magnesium contact wire is between PHC contact wire and copper and tin contact wire. Although copper and magnesium contact wire has high intensity, the conductivity is much the same as CS contact wire and it is difficult to adopt the wire for short headways.

Table 9.3-2 Different Types of Contact Wires

Description	Conductivity [% IACS]	Rupture Strength [MPa]	Hardness	Adopted Countries
Cu	98	347	low	France, South Korea
Cu-Sn	70	365	nominal	Japan, France, China
Cu-Ag	98	350	nominal	France
Cu-Mg	64	490	high	France, Spain, China
CS	60	592	high	Japan
PHC	81	582	highest	Japan

Source: JICA Study Team

(c) Automatic Tensioner

Recently in Japan an automatic tensioner is used for the spring tension balancer (STB). A wire tension balancer (WTB) was adopted in the past. With a WTB, it is necessary to change the wire regularly. The disadvantage of the WTB is that the rod in the weight may break because of corrosion and the wire may be cut by an earthquake or vibration. The STB has the advantage that the moving parts are sealed. In addition, the STB enables easy maintenance and reduced failure rate as well as reduction of maintenance costs. In Japan the automatic tensioner has changed from the WTB to the STB, but in other countries the WTB is used.

(3) Signals and Telecommunication

1) Signaling Method for HSR

For the signal equipment for HSR train control, basically ATC (Automatic Train Control) or ATP (Automatic Train Protection : continuous control type) with cab signals and continuous control, which is designed independently from previous signal equipment such as ATP (point-to-point control type) for existing lines, is adopted in view of high-speed train operation and quick response in case of emergency. Especially for HSR lines established later, mainstream ATC equipment has changed from analog systems to digital systems which realize a high level of control in consideration of differences in car performance. The respective characteristics of signal equipment for HSR and for existing lines are described below.

(a) Analog Type ATC and ATP (continuous control type)

The first systems installed for HSR lines, they provided a high level of safety and reliability in high-speed operation (over 200 km/h) with cab signals and continuous train control. As analog signals were used for signal transmission (sending frequency signals to the track circuit), the poor capacity for transmitting control information did not match later control needs such as high level control with consideration for differences in car performance.

(b) Digital Type ATC and ATP (continuous control type)

Digital type ATC and ATP (continuous control type) using digital data transmission (by track circuit or space radio) for signal transmission has changed from the conventional ATC system with only speed control which depends on ground signal equipment, to a system which transmits the current on-track position of the preceding train to onboard equipment by digital data transmission, thereby realizing high-level train control mainly by onboard control logic (e.g. considering the car’s maximum speed and brake performance for train control).

(c) Basic ATP (point-to-point control type) and ATS-P

This train control system for existing lines is currently applied to mixed operating sections with HSR trains and local trains (e.g. for through-traffic lines to existing stations in metropolitan areas, or for existing lines directly running through regional cities), in consideration of signaling compatibility with local trains and using existing signal equipment.

(d) New Type of Digital ATC and ATP (moving block type)

The new type of digital ATC and ATP does not use ground signal equipment (e.g. track circuit) for detecting the current on-track position of the train, instead using the onboard train positioning data transmitted to the ATC equipment for train control. (Moving block control function is available.) This type of system requires less ground signal equipment compared with conventional ATC and also reduces the train headway time (more than 24 trains/h) and lately it is installed on congested metro lines with shorter headway and on local lines requiring less ground signal equipment. In HSR, 3 minutes headway over high density traffic is not required while verification and validation of train detection and train integrity in high-speed train operation are required, so it has not yet been actually introduced for HSR.

Analog ATC (Automatic Train Control) and ATP (Automatic Train Protection: continuous control)

-Depends on ground signaling equipment

-Sends speed signal to onboard equipment

-Next train brakes so as not to exceed the permitted speed of the speed signal

Used by:

- Old type of ATC (Japan)

-TVM 300 (France, China)

Merits:

- Safe and reliable continuous control

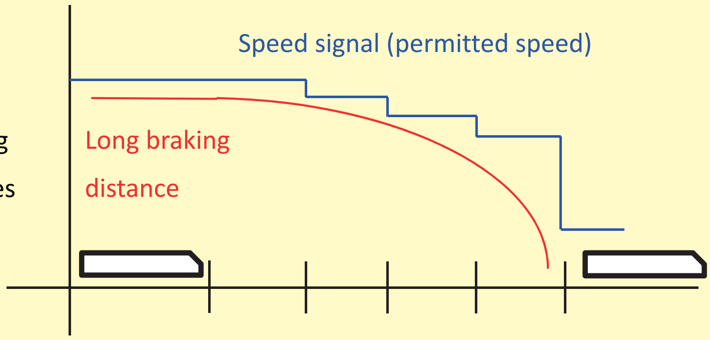
Demerits:

-Loss time due to step-by-step braking

-No variation of control for many types of cars

Used for:

-Old type of ATC for HSR trains



Digital ATC and ATP (continuous control)

-Depends on on-board signaling device

-Sends EoA (End of Authority) to onboard equipment

-Next train brakes adequately from EoA

Used by:

-DS-ATC (Japan)

-TVM 430 (France, Korea), LZB (Germany, Spain)

-ETCS L2 (Europe), CTCS L3 (China)

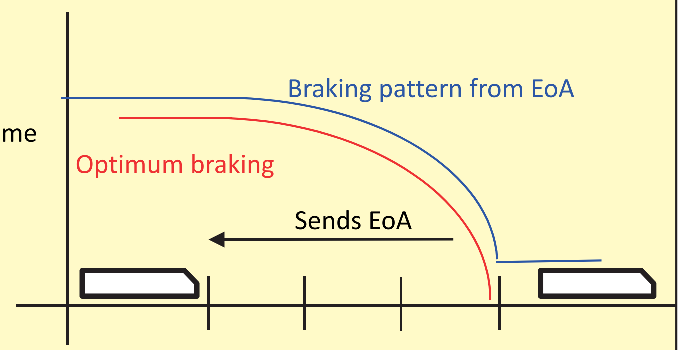
Merits:

-Single level brake control reduces loss time

-Optimum brake control for many types of cars is available

Used for:

-Current mainstream ATC for HSR trains



Source: JICA Study Team

Figure 9.3-6 Breakthrough in Train Control System for HSR

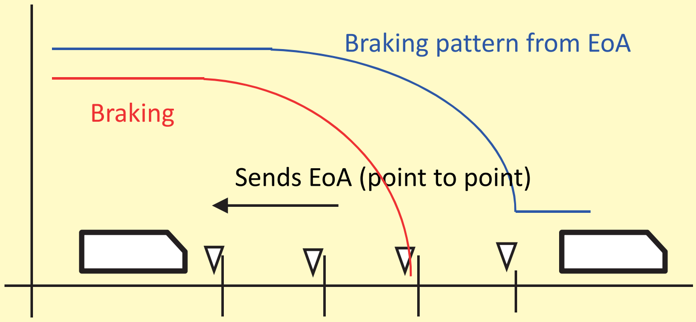
Basic ATP (Automatic Train Protection: point-to-point control)

Consists of:

- Wayside signal
- Cab signal

Used by:

- ATP (Europe, Asia, America), ATS-P (Japan)
- ETCS L1 (Europe, Asia)
- CTCS L2 (China)



Merits:

- Can use the existing signaling facilities

Demerits:

- Discontinuous control (point-to-point)

Used for:

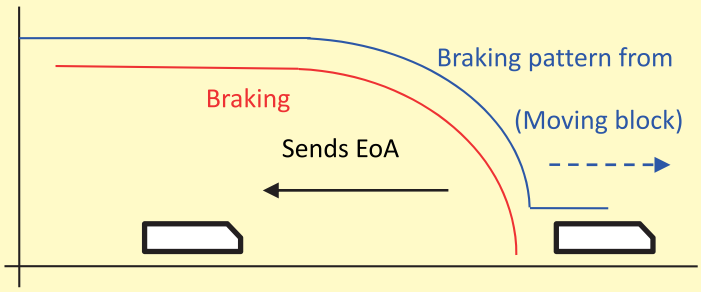
- Good for mixed operation with existing trains (Low speed operation)
- Not good for HSR dedicated lines

New Type of Digital ATC (Moving Block)

- Depends on on-board signaling device
- Reduces ground signal equipment
- Next train brakes adequately from EoA
  (continuously moving with preceding train: moving block)

Used by:

- ATACS (Japan)
- CBTC (Europe, Asia, America)
- ETCS L3 (Regional : Europe)



Merits:

- Reduces train headway time
- Reduces ground signal equipment

Demerits:

- Difficult to ensure train integrity

Used for:

- Good for commuter trains (more than 24 trains/ hour)
- Good for regional trains (reduces cost of ground signaling equipment)

Source: JICA Study Team

Figure 9.3-7 Other Train Control Systems

2) Signaling Methods for HSR around the World

In Europe from the 1980s HSR lines were constructed in France and Germany, countries which had their own original signal control systems (analog type and digital type). In recent years the need for seamless HSR through-operation between countries (interoperability) is increasing and introduction of the European Rail Traffic Management System (ERTMS) and European Train Control System (ETCS) is proceeding to realize such interoperability. In this case, introduction of the ETCS is proceeding step by step in view of signaling compatibility between HSR lines and existing lines and mixed operation with local trains without ETCS onboard equipment. On sections using existing lines in metropolitan areas, ETCS level 1 is installed for the purpose of using the existing signal equipment. Installation of ETCS level 2 is proceeding on the newly constructed HSR dedicated lines (except a small part of French and German lines). ETCS level 3 which has the ability to reduce ground signal equipment (e.g. track circuit) and offers a moving block control function is still at the research and development stage except for implementation on Swedish local lines (16 trains / day: for cost reduction of signal ground equipment), and there are still no cases of introduction on lines in metropolitan areas (existing lines) or on HSR lines.

In Japan the change in ATC equipment on HSR lines is proceeding step by step from the conventional analog type to the digital type, realizing high-level ATC control (e.g. optimum brake control by the onboard equipment). And at JR EAST, HSR direct through-operation from Tokyo to regional cities in the northern area (e.g. Akita, Yamagata) via existing lines has been realized, and on sections of existing lines with mixed operation with local lines, ATS-P (similar to the European ATP (point-to-point control type) and ETCS level 1) has been installed for train control using existing signal equipment.

In recent years, in various European countries other than France and Germany and in Asian countries, HSR has been rapidly introduced and signal systems based on the respective systems of the countries where the systems were developed have been introduced. In Spain the German system (LZB) was adopted in the beginning, and for the newly constructed lines ETCS level 1 and level 2 have been introduced; in Korea the French method (TVM 430) was adopted; in China the French scheme (TVM300), etc. was adopted in the beginning, and for the newly constructed lines CTCS level 2 and level 3 which have the same functions as ETCS (same functions as ETCS level 1 and level 2 respectively) have been introduced. A comparative study of the signaling methods of international HSR (for HSR dedicated lines) has been carried out for introduction of HSR this time and is described in the comparison table below.

Table.9.3-3 Comparison of signaling methods of international HSR

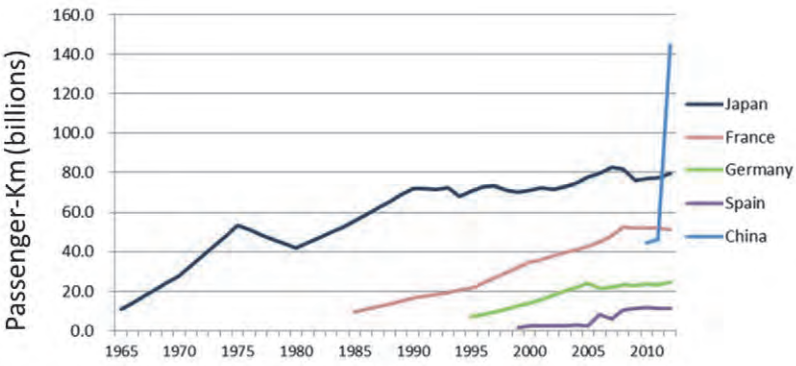
	Japan (JR East)	France	Spain	Korea	China
Signaling method	DS-ATC	TVM300, 430 ETCS-L2	LZB ETCS-L2	TVM430	CTCS-L2, L3
Signaling	Cab signal	Cab signal	Cab signal	Cab signal	Cab signal
Max operation speed	320 km/h	320 km/h	300 km/h	300 km/h	300 km/h
Train control	Continuous control	Continuous control	Continuous control	Continuous control	Continuous control, point to point
Signal transmission	Digital	Analog, Digital	Digital	Digital	Analog, Digital
Developed country	Japan	France	Germany	France	France, etc.
Operational length	1130 km	1317 km	1535 km	346 km	2859 km
Later system introduced (HSR established)	2002 (1964)	2007 (1981)	2006 (1992)	2004 (2004)	2010 (2007)

Source: JICA Study Team

(4) Operation and Others

1) Historical Comparison

The Japanese Shinkansen has achieved satisfactory results since operation started in 1964, with no fatal accidents. Figure 9.3-8 shows the transportation volume of each country's high-speed railways in Japan (operation started in 1964), France (operation started in 1981), Spain (operation started in 1992) and China (operation started in 2007). China's transport volume has grown rapidly, so it is no longer simply a matter of advantage in terms of "transport volume". However, the fact that "stable safety and experience" has been maintained for long time has not changed.



Source: JICA Study Team

Figure 9.3-8 Historical Transport Volume of HSR

Many procedures and devices related to the operating system and staff training have improved over half a century in the Japanese HSR field. High-level management policies and technical skills to realize safety and stability are strongly demanded for HSR operation. These policies and skills enable the necessary improvements to be made against dangerous situations not assumed in the existing HSR system. The many accidents that have been reported in other countries reflect the difficulty of maintaining appropriate policies and skills in many countries other than Japan.

2) Validity of HSR Network Connection to Conventional Railways

Most of the high-speed railway network in Japan consists of dedicated railways. However, HSR in other countries actively uses the conventional railway network, especially in metropolitan areas. Usage of conventional railway networks enables avoidance of huge costs due to construction work in already developed areas.

Today, many discussions have been held and views on whether a dedicated line is the best solution or not have been discussed. At the least, a dedicated line is better in terms of operation management, because conventional railway systems force the HSR system to sacrifice “high speed”, “large capacity”, “punctuality” and “safety”.

The challenges in the case of conventional line usage are described below.

(a) Longer Travel Time (Sacrifice of high speed)

Strict conditions on conventional railway networks such as small radius curves force HSR cars to reduce their operation speed.

(b) Transportation Volume (Sacrifice of large transport volume)

The small clearance gauge of conventional railway systems demands small HSR car design, so passenger capacity per train is also small. Increasing the number of cars is also limited.

(c) Transportation Quality (Sacrifice of punctuality)

Conventional railway systems include the possibility of delay time because of the high volume of passengers and many stations. This also affects HSR punctuality. Consequently, much reserve time is adopted to cover this situation and maintain punctuality in other countries except Japan. (Remark: Sacrifice of high speed)

(d) Train Protection (Sacrifice of safety)

In terms of the train protection system, there are many differences between dedicated lines and conventional lines. A high level of skill and training for staff are necessary. As a result, fatal accidents may occur at the boundary of dedicated sections and conventional sections due to the driver’s misunderstanding.

9.3.2 Main Accidents around the World

The Tokaido Shinkansen in Japan started operation in 1964. In inter-city transport, the Tokaido Shinkansen proved to the world that high-speed trains are an effective means of railway revival. Since then, high-speed railways have been constructed around the world, such as in France, Germany, China, Korea and Taiwan. Currently, high-speed railways across the world extend for over 18,000 km.

High-speed railways are effective for inter-city transport. However, if an accident occurs, the damage will be serious for high-speed travel. Therefore, the safety of high-speed railways is promoted intensively. Every country tries to prevent accidents.

In Japan, various safety measures have been implemented. As a result, during the 50 years since the inauguration of the Tokaido Shinkansen in 1964, no injuries or fatal accidents have occurred at all during commercial operation.

In this section, accidents around the world will be explained. Then, the reason why no accidents occur in Japan will be explained.

(1) Accidents around the World

The main accidents around the world are shown below.

Table 9.3-4 Main Accidents around the World

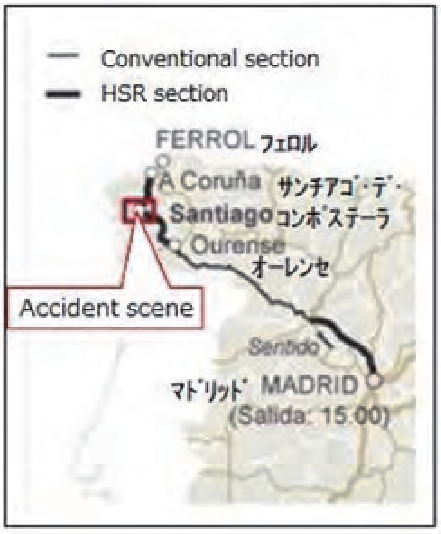
No.	Country	Date	Category	Casualties	
				Fatalities	Injuries
1)	Spain	24 Jul. 2013	Derailment/Overturning	77	150
2)	China	23 Jul. 2011	Collision	35	192
3)	Korea	3 Nov. 2007	Collision	0	2
4)	Germany	3 Jun. 1998	Derailment/Overturning	101	200
5)	France	15 Dec. 1992	Derailment/Overturning	0	27

Source: JICA Study Team

In Japan, as described above, in the 50 years since the inauguration of the Tokaido Shinkansen in 1964, no injuries or deaths have occurred at all during commercial operation.

(2) Outline of Accidents

1) High-speed Train Accident in Spain



・Date: Wed. 24 July 2013, 20:41
・Location: Santiago de Compostela Station
・Train: HSR “Alvia” 4155
・Casualties: Fatalities 77　Injuries　about 50
・Cause: Derailment/overturning due to excessive speed
・Outline

The site of the accident is a curved section with an 80 km/h speed limit running parallel to conventional lines. It is a straight section of the new high-speed line with a 200 km/h speed limit that passes through a tunnel. The driver of the train is supposed to reduce the running speed from 200 km/h to 80 km/h manually. However, the following fact was found by analysis of the operation record. The train entered this section at 192 km/h. As a result, the train was derailed due to the excessive speed. In the local news, it was reported that the train driver had received an incoming call from someone on the staff of National Railways a few minutes before the accident.

・Differences with Japan

In Japan, ATC is installed on the Shinkansen lines. ATC has the function of automatically regulating the train speed below the speed limit for curves and turnouts. Also, through operation of the Shinkansen on conventional lines, such as the Akita and Yamagata Shinkansen, the function of automatically regulating the train speed below the speed limit for curves and turnouts is provided. Therefore, the same type of accident does not occur with the Japanese Shinkansen.

77 killed in train accident in Spain

SANTIAGO DE COMPOSTELA, Spain (AP)—The death toll in a passenger train crash in northwestern Spain rose to 77 on Thursday after the train jumped the tracks on a curvy stretch just before arriving in the northwestern shrine city of Santiago de Compostela, a judicial official said.

Seventy three people were found dead at the scene of the accident and four died in hospitals, said Maria Pardo Rios, spokeswoman for the Galicia region's main court. At least 141 people were injured after the eight-carriage train carrying 218 passengers derailed about an hour before sunset Wednesday night.

It was Spain's deadliest train accident since 1972, when a train collided with a bus in southwestern Spain, killing 86 people and injuring 112.

Spanish Prime Minister Mariano Rajoy was heading Thursday to the scene of the crash. He was born in Santiago de Compostela, where officials canceled ceremonies for its annual religious festival that attracts tens of thousands of Christian pilgrims from around the world.

Rescue workers spent the night searching through toppled and smashed cars alongside the tracks at the crash site, and Pardo said it was possible that the death toll could go higher.

As dawn arrived, cranes brought to the scene were used to lift the cars off the tracks and rescue workers were seen collecting passenger luggage and putting it into the back of a truck next to the tracks.

The site itself was a scene of horror immediately after the crash, with at least one car catching fire and smoke billowing from the scene. Another car broke into two parts as residents of the urban neighborhood alongside the tracks tried to help victims out of the toppled cars.

Rescue workers lined up bodies covered in blankets alongside the tracks and some passengers were pulled out of broken windows.

State-owned train operator Renfe said in a statement an unspecified number of staff were also on board the train during the 8:41 p.m. crash on a section of tracks about 4 kilometers from Santiago de Compostela that came online two years ago.

A picture on Wednesday shows derailed cars at the site of a train accident near the city of Santiago de Compostela, Spain.

Source: Japan News

Figure 9.3-9 Article about the Accident

2) High-speed Train Accident in China

・Date: Sat. 23 July 2011, 21:30

・Location: Yongjia – Wenzhou, China

・Trains: HSR D301 and D3115

・Casualties: Fatalities 35　Injuries 192

・Cause: Facilities trouble due to a serious defect in the system architecture caused by lightning.
　　　　Inadequate safety management after the trouble.

・Outline

The subsequent D301 train collided with the D3115 train that had stopped in the above section due to lightning. As a result, cars one to four of the D301 that collided with the D3115 were derailed. The cars then dropped from the 20m-high viaduct. In addition, cars 15 and 16 of the D3115 were also derailed.

According to the report by the Chinese accident investigation team, the following have been reported.

-Facilities trouble due to a serious defect in the system architecture caused by lightning.

-Inspection prior to introduction had not been performed rigorously.

-Lack of safety management after the occurrence of trouble, such as lightning.

However, at this time, the clear cause of the collision has not been reported in the subsequent report.

・Differences with Japan

In Japan, signal equipment may malfunction due to lightning. As a result, the trains cannot be operated. However, accident manuals have been created for dispatchers and train drivers. Subsequent operation is performed according to the manual. In addition, training in the handling of accidents is implemented periodically.

Source: East Japan Railway Company

Figure 9.3-10　Accident Site and Accident Situation

3) High-speed Train Accident in Korea

・Date: Sun. 3 Nov. 2007, 6:28
・Location: Busan Station, Korea
・Trains: HSR KTX110 and KTX112
・Casualties: Fatalities 0   Injuries 2
・Cause: Ignoring of signal due to dozing by the driver
・Outline

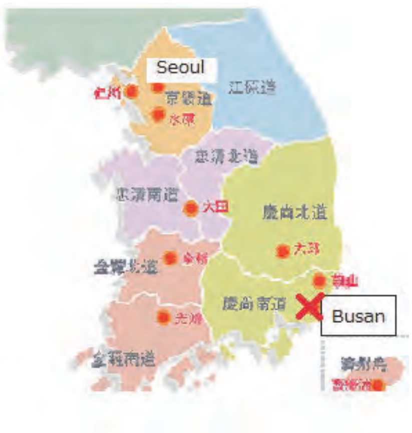
The KTX112 deadhead train from the depot to Busan Station collided with the KTX110 that had stopped at Track No.9 in Busan Station.

According to local reports, the cause of the accident was that the train driver of the KTX112 missed the stop signal due to dozing. At that time, the ATS was activated and the alarm sounded. However, the emergency brake did not work because the train driver pushed the ATS confirmation switch.

・Differences with Japan

In Japan, ATC is installed on the Shinkansen lines. ATC has the function of controlling the train interval and automatically stopping the train when it approaches the train ahead.

On Japanese conventional lines, a similar accident occurred at Higashi-Nakano Station (Chuo Line) in 1988. As a countermeasure following this accident, equipment was introduced to activate the emergency brake by a stop signal when the train exceeded the protection block, regardless of whether or not the ATC confirmation switch is pushed by the train driver.



Source: East Japan Railway Company

Figure 9.3-11 Accident Site and Accident Situation

4) High-speed Train Accident in Germany

・Date: 3 June 1998
・Location: Eschede, Germany
・Train: HSR ICE884 “Wilhelm Conrad Rontgen”
・Casualties: Fatalities 101   Injuries 200
・Cause: Derailment/overturning due to wheel damage
・Outline

When the train was traveling at about 200 km/h towards Eschede south of Hamburg, the outer ring of the front axle of the rear bogie of the first car broke and the outer ring hit the train body. The train continued to travel for 5.5 km in this state. The train was derailed by the impact when the damaged outer ring hit the turnover about 200 m before the railway bridge over the road. The second car and third car also derailed. The third car crashed into the bridge. The bridge was destroyed by the impact of the crash. The following cars crashed into the collapsed bridge one after another and it was a catastrophe.

・Differences with Japan

The damaged wheel had a dual structure attached to the outer ring through a thin rubber cushion on the outside of the wheel to reduce the cost and improve the ride quality. However, this type of wheel is not used in Japan.

There are indicator lights to inform the train driver in the cab of the Japanese Shinkansen if the temperature of the axle box rises due to a damaged axle or fixed axle while traveling. When the train driver notices the indicator light, the driver stops the train with the brake.

Source: East Japan Railway Company

Figure 9.3-12 Accident Site and Accident Situation

5) High-speed Train Accident in France

・Date: 15 December 1992

・Location: LGV Southeast Line Macon – Loche, France

・Train: HSR TGV 920

・Casualties: Fatalities 0　Injuries 27

・Cause: Derailment caused by locking of wheels

・Outline

This train was derailed between Macon Station and Loche Station while traveling at about 270 km/h on the LGV Southeast Line. The train had been stopped by emergency stop before derailment. At that time, the flat point of the wheel occurred. According to the report, the flat occurred due to failure of the anti-skid brake control equipment. Fixed axle occurred due to the flat point of the wheel. Therefore, the train bogie was derailed when passing through the turnover in the station yard. There were no injuries among the onboard passengers, but passengers on the platform were injured by the ballast from the track that was thrown up during the derailment.

・Differences with Japan

There is an indicator light to inform the train driver in the cab of the Japanese Shinkansen if the anti-skid brake control equipment fails. When the train driver notices the indicator light, the driver reports to the dispatcher and inspects the train. The driver stops the train and takes the appropriate steps. Therefore, if the anti-skid brake control equipment fails, there is no possibility of the train continuing to run.

Source: East Japan Railway Company

Figure 9.3-13 Accident Site

9.4 Comparison and Recommendation on High-Speed Railway System

(1) Rolling Stock

As there are many differences between the various countries' rolling stock for high-speed railways, the rolling stock is compared to identify the superiority in terms of "experience", "high-speed performance", "energy-saving performance "and "security and reliability of operation based on Indonesian geography and environment, such as steep gradients, earthquakes and rainfall" according to the description in Section 6.3.1. The comparison results are shown in Table 6.5-15.

The Japanese Shinkansen pioneered high-speed rail service operation and has a 50-year history. The Shinkansen delivers superior performance in high speed and energy efficiency which are important items for high-speed railways.

In addition, the Shinkansen operates in Japan where most of the area is mountainous, earthquakes are frequent and the environment has high temperature and humidity. Therefore, the Shinkansen is a suitable high-speed train for Indonesian geostatic and environmental conditions (i.e. steep gradients, high frequency of earthquakes and high rainfall).

According to the Shinkansen's superiority mentioned above, the proposed rolling stock is adapted to the Japanese Shinkansen system and the concrete series is the E5 Series because the E5 Series is the latest rolling stock with an operation speed of 300 km/h or higher. (The E6 Series is also the latest type of Shinkansen with an operation speed of more than 300 km/h. This type has narrower body width than the E5 Series because it can run both dedicated high speed corridor and conventional line.)

Table 9.4-1 Comparison Table of Rolling Stock

Item	Japan	France	Spain	China	South Korea
Experience	◎	○	△	×	×
High speed	◎	◎	○	○	○
Energy saving	◎	△	△	○	△
Steep gradient	◎	◎	×	△	×
Earthquake	◎	○	×	○	×
High rainfall	○	△	△	△	○
Small cross section tunnel	◎	△	△	△	△

Source: JICA Study Team

(2) Power Supply

An examination of the power supply system is described as follows. Adopting a DC feeding system for HSR is not realistic. If DC1, 500 V is adopted for HSR, the electric current will be very big and the electrical wire size will be extremely big. In addition, more substations will be required than for AC and the construction costs will be enormous. Therefore, an AC feeding system must be adopted for HSR.

Two kinds of feeding systems can be adopted for HSR. One is the AC 1×25 kV system, and the other is the AC 2×25 kV system. Comparing the two systems, the AC 1×25 kV system has problems such as a large EMI, large voltage drop and short interval between substations. Considering the above-mentioned circumstances, the AC 2×25 kV system is better than the AC 1×25 kV system because the technical factors and construction costs are better. Therefore, the AC 2×25 kV system should be adopted for HSR.

The incoming voltage will be 150 kV in accordance with a meeting with PLN.

A change-over section will be adopted because the Japanese early earthquake detection system will be adopted.

Three kinds of catenary systems can be adopted for HSR. First, a simple catenary system can be adopted. This is an ordinary catenary system. It is a simple structure and construction costs are cheap and it is adopted all over the world. When it is adopted for a high density line, consideration is necessary. Java HSR is not a high density line and it can be adopted. Secondly, a twin simple catenary system can be adopted. This is a complex structure and construction costs are expensive.

Therefore, the twin simple catenary system is not suitable for Java HSR. It goes without saying that the maintenance costs are the most expensive of all the systems. Finally, a compound catenary system can be adopted. The structure is simpler than the twin simple catenary. The voltage drop is smaller than the simple catenary. The compound catenary system is suitable for a high density line, for instance, 4 minutes headway and 16-car trains. However, in the case of Java HSR, the voltage drop is small enough due to good train energy consumption. Therefore, the simple catenary system is suitable for Java HSR main line and depot.

The distribution system may be 2 220-volt wires or 3 380-volt wires per station. The station substations (SSS) will be supplied with power from a traction substation (TPS) or PLN transmission line. A transformer at the SSS transforms the high voltage into low voltage.

The signaling load is important and an exclusive high voltage line will be laid from the TPS to the transformer. Each station load will be supplied with power from PLN to the transformer.

Maintenance vehicles are used for construction and maintenance. The maintenance vehicles are a track-motor car, a snow-removing vehicle, a vehicle for work at height and a rail-road vehicle. The maintenance vehicles run on rails and should not be easily derailed. The parts used for rail moving equipment must have stress-bearing strength but the load should not exceed the weight that is heavier than the train weight.

In Japan the wheels are of a structure that allows them to run on curves with a radius of 200 m.

Japanese maintenance vehicles can run up 35% slopes, such as the Nagano Shinkansen, and Japanese companies can make maintenance vehicles which can run up Java HSR slopes.

(3) Signaling and Telecommunication

For HSR-dedicated lines, all the countries have adopted cab signaling and a continuous control system (excluding the Chinese CTCS-L 2). From these systems, we should conduct a detailed comparison between the Japanese DS-ATC and European ETCS-L2 which are considered to be a new and influential type of signal system for introduction on the Java HSR (max. operating speed 300 km/h) with provision of the necessary functions below.

Table.9.4-2 Detailed Functional Comparison of DS-ATC and ETCS-L2

	DS-ATC (Japan)	**ETCS Level 2 (Europe)**
Block system	Fixed block	Fixed block
Train detection	Track circuit	Track circuit, axle counter, etc.
Transmission of MA	Rail : Digital Track circuit	Space radio : GSM-R
Main ground equipment	ATC interlocking combined logic controller (reduced cost by simpler ground equipment)	Radio Block Center (RBC) connected with interlocking device
Method of braking control	○: Retrieval of single-step braking pattern stored in the onboard device	○: Continuous calculation of braking pattern by the onboard device
Deceleration control when train stops	◎: Automatic speed control in consideration of improved riding comfort	○: Manual speed control
Minimum delay time of signal transmission	○: 3 sec (for emergency braking operation)	△: about 10 sec (connection time of GSM-R)
Number of trains during most congested hour	◎: 14 (JR EAST : from Tokyo to Omiya)	○: 5 (RFI in Italy : from Rome to Naples)
Investment costs (for new construction)	○: 1 (with interlocking)	△: 1.3 (with interlocking and GSM-R)
Remarks	○: Rail breakage detection is also available	△: Unavailable in busy areas such as main stations because the radio (GSM-R) transmission capacity is low.

Source: JICA Study Team

In terms of functions, the DS-ATC and ETCS-L2 both use digital transmission-aided cab signals, fixed blocks, and on-board logic for single-step braking control, and there are no big differences in the basic features the differences in deceleration control, which can provide automatic speed control or cannot.
In terms of performance, due to the fact that the ETCS-L2 uses wireless technology (GSM-R) which was used for mobile phones two generations ago, there are differences in the signal transmission time,

and the train number that can be controlled at the same time. So the DS-ATC is considered to be more advantageous, especially in emergency braking control when a strong earthquake happens as can be expected with Java HSR.

In terms of the maximum number of scheduled trains, the Japanese scheme which takes into consideration various forms of transportation, such as urban mass transit including commuting and long-distance high-speed transport, seems to have an advantage. Also in terms of construction cost, considering the cost of introducing the GSM-R, the DS-ATC can be equal or better.

Overall, with better aspects of performance, forms of transportation and construction cost, and with no need to consider the problem of expiration of support for the GSM-R (by 2025), etc., introduction of the DS-ATC is considered desirable.

Chapter 10

Specification Based on Shinkansen System

Chapter 10 Specification Based on Shinkansen System

10.1 Major Features of the Specifications

The specifications of the proposed high-speed railway system are examined based on worldwide standards for high-speed railway systems with consideration given to the topographic features and relevant regulations in Indonesia.

The maximum speed design is set at 350km/h. Ground facilities such as curve radius and transition curves are designed to cope with speeds up to 350km/h in the future. The maximum operation speed is set at 300km/h in consideration of technical trends and the traveling time between Jakarta and Bandung. Therefore, the maximum speed performance of the rolling stock is set at 320km/h.

Regarding traffic direction, we decided to follow the traffic direction of the conventional lines in Indonesia. Some countries that have high-speed railway systems have adopted left-hand traffic. However, in Indonesia, right-hand traffic on conventional lines is regulated by law. Therefore, in this project, we will adopt right-hand traffic.

Concerning the distance between the center of the tracks, in the case of Japan, it was set at 4.3m or more after construction of the Sanyo Shinkansen which was inaugurated in 1972. According to the technical specifications for interoperability of the trans-European high-speed rail system (TSI), in the case of a maximum speed of less than 300km/h, the minimum distance between the track centers is regulated at 4.2m and in the case of a maximum speed of more than 300km/h, the minimum distance should be 4.5m.

The maximum cant is set at 200mm and the maximum cant deficiency is set at 90mm. In this case, the steady lateral acceleration on the curve section does not exceed 0.08g without the provision of car tilting devices. Under these conditions, high-speed trains can travel at speeds up to 350km/h on curve sections which have a curve radius of 5000m or more. In this project, the minimum curve radius is set at 6000m allowing for a certain margin.

When traveling between Jakarta and Bandung, the section between Purwakarta district and Bandung is steep. The section has a height difference of 700m over a 40km distance. Therefore, the maximum gradient is set at 30 per mile in consideration of the proven technology in Japan.

Regarding the maximum axle load, according to TSI, it should be within 17t with a maximum speed of 250km/h or more. However, from the viewpoint of technical trends, the maximum axle load should be within 16t. Even in European rolling stock, the maximum axle load of the Velaro Series manufactured by SIEMENS is 16t, and also, construction standards in Japan adopt a maximum axle load of 16t. In this project, in consideration of the load affecting the tracks, energy consumption and coping with steep sections, the maximum axle load is set at 16t.

The specifications for the E&M system are designed to be suitable for Indonesia in consideration of the worldwide high-speed railway systems described in the above section. Due to the topographic features and demand trends, the system configuration is similar to the Japanese Shinkansen system.

The train-set is a 12-car formation with 3.4m car body width that can accommodate a 2+3-seat arrangement, in order to correspond to mass transport between Jakarta and Bandung. The length of one car is 25m, therefore the effective length of the train platform is set at 310m.

All rolling stock maintenance, including light maintenance such as daily inspection and heavy maintenance such as overhaul, is carried out in the rolling stock workshop located at Cikarang.

Concerning the power supply system, if the voltage does not exceed 175 kV, Scott-T transformers are used on the Japanese Shinkansen, because neutral grounding is not necessary with this voltage in Japan. However, in Indonesia, as neutral grounding is required with any voltage, we propose roof-delta transformers that have neutral grounding.

The span distance is set at 60m. This is longer than in Japan where it is 50m. It may contribute to cost reduction.

The basic features of the specifications are shown in the table below.

Table 10.1-1 Basic Features of the Specifications of Java High-speed Rail

Item		Specification	Remarks
Operation	Design maximum speed	350km/h	
	Maximum operation speed	320km/h	300km/h at inauguration
	Traffic direction	Right-hand traffic	
Construction Standards	Gauge	1435mm	
	Minimum curve radius	6000m	
	Minimum vertical curve radius	25000m	
	Maximum cant	200mm	
	Permissive cant deficiency	90mm	
	Maximum gradient	35‰	
	Distance between center of tracks	4500mm	
	Maximum axle load	16t	
	Width of formation level	11.3m	
	Effective length for train stopping	310m	
Rolling Stock	Train formation	10M2T(12 cars)	
	Traction power	12000kW	
	Passenger capacity	925	
Power supply	Electrification system	AC25kV/ 50Hz	
	Feeding system	AT-Feeding	
	Receiving transformer	Roof-Delta	Neutral grounding is required
	Overhead catenary system	Simple	
	Span distance	60m	
Signaling	Signaling system	Cab signal	
	Train protection system	DS-ATC	
Telecommunication	Communication system	Digital train radio	

Source: JICA Study Team

10.2 Suitable Characteristics for Utilization of Shinkansen System in Indonesia

Some topographic features in Indonesia are similar to the topographic features in Japan. The country is surrounded by the sea and there are many steep mountains. Also, there are many earthquakes and the high-speed rail system in Japan has been cultivated against natural disasters including large earthquakes. The countermeasures against earthquakes are proven technology, and they are expected to contribute to introduction of the Indonesian high-speed railway system. In addition, the Japanese high-speed rail system incorporates technology against steep sections which is adequately proven. In order to provide transport between Jakarta and Bandung in as short a time as possible, this technology will be very useful and will be utilized.

10.2.1 Earthquake Countermeasure System

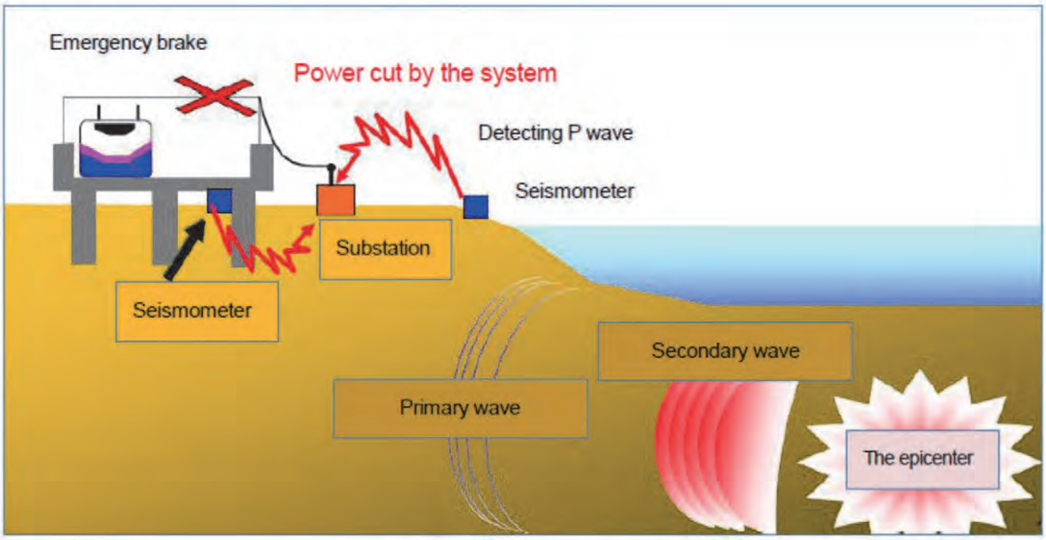
In Japan an early earthquake detection system is adopted in case of an earthquake. There are three principles that apply to countermeasures for earthquakes. They are as shown below:

1. Structures must not be broken.
   The structures are reinforced against earthquakes.
2. Trains must stop as quickly as possible.
   The train emergency stop system is introduced.
3. If a train leaves the tracks, the damage must be minimized.
   Trains must not be completely derailed.

(1) Early Earthquake Detection System in Outline

Coastline seismometers are installed at the coast to detect the primary wave (P wave). The train emergency brake is applied before the secondary wave reaches the lines.

When the seismometer detects the primary wave, it judges the affected area on the basis of the epicenter and magnitude. Next, it transmits a signal to cut off the power from the substation which is affected. The circuit breakers are opened to cut off the power at the substation after the substation receives the signal. It takes 2 seconds from detection of the P wave to activation of the breakers. The emergency brakes are applied automatically after the train detects the power cut.

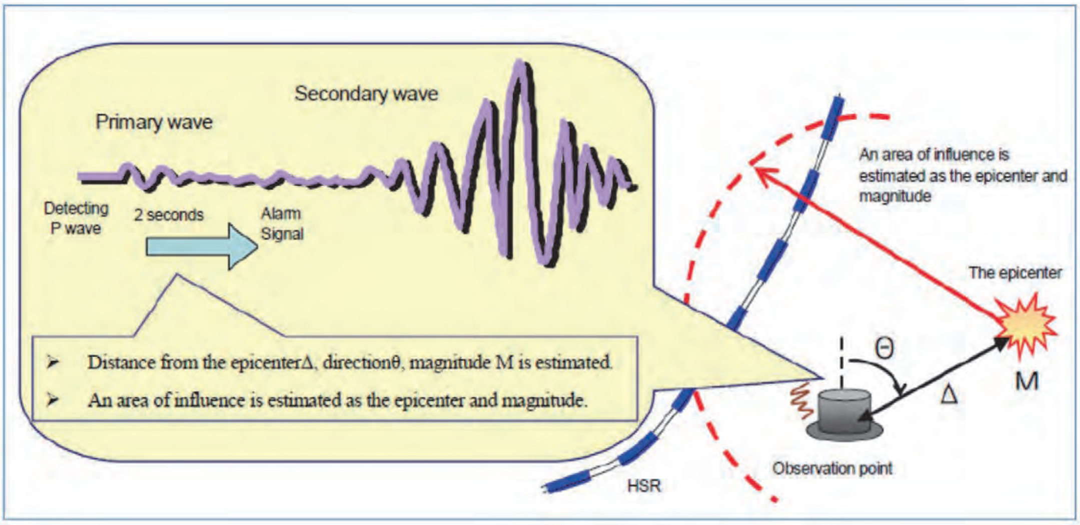


Source: JR East Railway Company

Figure 10.2-1 Early Earthquake Detection System

(2) Principle of Earthquake Early Warning from P Wave

The early earthquake system outputs an alarm at a single observation point. It estimates the epicenter distance (Δ) , direction (θ) and magnitude (M) after the seismometer detects the P wave. It judges the affected area on the basis of the epicenter distance and magnitude. Next, the circuit breakers are opened to cut off the power at the substation which is affected and the emergency brakes are applied automatically.



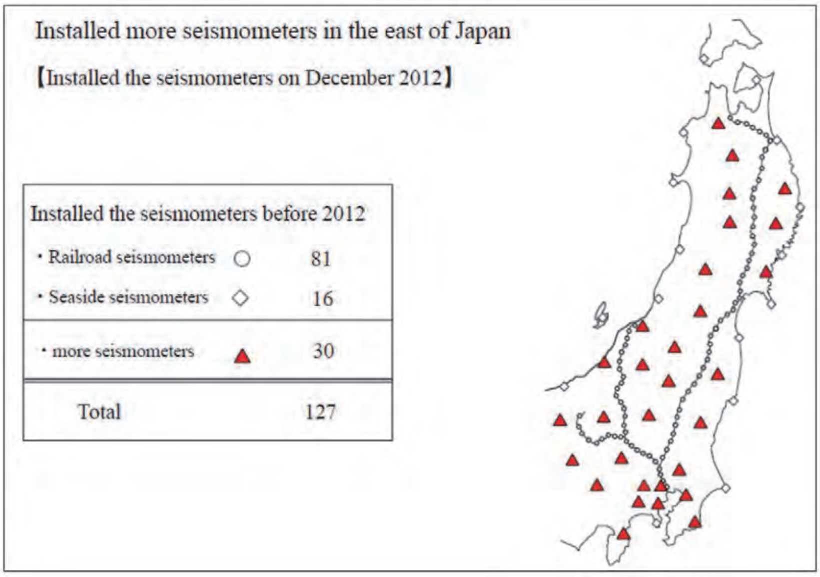
Source: JR East Railway Company

Figure 10.2-2 Principle of Early Earthquake Detection System

(3) Seismometry Network

A seismometry network is formed by the coastline seismometers and inland seismometers along the railway line. Figure 10.2-3 shows the additional seismometers installed by JR East Railway Company.

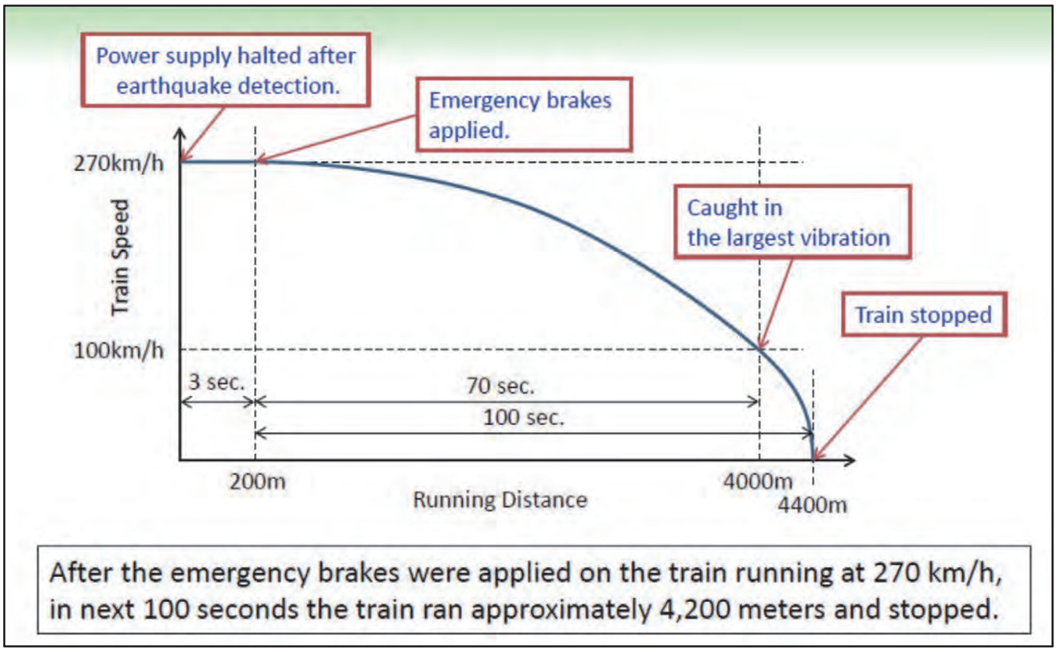
The coastline seismometers are basically installed every 50km on the coast and the inland seismometers are basically installed at the substations.



Source: JR East Railway Company

Figure 10.2-3 Additional Installed Seismometers

Figure 10.2-4 shows a graph of the train speed when the seismometer detects the P wave. The emergency brakes are applied three seconds after the power cut. When the secondary wave, the largest vibration, reaches the train, the train has reduced speed to 100km/h and the safety of the passengers is ensured.



Source：JICA Study Team

Figure 10.2-4 Train Motion in Great East Japan Earthquake

10.2.2 Countermeasures for Steep Sections

(1) Going Up Steep Sections

When going up a steep section, adequate adhesion between the wheels and the rails is needed. If the number of driving wheels is not enough for the load weight, the wheels may start to slip and the train cannot proceed up the steep section. A greater number of driving wheels is preferable for going up steep sections. Therefore, EMU type trains that have distributed driving axles are superior to locomotive hauling trains. Even in the case of the EMU, a large number of driving coaches is advantageous in order to ensure adequate adhesion.

In addition, capacity utilization of the motors may be higher on steep sections and this causes severe conditions for the motors. To counter this issue, measures are taken by connecting more driving coaches or improving the performance of the motor itself.

(2) Going Down Steep Sections

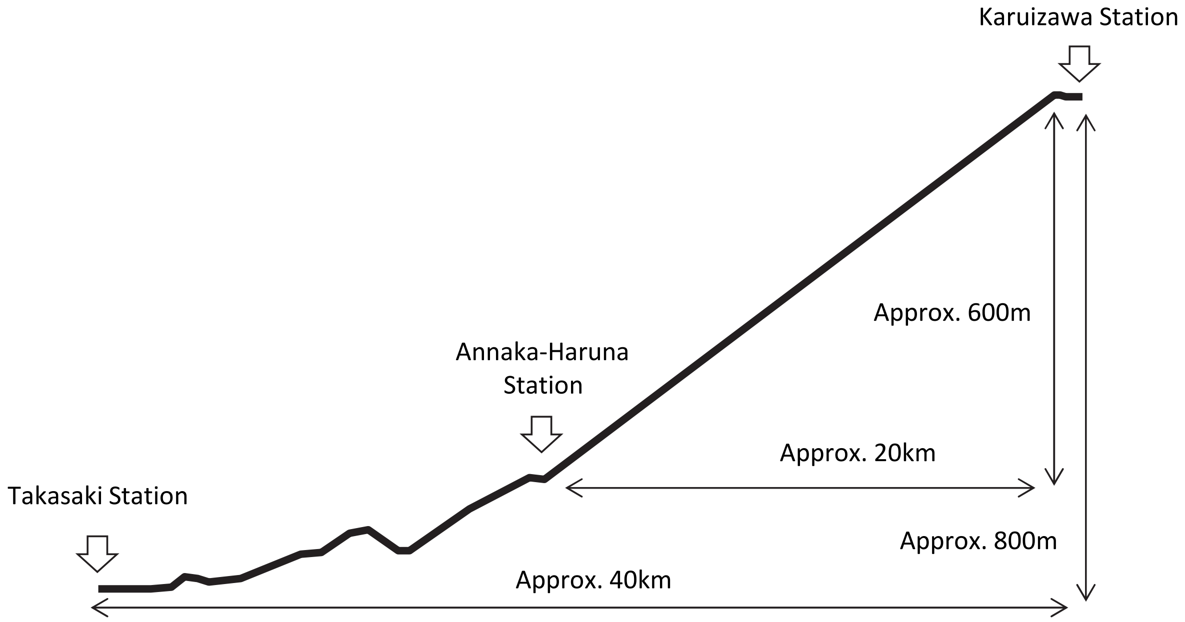
The issues when going down a steep section should be examined from the viewpoint of safety. If the braking performance is not adequate, the train will accelerate due to gravity and finally, the speed of the train will reach a dangerous velocity at the end of slope. Therefore, the issue is how to safely absorb the potential energy caused by the height difference.

Thanks to the development of semiconductor technology, it has become easier to convert this potential energy into electrical energy using the regeneration brakes. If the electrical facilities do not fail, this potential energy can be used effectively using this method. However, if some failure occurs in the electrical facilities, the mechanical brakes will absorb this potential energy because the regeneration brakes cannot be used.

From the viewpoint of safety, the temperature of the mechanical brake device should be kept at a certain value. Especially in the case of high-speed trains, the energy absorbed from the potential energy by the brakes tends to be larger than the energy emitted by heat radiation from the brakes because the faster the train speed on steep sections, the more potential energy the brake device absorbs. To solve this issue, a brake device that has an adequate heat radiation feature is required. In addition, a lighter car body is required to reduce the potential energy.

Figure 10.2-5 shows the longitudinal profile of the Hokuriku Shinkansen between Takasaki and Karuizawa. This section has a height difference of 800m over a 40km distance. Especially between Annaka-Haruna and Karuizawa, there is a continuous 30 permil steep section over a 20km distance.

The Japanese Shinkansen delivers adequate performance on this steep section and it has been proven. Therefore, it can be said that the Japanese Shinkansen is a reliable high-speed rail system for operation on steep sections.



Source: JICA Study Team

Figure 10.2-5 Longitudinal Profile of Hokuriku Shinkansen between Takasaki and Karuizawa

10.2.3 Countermeasures Against Disaster

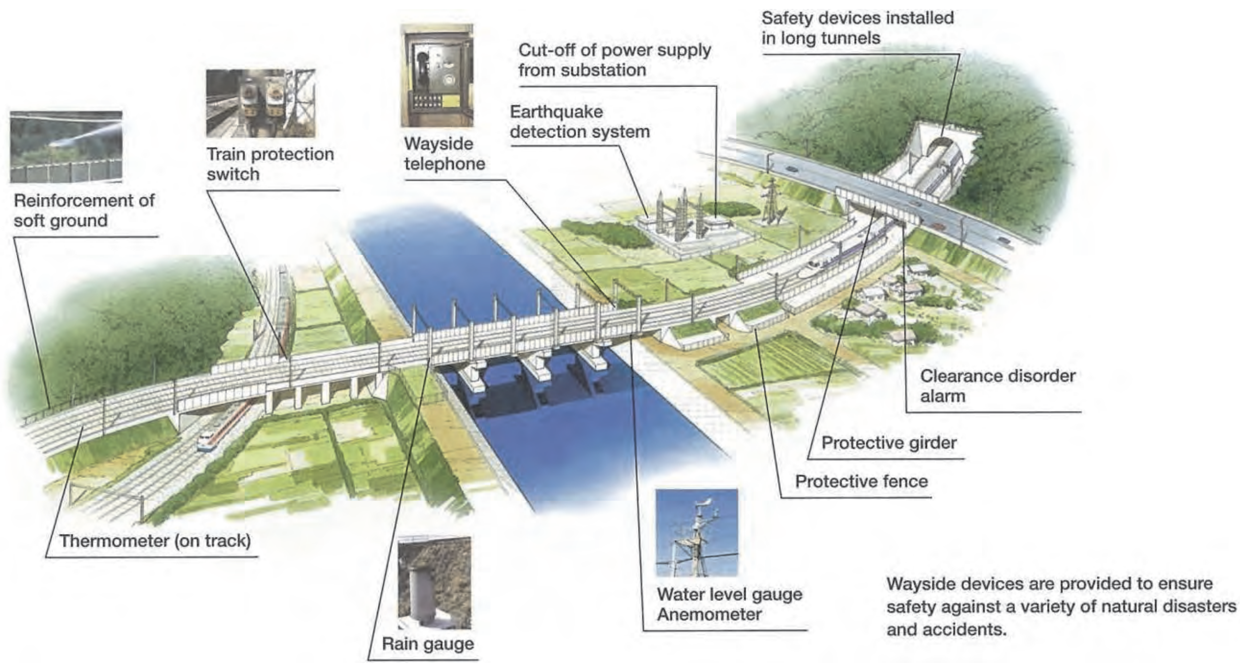
Japan is a mountainous island country. The terrain has many ups and downs. There are many disasters such as landslides, flooding and earthquakes in Japan. Railway lines have also been repeatedly affected by natural disasters. Detective devices to prevent damage due to disasters have been developed using Japan's rich experience.

The Japanese Shinkansen uses the following devices and countermeasures to prevent disaster damage.

Table 10.2-1 Wayside Shinkansen Facilities for preventing disaster damage

Reinforcement	Reinforcement of soft ground and embankments by sheet piles and tie-rods or retaining walls. From the experience of damage caused by past earthquakes, hoop reinforcement iron bars have been increased in the pillars of viaducts.
Train Protection Switch	If the maintenance patrol staff find any irregularity in the track or facilities, they push the train protection switch. The signal is sent to the train cabin and the train emergency brake is automatically activated.
Wayside Telephone	The maintenance patrol staff can communicate with the control center using the wayside telephones.
Cut-off of Power Supply at Substation	The power receiving circuit-breaker uses a conical spring operating mechanism in the gas circuit breaker. It can be operated from the control center.
Safety Devices Installed in	A train detector alarm is installed in tunnels.

Long Tunnels	In long tunnels, infrared sensors to detect train fires, strain gauges to measure deformation of the tunnel section or spring water gauges to measure the spring water amount are installed depending on demand.
Rail Thermometer	For the maintenance of the track, the rail temperature is automatically recorded.
Rain Gauge	To judge the risk of flood or slope failure, the continuous rainfall amount is measured automatically and an alarm is sent to the control center if the rainfall amount exceeds the set value.
Water Level Gauge	The water level of the river is measured and transmitted to the control center. The staff decide whether to reduce the speed or stop the train according to the river height.
Anemometer	Strong wind may upset the train. The anemometer notifies the wind velocity to the control center. If the wind speed exceeds the limit, the train speed is reduced or the train is stopped manually.
Protective Fence	To prevent people entrancing the Shinkansen tracks, the Shinkansen line is surrounded with a protective fence.
Protective Girder and Clearance Disorder Alarm	At the crossings with roads, protective girders and clearance disorder alarms are installed depending on demand. They protect cars from crashing into the girder or detect and notify the control center of any lack of clearance above the track.



Source: JORSA pamphlet

Figure 10.2-6 Wayside Shinkansen Facilities

10.3 Track Planning

10.3.1 Selection of Ballast or Ballast-less Tracks

It is necessary to determine whether to use ballast track or ballast-less track for the high-speed railway. In Japan, the Tokaido Shinkansen, the first high-speed railway which opened in 1964, has ballast track. Compared to slab track, ballast track has lower construction costs but higher maintenance costs over the long term. Therefore, when comparing the construction cost and maintenance cost, slab track is more advantageous. Basically, the Shinkansen uses slab track, which is ballast-less, for viaducts, bridges, and tunnels. In the last several decades, slab tracks have also been used on Shinkansen embankments and cuttings thanks to advances in embankment structure and reinforced roadbed designed for low-maintenance tracks. In addition, Taiwan and China, which have built and operated high-speed railways in recent years, also use mainly ballast-less tracks.

10.3.2 Recommendations for Track Structure of Java HSR Line

Based on the results of the comparison of the total cost mentioned above, although the labor wages, cost of materials, etc. in Indonesia are only a fraction of those in Japan, if these rates are applied to all the items, the years of investment returns tends to be somewhat longer but the slab track is deemed to be advantageous in terms of total cost. For this reason, we recommend slab track as the track structure for tunnel sections and viaduct sections where the roadbed is concrete. But for the sections where environmental consideration is required, the direct elastic fastening system is recommended.
We recommend using ballast track on embankments and cutting structures, car depots and maintenance depots. For the slab track, we recommend the frame-shaped slab.

Source: JICA Study Team

Figure 10.3-1 Framed-shaped Slab on Shinkansen Viaduct

We recommend the use of synthetic sleepers for main line turnouts because they do not warp, twist, corrode, or crack. The concrete roadbed sections will use a synthetic sleeper direct-coupling structure as the turnout structure. A movable nose crossing is recommended where the passing speed exceeds 130km/h.

Table 10.3-1 Track Structures by Line Type

Line classification		Main line			Side line		
		Main line	Passing track	Deadhead line	Storage line for arrival and departure	Regular side line	Maintenance depot line
Rail		60-kg continuous welded rail (using glued insulated rail for insulation)	60-kg continuous welded rail (using glued insulated rail for insulation) or standard size		Standard size of 50N or above		
Slab track	Slab type	According to the table of track slab sections between Mumbai and Ahmedabad			------------------------------		
Ballast track	Sleeper	43 P sleepers/25 m	43 P sleepers/25 m		42 PC sleepers/ 25 m or 42 Wooden sleepers/25 m		39 Wooden sleepers/25 m
	Roadbed thickness	Earth structure (reinforced roadbed) Ballast 300 mm		Ballast 200 mm			Ballast 150 mm
Turnout	Number	Standard tongue: #16 or above Crossing line: #12 or above Scissors: #16 or above Turnout to maintenance depot: #12 or above		#9 or above			#9
	Crossing	Movable nose crossing, but fixed crossing if V≦ 110km/h (manganese or welded)		Fixed crossing (manganese or welded)			Assembled
	Sleeper	Synthetic sleeper, but wooden sleeper for #9 (protective sleeper wherever needed)					
		If there is a turnout in the slab track section, direct fastening with plastic sleepers will be used.					

Source: JICA Study Team

10.4 Operation Planning

10.4.1 Types of trains

There are 3 types of trains to meet passenger demand. Table 10.4.1 shows the stopping pattern of each type of train. The results of demand forecasting show that over the half of the passengers will use the high-speed rail network for the round-trip Jakarta–Bandung section, so express trains connecting 2 stations directly without stopping at intermediate stations are necessary. Otherwise, an extra train is also necessary to meet surges in demand such as during Ramadan season.

Table 10.4.1 Pattern of stops

	Jakarta	Bekasi	Chikarang	Bandung	Gedebage
Local	●	●	●	●	→●
Express	●			●	→●
Extra	●			●	→●

Source: Study Team

10.4.2 Estimation of Traveling Time

Table 10.4.2 shows the traveling time between stations. These times are calculated according to the train performance curve based on the specifications of JR-East's E5 Series. The maximum traveling speed is 300 km/h.

Table 10.4.2 Traveling Times for Each Type of Train

Down		Station	Up	
Express	Local		Local	Express
		Jakarta		
10'00"	11'30"		12'00"	10'00"
↓		Bekasi		↑
3'30"	7'30"		8'00"	3'30"
↓		Cikarang		↑
23'30"	30'30"		31'30"	23'30"
		Bandung		
7'00"	7'00"		6'30"	6'30"
		Gedebage		
45'00"	59'30"	Total	61'00"	44'30"

*The arrows indicate that the train passes through the station without stopping
*The standing time at all stations is 60 seconds

Source: Study Team

10.4.3 Operation Planning

Figures 10.4.2 and 10.4.3 show the expected diagrams as of 2020 and 2050.

Table 10.4.3 shows the transport demand every 10 years after 2020 and key factors for train operation planning, with a passenger load factor of 60% ~ 70%. All calculated figures are based on demand forecast data. Figure 10.4.1 shows the train set procurement plan.

Table 10.4.3 Demand Forecast and Key Factors for Operation Planning

Year	Demand (persons)	Number of train sets			Number of trains in service*1	Transport capacity*2 (persons)	Remarks
		Regular	Extra	Total			
2020	39,000	5	2	7	70	45,325	Based on the expected diagram in 2020
2030	60,000	8	3	11	106	68,635	Estimated from demand forecast data
2040	97,000	14	4	18	204	132,090	
2050	126,000	14	4	18	204	132,090	Based on the expected diagram in 2050

*1 Excluding extra trains between Cikarang and Bandung

*2 All trains are operated with 12 cars, Transport capacity / 1 train is 925 persons. In case of 70% passenger load factor

Source: Study Team

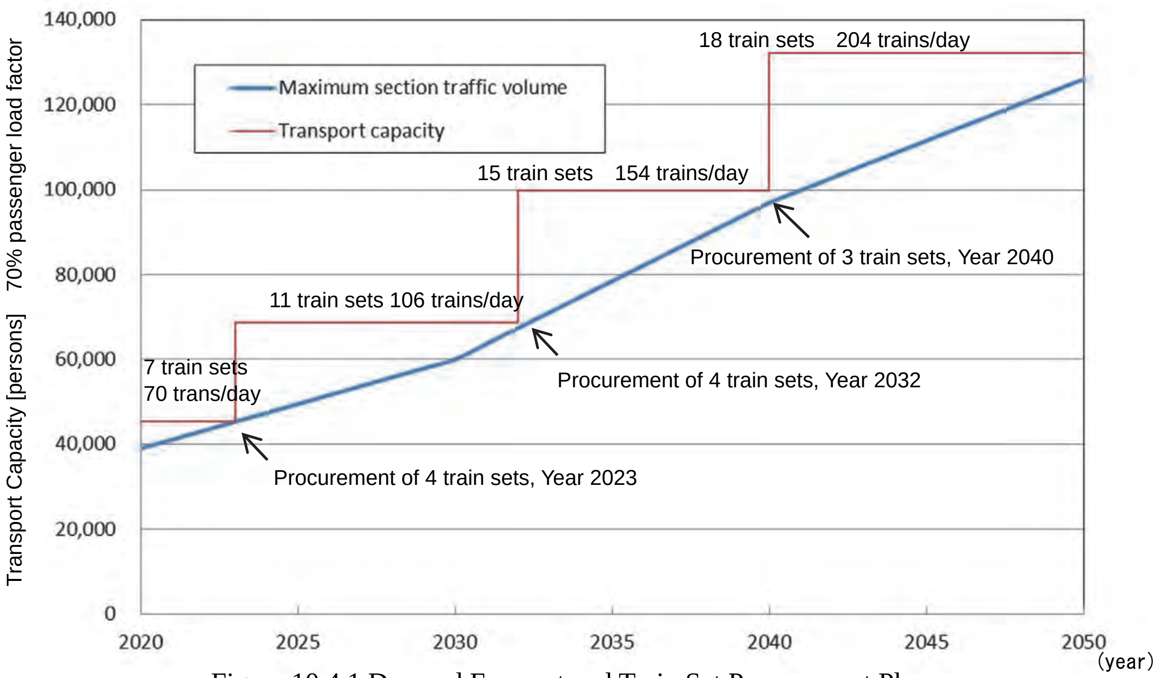
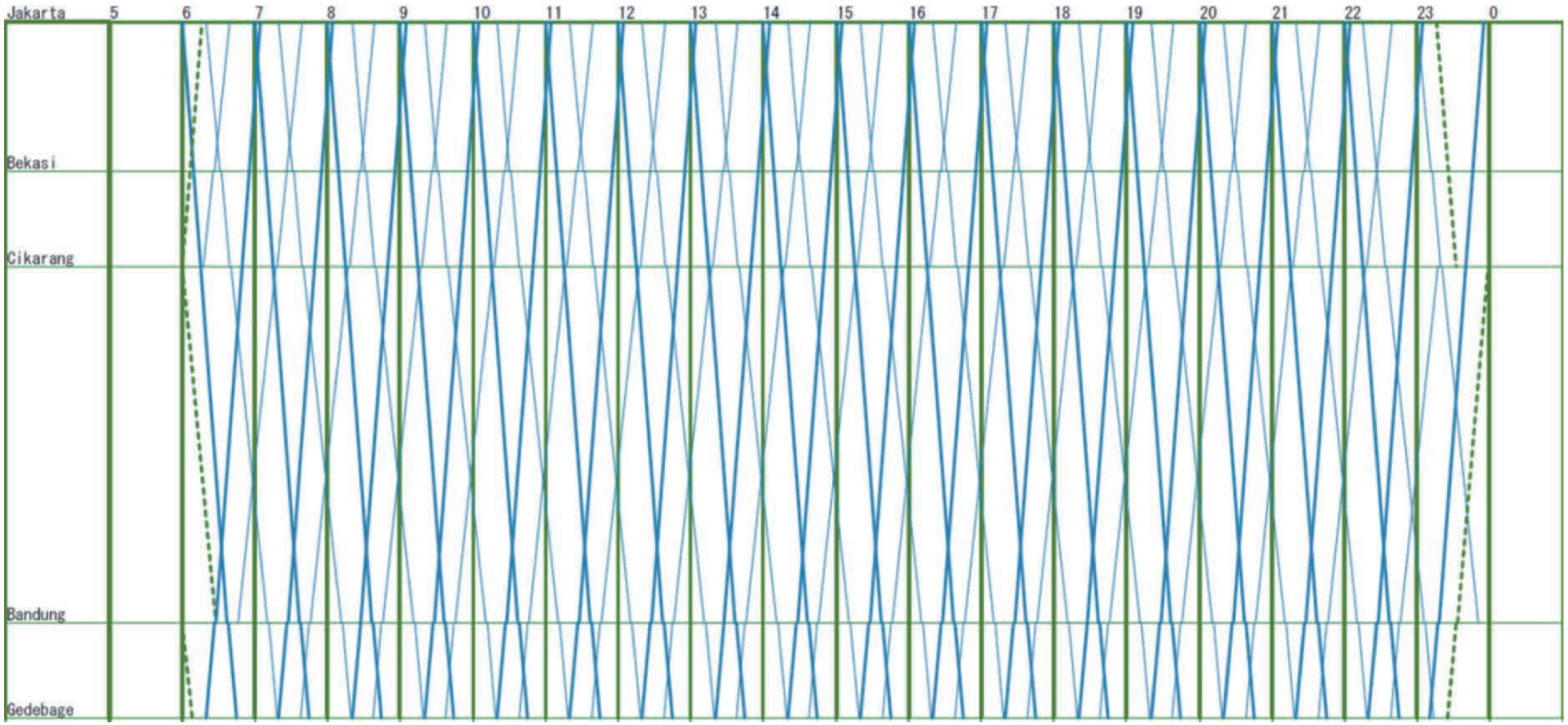


Figure 10.4.1 Demand Forecast and Train Set Procurement Plan

*Extra trains are not included in the maximum transport capacity

Source: Study Team



Bold line: Express Thin line: Local

Figure 10.4.2 Expected Diagram in 2020

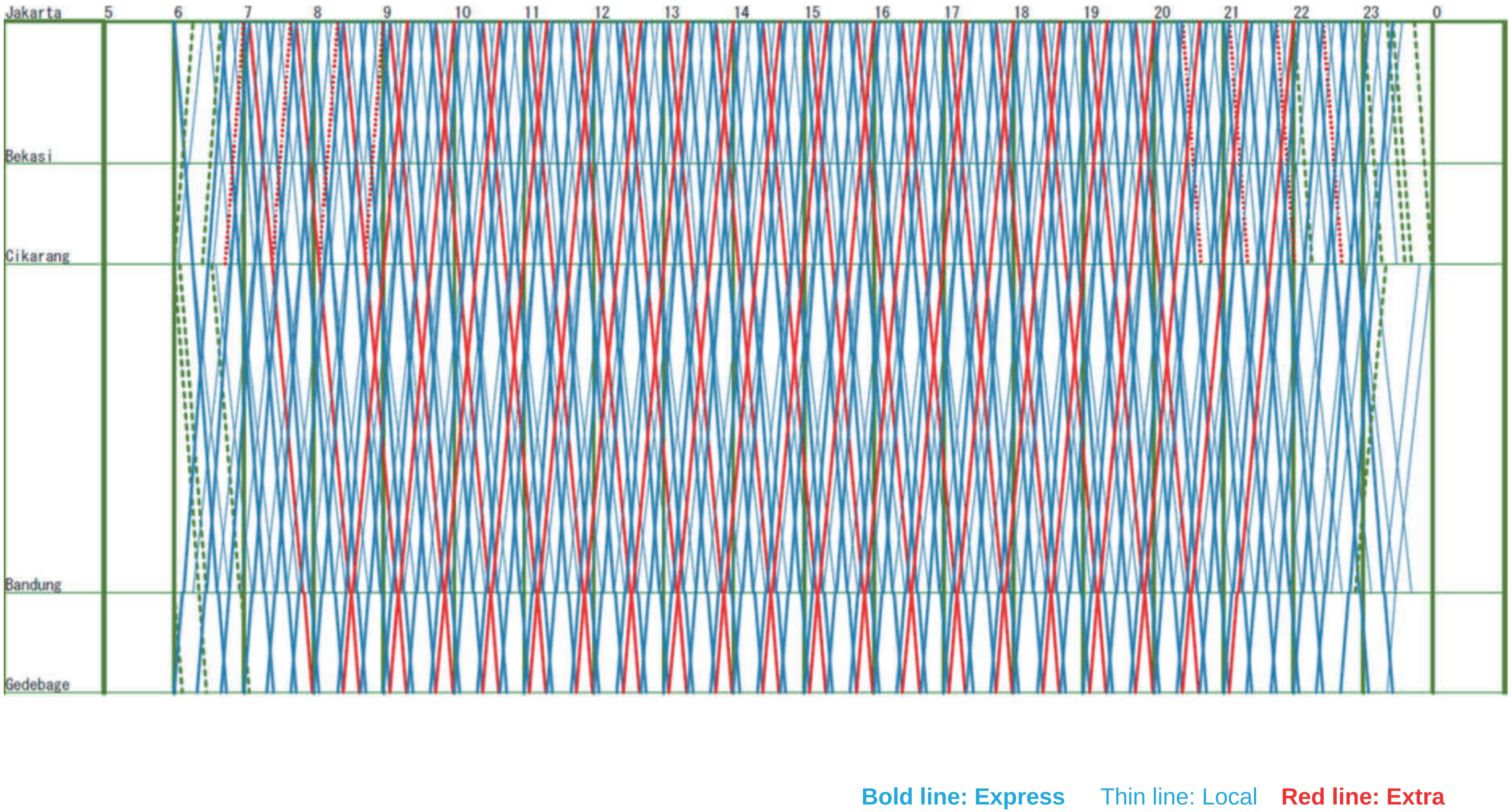


Figure 10.4.3 Expected Diagram in 2050

10.4.4 Impact of Manggarai Station Opening

Table 10.4.4 shows stopping pattern after Manggarai Station opening, which is planned in a future after HSR operation commencement. This station will be located on 3k960m from Jakarta Station. Table 10.4.5 shows the result of running time calculation in this case. If the dwell time is set as 60 seconds at this station, total running time between Jakarta and Bundung will need another 3 minutes 30 seconds additionaly compaired with the original plan which is shown on Tables 10.4.1 and 10.4.2.

Table 10.4.4 Pattern of Stops after Manggarai Station Opening

	Jakarta	Manggarai	Bekasi	Chikarang	Bandung	Gedebage
Local	●	●	●	●	●	→ ●
Express	●	●			●	→ ●

*There is no change for other type

Source: Study Team

Table 10.4.5 Traveling Times for Local & Express Train after Manggarai Station Opening

Down		Station	Up	
Express	Local		Local	Express
		Jakarta		
5'00"	5'00"		5'00"	5'00"
		Manggarai		
7'30" ↓	9'00"		9'30"	7'30" ↑
		Bekasi		
3'30" ↓	7'30"		8'00"	3'30" ↑
		Cikarang		
23'30"	30'30"		31'30"	23'30"
		Bandung		
7'00"	7'00"		6'30"	6'30"
		Gedebage		
48'30"	63'00"	Total	64'30"	48'00"

Source: Study Team

10.5 Rolling Stock Planning

10.5.1 Basic Specifications of Rolling Stock

The suitable conditions for the Indonesian high-speed railway network are considered as follows:

- Superior energy saving performance as a countermeasure against global warming
- Highly reliable operation on steep gradient sections
- Abundant proven countermeasures against earthquakes

Japanese Shinkansen trains satisfy the above conditions because of the following features:

- Regarding energy saving performance, Japanese Shinkansen trains are the most efficient transportation system due to mass transportation with 5 seats per row and low running resistance.
- Regarding steep gradient sections, the Shinkansen trains operate on a 20km 30‰ gradient section on the Hokuriku Shinkansen Line and a 35‰ gradient section on the Kyushu Shinkansen Line.
- Regarding earthquakes, since the Shinkansen system has an Early Earthquake Detection System and Derailment Prevention Guides as countermeasures against earthquakes, Japanese Shinkansen lines have achieved zero passenger fatalities in spite of the high frequency of earthquakes. There have been 29 earthquakes of magnitude-7 or higher in Japan since 2000.

The proposed train is based on Shinkansen trains and specifically the E5 Series which is the cutting-edge Shinkansen with a maximum operation speed of 320km/h.
Table 10.5-1 shows the specifications for the proposed train and Figures 10.5-2 and 10.5-3 show the exterior and interior images of the train.

Source: JR East Railway Company

Figure 10.5-1 Exterior image of train

Figure 10.5-2 Business Class
(2+2 seats per row)

Figure 10.5-3 Mono Class
(2+3 seats per row)

Source: JR East Railway Company

Table 10.5-1 Specifications of Proposed Rolling Stock

Item		Data
Track Gauge		1,435mm
Power Supply System		AC25kV/50Hz
Maximum Operation Speed		320km/h
Number of Cars per Train (Train Configuration)		12 cars (10M2T)
Maximum Train Output		12,000kW
Passenger Capacity		925 passengers per 12-car train
		Mono class: 5 seats per row
		Business class: 4 seats per row
		All reversible reclining seats
Maximum Axle Load (fully occupied)		14 tons or less
Principal Car Dimensions	Length (head/tail car)	26,500mm (head/tail cars) 25,000mm (intermediate cars)
	Maximum Width	3,350mm
	Maximum Height	4,490mm (Cars with pantograph), 3,650mm (Others)
	Distance between Bogie Center	17,500mm
Body Structure		Aluminum double-skin body (airtight body structure)
Bogie	Design	Bolsterless type
	Wheel Diameter	Φ=860mm
	Wheel Base	2,500mm
Propulsion System	Control System	IGBT PWM Converter/Inverter
	Traction Motor	Induction motor: 300kW
Brake System		Electric command air brake with regenerative brake
Traction and Braking Command Circuit		Digital transmission control and backup command line
Protection System		Single-step continuous (pattern) control by ATC

Source: JICA Study Team

Table 10.5-2 shows the passenger capacity of each car. The proposed train is planned so that the 7th car is business class and the other cars are mono class. In addition, 2 toilets are allocated at the back of odd number cars and the 8th car as the 7th car toilets are for business class passengers only. One of the two toilets in each car is for women only and a disabled stall is provided in the 5th car.

Table 10.5-2 Seating Capacity

Car Number	1	2	3	4	5	6	7	8	9	10	11	12
Class*	M	M	M	M	M	M	B	M	M	M	M	M
Capacity	30	100	85	100	60	100	55	85	85	100	85	40
Toilet	○	–	○	–	○	–	○	○	○	–	○	–

*M: Mono Class、B: Business Class

Source: JICA Study Team

10.5.2 Countermeasures for Environmental Issues

Tunnel boom and exterior noise have emerged as environmental issues of high-speed railways. However, the E5Series minimizes their harmful effect by the following countermeasures.

(1) Tunnel Boom

Tunnel boom is the phenomenon where sonic boom occurs at the exit of tunnels and the windows and doors of buildings near the exit vibrate when a train enters a tunnel at high velocity. Since optimizing the head car shape is an effective way of reducing tunnel boom, the E5 Series head car shape has been decided as the long-nose type shown in Figure. 7.8-4 by optimization through simulations and tests.

(2) Exterior Noise

Exterior noise from high-speed trains is a major environmental issue. Therefore, E5 Series trains are equipped with the following items to reduce exterior noise.

a. Low-noise pantographs and pantograph noise insulation panels

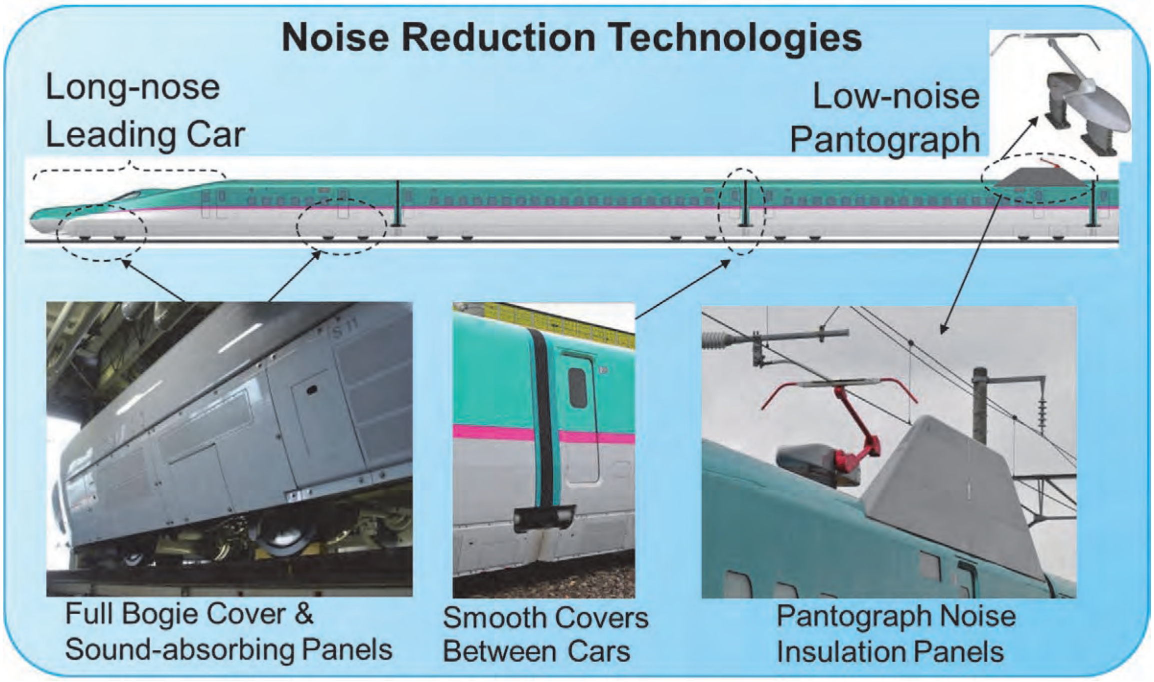
Low-noise pantographs dramatically reduce the aerodynamic noise and pantograph noise insulation boards enhance the noise-reduction effect of the pantograph.

b. Full bogie covers & sound-absorbing panels

Full bogie covers cut the machine noise from the tracks and sound-absorbing panels are installed on the covers as far as possible in order to achieve this effect.

c. Smooth covering between cars

Smooth covering between the cars reduces the aerodynamic noise from the join section. (The cover fully envelops the join between the cars.)



Source: JR East Railway Company

Figure 10.5-4 Countermeasures for Environmental Issues

10.6 Depots/Workshops

10.6.1 Basic Policy for Depots/Workshops

Maintenance (cleaning, inspection, and repair) is critical for securing the safety and maintaining the stability and comfort of the high-speed rail network. The Shinkansen maintenance system in Japan will be applied to the basic policy for the workshops. Highly efficient modern rolling stock maintenance depots / workshops will operate on the basis of heavy maintenance in the workshop and light maintenance in the depot.

(1) Securing of efficient and stable train operation:

Bogie inspection and overhaul which entails a large workload will be executed intensively in the workshop, while light maintenance will be done within a short time at properly located depots. Maintenance of parts appropriate to their reliability and durability will be executed according to the plan in the course of bogie inspection and overhaul, thereby minimizing the occurrence of unexpected inspection during operation or light maintenance. In this way, improvement of the efficiency of train operation and stable transport can be assured.

(2) Reliability enhancement through mechanization:

Rolling stock that runs at high speed is required to have high reliability. In particular, for the bogies, a high-level inspection system involving wheel tread control and ultrasonic flaw detection is required.

For this purpose, mechanization must be promoted to establish a high-precision inspection system so as to secure high reliability.

(3) Improvement of maintenance work efficiency:
To implement efficient inspection services, a system that enables inspections, such as bogie inspection (excluding overhaul), will be introduced in the workshop, enabling inspection without dividing the train into individual rolling stock. In this way, efficient operation of rolling stock will be secured.
In light of the above basic policies, an appropriate system for maintenance of HS rolling stock is to be provided.

10.6.2 Location of Depots / workshops in this Project

Depots should be located on both sides of the line for efficient operation, but the outskirts of Jakarta have undergone urbanization, so it is difficult to secure land for the depot near the city. For Bandung Terminal, land in Gedebage district is available, but it is not suitable for effective operation because the trains cannot be placed all together in one place. As a result of the line selection, Karawang area, which is located in the middle of the line and therefore presents little difficulty in operation, has been developed and maintenance work has gradually proceeded. Therefore, in this project the depot and workshop will be located in and connected to Cikarang Station.
Based on the results of the demand forecast, the layout of the facilities in the depot and workshop is determined by considering the length of 12 cars, or 300 meters. The series type places the stable line, inspection line, and heavy maintenance line straight, enabling the movement of trains to minimize the inspection and maintenance work in the depot. This type requires 2 kilometers of land linearly, and additional land 2.5 to 3 kilometers long and 100 to 150 meters wide including the approach from the main line. The rail maintenance depot is required to be located inside the depot, because a large rail maintenance car and machinery are used for the rail maintenance work for high-speed trains.

Source: JICA Study Team

Figure 10.6-1 Route of This Project

10.6.3 Design Conditions

- Target section and year

The target section is Jakarta – Gedebage.
The target year is 2050.

- Target car configuration and number of cars

2050 (Jakarta – Gedebage)

- 12 cars/train×18 trains = 216 cars

- Maintenance method

The number of cars is low at 216 cars. Therefore, there is a margin in the workshop plan. JST proposes the method of using repaired parts (not spare parts) from the above-mentioned. However, JST proposes the method of using spare parts for bogie maintenance for the improvement of operation efficiency.

- Bogie disassembly method

The number of cars is low at 216 cars. Therefore, there is a margin in the workshop plan. Therefore, JST proposes the method of disassembling the bogies by car. In the bogie inspection, JST proposes the method of disassembling the bogies using the bogie replacement system (pit type) which does not require division of the train. JST proposes the method of disassembling the bogies using the jacks for each car in the overhaul.

- Maintenance period

Table 7.9-1 below shows the maintenance period. The maintenance period for the new trains is based on the Japanese maintenance period, based on past experience, lessons-learnt and achievements.

Table 10.6-1 Maintenance Period

Category		Maintenance Points	Period	Venue
Light Maintenance	Daily Inspection	Supply and replacement of consumables, and inspection of operation and functioning of pantographs, running gears, brakes, door operating system, etc. Visual inspection mainly from the outside, according to the train usage conditions.	Less than 48 hours	Depot
	Monthly Inspection	Inspection of what is required for normal functioning of train, such as condition and functioning of pantographs, main circuit system, control system, brake system, bogies, and insulation of electric parts. Inspection of the bogies regarding the shape of the wheel tread and flaws in axles	Less than 30 days or 30,000 km	Depot
Heavy Maintenance	Bogie Inspection	Disassembly and inspection of main parts of bogies, e.g. wheel sets, wheels, driving device, brake system, main motors. Ensuring of efficiency of the inspection by using bogie replacement system.	Less than 18 months or 600,000 km	Workshop
	Overhaul	Detailed inspection of the main equipment disassembled from the cars. Repair and repainting of the bodies, and repair of the passenger cabin equipment.	Less than 3 years or 1,200,000 km	Workshop
Other Maintenance	ATC Inspection	Inspection of the condition and characteristics of onboard ATC equipment	Less than 90 days	Depot
	Extraordinary Inspection	Ad hoc inspection whenever necessary, e.g. at the time of equipment breakdown	Whenever necessary	Depot
	Wheel Re-profiling	Keeping the wheel tread and flange in good shape using wheel re-profiling machines.	In accordance with the re-profiling schedule and whenever necessary	Depot

Source: JICA Study Team

- Cleaning period

Table 10.6-2 below shows the cleaning period. The cleaning period for new trains is based on the Japanese cleaning period and current practices in Indonesia.

Table 10.6-2 Cleaning Period

Type		Period	Cleaning Content
Cleaning	Turn back cleaning	Every turn back and every depot entry	Picking up trash
	Daily cleaning	At same time as daily inspection	Interior cleaning (wiping the floor, windows, etc.). Exterior washing (front and rear).
	Monthly cleaning	At same time as monthly inspection	Interior cleaning (wiping and waxing the floor, windows, wall panels, hand-rails, passenger seats, etc.) Exterior washing (all car body and windows).
	Automatic train washing	Every daily and monthly inspection	Washing of car sides by automatic train washing machine

Source: JICA Study Team

- Hours required for maintenance

Table 10.6-3 below shows the hours required for maintenance.

Table 10.6-3 Hours Required for Maintenance of HSR

No	Category	Required Hours or Days	Work Days/Week
1	Daily Inspection	2 hours	7 days
2	Monthly Inspection	1 day	6 days
3	Bogie Inspection	4 days	6 days
4	Overhaul	24 days	6 days
5	Wheel re-profiling	3 days	6 days

Source: JICA Study Team

- Hours required for cleaning

Table 10.6-4 below shows the hours required for cleaning.

Table 10.6-4 Hours Required for Cleaning

No	Category	Required Hours or Days	Work Days/Week
1	Daily cleaning	2 hours	7 days
2	Monthly cleaning	1 day	6 days
3	Automatic train washing	10 min	7 days

Source: JICA Study Team

- Yearly work days and work hours

The yearly work days and work hours are specified below. They are based on current practices in Indonesia.

- Daily inspection, extraordinary inspection, daily cleaning : 365 days/year, 24 hours/day
- Monthly inspection, bogie inspection, overhaul, wheel re-profiling, monthly cleaning : 294 days/year, 8 hours/day

10.6.4 Scale of Depot/Workshop

The scale of the depot/workshop required for periodic inspections can be calculated when the km/day travelled by the train and the inspection period are determined. The items (required hours or days, yearly work days and work hours, etc.) required for the scale assessment method were determined to calculate the scale of the train depots and workshops. This resulted in the scale of the depot / workshop shown in Table 10.6-5. The Workshop Car Plan for 2050 is shown in Table 10.6-6.

Table 10.6-5 Scale of Depot / Workshop (2050)

Type of Inspection Work	No. of Cars x No. of Trains	No. of Cars in Train	No. of all Trains	No. of Trains Operated	Daily Train Running Distance	All Train Running Distance	Yearly All Train Distance	Overhaul Recurrence km Recurrence Months	Main Component Inspection Recurrence km/day Recurrence km	Admittance Ratio 365 day Recurrence	Upper Level Admittance Ratio	Yearly Inspected Trains	Yearly Inspected Cars	Days in Shop	Admittance Fluctuation	Yearly Fluctuation Inspected Trains	Yearly Work Days	Admittance Pitch Days	Simultaneous Trains	Simultaneous Cars at Facility	Remarks
		(Cars)	(Trains)	(Trains)	(km/day)	(km/day)	(km/year)	Recurrence km/day	Recurrence months			(trains/year)	(cars/year)	(days)		(trains/year)	(days/year)	(days/train)	(trains/day)	(cars/day)	
Overhaul						km type		1,200,000	1,096												
	216	12	18	14	2284	1,776.5	648,423	36	Limited to ___km	0.56	0	10.1	121.2	24	1.15	11.6	294	25.3	0.9	11.4	
Bogie						km type		1,096	600,000												
Inspection	216	12	18	14	2284	1,776.5	648,423	Limited to ___km	18	1.12	0.56	10.1	121.2	4	1.15	11.6	294	25.3	0.16	1.9	Excluding Overhaul
Monthly						km type		30,000	1,000												
Inspection	216	12	18	14	2284	1,776.5	648,423	30	Limited to ___km	22.44	0.56	393.8	4,725.9	1	1.15		294	0.6	1.5		Excluding Overhaul
Daily														2h/8h							Excluding Overhaul
Inspection		12	18					2		192.11	21.88	3,064.1	36,768.9	0.25	1.15		365	0.1	2.4		and Monthly Inspection
Monthly																					
Cleaning			18							22.44	0.56	393.8		1	1.15		294		1.5		Excluding Overhaul
Daily														2h/8h							Excluding Overhaul
Cleaning			18					2		192.11	21.88	3,064.1		0.25	1.15		365		2.4		and Monthly Cleaning
Automatic														10m/60m/24							
Train Washing			18					2		192.11		3,457.9	0.0	0.0069444	1.15	3,976.6	365	0.1	0.1		
Extraordinary										2%											
Inspection	216	12	18							0.02		0.4	4.3	10	1.15		365	881.6	0.011	0.1	
Wheel														(0.5*4*8)h/8h							
Re-profiling	216	12	18	14		1,776.5	648,423	150,000		4.32		77.8	933.7	3	1		294	3.8	0.8	9.5	

Source: JICA Study Team

Table 10.6-6 Workshop Car Plan (2050)

Working Day			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
Heavy Maintenance	Overhaul		R.I				Diassemble					Paint					Assemble						Test			T.R	R.I				Diassemble					Paint					Assemble						Test			T.R		
	Bogie Inspection														1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24														
															Bogie Change			T.R																					Bogie Change			T.R										
Preparation track	Receiving Inspection		1																							1																									
	Overhaul																			1	1	1	1	1	1	1																		1	1	1	1	1	1	1		
	Bogie Inspection																	1																								1										
	Total	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	1	0	0
Heavy Maintenance Track	Overhaul				1	1	1													1	1	1							1	1	1													1	1	1						
	Bogie Inspection														1	1	1																						1	1	1											
	Total	0	0	0	1	1	1	0	0	0	0	0	0	0	1	1	1	0	0	1	1	1	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	1	1	1	0	0	1	1	1	0	0	0	0	0	0

Note: R.I: Receiving Inspection, T.R: Test Run, Source: JICA Study Team

- Necessary number of tracks for maintenance and cleaning

As mentioned above, the necessary number of tracks for maintenance and cleaning in 2050 is shown in Table 10.6-7 below.

Table 10.6-7 Necessary Number of Tracks for Maintenance and Cleaning

<table>
<tr><td colspan="4">Year 2050</td></tr>
<tr><td>Daily Cleaning</td><td rowspan="4">3 Tracks
(Common use)</td><td>Overhaul</td><td>1 Track</td></tr>
<tr><td>Monthly Cleaning</td><td>Preparation</td><td>1 Track</td></tr>
<tr><td>Daily Inspection</td><td>Extraordinary Inspection</td><td>1 Track</td></tr>
<tr><td>Monthly Inspection</td><td>Wheel re-profiling</td><td>1 Track</td></tr>
<tr><td>Bogie Inspection</td><td>1 Track</td><td colspan="2"></td></tr>
</table>

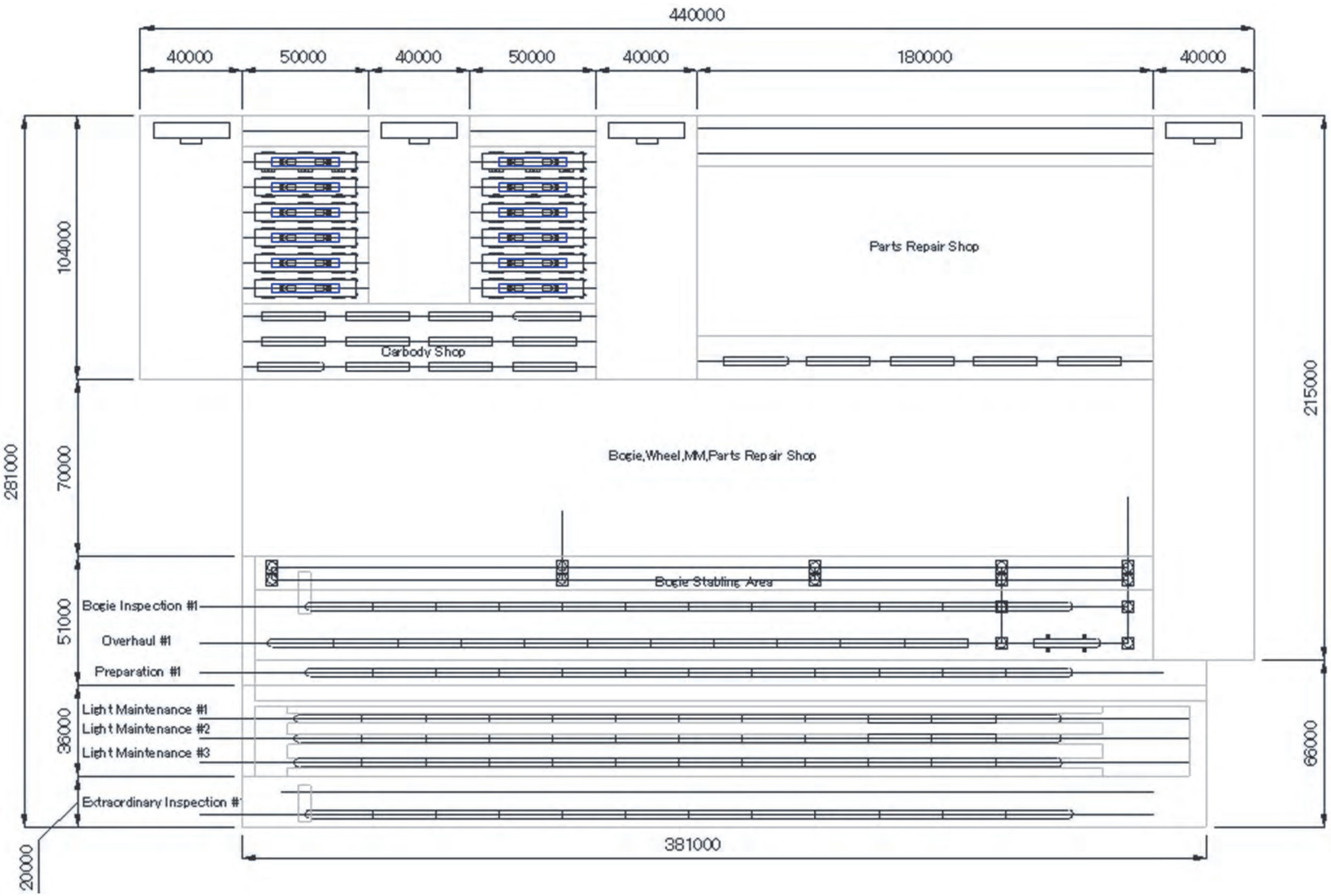
Source: JICA Study Team

- Necessary number of tracks for stabling

Based on the train operation plan, 18 train-sets will be required for operation in 2050. Therefore, in an emergency case scenario, the depot/workshop will require the capacity to stable 18 train-sets. The depot/workshop has the capacity to stable 4 train-sets (daily and monthly inspection tracks : 2 tracks, extraordinary inspection track : 1 track, preparation track : 1 track) without stabling tracks. Therefore, the required number of tracks for stabling will be 14 in 2050.

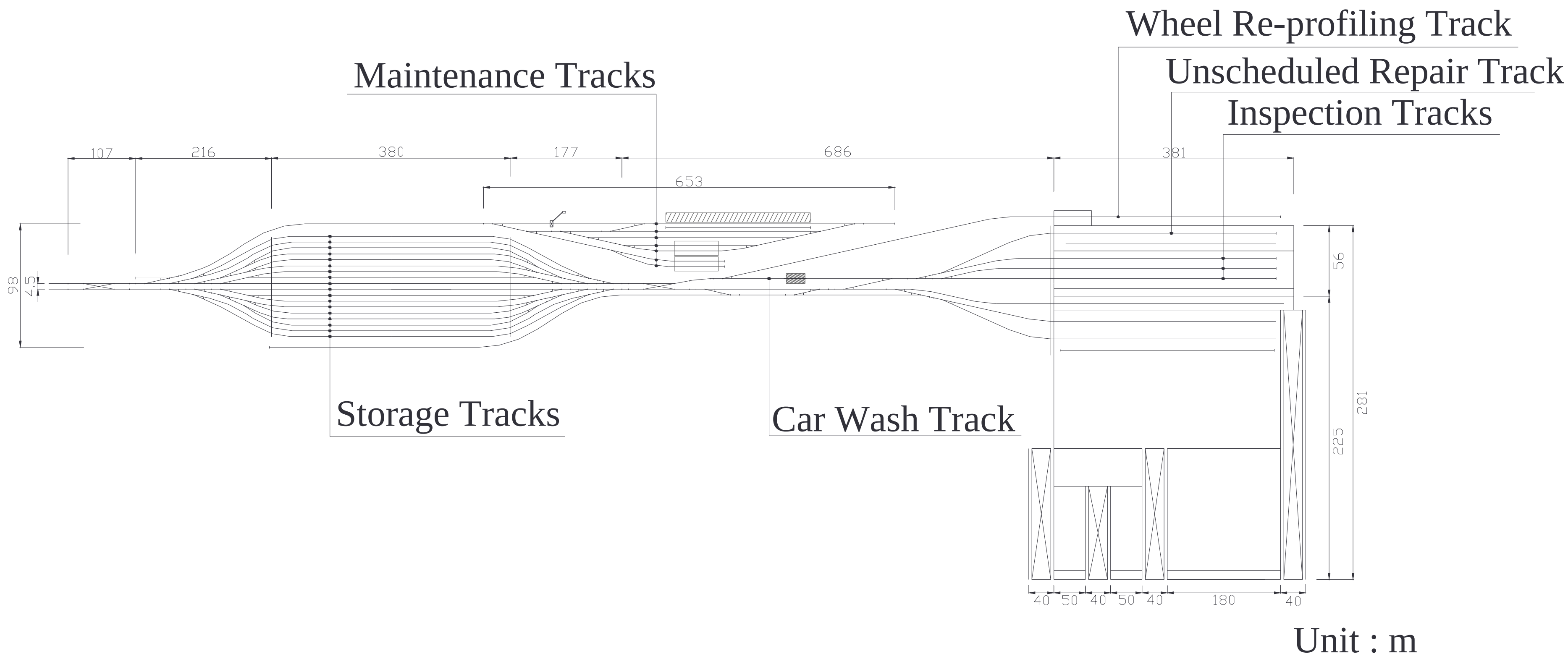
10.6.5 Layout in Main Workshop

A car body repair shop, paint shop and bogie repair shop will be required for inspection, maintenance and cleaning of HSR in the depot/workshop without the above tracks. In this case, the shops for maintenance and cleaning work (light maintenance, heavy maintenance, extraordinary inspection, etc.) need to be contained in the same building (the so-called Main Workshop). However, the light maintenance shop and heavy maintenance shop will enable work simultaneously in separate areas for operational efficiency. JST proposed the layout of the main workshop and the general layout of the depot/workshop shown in Figures 10.6-2 and 10.6-3.



Source: JICA Study Team

Figure 10.6-2 Layout of Main Workshop



Source: JICA Study Team

Figure 10.6-3 General Layout

10.7 Depot for Infrastrucure Maintenance

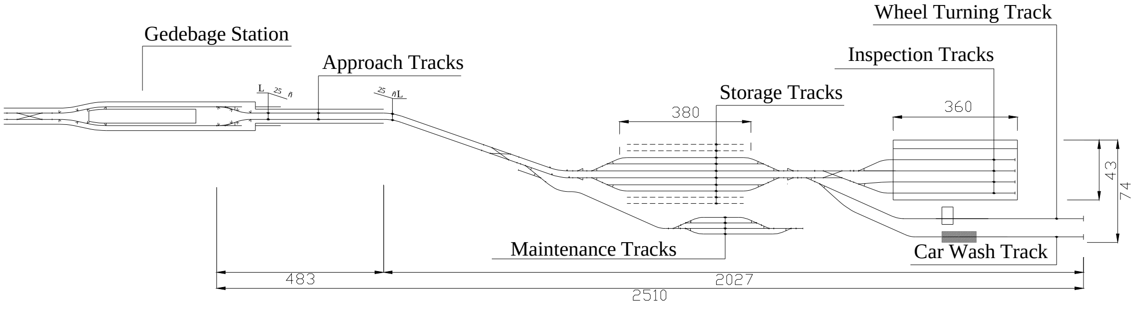
Since the infrastructure maintenance for Shinkansen is performed with installing a lot of machines, an infrastructure depot is needed for place of storage for heavy equipment for maintenance track and electric facility, inspection, preparation to exchange materials and stock of equipment.

(1) There are two types of infrastructure depot. One is a renewal depot and other is a general depot. The renewal depot is a main depot during exchanging materials and it has equipment for reshipment materials, such as rails, turnouts and crane equipment, and storage for maintenance car and storage truck group and inspection and repair truck group. The general depot is used as a staging base and it has a place for storage and inspection and repair and storage place for some materials.

(2) The distance between infrastructure depots tends to be generally located with a distance of from 30 to 50 km between each infrastructure depots because of huge quantities of works are completed in consideration of works such as meeting, exchange heavy equipment, transport and track possession period of 6 hours per day. In addition, alternately locating each depot is desirable.

(3) A wiring for infrastructure depot is needed storage track for material of track and electricity facility and storage and maintenance track for maintenance vehicle in consideration of structure of truck and maintenance period.

Location and size for the infrastructure depot will be decided after deciding the route for high speed railway and the maintenance plan. Infrastructure depot will be constructed adjacent to the rolling stock depot because there is room in planed rolling stock depot.
The layout for infrastructure depot at Cikarang depot shows Figure 10.6-3. In the future, the infrastructure depot will be constructed at Gedebage depot. (Figure 10.7-1)



Source: JICA Study Team

Figure 10.7-1 Gedebage Depot Layout

10.8 Substations and Catenary System Planning

(1) Outline

From an electrical point of view, an electric railway system consists of three main components: rolling stock, fixed equipment (traction power substations and overhead catenary system or OCS) and HV national grid feeding into the railway. Rolling stock characteristics and traffic patterns will determine the power demand of the catenary system of the railway line. Locomotives provide motive power for the rolling stock and generate reactive power and harmonics (power fluctuations and abnormalities that create harmonics which can severely distort the power supply and cause problems for others connected to the same source) which will be taken into account in the fixed equipment. The national grid will supply the necessary traction power demand and will have to supply the reactive power for the OCS and locomotives depending on their drive systems. Harmonic currents will be injected into the OCS and the national grid via the traction transformers. Most importantly, unbalanced voltage is created as explained below.

(2) Feeding System

The feeding system will be a 2×25kV feeding system. This system allows a long distance between substations. There is little EMI. It is easy to consider the receiving points to which power is supplied.

(3) Incoming Voltage

Generally, Japanese AC power substations for high speed railways are supplied by a power company. The incoming voltage is 275kV or 220kV or 154kV. The incoming voltage of Java high speed railways is 150 kV in accordance with the results of the meeting with PLN.

(4) Standard Voltage

The standard voltage for the AC feeding system is shown in Table 10.8-1. The voltage is established by IEC.

Table 10.8-1 IEC Standard Voltages

Electrification system	Lowest Permanent Voltage	Nominal Voltage	Highest Permanent Voltage
AC 25kV feeding system	22.5 kV	25 kV	27.5 kV

Source: IEC 60850 Ed.2

(5) Substation

a) Design criteria

The criteria for substation design, i.e. deciding on the intervals between substations and the capacity of the rectifiers, are as follows:

- When one substation is down, the neighboring substations are able to compensate;

In compliance with IEC standards, the voltage of the contact line should not be permissive.

b) Location of substations

The locations of the substations should meet the following conditions:

- Accessible from the road;
- Easy land acquisition;
- Grid connection to a power company is available.

The locations of the substations will be so that electricity can be supplied from PLN substations in accordance with the meeting results of the meeting with PLN if required.

c) Calculation of voltage drop

The maximum interval distance between the substations was determined by calculating the contact line voltage to meet the above-mentioned criteria. Although the permissive lowest voltage of the contact line is AC 22.5 kV as per the design criteria, the voltage drop is calculated to secure more than AC 23 kV for the contact line to ensure a margin.

d) Capacity of transformer

The capacity of the transformers was calculated based on the conditions mentioned in the previous section and the assumptions are shown in Table 10.8-2. The estimated power demand and transformer capacity are shown in Table 10.8-3. The main operation loads are the signaling and telecommunication equipment. The traction and operation loads are supplied with power by the transformers.

Table 10.8-2 Key Assumptions for Determining the Capacity of the Transformer

Item	Value
Acceleration power	14.4[MW]
Power of auxiliary circuit of rolling stock	2.3[MW]

Source: JICA Study Team

Table 10.8-3 Estimated Power Demand and Transformer Capacity

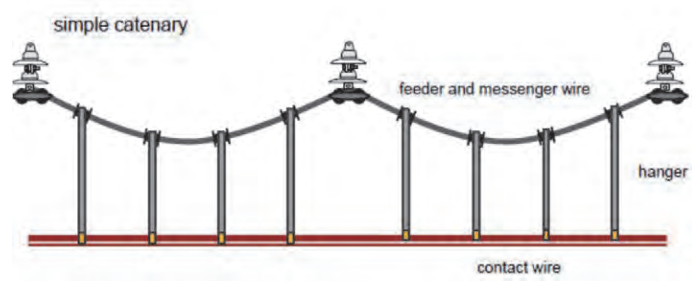
Item		2020-2049	After 2050
Substation for main line	Traction	32[MVA]	55[MVA]
	Operation	10[MVA]	10[MVA]
Substation for Depot	Traction	40[MVA]	55[MVA]
	Operation	10[MVA]	10[MVA]

Source: JICA Study Team

(6) Catenary System

A simple catenary system will be adopted for all lines, main lines and depot and storage tracks. The span between the poles will be 60 meters because the wind speed for operation control is 20m/s.

Table 10.8-4 Outline of Overhead Catenary System

Type	Feature	Application
	This is the simplest type of catenary system.	Main line Workshop/depot Storage track

Source: JICA Study Team

(7) Distribution System

Low voltage of AC 220 V for single phase and AC 380 V for three phases for all electrical facilities, will be supplied from the substation. The substation will be supplied with power from the traction substation or the grid. A transformer for the substations changes the high voltage to low voltage.

A parallel system should be adopted because the signaling loads are important for operation.

Medium voltage cables for two circuits will be laid between the traction substations and the transformer for the signaling equipment. One line will be live and the other will be a standby. A substation at each station will supply power to the station facilities. The power to the substation will be supplied by PLN.

(8) Electromagnetic Interference (EMI)

a) General

Generally speaking, electromagnetic interference (EMI) is disturbance that affects the electrical circuit due to either electromagnetic conduction or radiation emitted from the power supply system. The effect of EMI on other equipment in external systems depends not only on the emission level of the EMI source, but also on the distance to the object in the external system. The causes of electrical disturbance are classified according to two physical phenomena, i.e. (i) electromagnetic induction and (ii) electrostatic induction.

b) EMI countermeasures

In Japan EMI was reduced when the AC 2×25 kV system was adopted. One of the reasons is that the protecting wires (PW) have an electromagnetic shielding effect. In addition to moving the object and protecting it with a shield, EMI can be prevented.

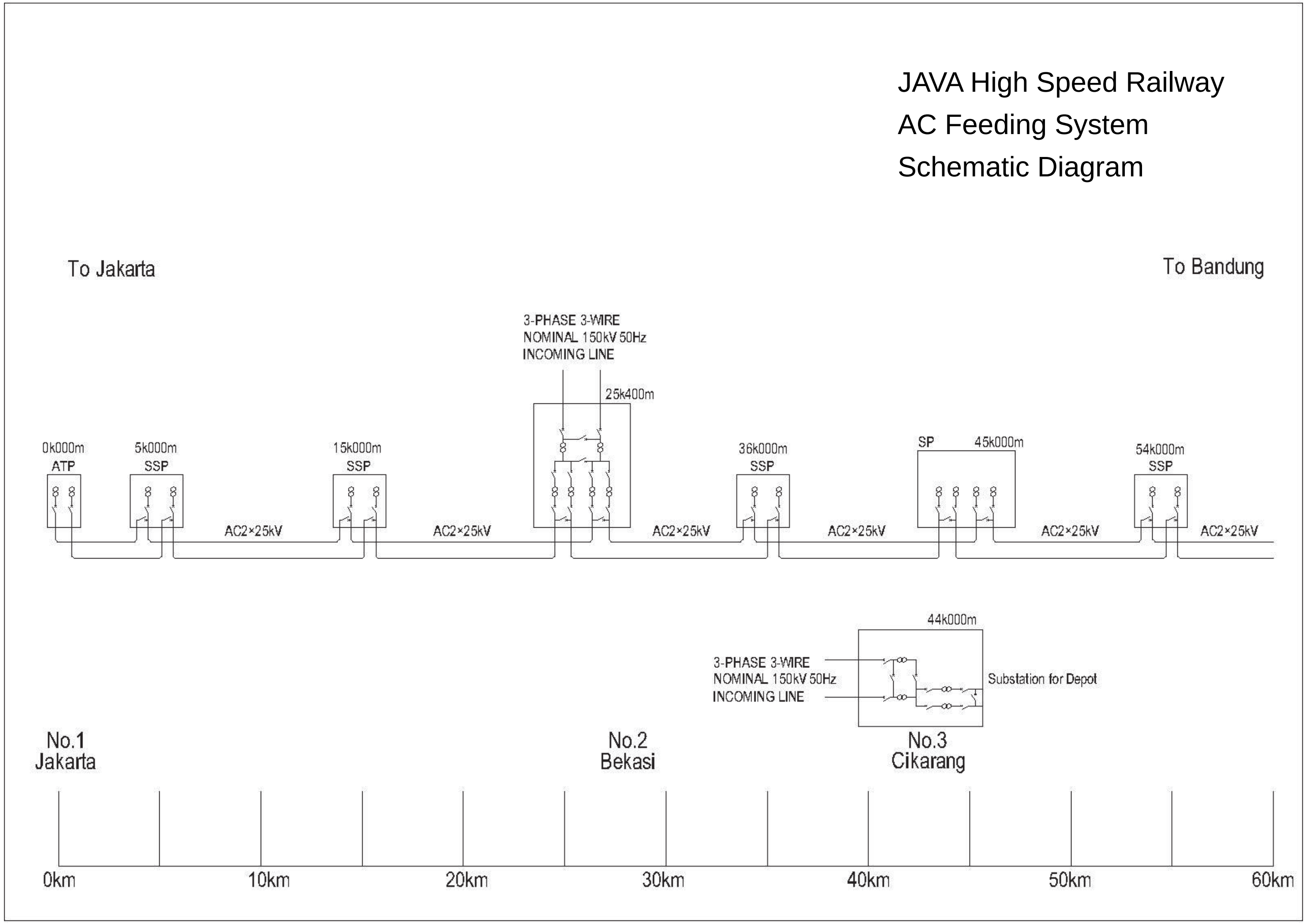
(9) Substations, Distribution and Catenary Systems

For the above reasons, the system should be recommended for Java high-speed railways as shown in Table 10.8-5. Schematic diagrams are shown in Figures 10.8-1 to 10.8-3.

Table 10.8-5 Substations, Distribution and Catenary Systems

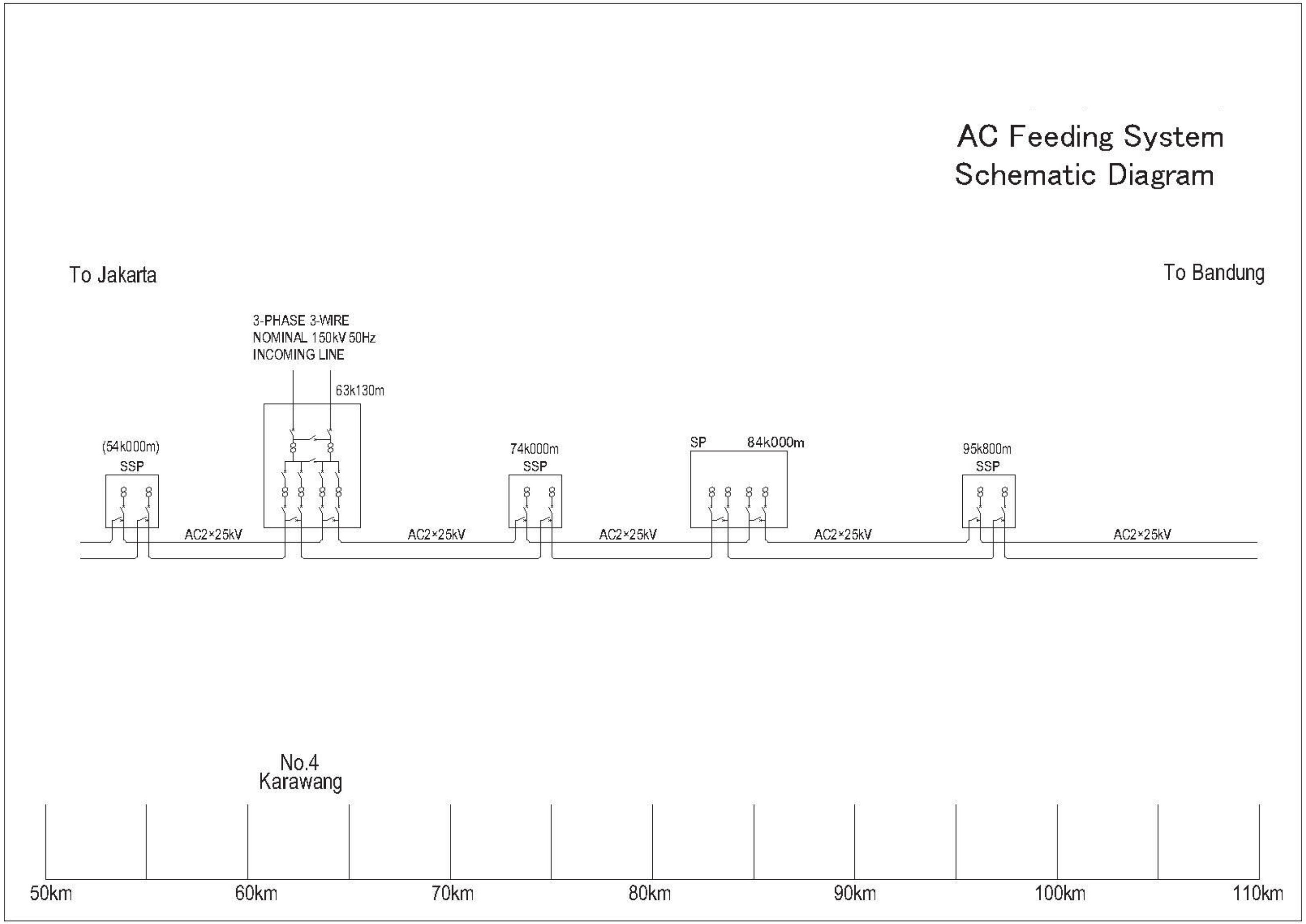
Criteria		Specifications
1. Average distance between substations Number of substations required for Java high-speed railway		Approx. 50 km Four substations for the main line One for workshop/depot
2. Feeding System		AC 2×25kV
3. Catenary system		Simple catenary system
4. Span between poles		60 meters
5. Substation	Incoming voltage	150kV
	Transformer for traction power	120MVA
	Transformer for operation equipment	10MVA
	Main transformer	Roof-delta
6. Section type		Change-over section
7. Distribution system		Parallel system

Source: JICA Study Team



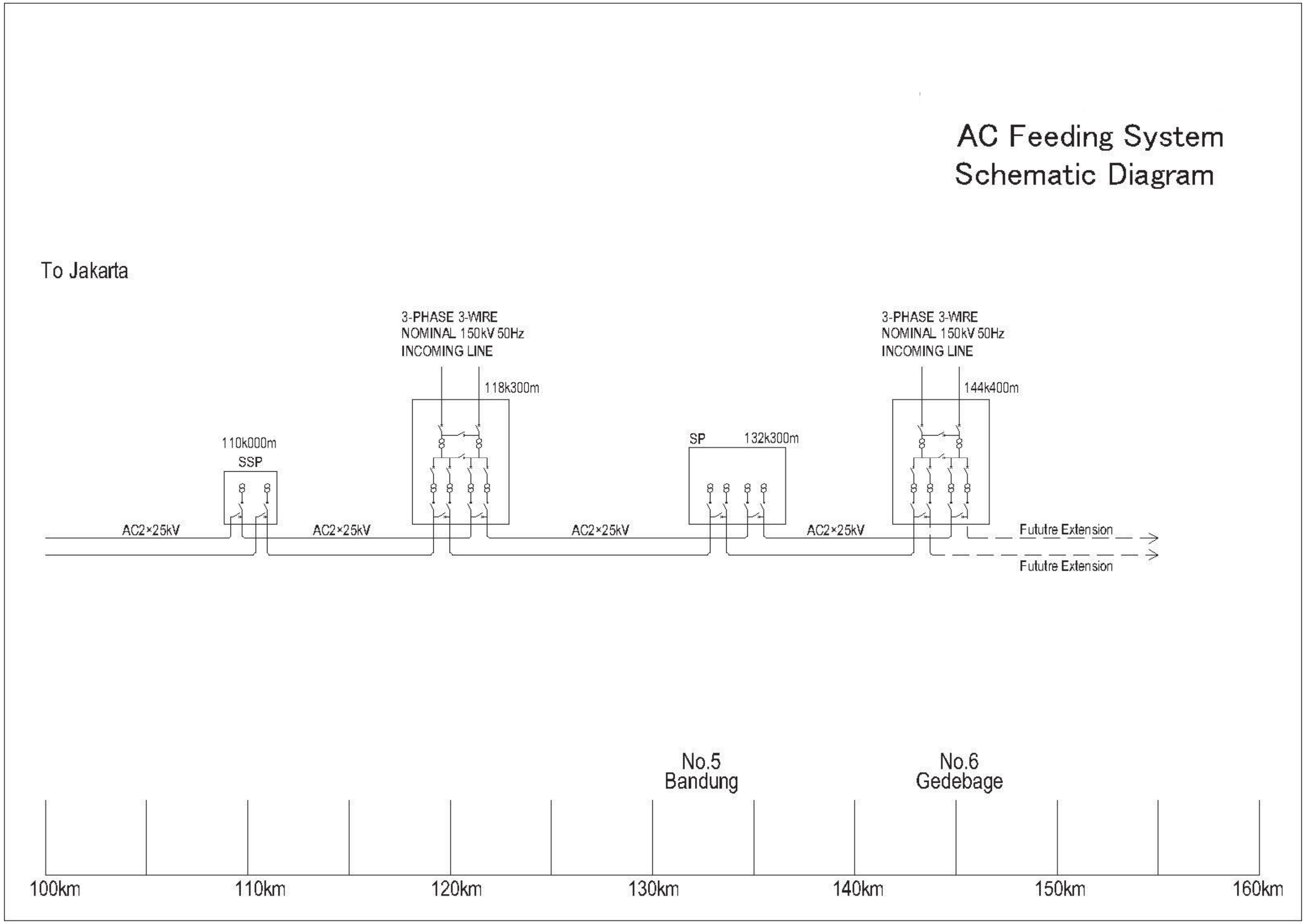
Source: JICA Study Team

Figure 10.8-1 AC Feeding System Schematic Diagram



Source: JICA Study Team

Figure 10.8-2 AC Feeding System Schematic Diagram



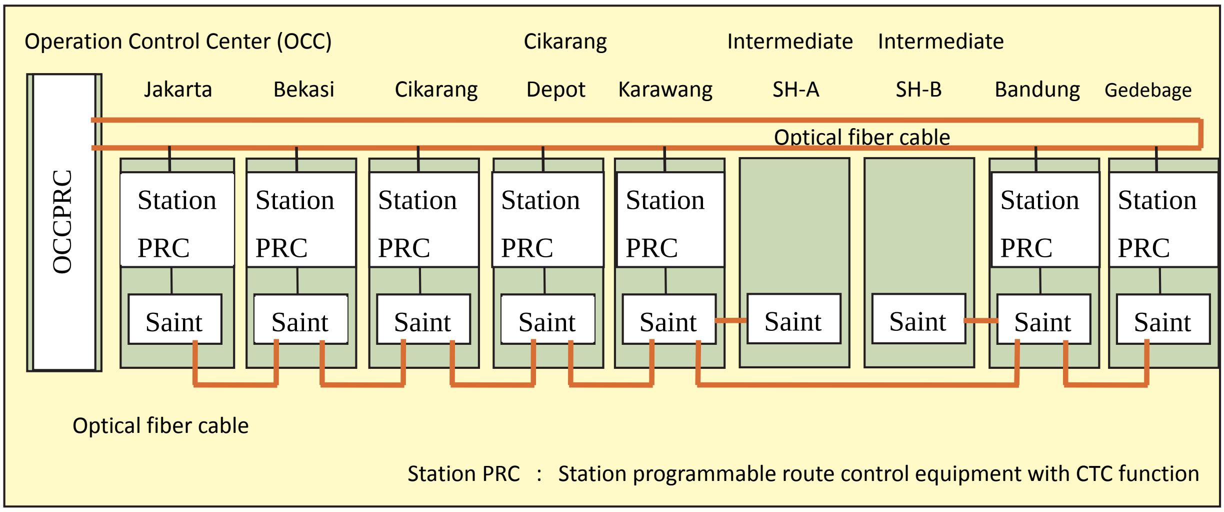
Source: JICA Study Team

Figure 10.8-3 AC Feeding System Schematic Diagram

10.9 Signal & Telecommunication Planning

10.9.1 Signal Planning

To ensure the safety and reliability of HSR operation, DS-ATC which has been installed on the Tohoku Joetsu Shinkansen operated by JR East should be introduced for signaling. The system consists of Station Programmable Route Control (Station PRC) equipment with centralized train control function and ATC interlocking combined logic controller (Saint) which have been installed on this line. The signal plan between Jakarta and Gedebage is shown in Figure 10.9-1, and an overview of DS-ATC signaling is shown in Figure 10.9-2, and details of the signal facilities will be given later.



Source: JICA Study Team

Figure 10.9-1 Signal Plan between Jakarta and Gedebage

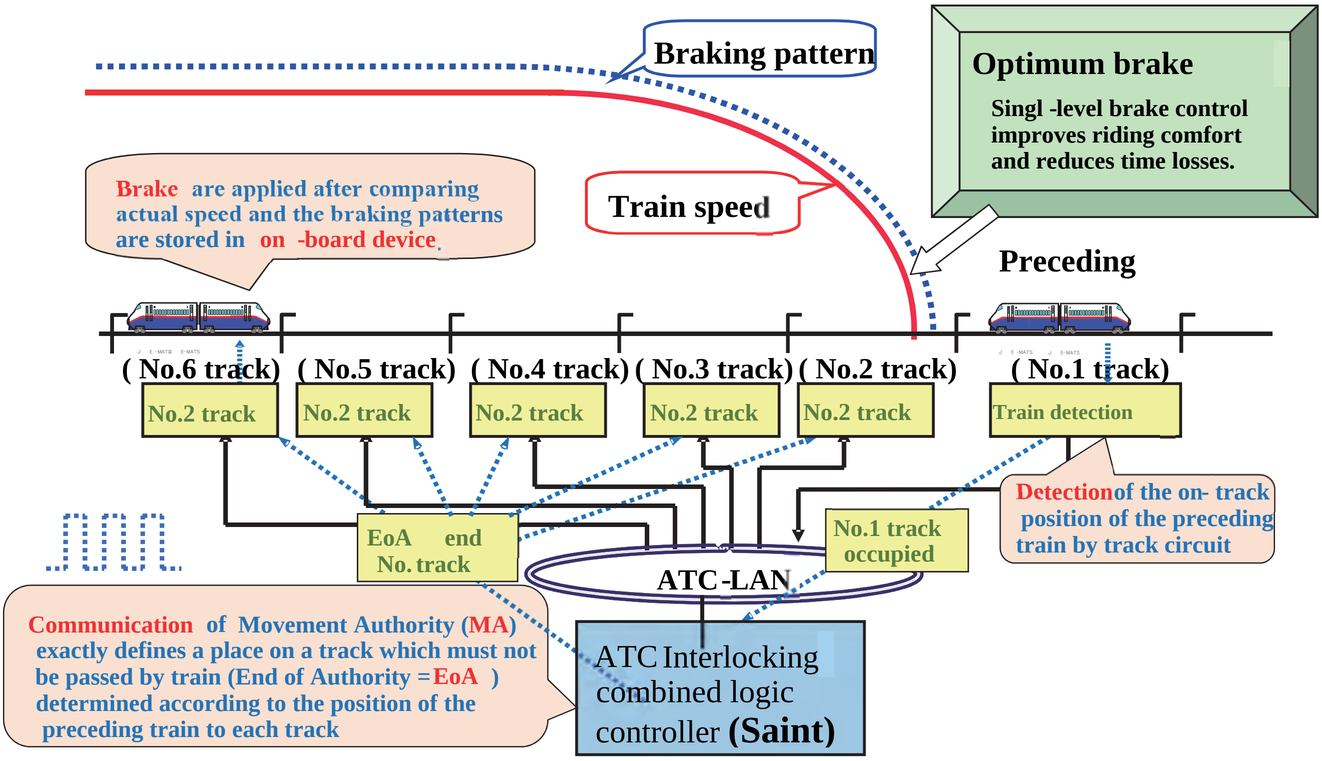


Figure 10.9-2 Overview of DS-ATC Signaling

Source : JICA Study Team

(1) Automatic Train Control (ATC) System

DS-ATC by digital data transmission mainly using onboard brake control patterns provides adequate brake control to ensure smooth deceleration in one stroke, starting at any point appropriate to the brake performance of the car toward the target point, based on the position of the preceding train which is transmitted as digital data information and the train’s own position which is detected by onboard equipment. Optimum brake control appropriate to the performance of the individual car enables shortening of the arrival time with less brake loss and improvement of riding comfort.

ATC equipment will be installed in the signal equipment room at each station. If the inter-station distance exceeds 35km, an intermediate signal equipment room will be provided. For the digital ATC ground device, a dual or triple redundant system will be employed to maintain the higher value of Mean Time Between Failure (MTBF). The ATC power supply will need a backup system for power failure, because of the importance of availability of the system. ATC indoor equipment and external equipment are insulated by means of the isolation transformer and lightning arrester, ensuring insulation coordination.

The necessary ATC route will be set up depending on the route alignment of each station. An ATC route between stations will be provided for the forward route only. (There will be no backward operation except in the case of disruption, e.g. failure of the signal equipment.)

(2) Interlocking

The interlocking system is for interlocking the switches on the route and the train detection system with the signal aspect in the station and workshop/depot for safety purposes. For this HSR, an electronic interlocking system with general-purpose use computer control which has a high level of safety and reliability for high-speed high-density HSR operation and is able to realize maintenance work route control, etc. will be employed. The system will also integrate the ATC logic and interlocking logic as the ATC interlocking combined logic controller (Saint).

(3) Centralized Train Control System

Station Programmable Route Control (Station PRC) equipment with Centralized Train Control (CTC) functions that enables serial data transmission with the transport operation control system, etc. will be employed.

Dedicated optical fiber cable will be installed between each station and OCC by railway company, ensuring high speed with high reliability data transmission.

(4) Switches

The switches are for switching and locking the turnouts. For the turnouts on the main track, TS-series electric switches which have a successful track record on Shinkansen turnouts will be used. In order to achieve insulation coordination, the switch control relays will be concentrated in the signal equipment room. By means of the isolating transformer, the equipment within the signal equipment room is protected from damage by grounding of the power line. For turnouts in the maintenance depot outside the main tracks, etc., NS-series electric switches will be used.

(5) Train Detection System

The train detection system will employ track circuit with a proven track record in HSR the world over and capable of detecting rail breakage. Insulated track circuit will be provided in the station yard while uninsulated track circuit of the voltage receiving type will be provided between stations. The track circuit will use the same signal (audible frequency band, AF wave) as the ATC signal. The track circuit in the rolling stock depot will be track circuit with the same signal as the ATC signal for the section from the main track to the arrival track. Other track circuits will be 83.3 Hz track circuits.

(6) Signal Cable and Cable Duct

- For the ATC signal transmission cable between the signal equipment room (where the equipment is concentrated) at each station and each track circuit, SQECA cable with electromagnetic induction shield will be used for signal transmission cables of 3km or more and SQEE cable will be used for signal transmission cables of less than 3km.
- SEVP cable will be used for the power supply and the control cables for the electric switches, etc.
- For inter-station data transmission by the transport operation system and ATC devices, etc., optical fiber cable will be used.
- For the benefit of maintenance, the signal cable will be housed basically in the cable trough or cable duct. Where the cable crosses under double tracks (e.g. from the up-line side to the

down-line side) at elevated line sections, the cross-under cable duct will be buried in the elevated line construction. This cross-under cable duct will be installed every 500m between stations.

(7) Train Protection Switches

Train protection switches will be provided over the entire route, enabling the train to be put into emergency stop when the maintenance staff detect any abnormality in the equipment, rolling stock, etc. during track route inspection. Emergency stopping of the train will be enabled when the switch is activated by the maintenance staff. The train protection switches will be provided at 500m intervals between stations, 150m intervals within the station yard, and 50m intervals on the platforms.

(8) Feed Division Control Track Circuit

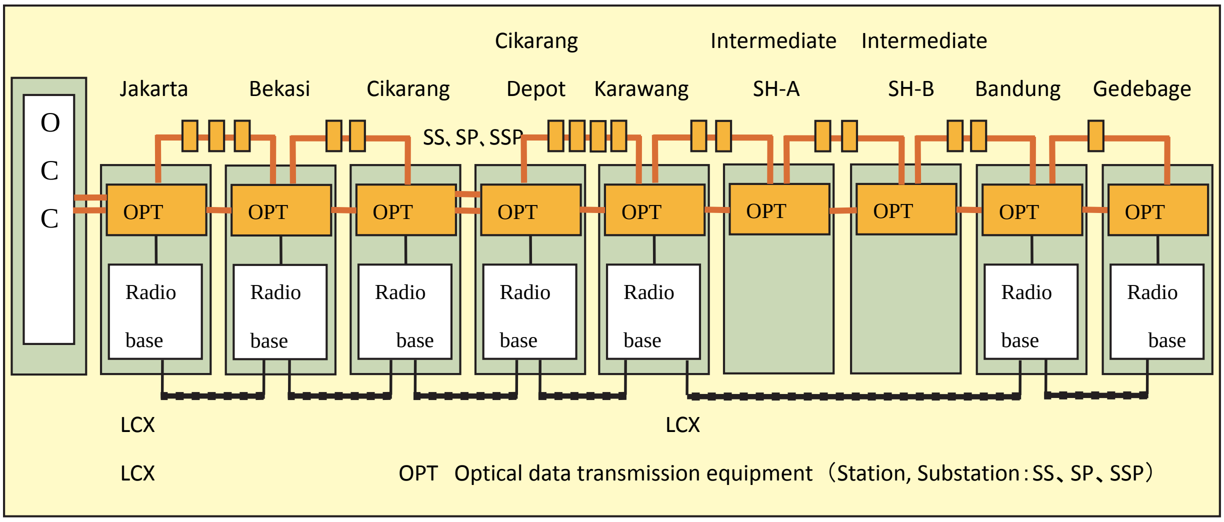
The automatic feed division system will be provided to enable the trains to pass, in power running and regenerative modes, through the different-phase power supply butting section at substations and sectioning posts. For this control, the feed division control track circuit will be provided. This system is necessary for the changeover sections. Unlike dead sections, constant application of voltage to the catenary will enable utilization of the early earthquake detection system.

(9) Clearance Obstruction Detecting Device

This will be provided in locations where derailment may occur on the adjacent conventional line and obstruct the clearance with the HSR tracks or on an overpass. If the device detects something obstructing the clearance, the ATC ground device will send the emergency stop signal to all block sections near the obstructing point, causing emergency stop of moving trains.

10.9.2 Telecommunication Planning

To ensure safe and punctual train operation and to provide passengers with satisfactory services, it is essential not only to transmit various information at high speed and in large amounts, but also to provide passengers with this information in a readily understandable way. The structure of the telecommunication system proposed for this HSR is shown in Figure 10.9-3 and the details are described below.



Source: JICA Study Team

Figure10.9-3 Structure of the Telecommunication System between Jakarta and Gedebage

(1) Train Radio

The train radio is used for communication between the train dispatcher in the operation control center and the train crew. The train radio is of the duplex operation, digital transmission type with Private Leaky Coaxial cable (LCX).

The method using LCX, which was originally developed for train radio, offers a large number of data channels, enabling communication of operation commands to the cab, passenger information, on-board internet service, etc. Note that LCXs are installed on double routes on each track side of HSR to ensure the reliability and punctuality of data transmission. As frequency bands of 2 GHz or less are widely used for commercial purposes in Indonesia, it is necessary to select a private frequency band before introduction of this train radio system.

(2) Trunk Transmission System

For HSR, the fiber-optic communication system with synchronous digital hierarchy (SDH) not affected by induction will be employed as the trunk transmission system because high circuit demand is expected. The ring consists of a 10G main system and 150 M sub-system, so that the failure of one item of equipment will not affect the overall system. The fiber-optic communication system will be installed at each station, rolling stock depot, operation control center, substation, sectioning post, sub sectioning post, etc. as necessary.

(3) Disaster Detection System

As for the disaster detection system, the following devices will be provided and the alarms will be displayed in the operation control center.

- Wind observation device

  The wind observation device observes the wind velocity which is converted into the frequency for transmission to the required point to ensure alarm sounding and recording.

- Rainfall monitor

  Rainfall meters are installed and, on the maintenance section, indicators and recording alarms will be provided to enable monitoring. Restrictions on train operation due to rainfall are made on the basis of the overall conditions based on the current rainfall/hour and continuous rainfall since the rain started, etc.

- Rail temperature alarm

  The long-rail temperature alarms will be provided to enable rapid and adequate countermeasures in case of sudden temperature rise.

(4) Measures against Various Disturbances

This HSR project uses AC25kV, so measures must be taken to prevent electromagnetic induction interference for the communication lines of the telecommunication carrier and electric power company. It is also necessary to provide the houses along HSR tracks with measures to prevent interference.

10.10 Architecture

10.10.1 Basic Policy of Station Building Planning

When designing HSR stations, not only is provision of the facilities necessary for operation important, but also the size of the open space, clarity of movement flow, transfer to cars and MRT, since many passengers move at the same time with a lot of luggage.

Streamlining passenger flow and attracting people to surrounding commercial facilities greatly affects the success of the business. The relationship with the surrounding environment including the station plaza, roads, other modes of transportation and commercial development is particularly important for HSR station planning. Spatial planning which is not completed inside the station shall be noted for HSR stations.

(1) Featuring elements for HSR stations

1) Roof and wall cladding

Internal wind pressure in the station due to the passage of high-speed trains is an HSR-specific matter. It is necessary to conduct predictive analysis of the pressure fluctuation and to determine the pressure fluctuation target value at the design stage. Reducing the wind pressure to meet the target value is important for HSR station design.

2) Universal design / elevator and escalators

Braille blocks:
A Braille block route from the station entrance to the platforms is planned.
Universal design toilets:
Universal design toilets will be provided with at least one booth in each toilet area which has wheelchair rotation space and multi-functions such as handrail, wheelchair accessible wash basin, and baby chair.
Wheelchair accessible ticket counter / see-through ticket gate:
A manned ticket gate with a face-to-face counter surrounded by glass will be planned at the automatic ticket gate passage.

Lifting equipment:
At least one path from the entrance to the platforms that can be maneuvered by using the elevator will be secured. From the concourse to platform level, at least one upward escalator and one downward escalator will be installed.

3) Platform gates

Platform gates will be installed at each platform for protection from wind pressure and to prevent falling. Platform gates are placed in a position 2m from the platform edge, and 1.3m high from the platform surface according to the Guidelines for Railways and Transportation Mechanisms by the Japan Railway Construction, Transport and Technology Agency (JRTT).
At the stop-line platform gates will be placed in a position 0.7m from the platform edge.

(2) Gender-sensitive planning
Gender equality shall be considered in station planning, not only for passengers but also for station staff and train operation staff.
For passengers, toilets and ‘musholla’ prayer rooms shall be separated for men and women. Space for passenger with babies and toddlers shall be provided as baby rooms.
For station staff, toilets, locker rooms and resting rooms shall be separated for men and women. Planning must be flexible to correspond to the male-female staff ratio.

10.10.2 Station Planning

(1) Jakarta (Dukuh Atas) Station
1) Location and Existing Conditions

Jakarta Station is the westernmost station of the HSR line.
The station is planned in Dukuh Atas district in Central Jakarta. Sudirman Boulevard runs south to north in Dukuh Atas district, and there is an underground MRT station currently under construction

and Sudirman Station on the existing railway. Serpong Bekasi Line, Airport Line, and Monorail are also planned as future projects in the area, so Dukuh Atas district is the main transportation hub of Jakarta city.
The station is planned using the green belt around the river. Along the green zone is currently a residential area, behind which there is a dense residential and commercial area.

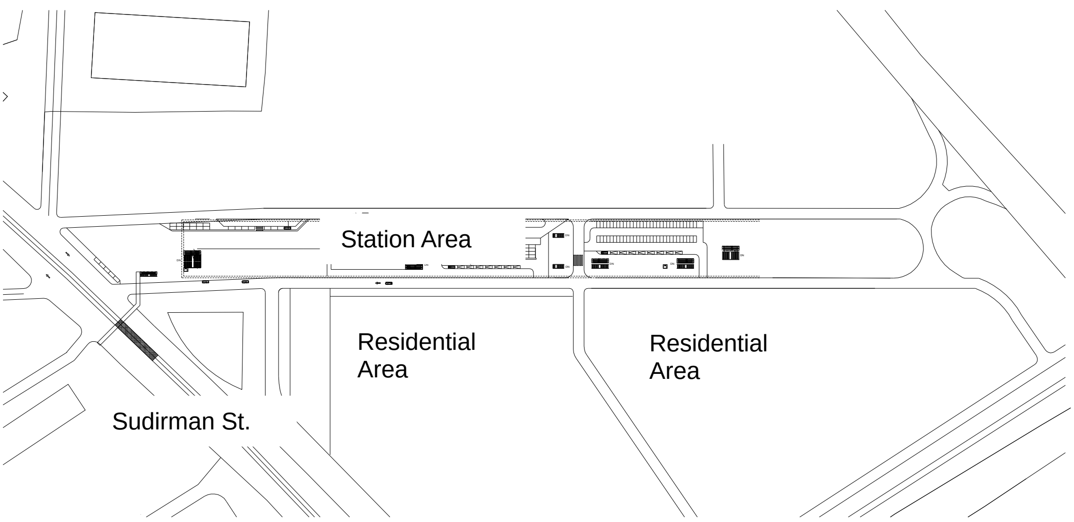
2) Station and Related Facilities

(a) Station building

Jakarta Station has two island platforms with 4 tracks. The platforms are on the third basement floor. The second basement floor consists of the ticket gates, paid concourse, waiting room, passenger toilets and musholla. On the same level, a station office, machine room, and electrical room are provided at both ends. On the first basement level, a connection hall will be provided
which will be connected to the underground passageway from the MRT. Along with the hall, various commercial premises will be provided.

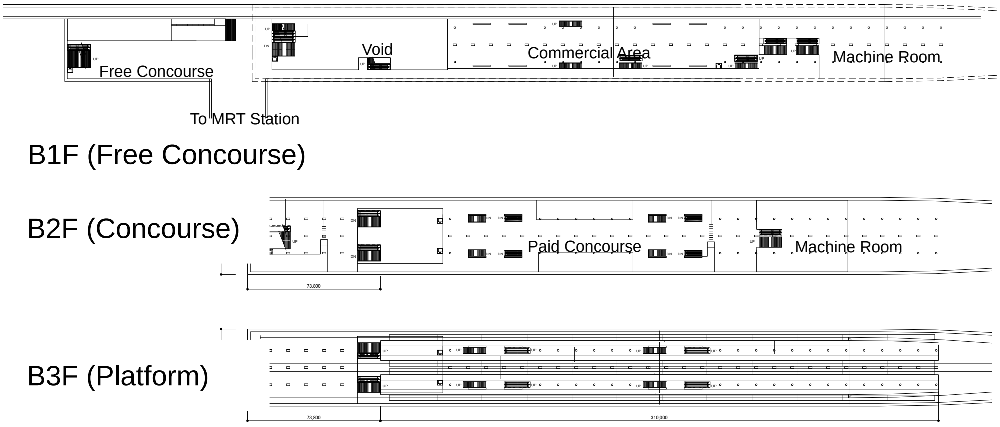
(b) Station square

Land acquisition to satisfy the station square function is difficult in the Dukuh Atas area. The station square is planned on the first floor above the station area.
In the Preparatory Survey on Jakarta Transport and Urban Structure Development Project (PPP Infrastructure), a traffic square with artificial ground is planned running east-west along Sudirman Bridge.
Even if this is completed, it will be far from the HSR station site, and there is a need to ensure an independent HSR traffic square.



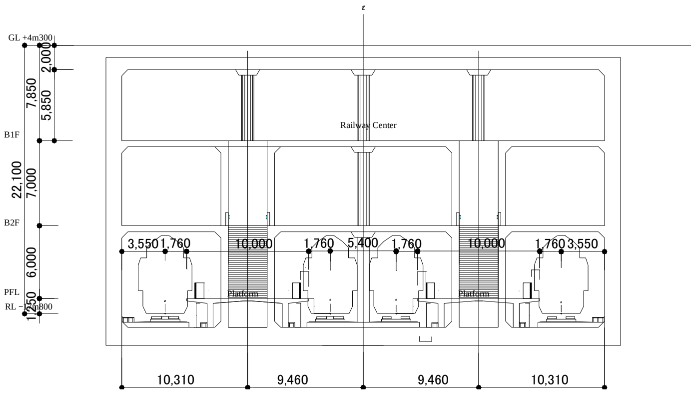
Source: JICA Study Team

Figure 10.10-1 Site Plan (Jakarta)



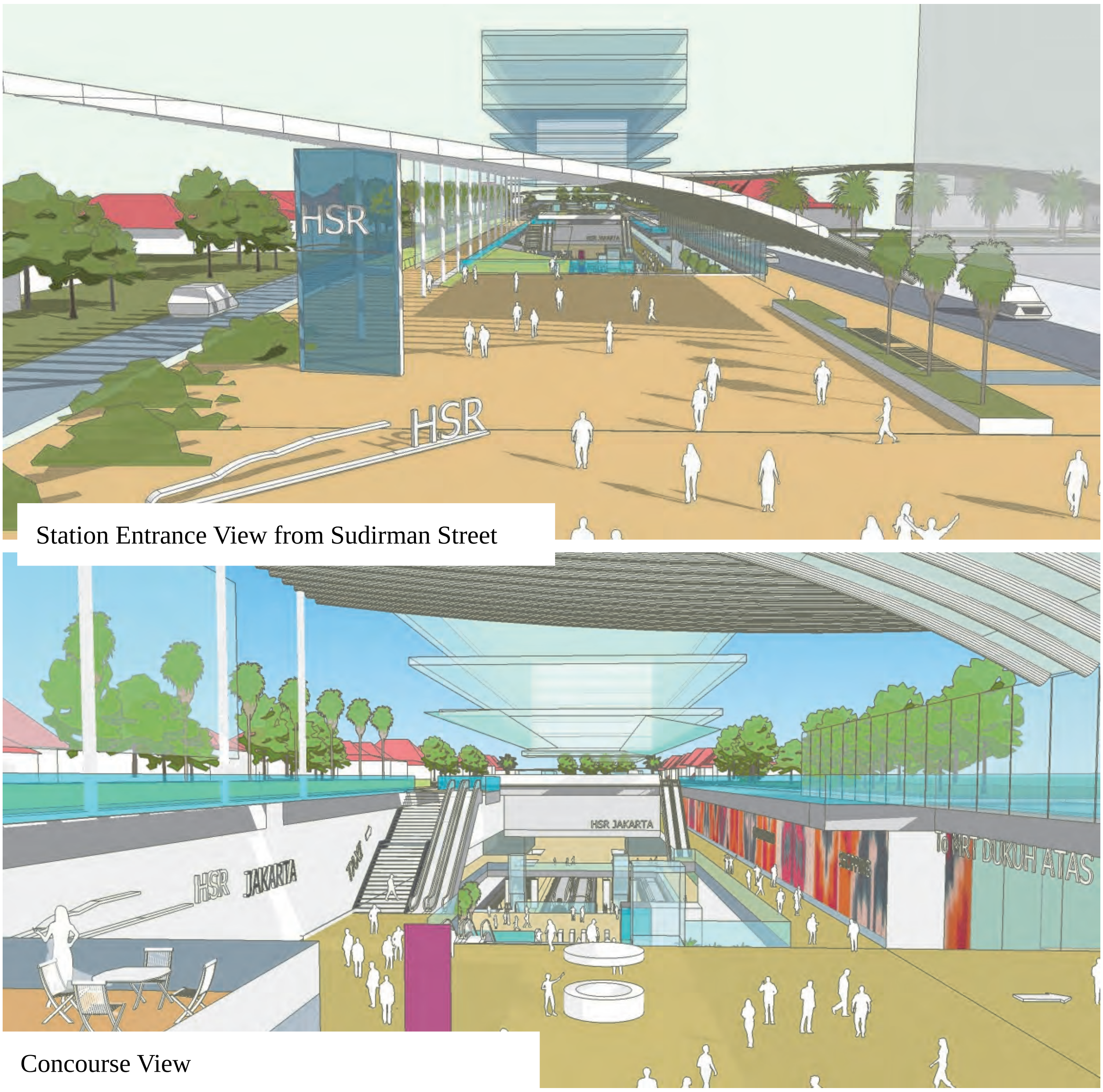
Source: JICA Study Team

Figure 10.10-2 Station Building



Source: JICA Study Team

Figure 10.10-3 Longitudinal Section

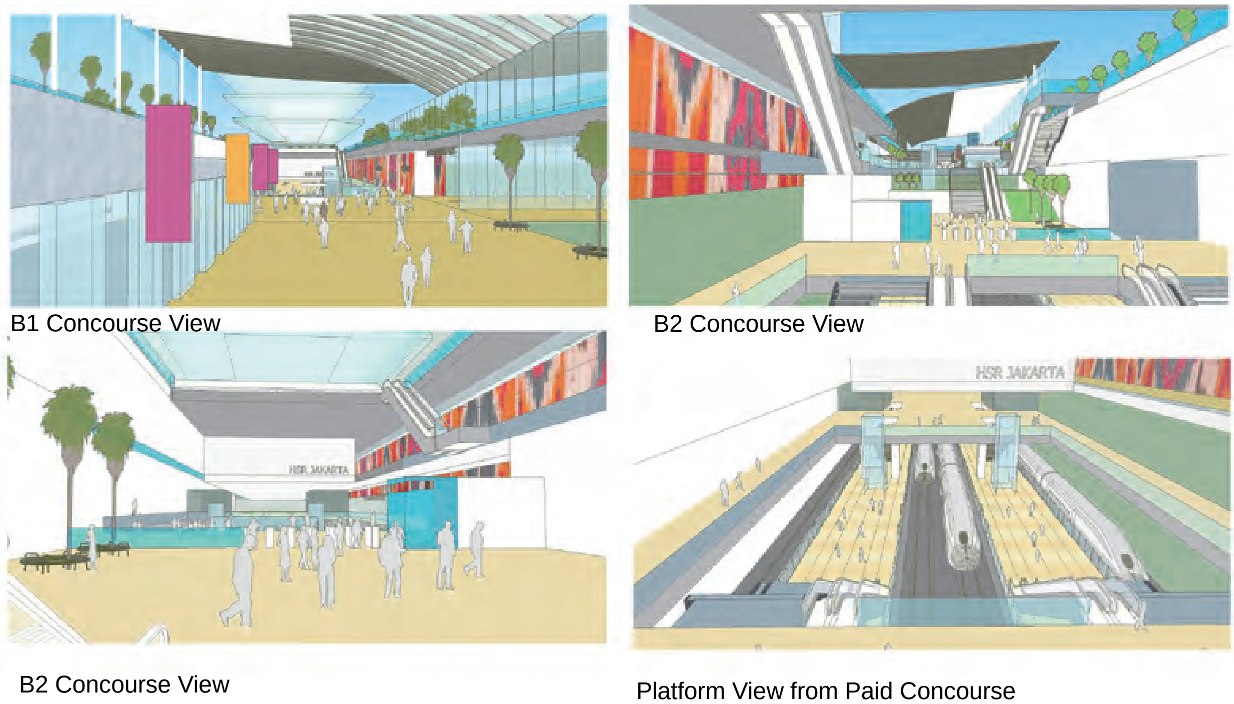


Station Entrance View from Sudirman Street

Concourse View

Source: JICA Study Team

Figure 10.10-4 Jakarta Station Image (1)



Source: JICA Study Team

Figure 10.10-5 Jakarta Station Image (2)

(2) Manggarai Station

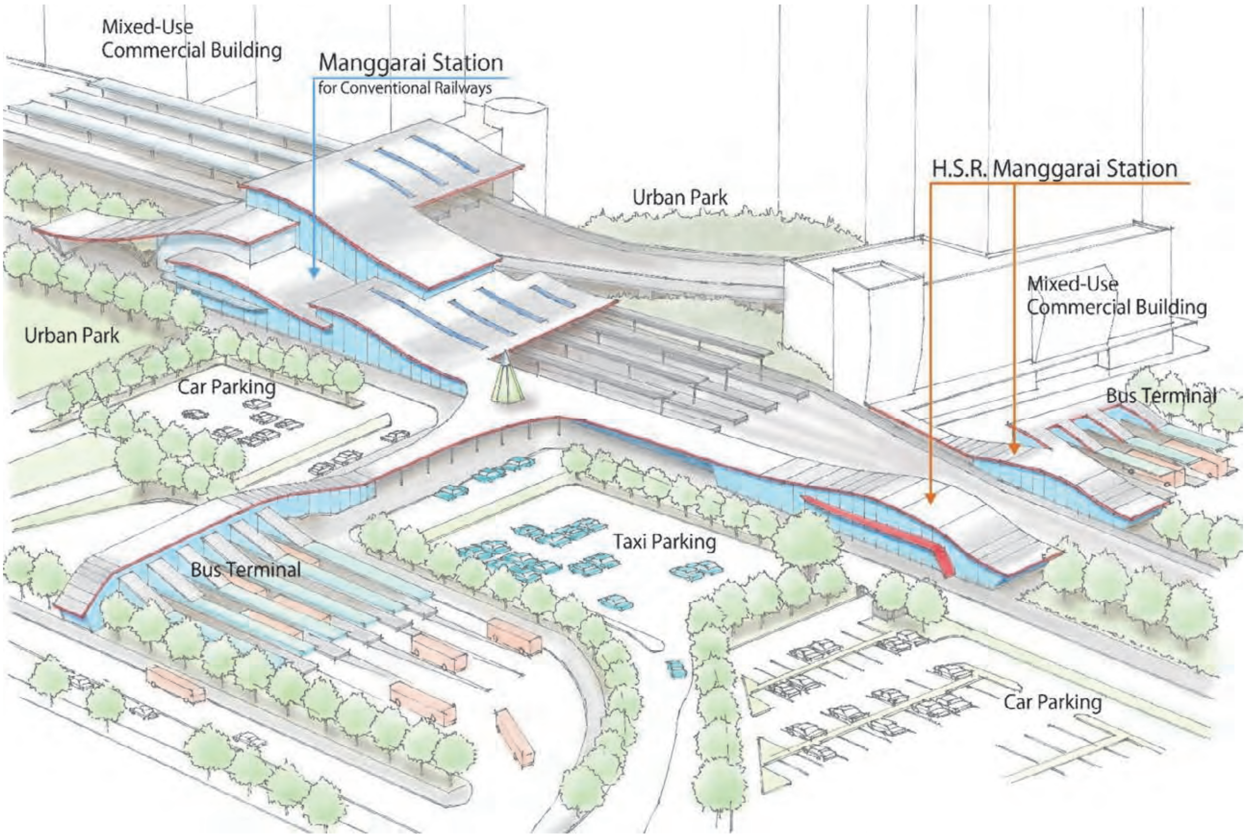
1) Location and Existing Conditions

According to the development studies in operation of HSR and alignment, the Manggarai area is considered as another HSR station location. As the existing Manggarai station is a large and very busy hub of multiple railway service lines for many destinations, the HSR Manggarai station can be another effective linkage to the Jakarta metropolitan region when it becomes operational. From the regional connectivity point of view, quite a large area of JABODETABEK is covered by the railway network stretching from Manggarai station. Therefore, the link to the HSR service at Manggarai will benefit a much larger community in the region.

2) Station and Related Facilities

Based on the alignment arrangement at the station location, the HSR station facility will be completely underground. It is important to minimize the vertical movement for passenger/use flow in the station with a proper safety program and mechanisms installed. Minimizing the connection distance between the stations is also one important criterion when the station complex is designed.

Because of the very congested situation in Manggarai station for particularly the conventional railway services, the HSR station should have an independent entrance, ticketing areas, ticket gate alleys, concourses to minimize cross circulation among services, while common spaces between the stations should also be provided for convenience of users. For better connectivity to ground transportation systems, the HSR station needs to have certain space for transit. However, the station front services, such as the bus bay, taxi bay, ride & drop section, parking space, etc., will be developed as a combined service with the conventional railway services.



Source: JICA Study Team

Figure 10.10-6 Development Concept Image of Future Manggarai Integrated Station and its Plaza

(3) Bekasi Station

1) Location and Existing Conditions

Bekasi Station is planned on Jakarta Cikanpek highway. It is located about 6 km southeast of the existing city center. New residential development is progressing in the periphery, together with the existing settlements, and agricultural land has also spread. There is a highway interchange about 2 km east and 3 km west. New city development is expected starting from the HSR station, since there is undeveloped land around and connection to the highway is favorable.

In addition, since there is a plan for a monorail along the highway, it is desirable that the monorail will extend to HSR Bekasi Station and it will be a transfer station.

2) Station and Related Facilities

(a) Station building

Bekasi Station is an elevated station with 2 island platforms and 4 tracks on the second floor above ground and a concourse on the first floor. A pedestrian passage is planned in the north-south direction on ground level. On the west side is a ticket barrier and on the east side is commercial premises. A signal communication equipment room, electrical room, and machine room are provided at both ends of the station.

(b) Station square

It is proposed to make the station square on the south side of the station. The station square will provide kiss and ride facilities, taxi stand, taxi parking and bus berths. Large development cannot be expected on the north side since there is a highway on the north side. We propose providing park and ride facilities. Road access to the east and west highway interchanges, and a road to the north side across the highway and the river should be secured for the area.

(4) Cikarang Station

1) Location and Existing Conditions

Cikarang Station is planned on Jakarta Cikanpek highway. It will be located about 10 kilometers northeast of the existing urban area, in the middle of LIPPO Cikarang industrial park and Kota Dertamas industrial park. Housing development is actively conducted currently in the region and considerable population growth is expected. Cikarang HSR Station is expected to be the core of future development. Current land use of the station site is pasture and some houses can be seen.

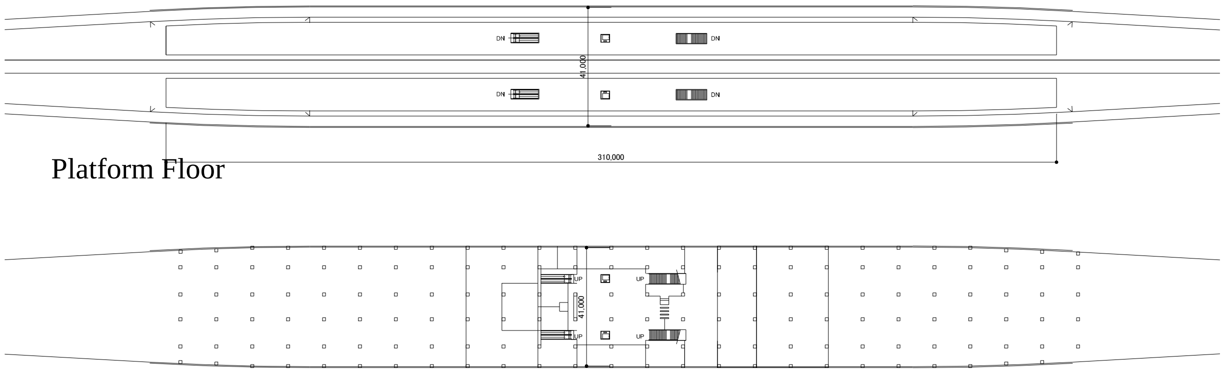
2) Station and Related Facilities

(a) Station building

Chikarang Station is planned to comprise 2 elevated stories. Two island platforms with 4 tracks will be on the second floor and a concourse on the first floor. Pedestrian passage is planned in the north-south direction, and on the west side is a ticket barrier and on the east side is commercial premises. A signal communication equipment room, electrical room, and machine room are provided at the both ends of the station.

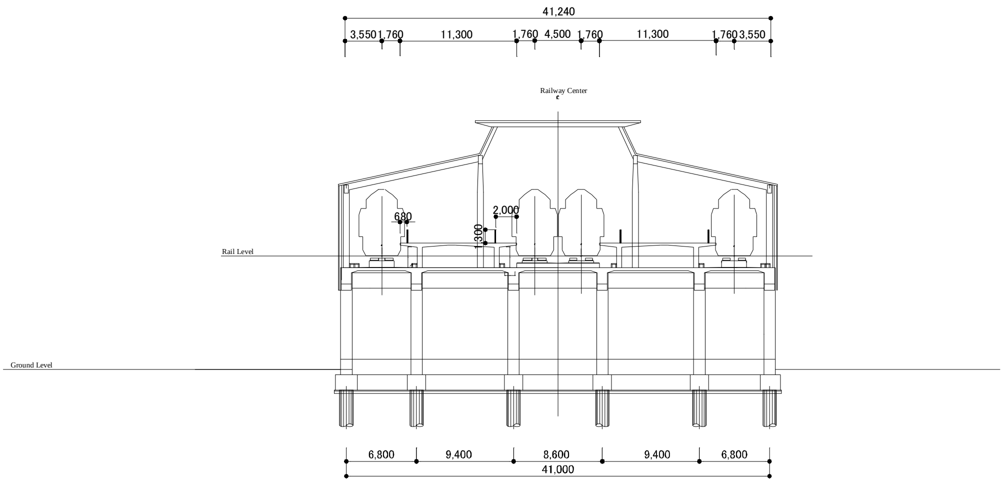
(b) Station square

It is proposed to make a station square on the south side of the station. The station square will provide kiss and ride facilities, taxi stand, taxi parking and bus berths. Large development cannot be expected on the north side since there is a highway on the north side. We propose providing park and ride facilities. Road access to the east and west highway interchanges, and a road network between LIPPO Cikarang and Kota Dertamas industrial park should be secured.



Source: JICA Study Team

Figure 10.10-7 Site Plan (Cikarang)



Source: JICA Study Team

Figure 10.10-8 Longitudinal Section

(5) Bandung Station

1) Location and Existing Conditions

HSR Bandung Station is planned to be built just above the existing station for local trains in the center of Bandung City. At present, land uses around the station are varied with a commercial area on the north side of the station and on the south side a residential area.

Adjacent to the station area to the north, there is a bus terminal but access between the rail station and bus terminal is poor and limited. On the north side of the station there is a parking lot with considerable capacity, but the area is not used for other functions.

Land use on the north side of the station should be optimized, and then the station area will have high potential to be developed as a sub center of Bandung City for its ability to attract more customers.

(a) Station building

Bandung Station is an elevated station with 2 island platforms and 4 tracks on the third floor above ground. The first floor will be used for the platforms and tracks of the existing station, and the HSR station functions will be provided on the second floor.

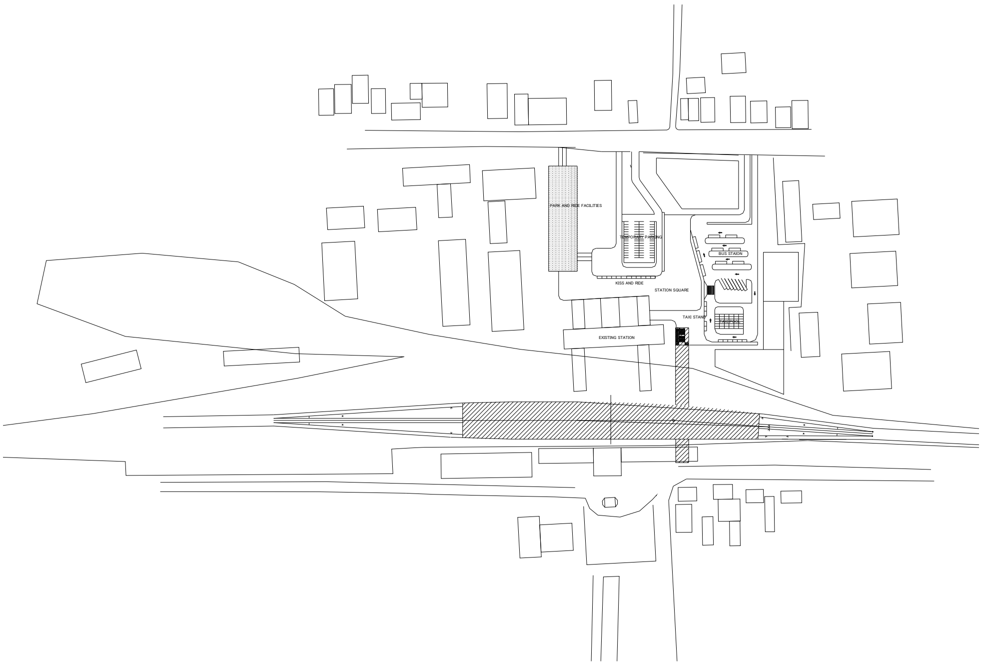
Passenger access to the station square from the north and south will be secured by an overpass pedestrian bridge through the station in the north-south direction on the second floor. This pedestrian bridge will provide a north to south path through the station area which does not exist at this moment.

(b) Station square

There are station buildings to the north and south in Bandung Station. It is favorable to plan a station square on both sides, but on the south side, vacant land is limited. We propose a station square on the north side by using the existing parking lots at the moment, and in the future, a station square on the south side shall be developed.

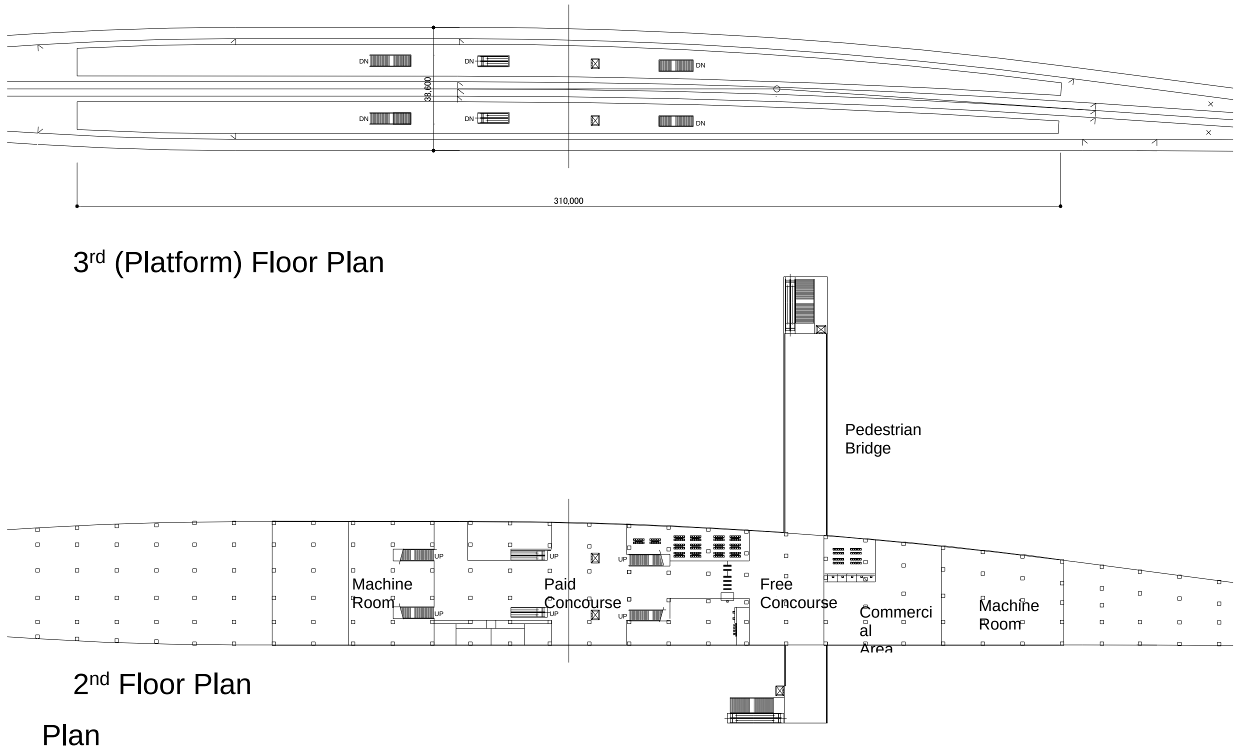
In consideration of the present conditions, it is assumed that most people will transfer to private car or taxi from HSR.

Considering the promotion of bus use, we propose a station square including bus station functions. The current station square provides only private car parking, but it will be necessary to increase the convenience of transfer by introducing public transport functions. In addition, we suggest providing a taxi stand, and taxi parking, and dividing the park and ride functions and kiss and ride functions for private cars, and pedestrian space should be also provided.



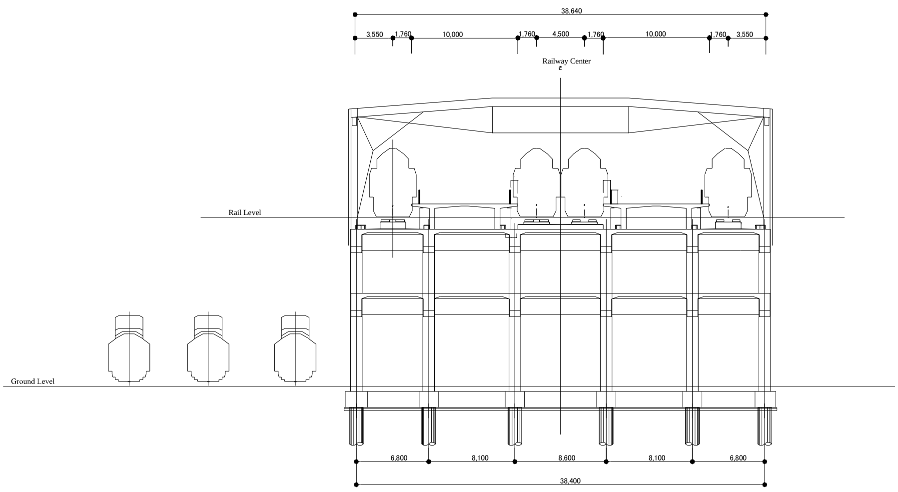
Source: JICA Study Team

Figure 10.10-9 Site Plan (Cikarang)



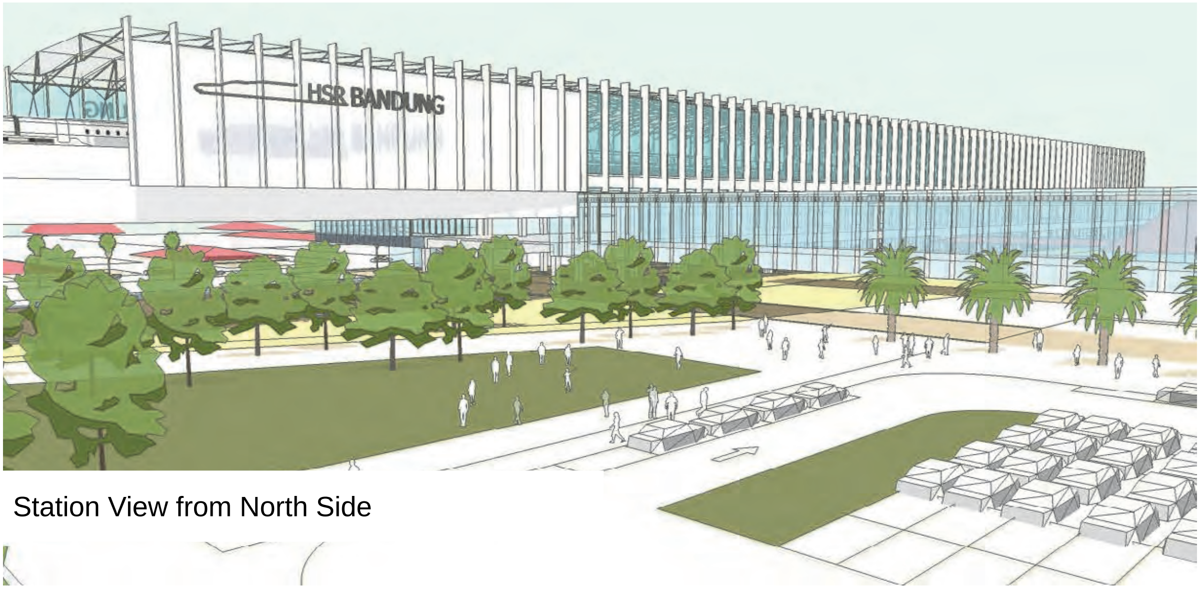
Source: JICA Study Team

Figure 10.10-10 Station Building



Source: JICA Study Team

Figure 10.10-11 Longitudinal Section



Station View from North Side

Station View from South Side

Source: JICA Study Team

Figure 10.10-12 Bandung Station Image (2)

(6) Gedebage Station

1) Location and Existing Conditions

Gedebade Station is the easternmost station of the HSR at this stage and there is plan for future extension plan eastward to Surabaya.

HSR Gedebage Station is planned in the vicinity of the existing Gedebage Station. The existing station is a freight station, and there is no passenger handling. Gedebage area is the development core of the region. In the future the Gedebage area will be the new urban center of Bandung, a smart city called

Bandung Technopolis. The location of Gedebage Station shall be determined in conjunction with this urban development plan.

2) Station building

Gedebage Station is planned to comprise 2 elevated stories. One island platform with 2 tracks will be on the second floor and a concourse on the first floor. Pedestrian passage is planned in the north-south direction, and on the west side is a ticket barrier and on the east side is commercial premises. A signal communication equipment room, electrical room, and machine room are provided at both ends of the station.

10.11 Train Operation System

The signaling facilities and the interlocking facilities are installed in the station for train operation safety. The safety of each train can be secured only with these facilities. However, high quality operation of a lot of trains on all lines in a good balance cannot be secured only with these facilities.

When a train is delayed, train operation adjustment such as changing the sequence of the trains, changing the sidetrack station, changing the train arrival-departure tracks, suspending train services and setting special trains is necessary. It is important to minimize the effect on train operation and to restore train operation as soon as possible. At the same time, it is important to notify information about train operation changes and the train operation status.

In order to perform appropriate train operation, collection and grasp of train operation information in a timely manner, appropriate instructions and provision of information to the relevant place are required. Therefore, CTC (Centralized Train Control) and PRC (Program Route Control) have been introduced to support train operation.

Since the Tokaido Shinkansen Line started operation in 1964, various train control systems have been introduced in Japan.

The route control first introduced with the Tokaido Shinkansen was hand-operated control from the center using CTC. However, the automatic route control system (COMTRAC) which utilizes a computer was then introduced because it was assumed that smooth train operation control would be upset by the increase in the number of trains and station stop patterns.

This system was the beginning of the train operation control system of the Shinkansen. Since then, various systems have been introduced according to the advancement of technology.

Taking the above-mentioned into consideration, the study team proposes the following system for train operation control which is suitable for the high-speed rail network in Indonesia this time.

10.11.1 Concept of Train Operation Control System

The basic concept of the train control system to be introduced for high-speed trains in Indonesia is as follows.

- In response to increasingly varied needs

The system responds to the increasingly sophisticated HSR operation patterns, such as speed increases and high-density operation.

- Achieving safe and reliable control of high-speed trains
  Flexibly responding to train operation status or weather, this system achieves safe and reliable train control.
- Providing passengers with various information
  This system promptly provides a wide variety of guidance information to passengers such as stopping stations, departure times, departure platform numbers and expected train delays corresponding with changes in operation.

Based on the above, the system to be introduced for high-speed trains in Indonesia is as follows.

- The automatic route control function is introduced to secure punctual operation at high speed.
- The operation control system in this project is an independent decentralized system with the train operation diagram for a few days held at each station so as to diversify the risk of disaster or equipment failure, etc.
  If the train order is changed by the dispatcher, the system appropriately operates the train route and provides the train information to passengers.
- Route control at each station is automatically performed according to the diagram held at each station.
- The operation control system is of a multiple type.
- The central system and the station equipment are connected by the dedicated optical cable.

10.11.2 Function of Train Operation Control System

Based on the concept described in 6.12.1, the operation control system, transport planning system, centralized monitoring system, maintenance work management system and electric power control system are introduced as the system in the Operation Control Center (OCC). The early earthquake detection system is introduced to stop the train quickly during seismic events.
The early earthquake detection system is independent from the train operation control system.

(1) Train Operation Control system

This system conducts accurate train operation control in response to various changes in train operation status.

- Grasping the train operation status on all lines using the train operation display terminal
  Information such as real-time train location, temporary speed limits, and feeding status can be monitored on all lines on the train operation display terminal.
  Trains marked on the screen inform dispatchers of information such as train status (delay time, etc.). If information on wayside rain, wind, or rail temperature is received from the centralized

monitoring system or if the system receives earthquake information from the electric power control system, the system automatically proposes temporary speed limits.

- Accurate train operation arrangement by expected diagrams

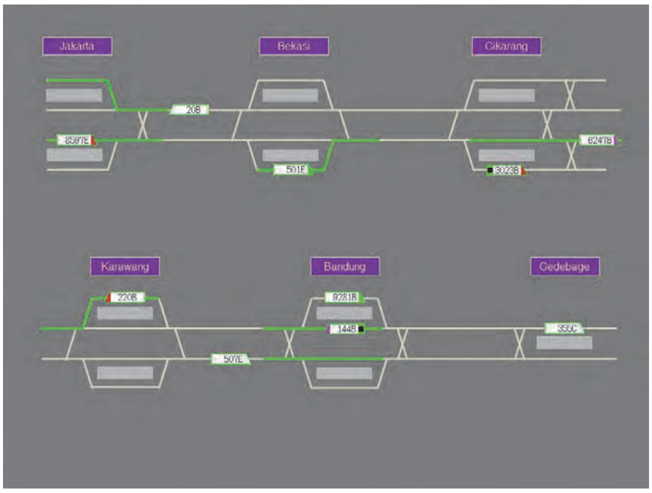
  The traffic operation arrangement terminal predicts future delays based on the constant operation status and facilities status. Additionally, the system is equipped with a function to test how the diagram will change by inputting arrangements in advance to support accurate train operation arrangement. All diagram changes entered are automatically controlled to support smooth operations.

- Route control by an autonomous decentralized method and the provision of guidance information to passengers

  PRC equipment at each station stores diagram information transmitted from the central system. Based on this information, the system automatically constructs the train routes. Figure 7.13-1 shows the automatic route control system.

  Additionally, based on diagram information and train location information, the system provides appropriate guidance to passengers using the passenger guidance equipment.

  Figure 7.13-2 shows the passenger guidance equipment.



Source: JICA Study Team

Figure 10.11-1 Automatic Route Control System

Source: JICA Study Team

Figure 10.11-2 Passenger Guidance Equipment

(2) Transport Planning System

This system supports the efficiency of planning tasks such as timetabling and car scheduling.

- Streamlining of train diagram formulation and validity confirmation

  This system supports the creation of train diagrams and car scheduling. Additionally, the system checks these data.

(3) Centralized Monitoring System

This system constantly monitors disaster prevention information etc. to support safe train operation.

Information on wind speed, rainfall, rail temperature, etc. is automatically transmitted from the detecting instruments installed at each measuring location to the central system, and then used to put operation regulations into force.

(4) Maintenance Work Management System

This system conducts total management of maintenance work plans and execution status.

Maintenance work is controlled in a centralized manner to prevent entry of trains into the maintenance section.

(5) Electric Power Control System

The Operation Control Center centrally controls and monitors the electrical systems using the electric power control system.

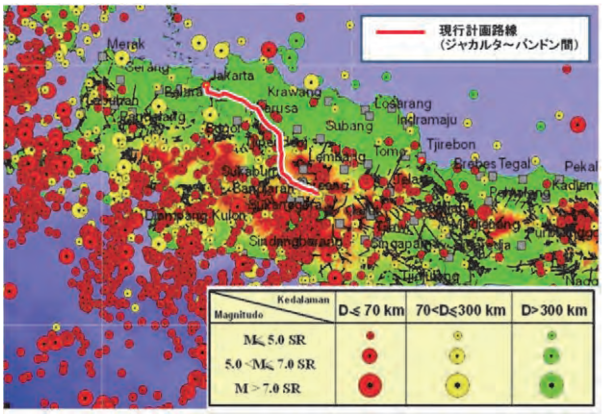
This system monitors the status of equipment and failures at substations and controls the switching of feeding.

The system corresponds with the early earthquake detection system. If an earthquake occurs, it is possible to stop the train by stopping feeding by transmitting the earthquake information to the substation.

(6) Early Earthquake Detection System

Seismographs will be installed along the coastal route and HSR route. When an earthquake that reaches the power transmission shutdown standard is detected, this system will transmit the signal via optical cable to each substation, activating the circuit breaker. When the power transmission is cut, the stop signal appears. Emergency brakes will be applied immediately to the trains.

The area of the planned high-speed railway is an earthquake-prone area. Figure 7.13-3 shows the epicenter distribution map for earthquakes that have occurred since 1990. Actually, 20 earthquakes of magnitude 5 or more have occurred and inflicted disaster on Java and the surrounding areas. Introduction of this system to stop the trains immediately in case of a major earthquake is indispensable.



Source: JICA Study Team

Figure 10.11-3 Epicenters around Java Island (Statistics from 1990 to 2012)

10.12 Automatic Fare System and Fare Collection Facilities

(1) Outline of Automatic Fare System and Fare Collection Facilities

There are various methods to collect railway fares. The most typical method is to purchase a ticket in advance, pay for the ticket, show the ticket at the ticket gate of the departure station, show the ticket for inspection by the conductor during the journey, and show the ticket at the ticket gate of the arrival station to prove that the fare has been paid. Figure 7.14-1 shows the ticket gate for long-distance trains.

Source: JICA Study Team

Figure 10.12-1 Ticket Gate for Long-distance Trains

This method was formerly the main method in Japan. It was practiced also for the Shinkansen.
This method is also practiced for long distance-trains in Indonesia.
Then, the automatic gate and automatic ticket system using magnetized tickets was introduced for the Japanese Shinkansen. Figure 10.12-2 shows an automatic ticket gate for the Japanese Shinkansen.

Source: JICA Study Team

Figure 10.12-2 Automatic Ticket Gate for Japanese Shinkansen

Taking advantage of the progress in IC cards, the automatic ticket gates for the Shinkansen today can also handle the IC card system. And a ticketless service has been introduced using mobile terminals.
For most Shinkansen, the check-in data from the automatic Shinkansen ticket gates and the ticketing data from the ticket-vending machines are transmitted to the conductor's terminal. Eliminating the onboard ticket inspection of reserved seat tickets not only saves labor costs but also improves the level of customer service.
On the other hand, in Indonesia, the method is that described above for long-distance trains. However, on commuter trains in Jabodetabek, automatic ticket gates have been introduced and IC-cards are used for check-in and check-out. Figure 10.12-3 shows the automatic ticket gate in Jabodetabek.

Source: JICA Study Team

Figure 10.12-3 Automatic Ticket Gate in Jabodetabek

In view of the fare collection methods for other transportation and the progress of IC technology in Indonesia, when launching the high- speed railway network, it is thought to be impossible to continue methods such as the current long-distance train fare collection method forever.
However, regarding check-in and check-out at the station, the method of checking tickets by the station staff at the ticket gate is widespread.
When the high-speed railway is launched, installation of automatic ticket gates is desirable because automatic ticket gates are not inferior to the methods for other transportation.

Regarding the introduction of automatic ticket gates, the merits are as follows.

- Efficient station operation and conductor operation
  The number of station staff at the ticket gate is reduced by the introduction of automatic ticket gates. It is not necessary to inspect the tickets on board the train by transmitting the check-in data from the automatic ticket gates.
- Reliable fare toll collection
- Improved customer convenience
- Collection of management statistics

However, a network for connecting the equipment, such as the automatic ticket gates, ticket-vending machines, revenue management terminals and the conductor’s terminal, to achieve the above merits is required. And the cost of such equipment installation is required.
The installation cost of the fare system is not related to the section length. For the relatively short-distance section from Jakarta to Bandung, it will be expensive to introduce this system. When introducing the system, it will be necessary to compare the above-mentioned merits with the installation cost.

(2) Application of IC cards

In Japan, IC cards have not only been introduced at automatic ticket gates, but an electronic money function has been added to them. The addition of the electronic money function allows IC cards to be used for transport facilities other than the rapid transit system (including conventional train lines, subways, bus lines and taxis).
The basic mechanism of electronic money is shown in Fig. 10.12-4.

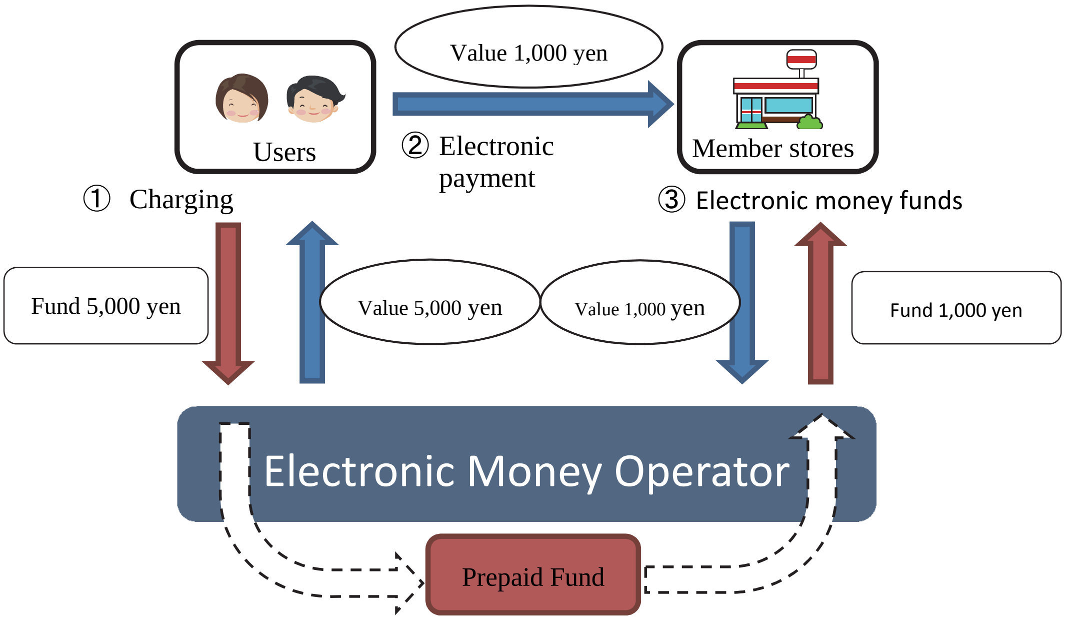


Fig. 10.12-4 Basic Mechanism of Electronic Money

Additional functions enable IC cards to be used in shopping facilities (such as department stores and convenience stores), restaurants, parking lots and gas stations as shown in Fig. 10.12-5. The application range of IC cards is expanding to various fields other than transport facilities.The electronic money settlement scheme is shown in Fig. 10.12-6. Basically, the settlement scheme consists of electronic money operators, member stores and users. Each electronic money operator enters into a membership contract with the member stores, under which the operator receives a commission (2% to 7% in Japan) from the member stores.

In Japan, the railway operators play the role of electronic money operators and their electronic money income is a major source of income besides that from their railway operation business.

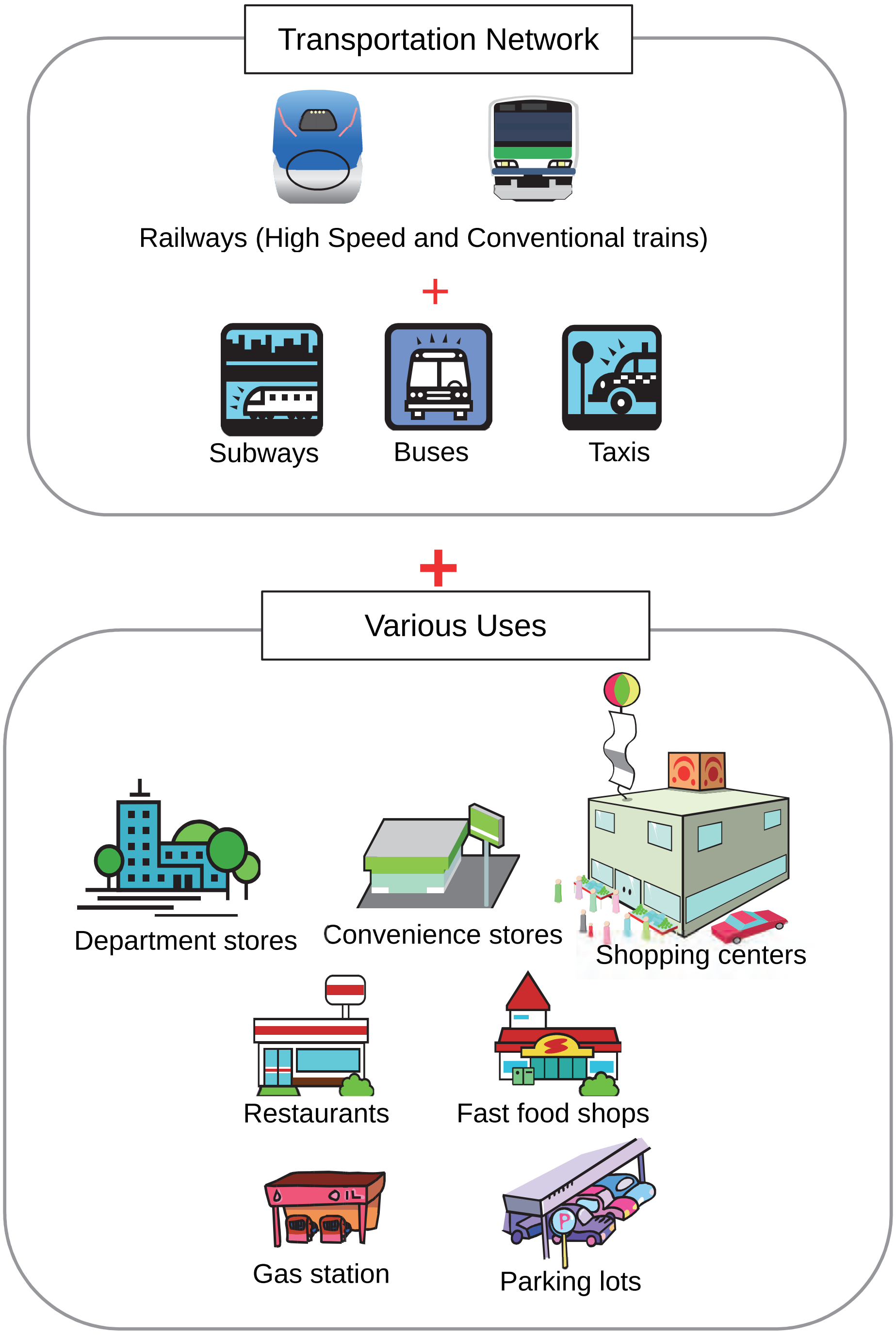


Fig. 10.12-5 Application of IC cards in Japan

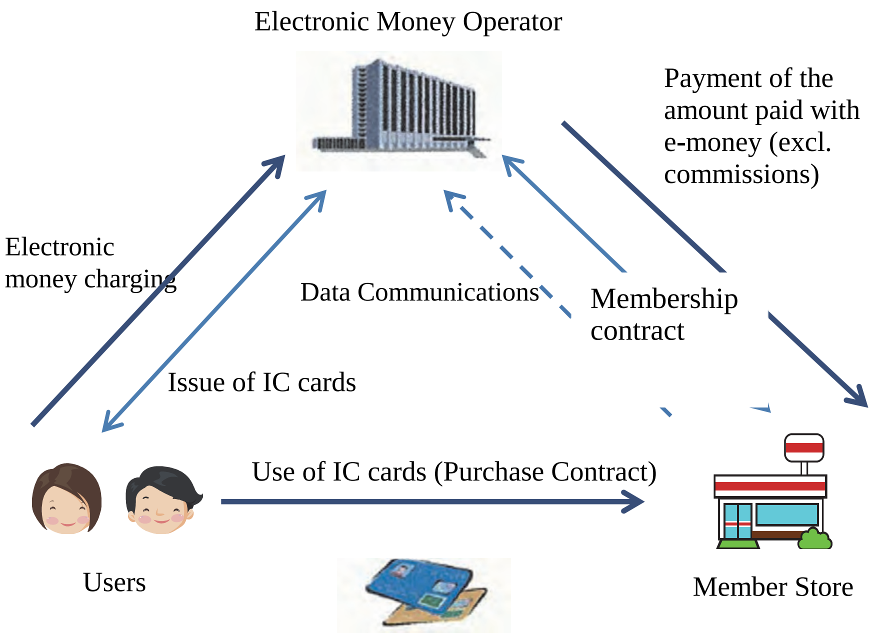


Fig. 10-12.6 Electronic Money Settlement Scheme

IC cards with an electronic money function as shown in Fig. 10.12-7 are also widespread in Indonesia.

Fig. 10.12-7 IC cards used in Indonesia

These IC cards can also be used for payments not only for Jabodetabek commuter trains in the Jakarta Metropolitan Area, but also for other transport facilities such as Trans Jakarta, expressways, shopping facilities, and parking lots similarly to the IC cards used in Japan.
Therefore, it is considered that Indonesia has a good grounding for the wide use of IC cards which can also be used for high-speed rail lines as in Japan.

As with the automatic ticket gates, it is desired that the introduction of such IC cards with an electronic money function will be examined taking into consideration the cost and advantages of their introduction.

Chapter 11

Environmental and Social Considerations

Chapter 11 Environmental and Social Considerations

11.1 Framework of Environmental and Social Considerations in this Study

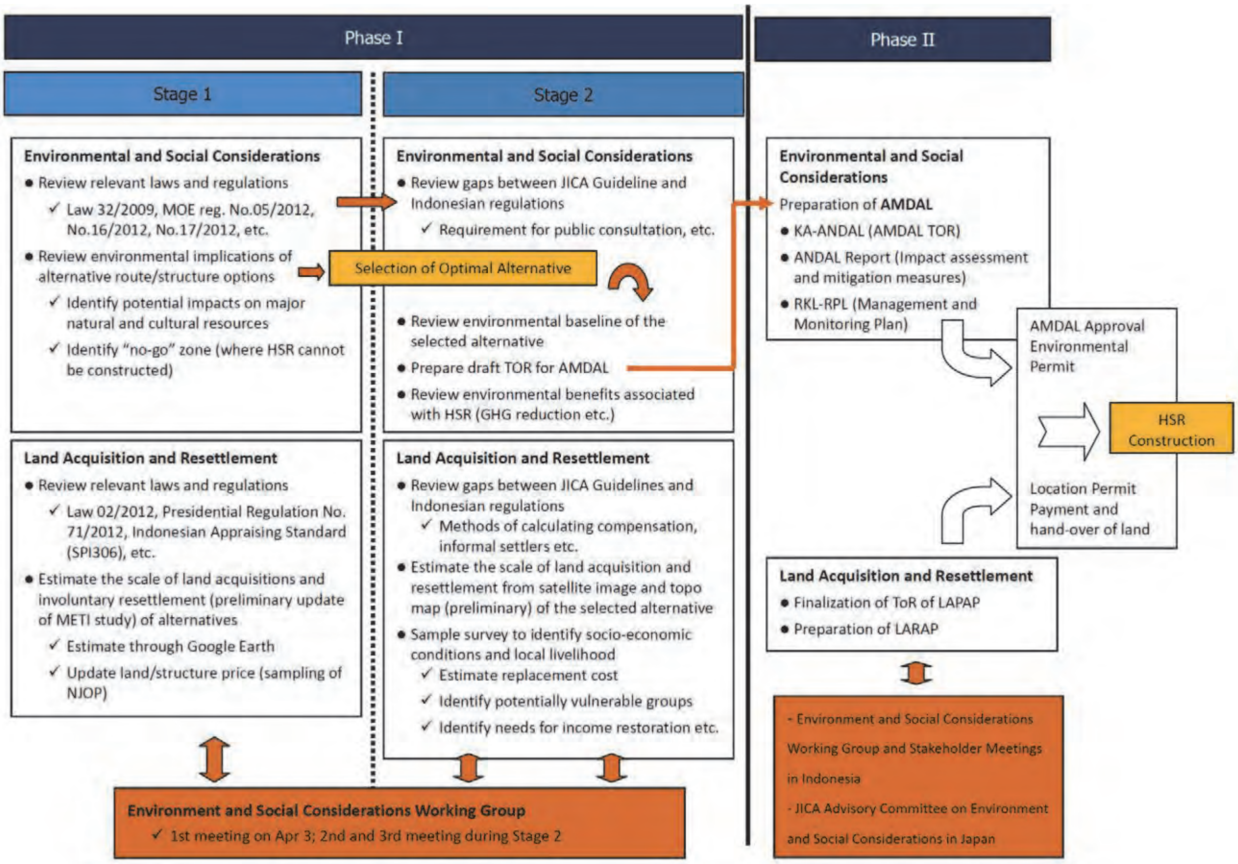
(1) Background

The project is the first high-speed railway project in Indonesia. Considering the scale (total length) of the project and the nature of the high-speed railway, a review of the environmental and social considerations is important to avoid, minimize and mitigate the negative impacts of the project. For example, the impacts on the natural environment, noise and vibration, land acquisition, resettlement, and division of the community are typically controversial for high-speed railways, and they have to be studied carefully and appropriately. Therefore, this Study is categorized as a Category A project as defined in the JICA Guidelines for Environmental and Social Considerations in 2010 (JICA Guidelines). In the case of Category A projects, JICA encourages the project proponents to consult local stakeholders about their understanding of development needs and the likely adverse impacts on the environment and society.

(2) Overall Framework of Environmental and Social Considerations for the Study

The overall framework of environmental and social considerations for this Phase I study and expected Phase II and future studies are as follows.

In Phase I, firstly the Stage I study aims to conduct a baseline survey to select the optimal alternative through comparative analysis of transportation modes and high-speed railway alternatives. In Stage II, environmental and social considerations for the selected alternative will be conducted.



Source: JICA Study Team

Figure 11.1-1 Overall Framework of Environmental and Social Considerations in the Project

(3) Environmental and Social Considerations Working Group

Considering the scale and impact of this project, the Indonesian side and the JICA Study Team jointly formed a Spatial Plan and Environmental and Social Considerations Working Group to exchange information and views related to environmental and social considerations. It is important and beneficial for the project to involve the major stakeholders including not only DGR and the Ministry of Environment, but the Ministry of Agriculture and Ministry of Environment and Forestry. The result, major participating organizations and schedule are as follows.

Table 11.1-1 Environmental and Social Considerations Working Groups

Timing / Items	Draft contents of discussion
Organizations to be invited	● Ministry of Transport, Ministry of Environment, Ministry of Agriculture, Ministry of Forestry, Jakarta Capital City and West Java Province (Environmental Agency, Land Agency etc.)
1st WG	● Stage I, 3rd April 2014 ● Explanation and discussion of overall framework of environmental and social considerations
2nd WG	● Stage II, November 2014 to January 2015, 13 times (9 times: local governments and 4 times: central government) ● Explanation and discussion on alternatives and study on environmental and social considerations, spatial plan and further actions to be taken by the Study Team and local governments ● Explanation and discussion on alternatives and discussion on specific issues related to central government agencies on environmental and social considerations
3rd WG	● WG was not arranged due to tight schedule of Indonesian side, ● Explanation of the result of the study by distribution of “route book” on alignment, station and structure options decided through the discussion with stakeholders and achieved basic consensus among stakeholders ● Discussion of the plan for environmental and social considerations in Phase II was conducted in the final JCC held in April 2016.

Source: JICA Study Team

11.2 Environmental and Social Considerations

The following scope was implemented for environmental and social considerations in the study.

1) Review and analysis of key laws and regulations related to environmental and social considerations
2) Review of practices relating to environmental and social considerations in relevant projects
3) Review of alternative transport modes from the viewpoint of environmental and social considerations
4) Comparison of alternatives for HSR in terms of environmental and social considerations
5) Implementation of baseline survey for environmental and social considerations
6) Environmental and social considerations for optimal option

The following are the major achievements during Stage II of the study.

(1) Components of the Project and Relationship between them and Environmental and Social Impact

The components of the project and the location map are shown below.

Table 11.2-1 Relationship of Project Components and Environmental and Social Considerations

Period	Component	Range of impact
Pre -construction	● Land acquisition and resettlement	● 140km of railway track, side road, station, depot, substation, construction road, etc.
	● Update of Spatial plan, etc.	● Local governments along railway
Construction	● Felling trees	● 140km of railway track, side road, station, depot, substation, construction road, etc.
	● Civil works of the structures (embankment, cutting, tunnel, bridge, viaducts and etc.)	● 140km of railway track (embankment, cutting, elevated structure, shield tunnel, NATM, bridge), side road, station (elevated, ground, underground), depot, substation, construction road, etc.
	● Heavy vehicle mobilization	● ditto
	● Construction of depot, station, related facilities, railway track, etc.	● ditto
	● Traffic control around construction sites	● ditto
Operation	● Operation of HSR	● Along railway track
	● Existence of depot, station, related facilities, railway track, etc.	● Railway track, side road, station, depot, power station, etc.
	● People concentration	● Around station

Source: JICA Study Team

Source: JICA Study Team

Figure 11.2-1 Alignment

Source: JICA Study Team

Figure 11.2-2 Structure

(2) Baseline Information on Natural, Living and Social Environment

Baseline information is shown in Chapter 2 and Chapter 7.

(3) EIA in Indonesia

Environmental Impact Assessment

In Indonesia project proponents are required to undertake an *Analisa Mengenai Dampak Lingkungan* (AMDAL or EIA) and obtain an Environmental Permit as the major environmental prerequisites for project commencement. The specific requirements for AMDAL and Environmental Permits are stipulated in Law Number 32 / 2009 on Protection and Management of the Environment and Government Regulation No. 27 / 2012 regarding Environmental Permits respectively. The specific procedures for AMDAL, and public involvement in particular, are regulated in Ministry of Environment Regulations No. 16 / 2012 and No. 17 / 2012.

Appendix I of MOE Regulation No. 5 / 2012 imposes a “positive list” for projects and/or activities that require a full EIA according to the type, scale and location of the activity for a variety of sectors. With reference to the railway sector, Regulation No. 5/ 2012 requires that construction of railways with a length of 25 km or more on the ground must undergo an EIA (Section F, Appendix I). Railways are also included in JICA’s illustrative list of sensitive sectors for which JICA considers a full EIA is normally required in JICA guidelines for environmental and social considerations (Appendix 3).

Prior to commencing AMDAL work, the project proponent is required to notify the relevant environmental impact management agency. Based on the type, scale and location of the project, AMDAL approval may be granted at the central, provincial or district level. Since the proposed project runs through multiple provinces, review and approval will occur at the central level by MOE. AMDAL work for the proposed HSR project is to be carried out in Phase II by the following procedures.

The first step of the AMDAL process is the preparation of the ToR (KA-AMDAL) and approval by the AMDAL Commission. This defines:

i. Scope of the study;
ii. Type of activities of the project that may impact the environment;
iii. Environmental parameters likely to be affected by the project;
iv. Method of data collection and analysis;
v. Identification of potential important impacts; and,
vi. Methods of impact prediction and evaluation.

Before preparing the ToR, the proponent is required to make a public announcement of the proposed project through publication in a local newspaper, and the stakeholders have a month in which to submit their comments and suggestions for the ToR. A public consultation meeting is held prior to finalizing the ToR. During this meeting the project proponent is expected to present a full description of the project and the potential impacts associated with it.

Based on the approved ToR, the proponent prepares the AMDAL, RKL and RPL Documents and submits them for evaluation. AMDAL evaluation is a two-step process. In the first round, the documents are reviewed by the Technical Committee. Based on the committee's comments, the documents will be revised by the proponent and re-submitted. If the revised report is accepted by the Technical Committee, it is forwarded to the Appraisal Committee, and the same review and revision process will take place as necessary. During the review process, an additional public consultation is held to disclose the project assessment and to obtain feedback from the stakeholders. Comments received from the AMDAL Commission and the public are considered when the project proponent revises the reports.

Once the review finds the AMDAL process satisfactory, the relevant government agency (in this case, MOE) will issue a letter of "approval to proceed with the project". Once the AMDAL document is approved by the Commission and the project receives environmental feasibility approval, then the project proponent is required to obtain an environmental permit and other required permits such as a permit for clearing the land before commencing construction. The Environmental Permit becomes invalid if the proposed project is not undertaken within three years of the issuance of the permit, according to Government Regulation No. 27 / 2012 (Article 50).

Besides these basic laws and regulations, the study will refer to other related laws. So far, the following laws and regulations are identified as reference information for environmental and social considerations.

Table 11.2-2 Laws and Regulations related to EIA (National Level)

No.	Laws and Regulations	Description
1	Law No. 32/2009	Concerns the Protection and Management of the Environment. Stipulates environmental protection, policies, and rights and obligations of all stakeholders with regard to environmental protection and management.
2	Government Regulation No. 27 / 2012	Concerns Environmental Permits
3	MOE Regulation No. 05 / 2012	Concerns the Types of Activity Plans Requiring AMDAL Document
4	MOE Regulation No. 16 / 2012	Concerns Guidelines for the Preparation of Environmental Documents
5	MOE Regulation No. 17 / 2012	Concerns Guidelines for Public Participation in AMDAL Process and Environmental Permits
6	Law No. 26 / 2007	Concerns Spatial Planning
7	Law No. 31 / 1999	Concerns Forestry
8	Minister of Forestry Regulation No 16 of 2014	Concerns Forest Landuse Permit
9	Law No. 41 / 2009	Concerns Protection of Sustainable Agricultural Land
10	Minister of Agriculture Regulation Number 81 of 2013	Technical Guidance Procedures for the Conversion of Sustainable Agricultural Land
11	Law No. 19 / 2013	Concerns Protection and Empowerment of Farmers
12	The National Ambient Air Quality Standards (covering SPM, PM10, SO_2, NO_2, O_3, Pb, and CO)	Stipulates guidance on implementation of Law on Environmental Protection.
13	State Ministry of Environment Decree No. KEP-48/MENLH/11/1996	Environmental Noise Standards
14	State Ministry of Manpower Decree No. KEP-51/MEN/1999	Physical threshold values at work sites
15	Local Government Regulation No. 1/2012 of DKI Jakarta	Spatial plan of DKI Jakarta 2030
16	Local Government Regulation No. 2/2005 of DKI Jakarta	Concers Pollution Control
17	Local Government Regulation No. 22/2010 of West Java	Spatial plan of West Java Province 2009-2029

Source: JICA Study Team

(4) Comparison of Alternative Options Including Zero-option

The comparison of alternative options are discussed in Chapter 4. The summary of the comparison is shown below.

Table 11.2-3 Comparison of Alternative Options

No.	Comparison	Contents
1	Zero-option	Setting zero-option: Without-HSR (zero-option), increase in transportation demand will be met by improving air, conventional railway, and highway

No.	Comparison	Contents
		transportation. Evaluating zero-option: In Stage I study, these transportation mode options were studied from environmental and social considerations. In Stage II, capacity, environmental friendliness, and required land acquisition were studied and HSR was evaluated as the best option to meet the demand increase.
2	Basic route	Setting options: Option A along highway, option C through Bogor, and option B passing in the middle of A and C were set. Evaluating options: From demand and cost, option A was selected.
3	Location of Jakarta station	Setting options: Considering the ideas from Indonesian side, 8 potential locations for the station were set. First selection: Considering the hazard map, 6 locations out of 8 were selected. Second selection: 6 locations were compared from technical, economical and environmental aspects and Dukuh Atas station was evaluated as best.
4	Alignment	Setting options: For each of the four sections of Jakarta-Bekasi, Bekasi-Purwakarta, Purwakarta-Padalarang and Padalarang-Gedebage, two or three alternative alignments were set. Evaluating options: Length and structure of track, ridership, operation, bottleneck of construction (including environmental and social considerations), construction period and cost were studied to compare the alignment options.
5	Stations besides Jakarta	Setting options: Station options were set along the alignment. Future stations considering the development plans of Indonesian side were also taken into consideration. Evaluating options: Optimal station location along the alignment was set following the discussion with local governments.
6	Depot location	Setting options: 5 potential locations were set avoiding the city area around Jakarta and Bandung, and mountainous area between Purwakarta and Bandung. Evaluating options: Availability of land and function of depot were the criteria in comparing the depot options.

Source: JICA Study Team

(5) Result of Scoping and ToR for Environmental and Social Considerations Study

The result of scoping is shown below. Based on this result, baseline survey for environmental and social considerations was implemented, whose ToR is summarized below. Since EIA will be conducted in the next phase, the main objectives of this ToR were to collect secondary data and field check of the optimal option.

Table 11.2-4 Results of Scoping

Category	**Item**	**Scoping Results**			
		Pre-construction Stage	**Construction Stage**	**Operation Stage**	**Reason for Scoping**
Na	Climate/	D	D	D	P: No impact is expected.

Category	Item	Scoping Results			
		Pre-construction Stage	Construction Stage	Operation Stage	Reason for Scoping
	Meteorological Phenomena				C/O: The impacts on micro-climate and micro meteorological phenomena are negligible because the structures of HSR would not disturb wind path.
	Topography	D	B-	D	P: No impact is expected.
					C: There are some impacts on topographic features in the area where mountains/hills exist along the alignment caused by generation of embankment or cut section.
					O: After completion of construction, topography will be stable and no impact is expected.
	Geology	D	D	D	P: No impact is expected.
					C: No impact is expected.
					O: No impact is expected.
	Soil Erosion	D	B-	B-	P: No impact is expected.
					C: For the earthworks, especially when it is raining, some soil erosion is expected.
					O: New surface in embankment or cut section may be washed away by rainwater.
	Hydrology	D	D	B-	P: No impact is expected.
					C: Change of land and topography during construction works may cause minor impacts on hydrological cycle or regimes.
					O: In embankment or cut section, some impacts are expected on hydrological cycle or regimes. These sections are planned at many areas in Karawang and other prefectures.
	Groundwater	D	B-	B-	P: No impact is expected.
					C: Usage of groundwater for the construction work will not be at a scale that changes hydrological regime. However some impacts on the ground water are expected at the tunnel construction site.
					O: Usage of groundwater for the operation of the HSR will not be at a scale that changes the groundwater level. On the other hand, the tunnel structure may disturb the hydrological cycle or regimes to some extent.
	Ecosystem, Flora, Fauna and Biodiversity	D	B-	B-	P: No impact is expected.
					C: Most of the area along the alignment is already developed, therefore no impact on the valued ecosystem is expected. However, some impacts on various ecosystems and biota including mountains and agricultural areas caused by the construction works are expected.
					O: Existence of the HSR structures and HSR operation may cause negative impact on the ecosystem.
	Protected Areas/Forest	B-	B-	B-	P: The planned alignment is more than about 9 km away from the protected area. It is necessary to allocate the alternative areas and acquire permission to use the forest area, since the alignment will pass the production forests in Kabupaten Bekasi and Karawang.
					C: By the construction work, some of the forest area will be opened up.
					O: By the HSR structure, some of the forest area will be opened up. This will mean more sunshine on the inner part of the vegetation area, which would affect the edge of the forest area.
	Coastal Zone	D	D	D	P/C/O: No impacts are expected, because the HSR alignment is far enough away from the coastal zone and the planned alignment will not pass the tidelands and the mangrove forests which are peculiar to the coastal region.

Category	Item	Scoping Results: Pre-construction Stage	Construction Stage	Operation Stage	Reason for Scoping
	Landscape	D	D	B+/ B-	P: No impact is expected. C: Change of landscape is limited during the construction. O: By the structures such as viaduct, embankment and station buildings, both positive and negative impacts on landscape are expected.
	Natural Disaster	D	B-	B-	P: No impact is expected. C: The degree of risk in landslide/soil erosion areas along the planned alignment is evaluated as intermediate level. O: The planned alignment will pass the flooding, landslide/soil erosion areas, the earthquake areas and so on.
Living Environment	Air Pollution	D	B-	A+/ B-	P: No impact is expected. C: Some negative impacts are expected due to operation of construction equipment and vehicles. One of these is the dust incidental to earthwork especially during the dry season. O: Overall reduction of air pollutant emission is expected from the modal shift of passenger transportation to the HSR. On the other hand, increase in air pollutants from increased access by cars and buses around the station is expected.
	Offensive Odor	D	D	D	P/C/O: No impact is expected.
	Water Pollution	D	B-	B-	P: No impact is expected. C: Turbid water due to the earthworks, bridge pier construction work and wastewater effluents from construction workers' camps/yards are expected to pollute the surrounding rivers/canals to some extent. O: Some impacts on water quality in surrounding water bodies and canals are expected due to polluted water from passengers at the stations and wastewater from maintenance activities in the depot.
	Bottom Sediment Contamination	D	D	D	P: No impact is expected. C: Although some construction materials such as cement and sand are expected to be washed out mainly by the rain, the impacts on bottom sediment are expected to be small. O: Although some wastewater is expected to be generated from maintenance activities in the depot, the impacts on bottom sediment from the wastewater are expected to be small.
	Soil Contamination	D	C-	B-	P: No impact is expected. C: Some impacts on soil from deposition of pollutants from construction materials in the construction site are expected to be small. On the other hand, in the case where the soil in the construction sites is already contaminated, by some other reason, some impacts are expected by the construction activity. Thus, further study is necessary. O: Some impact may be expected on soil from deposition of pollutants from maintenance activities in the depot.
	Ground Subsidence	D	D	D	P: No impact is expected. C: Groundwater utilization by the construction works will not be at a scale that changes groundwater flow. O: No impact is expected.
	Noise/	D	B-	A-	P: No impact is expected.

Category	Item	Scoping Results: Pre-construction Stage	Construction Stage	Operation Stage	Reason for Scoping
	Vibration				C: Noise and vibration are generated by operation of construction equipment and vehicles, although they are temporary. Nonetheless, some impacts are expected on the residents and facilities near the construction sites such as schools and hospitals that require peace and quiet.
					O: Noise and vibration will be generated by movement of the high speed trains and some impacts are expected on the residents and facilities along the HSR alignment such as schools and hospitals that require quietness.
	Low Frequency Noise/Micro-pressure Wave	D	D	A-	P: No impact is expected.
					C: No impact is expected.
					O: Some impact by low frequency/micro-pressure wave at the tunnel sub-sections is expected. Low frequency noise from the train passing an open section is extremely small.
	Wave Obstruction	D	D	B-	P: No impact is expected.
					C: No impact is expected.
					O: Radio waves would be disturbed by movement of high speed trains and some impacts such as flutter and pulse interferences on TV are expected. In addition, elevated structures such as viaducts (typical design is about 10m high) would cause some wave disturbance impacts.
	Sunshine Obstruction	D	D	B-	P: No impact is expected.
					C: No impact is expected.
					O: Sunshine will be obstructed by the viaduct and station buildings.
	Wastes/Hazardous Materials	D	B-	B-	P: No impact is expected.
					C: A certain amount of construction and demolition waste, which may include hazardous materials, and waste from construction workers' camps are expected to be generated.
					O: A certain amount of waste from passengers at the station and maintenance works at the depot is expected to be generated.
Social Environment	Involuntary Resettlement	A-	B-	D	P: About 256.3 ha of land are necessary for development of the HSR structures (viaduct, station, depot, etc.).
					C: Temporary relocation might be required for setting up of construction yards and workers' camps for the construction activities.
					O: No impact is expected.
	Land Use	B-	B-	A+	P: The current land use would be changed by land acquisition and resettlement.
					C: The land change by the construction of the HSR structures is expected to be small and land clearance for construction yards and workers' camps is temporary. However, the land use around the construction site may be changed by doing business with construction workers without control.
					O: The HSR station will be developed together with areas around the station as an integrated development. In addition, land use is expected to be changed gradually with further development mainly around the station in accordance with municipal/city plans and private investments.
	Utilization of	D	B-	D	P: No impact is expected.

Category	Item	Scoping Results			
		Pre-construction Stage	Construction Stage	Operation Stage	Reason for Scoping
	Local Resources				C: Using a large amount of local resources such as sand and quarrying for the construction activities would obstruct its utilization by the local people for other purposes.
					O: No impact is expected.
	General, Regional /City Plans	B-	D	B+	P: Many ministries are required to update their plans in accordance with the HSR plan.
					C: No impact is expected.
					O: In accordance with the HSR development including development of its surrounding areas, future general plan/city plans, which include future development plan, are expected to be prepared in all city/ministries.
	Social Institutions and Local Decision-making Institutions	C-	C-	C-	P: Some impacts on social institutions and local decision-making institutions are expected from land acquisition and resettlement. However further examination is necessary.
					C: Some impact on social institutions and local decision-making institutions are expected from the inflow of many construction workers and other people from outside the area. However, further examination would be necessary.
					O: Some impacts on social institutions and local decision-making institutions are expected from disturbances on movement of local people by the HSR structures. However, further examination is necessary for impact assessment.
	Social Infrastructure and Services	B-	B-	B+/ B-	P: Some impacts on social infrastructure and services are expected from land acquisition and resettlement, such as resettlement of community facility (village hall, etc.).
					C: Though temporary, impacts on social infrastructure and services from the setting up of construction yards and workers' camps, and traffic jams caused by increase of construction vehicles are expected. Notably, impacts on existing local social infrastructure and services are expected, such as relocation of public utilities and local roads.
					O: Development of the HSR station together with its surrounding areas would improve social infrastructure and services in the area and the country. On the other hand, some impacts on social infrastructure and services by the existence of the HSR structures are expected.
	Local Economy and Livelihood	B-	B+	A+/ B-	P: Some negative impacts on the local economy and livelihood are expected because of losses in employment opportunities and income sources resulting from land acquisition and resettlement.
					C: Some positive impact on the local economy is expected because of possible increment of business/employment opportunities generated by the construction activities.
					O: Some positive impact on the local economy is expected because of possible increment of business/employment opportunities generated by the HSR service, especially businesses around the station, and employment of the workers for track maintenance, etc. On the other hand, some negative impacts are also expected after the completion of the construction activities because of termination of temporary employment opportunities of local workers.

Category	Item	Scoping Results: Pre-construction Stage	Construction Stage	Operation Stage	Reason for Scoping
	Unequal Distribution of Benefit and Damage	B-	B-	B-	P: Unequal situations are expected among the project affected households/people and not affected households/people caused by land acquisition and resettlement.
					C: Some unequal situations are expected among the local people during construction, e.g., some affected households need to be relocated far away while their non-affected neighbors can do business with the construction workers.
					O: Some unequal situations are expected among the local people. People who live far from the station but along the alignment will possibly incur damage such as noise and vibration impacts, and some impacts on social infrastructure, services, and livelihood and water usage. Meanwhile, the local people living near the stations may receive the benefit from the HSR service and related opportunities of businesses.
	Local Conflicts of Interest	C-	C-	C-	P/C/O: Local conflicts of interest are expected among local people, especially between beneficiaries and project affected people caused by unequal distribution of benefit and damage during pre-construction, construction and operation stages. Further examination would be necessary for impact assessment.
	Water Usage, Water Rights and Communal Rights	C-	C-	C-	P: Some impacts on water usage for the resettled houses/residents are expected from land acquisition and resettlement. However, further examination would be necessary for water rights and communal rights.
					C: Impacts on water usage such as obstruction to access of water sources for domestic and irrigation uses by the construction activities are small and temporary. However, further examination would be necessary for water rights and communal rights.
					O: Impacts on water usage such as obstruction to access of water sources for domestic and irrigation uses by the existence of the high-speed railway structures are expected. However, further examination would be necessary for the disturbance by the structures.
	Cultural and Historical Heritage	D	C-	C-	P: There are no cultural and historical heritage sites directly damaged by the HSR.
					C: Noise and vibration caused by operation of the heavy equipment and vehicle may affect heritage sites along the planned alignment. Further examination would be necessary.
					O: Noise and vibration caused by operation of the HSR may affect heritage sites along the planned alignment. Further examination would be necessary.
	Religious Facilities	B-	B-	B-	P: Small scale village level religious facilities may be relocated.
					C/O: Noise and vibration during construction and operation stages may affect religious facilities along the planned alignment.
	Sensitive Facilities (ex. hospital, school, precision machine factory)	A-	B-	B-	P: Some public facilities and schools may have to be relocated.
					C: Noise and vibration caused by the construction work may affect schools and hospitals along the planned alignment.
					O: Noise and vibration caused by the operation of the HSR may affect schools and hospitals along the planned alignment.
	Poor People	C-	B+	C-	P: Further examination would be necessary for the poor people because it is more difficult for them to recover their livelihood, after land acquisition and resettlement, as compared to other PAPs.

Category	Item	Scoping Results: Pre-construction Stage	Construction Stage	Operation Stage	Reason for Scoping
					C: There is a possibility that the poor people would also have employment opportunities in construction and its associated business activities.
					O: There is a possibility that the enjoyment of the benefits of the HSR service by the poor people would be difficult. Further examination would be necessary.
	Ethnic Minorities/ Indigenous People	D	D	D	P/C/O: No impact on ethnic minorities/indigenous people along the alignment is expected.
	Gender	D	C-	C-	P: No impact is expected.
					C: Equal employment opportunities for both sexes are required for the construction works. Further examination would be necessary.
					O: The HSR service will be equal for both sexes. On the other hand, equal employment opportunities for both sexes are required for the HSR operation. Further examination would be necessary.
	Children's Rights	D	D	D	P: No impact is expected.
					C/O: Since National Action Plan for the elimination of child labor has been formulated, no impact on children's rights is expected.
	Public Health (sanitation and infectious diseases)	D	B-	B-	P: No impact is expected.
					C: Some impacts on public health are expected due to unsanitary conditions caused by the influx of a large number of workers. In addition, increase of risks related to Sexually Transmitted Diseases (STD) or Sexually Transmitted Infections (STI) and HIV/AIDS is expected among the workers and local communities.
					O: Some impacts on public health are expected due to the increase of passengers and business persons around the station area.
	Occupational Health and Safety (OHS)	D	B-	B-	P: No impact is expected.
					C: Occupational health and safety for the construction workers should be paid attention to.
					O: During the HSR operation, occupational health and safety for the workers during the track maintenance and at the depot should be paid attention to.
Other	Accidents	D	B-	C+/ C-	P: No impact is expected.
					C: Increase of risks of accidents associated with construction activities is expected due to the operation of heavy equipment and vehicles.
					O: Increase of risks of accidents associated with the HSR is expected. On the other hand, positive and/or negative impacts are expected from the modal shift of passenger transportation from cars, buses, air transport, and conventional trains to the HSR.
	Climate Change	D	B-	A+	P: No impact is expected.
					C: Although increase of GHGs emission is expected due to operation of heavy equipment and vehicles, the impact is temporary and small.
					O: Overall reduction of GHG emission is expected from modal shift of passenger transportation from cars, buses, air transport and conventional trains to the HSR.

Source: JICA Study Team

Table 11.2-5 ToR for Environmental Assessment Survey

Objective	Survey Item
Collection of Baseline Environmental and Social Information	・Natural Environment: Geography, geology, soil erosion, hydrology, groundwater, flora and fauna, landscape ・Living Environment (Pollution): Air quality, water quality, noise, vibration, soil contamination, ground subsidence, waste management, grievance mechanism on environmental pollution ・Social Environment: Population, settlements and developed area, indigenous people, poverty and the characteristic of distribution of poverty, livelihood and economy, current land use, spatial plan, sensitive public facilities (schools, hospitals, religious and cultural sites), water rights, disasters
Review of regulations and institutions on environmental and social considerations	・Collection of laws and regulations on environmental impact assessment (e.g. Law no. 32/2009 on environmental protection and management, Ministry of Environment (MoE) Regulation no. 5/2012, Government Regulation no. 27/1999, MoE Regulation No. 24/2009, etc.) ・Collection of regulations on environmental standards (air, water, noise, vibration, waste, etc.) ・Collection of laws and regulations on information disclosure (e.g. Regulation of Ministry of Environment, No. 8/2000) ・Gap analysis with JICA Guidelines for Environmental and Social Considerations (April 2010) ・Review on roles and responsibilities of related organizations on environmental and social considerations (e.g. MoE, environmental agency of DKI, Central Java Province and Regencies, professionals, NGO)
Review of budget, budget source and implementation structure	・Review of budget, budget source and implementation structures of environmental management plan and environmental monitoring plan

Source: JICA Study Team

(6) Result of Environmental Assessment and Impact Evaluation

After reviewing the result of the baseline survey for environmental and social considerations, impact evaluation was conducted based on the result of scoping. The ratios of the impact were the same as the ones in scoping.

Table 11.2-6 Results of the Environmental Assessment and Impact Evaluation

Category	**Items**	**Results of the Evaluation**			
		Pre-construction Stage	**Construction Stage**	**Operation Stage**	**Reason for Evaluation**
Natural Environment	Climate/ Meteorological Phenomena	D	D	D	P: No impact is expected. C/O: The impacts on micro-climate and micro meteorological phenomena are negligible because the structures of HSR would not disturb wind path.
	Topography	D	B-	D	P: No impact is expected. C: There are some impacts on topographic features in the area where mountains/hills exist along the alignment caused by generation of cut section (about 21.0km) and embankment (about 34.6km). O: After completion of construction, topography will be stable and no impact is expected.
	Geology	D	D	D	P: No impact is expected. C: No impact is expected. O: No impact is expected.
	Soil Erosion	D	B-	B-	P: No impact is expected.

Category	Items	Results of the Evaluation			
		Pre-construction Stage	Construction Stage	Operation Stage	Reason for Evaluation
					C: For the earthworks, especially when it is raining, some soil erosion is expected. O: Among 140km of the overall length, embankment and cut section occupies about 55.6km. New surface in embankment or cut section may be washed away by rain water.
	Hydrology	D	D	B-	P: No impact is expected. C: Change of land and topography during construction works may cause minor impacts on hydrological cycle or regimes. O: In embankment or cut section, some impacts are expected on hydrological cycle or regimes. These sections are planned at many areas in Karawang and other prefectures.
	Groundwater	D	B-	B-	P: No impact is expected. C: Usage of groundwater for the construction work will not be at a scale that changes hydrological regime. However some impacts on the groundwater are expected at the tunnel construction site. O: Usage of groundwater for the operation of the HSR will not be at a scale that changes the groundwater level. On the other hand, the tunnel structure may disturb the hydrological cycle or regimes to some extent.
	Ecosystem, Flora, Fauna and Biodiversity	D	B-	B-	P: No impact is expected. C: Most of the area along the alignment is already developed, therefore no impact on the valued ecosystem is expected. However, some impacts on various ecosystems and biota including mountains and agricultural areas caused by the construction works are expected. O: Existence of the HSR structures and HSR operation may cause negative impact on the ecosystem.
	Protected Areas/Forest	B-	B-	B-	P: The planned alignment is more than about 9 km away from the protected area. It is necessary to allocate the alternative areas and acquire the use permission of the forest area, since the alignment will pass the production forests (about 33.35ha) in Kabupaten Bekasi and Karawang. C: By the construction work, some of the forest area will be opened up. O: By the HSR structure, some of the forest area will be opened up. This will mean more sunshine on the inner part of the vegetation area, which would affect the edge of the forest area.
	Coastal Zone	D	D	D	P/C/O: No impacts are expected, because the HSR alignment is far enough away from the coastal zone and the planned alignment will not pass the tidelands and the mangrove forests which are peculiar to the coastal region.
	Landscape	D	D	B+/ B-	P: No impact is expected. C: Change of landscape is limited during the construction. O: By the structures such as viaduct, embankment and station buildings, both positive and negative impacts on landscape are expected.
	Natural Disaster	D	B-	B-	P: No impact is expected. C: The degree of risk in landslide/soil erosion areas along the planned alignment 1 is evaluated as intermediate level. O: The planned alignment will pass the flooding, landslide/soil erosion areas, the earthquake areas and so on.
Living	Air Pollution	D	B-	A+/ B-	P: No impact is expected. C: Some negative impacts are expected due to operation of construction equipment and vehicles. One of these is the dust incidental to earthwork especially during the dry season.

Category	Items	Pre-construction Stage	Construction Stage	Operation Stage	Reason for Evaluation
					O: Overall reduction of air pollutant emission is expected from the modal shift of passenger transportation to the HSR. On the other hand, increase in air pollutants from increased access by cars and buses around the station is expected.
	Offensive Odor	D	D	D	P/C/O: No impact is expected.
	Water Pollution	D	B-	B-	P: No impact is expected.
					C: Turbid water due to the earthworks, bridge pier construction work and wastewater effluents from construction workers' camps/yards are expected to pollute the surrounding rivers/canals to some extent.
					O: Some impacts on water quality in surrounding water bodies and canals are expected due to polluted water from passengers at the station and wastewater from maintenance activities in the depot.
	Bottom Sediment Contamination	D	D	D	P: No impact is expected.
					C: Although some construction materials such as cement and sand are expected to be washed out mainly by the rain, the impacts on bottom sediment are expected to be small.
					O: Although some wastewater is expected to be generated from maintenance activities in the depot, the impacts on bottom sediment from the wastewater are expected to be small.
	Soil Contamination	D	C-	B-	P: No impact is expected.
					C: Some impacts on soil from deposition of pollutants from construction materials in the construction site are expected to be small. On the other hand, in the case where the soil in the construction sites is already contaminated, by some other reason, some impacts are expected by the construction activity. Thus, further study is necessary.
					O: Some impact may be expected on soil from deposition of pollutants from maintenance activities in the depot.
	Ground Subsidence	D	D	D	P: No impact is expected.
					C: Groundwater utilization by the construction works will not be at a scale that changes ground water flow.
					O: No impact is expected.
	Noise/ Vibration	D	B-	A-	P: No impact is expected.
					C: Noise and vibration are generated by operation of construction equipment and vehicles, although they are temporary. Nonetheless, some impacts are expected on the residents and facilities near the construction sites such as schools and hospitals that require quietness.
					O: Noise and vibration will be generated by movement of the high speed trains and some impacts are expected on the residents and facilities along the HSR alignment such as schools and hospitals that require quietness. Moreover, noise will be generated by the maintenance of the ballast track to a limited extent (earth roadbed section including the depot and the track maintenance base.)
	Low Frequency Noise/Micro-pressure Wave	D	D	A-	P: No impact is expected.
					C: No impact is expected.
					O: Some impact by low frequency/micro-pressure wave at the tunnel sub-sections is expected. Low frequency noise from the train passing an open section is extremely small.
	Wave Obstruction	D	D	B-	P: No impact is expected.
					C: No impact is expected.

Category	Items	Results of the Evaluation			
		Pre-construction Stage	Construction Stage	Operation Stage	Reason for Evaluation
					O: Radio waves would be disturbed by movement of high speed trains and some impacts such as flutter and pulse interferences on TV are expected. In addition, elevated structures such as viaducts (typical design is about 10m high) would cause some wave disturbance impacts.
	Sunshine Obstruction	D	D	B-	P: No impact is expected. C: No impact is expected. O: Sunshine will be obstructed by the viaduct and station buildings.
	Wastes/Hazardous Materials	D	B-	B-	P: No impact is expected. C: A certain amount of construction and demolition wastes, which may include hazardous materials, and waste from construction workers' camps are expected to be generated. O: A certain amount of waste from passengers at the station and maintenance works at the depot is expected to be generated.
Social Environment	Involuntary Resettlement	A-	B-	D	P: About 256.3 ha of land are necessary for development of the HSR structures (viaduct, station, depot, etc.). In parallel, 3,000 households will be affected. C: Temporary relocation might be required for setting up of construction yards and workers' camps for the construction activities. O: No impact is expected.
	Land Use	B-	B-	A+	P: The current land use would be changed by land acquisition and resettlement. C: The land change by the construction of the HSR structures is expected to be small and land clearance for construction yards and workers' camps is temporary. However, the land use around the construction site may be changed by doing business with construction workers without control. O: The HSR station will be developed together with areas around the station as an integrated development. In addition, land use is expected to be changed gradually with further development mainly around the station in accordance with municipal/city plans and private investments.
	Utilization of Local Resources	D	B-	D	P: No impact is expected. C: Using a large amount of local resources such as sand and quarrying for the construction activities would obstruct its utilization by the local people for other purposes. O: No impact is expected.
	General, Regional /City Plans	B-	D	B+	P: Many ministries are required to update their plans in accordance with the HSR plan. C: No impact is expected. O: In accordance with the HSR development including development of its surrounding areas, future general plan/city plans, which include future development plan, are expected to be prepared in all city/ministries.
	Social Institutions and Local Decision-making Institutions	C-	C-	C-	P: Some impacts on social institutions and local decision-making institutions are expected from land acquisition and resettlement. However further examination is necessary. C: Some impact on social institutions and local decision-making institutions are expected from the inflow of many construction workers and other people from outside the area. However, further examination would be necessary.

Category	Items	Results of the Evaluation			
		Pre-construction Stage	Construction Stage	Operation Stage	Reason for Evaluation
					O: Some impacts on social institutions and local decision-making institutions are expected from disturbances on movement of local people by the HSR structures. However, further examination is necessary for impact assessment.
	Social Infrastructure and Services	B-	B-	B+/ B-	P: Some impacts on social infrastructure and services are expected from land acquisition and resettlement, such as resettlement of community facility (village hall, etc.).
					C: Though temporary, impacts on social infrastructure and services from the setting up of construction yards and workers' camps, and traffic jam caused by increase of construction vehicles are expected. Notably, impacts on existing local social infrastructure and services are expected, such as relocation of public utilities and local roads.
					O: Development of the HSR station together with its surrounding areas would improve social infrastructure and services in the area and the country. On the other hand, some impacts on social infrastructure and services by the existence of the HSR structures are expected.
	Local Economy and Livelihood	B-	B +	A+/ B-	P: Some negative impacts on the local economy and livelihood are expected because of losses in employment opportunities and income sources resulting from land acquisition and resettlement.
					C: Some positive impact on the local economy is expected because of possible increment of business/employment opportunities generated by the construction activities.
					O: Some positive impact on the local economy is expected because of possible increment of business/employment opportunities generated by the HSR service, especially businesses around the station, and employment of the workers for track maintenance, etc. On the other hand, some negative impacts are also expected after the completion of the construction activities because of termination of temporary employment opportunities of local workers.
	Unequal Distribution of Benefit and Damage	B-	B-	B-	P: Unequal situations are expected among the project affected households/people and not affected households/people caused by land acquisition and resettlement.
					C: Some unequal situations are expected among the local people during construction, e.g., some affected households need to be relocated far away while their non-affected neighbors can do business with the construction workers.
					O: Some unequal situations are expected among the local people. People who live far from the station but along the alignment will possibly incur damages such as noise and vibration impacts, and some impacts on social infrastructure, services, and livelihood and water usage. Meanwhile, the local people living near the stations may receive the benefit from the HSR service and related opportunities of businesses.
	Local Conflicts of Interest	C-	C-	C-	P/C/O: Local conflicts of interest are expected among local people, especially between beneficiaries and project affected people caused by unequal distribution of benefit and damage during pre-construction, construction and operation stages. Further examination would be necessary for impact assessment.

Category	Items	Pre-construction Stage	Construction Stage	Operation Stage	Reason for Evaluation
	Water Usage, Water Rights and Communal Rights	C-	C-	C-	P: Some impacts on water usage for the resettled houses/residents are expected from land acquisition and resettlement. However, further examination would be necessary for water rights and communal rights.
					C: Impacts on water usage such as obstruction to access of water sources for domestic and irrigation uses by the construction activities are small and temporary. However, further examination would be necessary for water rights and communal rights.
					O: Impacts on water usage such as obstruction to access of water sources for domestic and irrigation uses by the existence of the high-speed railway structures are expected. However, further examination would be necessary for the disturbance by the structures.
	Cultural and Historical Heritage	D	C-	C-	P: There are no cultural and historical heritage sites directly damaged by the HSR.
					C: Noise and vibration caused by operation of the heavy equipment and vehicle may affect heritage sites along the planned alignment. Further examination would be necessary.
					O: Noise and vibration caused by operation of the HSR may affect heritage sites along the planned alignment. Further examination would be necessary.
	Religious Facilities	B-	B-	B-	P: Small scale village level religious facilities have to be relocated.
					C/O: Noise and vibration during construction and operation stages may affect religious facilities along the planned alignment.
	Sensitive Facilities (ex. hospital, school, precision machine factory)	A-	B-	B-	P: Some public facilities and schools (two facilities at the present time) will have to be relocated.
					C: Some impacts, such as noise and vibration caused by the construction work may affect schools and hospitals along the planned alignment.
					O: Some impacts, such as noise and vibration caused by the operation of the HSR may affect schools and hospitals along the planned alignment.
	Poor People	C-	B+	C-	P: Further examination would be necessary for the poor people because it is more difficult for them to recover their livelihood, after land acquisition and resettlement, as compared to other PAPs.
					C: There is a possibility that the poor people would also have employment opportunities in construction and its associated business activities.
					O: There is a possibility that the enjoyment of the benefits of the HSR service by the poor people would be difficult. Further examination would be necessary.
	Ethnic Minorities/ Indigenous People	D	D	D	P/C/O: There are no ethnic minorities/indigenous people along the alignment.
	Gender	C-	C-	C-	P: Land acquisition and resettlement are an important incident to a family and some women would have a bigger burden for that. Further examination would be necessary.
					C: Equal employment opportunities for both sexes are required for the construction works. Further examination would be necessary.
					O: The HSR service will be equal for both sexes. On the other hand, equal employment opportunities for both sexes are required for the HSR operation. Further examination would be necessary.
	Children's Rights	D	D	D	P: No impact is expected.
					C/O: Since National Action Plan for the elimination of child labor has been formulated, no impact on children's rights is expected.

Category	Items	Results of the Evaluation			
		Pre-construction Stage	Construction Stage	Operation Stage	Reason for Evaluation
	Public Health (sanitation and infectious diseases)	D	B-	B-	P: No impact is expected.
					C: Some impacts on public health are expected due to unsanitary conditions caused by the influx of a large number of workers. In addition, increase of risks related to Sexually Transmitted Diseases (STD) or Sexually Transmitted Infections (STI) and HIV/AIDS is expected among the workers and local communities.
					O: Some impacts on public health are expected due to the increase of passengers and business persons around the station area. (When the section between Jakarta and Bandung is opened in 2020, about 44,000 passengers are expected to use the train which will then increase more than three times in 2050.)
	Occupational Health and Safety (OHS)	D	B-	B-	P: No impact is expected.
					C: Occupational health and safety for the construction workers should be paid attention to.
					O: During the HSR operation, occupational health and safety for the workers during track maintenance and at the depot should be paid attention to.
Other	Accidents	D	B-	C+/ C-	P: No impact is expected.
					C: Increase of risks of accidents associated with construction activities is expected due to the operation of heavy equipment and vehicles.
					O: Increase of risks of accidents associated with the HSR is expected. On the other hand, positive and/or negative impacts are expected from the modal shift of passenger transportation from cars, buses, air transport, and conventional trains to the HSR.
	Climate Change	D	B-	A+	P: No impact is expected.
					C: Although increase of GHGs emission is expected due to operation of construction equipment and vehicles, the impact is temporary and small.
					O: Overall reduction of GHG emission is expected from modal shift of passenger transportation from cars, buses, air transport and conventional trains to the HSR.

Note: A: Serious impact is expected (+: Positive impact, -: Negative impact),
B: Some impact is expected (+: Positive impact, -: Negative impact),
C: Since extent of impact is unknown, further examination will be required (+: Positive impact, -: Negative impact),
D: No impact is expected,
P: Pre-Construction; C: Construction; and O: Operation
Source: JICA Study Team

(7) Mitigation Measures and their Budget

Though the detail will be studied in the next phase, the impact during the construction will be taken care of in the construction plan. The following table summarizes the draft mitigation measures. The budget for the mitigation measures is borne by the project proponent for construction during pre-construction and construction stages and by the operation body during the operation stage.

Table 11.2-7 Draft Mitigation Measures

Category	Item	Results of Study for Mitigation Measures			
		Pre-construction Stage	**Construction Stage**	**Operation Stage**	**Mitigation Measures**
Natural Environment	Geology	D	B-	D	C: Select appropriate alignment at the detail design stage to make the cut and embankment sections as small as possible.
	Soil Erosion	D	B-	B-	C: Conduct the construction work in the dry season in the area where soil erosion is expected.
					O: Cover the new surface in embankment and cut sections with structures or vegetation.
	Hydrology	D	D	B-	O: Design the culverts for the channel in cut and embankment sections in order to prevent an adverse influence on hydrology.
	Groundwater	D	B-	B-	C: Pay special attention in order to prevent an adverse influence on groundwater by tunnel construction.
					O: Implement groundwater monitoring near the tunnel and pay special attention in order to prevent an adverse influence on groundwater.
	Ecosystem, Flora, Fauna and Biodiversity	D	B-	B-	C: Pay special attention to the construction time and the habitat fragmentation in order to prevent an adverse influence on various ecosystems and biota including mountains and agricultural areas.
					O: Set up the structures that consider the habitat fragmentation (culvert structure for embankment), implement the measures towards high speed railway noise (sound barrier, buffer station).
	Protected Areas/Forest	B-	B-	B-	P: Ensure the alternative areas.
					C: Plant trees in the alternative areas.
					O: Implement the monitoring of forest near the area in which trees will be felled, and forest management if necessary.
	Landscape	D	D	B+/ B-	O: Plan the structures in harmony with the surrounding landscape.
	Natural Disaster	D	B-	B-	C: Implement the monitoring in the flooding area, landslide/soil erosion areas and the earthquake areas during construction, prepare the countermeasure manual in the event of a natural disaster.
					O: Implement the monitoring in the flooding area, landslide/soil erosion areas and the earthquake areas during operation. Prepare for usage of the countermeasure manual in the event of a natural disaster.
Living Environment	Air Pollution	D	B-	A+/ B-	C: Cut unnecessary operation of the heavy equipment, conduct regular sprinkling of water during construction works.
					O: Arrange the access traffic in order to minimize traffic jams around the stations.
	Water Pollution	D	B-	B-	C: Conduct the countermeasure against turbid water and install sewage treatment system for waste water from construction workers' camps/yards.
					O: Treat the polluted water from passengers at the stations and wastewater from maintenance activities in the depot.
	Soil Contamination	D	C-	B-	C: Inquiry about the presence of soil contaminant in the project area, and apply necessary measures.
					O: Pollutants from maintenance activities in the depot should be appropriately treated

Category	Item	Pre-construction Stage	Construction Stage	Operation Stage	Mitigation Measures
		Results of Study for Mitigation Measures			
	Noise/ Vibration	D	B-	A-	C: Take a proper care of times and duration for construction works.
					O: Use noise reduction walls, implement the construction works and usage of vehicles taking into account noise and vibration, implement the monitoring and apply the necessary measures for the residents and facilities such as schools and hospitals that require quietness.
	Low Frequency Noise/Micro-pressure Wave	D	D	A-	O: Set up the necessary buffer stations at the tunnel sub-sections, introduce the vehicles that take into account low frequency/micro-pressure wave.
	Wave Obstruction	D	D	B-	O: Implement the monitoring for wave obstruction, set up antenna if necessary.
	Sunshine Obstruction	D	D	B-	O: Design structures with consideration of sunshine obstruction, conduct the information session and compensate if necessary.
	Wastes/ Hazardous Materials	D	B-	B-	C/O: Comply with relevant Indonesian laws on management of water generated in construction and operation stages.
Social Environment	Involuntary resettlement	A-	B-	D	P/C: Conduct the process of land acquisition and involuntary resettlement with adherence to relevant Indonesian law and international standard.
	Land Use	B-	B-	A+	P: Modify the land use plan in pre-construction stage with adherence to relevant Indonesian law.
					C: Implement the monitoring in construction stage to check if land use that does not comply with land use plan without control is going to be developed
					O: Prepare and conduct the plan in order to maximize the regional benefit through development of the HSR stations together with areas around the stations.
	Utilization of Local Resources	D	B-	D	C: Prepare and conduct the construction plan that will prevent excessive use of local resources such as sand and quarrying for the construction activities.
	General, Regional / City Plans	B-	D	B+	P: Modify the development plan and land use plan in pre-construction stage with adherence to relevant Indonesian law.
					O: Prepare general plan/city plans, which can contribute to TOD and regional development for maximizing the positive impact.
	Social Institutions and Local Decision-making Institutions	C-	C-	C-	P: Investigate the effect on social institutions and local decision making institutions from land acquisition and resettlement in LARAP, and consider the necessary measures.
					C: Implement the monitoring of the impact on social institutions and local decision-making institutions from the inflow of many construction workers and other people from outside the area, and consider the necessary measures.
					O: Implement the monitoring of the impact on social institutions and local decision-making institutions from disturbances on movement of local people by the HSR structures, and consider the necessary measures.
	Social Infrastructure and Services	B-	B-	B+/ B-	P: Prevent the resettlement of community facility (village hall, etc.) from land acquisition and resettlement, and ensure the alternative function in case of resettlement.

Category	Item	Results of Study for Mitigation Measures			
		Pre-construction Stage	Construction Stage	Operation Stage	Mitigation Measures
					C: Consider the countermeasures and implement them in order to prevent an adverse impacts on social infrastructure and services from the setting up of construction yards and workers' camps, and traffic jam caused by increase of construction vehicles.
					O: Develop the HSR stations together with its surrounding areas in order to maximize the improving effect of social infrastructure and services in the area and the country, and implement the monitoring.
	Local Economy and Livelihood	B-	B+	A+/ B-	P: Implement the measures against losses in employment opportunities and income sources resulting from land acquisition and resettlement in accordance with the resettlement plan, and implement the monitoring.
					C: Take account of the increment of business/employment opportunities generated by the construction activities in order to cause positive impact on the local economy.
					O: Form and conduct the plan that takes account of TOD in order to maximize the impacts on local economy, such as increment of business/employment opportunities generated by the HSR service, and help the temporary workers to find new employment.
	Unequal Distribution of Benefit and Damage	B-	B-	B-	P: Prepare and conduct the resettlement plan in order not to generate unequal situations of benefit and damage caused by land acquisition and resettlement.
					C: Take account of the affected households as much as possible.
					O: Promote TOD in order to improve the convenience of people living far from the stations.
	Local Conflicts of Interest	C-	C-	C-	P/C/O: Form the plan and implement the monitoring in order not to generate local conflicts of interest, and set up the consulting counter so that people can submit opinions regarding the construction and the operation.
	Water Usage, Water Rights and Communal Rights	C-	C-	C-	P: In formulation of LARAP, conduct the survey for water rights and communal rights, and make sure adverse impact is not caused.
					C: Consider and conduct the necessary mitigation measures based on the survey for water rights and communal rights.
					O: Consider and conduct the necessary mitigation measures toward water usage based on the survey.
	Cultural and Historical Heritage	D	C-	C-	C: Conduct the survey and the monitoring in order not to influence on the heritage sites near the alignment from noise and vibration caused by operation of the heavy equipment and vehicles.
					O: Conduct the survey and the monitoring in order not to influence on the heritage sites near the alignment from noise and vibration caused by operation of the HSR.
	Religious Facilities	B-	B-	B-	P: Explain adequately regarding religious facilities that are going to be relocated, and take into consideration the alternative facility (relocation or introduction of neighborhood facilities).
					C/O: Conduct the survey and the monitoring and measures in order not to have negative influence on religious facilities from noise and vibration caused by construction and operation of the HSR.

Category	Item	Results of Study for Mitigation Measures			
		Pre-construction Stage	Construction Stage	Operation Stage	Mitigation Measures
	Sensitive Facilities (ex. hospital, school, precision machine factory)	A-	B-	B-	P: Explain adequately regarding public facilities that are going to be relocated, and take into consideration the alternative facility (relocation or introduction of neighborhood facilities).
					C: Form the plan, conduct the monitoring and measures in order not to influence on schools and hospitals near the alignment from noise and vibration caused by the construction works.
					O: Form the plan, conduct the monitoring and measures in order not to influence on schools and hospitals near the alignment from noise and vibration caused by the operation of the HSR.
	Poor People	C-	B+	C-	P: Conduct the survey for poor people in formulation of LARAP, and take account of them.
					C: Make sure poor people can get benefit from construction and its associated business activities.
					O: Take account of the plan in order to achieve TOD that ensures poor people benefit.
	Gender	C-	C-	C-	P: Take account of gender in formulation and implementation of LARAP.
					C: Assure equal employment opportunity for both sexes in construction stage.
					O: Assure equal employment opportunity for both sexes in operation stage.
	Public Health (sanitation and infectious diseases)	D	B-	B-	C: Design and implement HIV/AIDS and STI prevention programs for workers and communities.
					O: Design and implement mass communication programs at stations to enhance local people awareness on possible risks.
	Occupational Health and Safety (OHS)	D	B-	B-	C: Place strict management of occupational health and safety for the workers.
					O: Place strict management of occupational health and safety for the workers during track maintenance and at the depot.
Other	Accidents	D	B-	C+/ C-	C: Implement the safety measures and management, train the drivers.
					O: Set up necessary facilities such as secure door, safety fence on railroad premises in order to eliminate accidents caused by high speed trains.
	Climate Change	D	B-	A+	C: Minimize GHG emission by cutting unnecessary operation of the heavy equipment and taking measures to relieve traffic jams.
					O: Conduct TOR, promote the reduction of GHG emission by synergistic effect of the HSR.

Note: A: Serious impact is expected (+: Positive impact, -: Negative impact),

B: Some impact is expected (+: Positive impact, -: Negative impact),

C: Since extent of impact is unknown, further examination will be required (+: Positive impact, -: Negative impact),

D: No impact is expected,

P: Pre-Construction; C: Construction; and O: Operation

Source: JICA Study Team

(8) Monitoring

The above-mentioned environmental items and the matters related to the mitigation measures are monitored. The details will be planned in the next phase of this Study.

(9) Stakeholder Meeting

During the study, three sessions of spatial plan and environmental considerations WG were planned as explained in 11.1 (3). The following are the result of series of 2nd WG which were held 13 times totally with local governments and central government organizations.

Table 11.2-8 2nd WG for Spatial Plan and Environmental and Social Considerations

Organizations	Date	Contents of discussions
DKI Jakarta	21 Nov 2014	Discussion on the comparison result of 8 potential station locations and request for further information especially on development plans.
West Java Province (with related local government)	14 Nov 2014	Explanation of the progress of the study on HSR plan with regard to environmental and social considerations, alignment, station and regional development (spatial plan) for discussion and further information request on development plans. Preparation for individual meeting with cities and regencies.
Bekasi City	23 Dec 2014	Explanation of the progress of the study on HSR plan with regard to environmental and social considerations, alignment, station and regional development (spatial plan) for discussion and further information request on development plans.
Bekasi Regency (Cikarang Area)	18 Nov 2014	Explanation of the progress of the study on HSR plan with regard to environmental and social considerations, alignment, station and regional development (spatial plan) for discussion and further information request on development plans.
Karawang Regency	19 Nov 2014	Explanation of the progress of the study on HSR plan with regard to environmental and social considerations, alignment, station and regional development (spatial plan) for discussion and further information request on development plans.
Purwakarta Regency	15 Dec 2014	Explanation of the progress of the study on HSR plan with regard to environmental and social considerations, alignment, station and regional development (spatial plan) for discussion and further information request on development plans.
Cimahi City	19 Dec 2014	Explanation of the progress of the study on HSR plan with regard to environmental and social considerations, alignment, station and regional development (spatial plan) for discussion and further information request on development plans.
West Bandung Regency	19 Dec 2014	Explanation of the progress of the study on HSR plan with regard to environmental and social considerations, alignment, station and regional development (spatial plan) for discussion and further information request on development plans.
Bandung City	20 Nov 2014	Explanation of the progress of the study on HSR plan with regard to environmental and social considerations, alignment, station and regional development (spatial plan) for discussion and further information request on development plans.
Ministry of Agriculture	18 Dec 2014	Explanation of the progress of the study on HSR plan with regard to environmental and social considerations, alignment, station and regional development (spatial plan) for discussion and information sharing on the Ministry's policy on the protection of agricultural areas, land use change procedure and distribution of paddy area.
Ministry of Environment and Forestry (Forestry in charge)	18 Dec 2014	Explanation of the progress of the study on HSR plan with regard to environmental and social considerations, alignment, station and regional development (spatial plan) for discussion and information sharing on the Ministry's policy on the protection of forest areas, land use change procedure and distribution of forest area.
Ministry of Environment	18 Dec 2014	Information sharing on 3rd WG and discussion on its contents.

and Forestry (Environment in charge)		
National Land Agency	22 Jan 2015	Information sharing on 3rd WG and discussion on its contents, and information sharing on land acquisition policy.

Source: JICA Study Team

(10) Preliminary Scoping Based on the Baseline Survey for Environmental and Social Considerations

Secondary information on natural, living and social environment was collected and the following preliminary scoping was conducted.

Table 11.2-9 Potential Impact on Environment

Category	Items	Impact		
		P	C	O
Natural environment	Climate/meteorological phenomena	D	D	D
	Topography	D	B-	D
	Soil erosion	D	B-	B-
	Hydrology	D	D	B-
	Ground water	D	B-	B-
	Ecosystem/flora and fauna	D	B-	B-
	Protected area/forest	B-	B-	B-
	Coastal zone	D	D	D
	Landscape	D	D	B+/B-
	Natural disaster	D	B-	B-
Living environment	Air pollution	D	B-	A+/B-
	Water pollution	D	B-	B-
	Soil contamination	D	C-	B-
	Noise/vibration	D	B-	A-
	Low frequency noise/micro-pressure wave	D	D	A-
	Sunshine obstruction	D	D	B-
	Wave obstruction	D	D	B-
	Waste/hazardous waste	D	B-	B-
Social environment	Involuntary resettlement	A-	B-	D
	Land use	B-	B-	A+
	Utilization of local resources	D	B-	D
	General, regional/city plans	B-	D	B+
	Social institutions and local decision-making institutions	C-	C-	C-
	Social infrastructure and services	B-	B-	B+/B-
	Local economy and livelihood	B-	B+	A+/B-
	Unequal distribution of benefit and damage	B-	B-	B-
	Local conflicts of interest	C-	C-	C-
	Water usage, water rights and communal rights	C-	C-	C-
	Cultural and historical heritage	D	C-	C-
	Religious facilities	B-	B-	B-
	Sensitive facilities (ex. hospital, school, precision machine factory)	A-	B-	B-
	Poor people	C-	B+	C-
	Ethnic minorities/Indigenous people	D	D	D
	Gender	C-	C-	C-
	Children's rights	D	D	D
	Public health	D	B-	B-
	Occupational Health and Safety (OHS)	D	B-	B-
Others	Accident	D	B-	C+/C-
	Climate change	D	D	A+

Note: A: Significant positive/negative impact is expected.
B: Positive/negative impact is expected to some extent.
C: Extent of positive/negative impact is unknown. (A further examination is needed, and the impact could be clarified as the study progresses)
D: No impact is expected.
+: Positive impact, -: Negative impact
P: Pre-construction, C: construction, O: operation
Source: JICA Study Team

(11) Environmental and Social Considerations on the Optimal Option

The environmental and social considerations study including the field survey was conducted on the optimal option. Based on this practice, several improvements including the location of depot and the change in structure from an elevated one to an underground one were made.

11.3 Land Acquisition and Resettlement

(1) Legal Framework for Land Acquisition and Involuntary Resettlement

The principal laws and regulations of the Government of Indonesia governing land acquisition, compensation and resettlement include the following: i) Law of the Republic of Indonesia No. 2/ 2012 concerning Land Acquisition for Construction in the Public Interest; ii) Presidential Regulation No. 71 / 2012 concerning Implementation of Land Acquisition for Construction in the Public Interest (PP No. 71 / 2012); and iii) Indonesian Appraising Standard 306 (Standar Penilian Indonesia 306: SPI 306) (valid since April 2013). Since the project is likely to affect forest and paddy fields, relevant regulations such as Regulation No. P16/Menhut-II/2014 of the Ministry of Forestry, which articulates the procedures of obtaining forest use permit (Izin Pinjam Pakai Kawasan Hutan), will also be applied for the project. Major law and regulations related to land acquisition and compensation are shown below.

Table 11.3-1 Laws and Regulations Related to Land Acquisition and Involuntary Resettlement

No.	Laws and Regulations	Description
I. Land Acquisition / Compensation		
1	Basic Agrarian Law No. 5 / 1960	Defines the terminologies of land ownership and other land use categories.
2	Law No. 2 / 2012 concerning Land Acquisition for Development Activities in the Public Interest	Stipulates the land acquisition procedures, and articulates the necessary documents to be prepared for applying for land acquisition permission, methodology of compensation appraisal, grievance procedures, and monitoring/evaluation.
3	Presidential Regulation No. 71 / 2012 concerning Implementation of Land Acquisition for Development Activities in the Public Interest	Regulations guiding the implementation of the above law.
4	The National Land Agency Regulation No. 05/ 2012	Provides technical guidance for implementing Presidential Regulation No. 71/ 2012.
5	The Ministry Of Public Works Regulation No. 02/ PRT/ M/ 2014	Stipulates general rules for the use of underground space.

No.	Laws and Regulations	Description
6	PERGUB DKI No. 167 of 2012 on Underground Space	Regulates the use of underground space in DKI Jakarta.
7	Ministry of Finance No. 13 / PMK.02 / 2013 concerning Operational and Supporting Costs for Implementation of Land Acquisition for Construction in the Public Interest Budgeted from the National Budget	Stipulates the operational and supporting costs for land acquisition, including honoraria for staff involved in the land acquisition process.
8	Indonesian Appraising Standard 306 (SPI 306)	Guidelines for asset evaluation and compensation calculation, prepared by the Ministry of Finance and Indonesian Society of Appraisers (Masyarakat Profesi Penilai Indonesia: MAPPI)
9	Ministry of Forestry Regulation No. P16 / Menhut-II/ 2014	Stipulates the requirements and procedures for obtaining forest use permit.
10	Ministry of Agriculture Act No. 41/ 2009 on the protection of sustainable food agricultural land	Stipulates the requirements and procedures for converting paddy fields into different use.
11	Ministry of Agriculture Regulation No. 81/ Permentan/ OT.140/ 8/ 2013	Provides technical guidance on the implementation of the above Act.
II. Ethnic Minority Groups[1]		
1	Presidential Decree No. 111 / 1990	Defines the following criteria for identifying IPs: a) In the form of a small, closed, and homogenous community; b) An institution based on a family relationship; c) Generally located in a geographically isolated area; d) Generally lead a subsistence livelihood; e) Living in a simple manner in terms of technology; f) Livelihood is highly dependent on natural resources; and g) Limited access to social, economic and political services.
	Guidelines for Compensation for Customary Land (Head of BPN No. 5 / 1999)	Defines the terminology of customary rights, customary land, and communities under customary law, and stipulates the management provisions.

Source: JICA Study Team

Law No. 2 / 2012 and Presidential Regulation No. 71 / 2012 that provides guidance on the implementation of the law took effect in January 2012. The Law provides clear procedures and time frame for land acquisition, and fills several important gaps between Indonesian requirements and donors' requirements that had existed in previous laws and regulations. Major improvements from previous laws/regulations include the following: i) clear time frame for land acquisition; ii) clear procedures by phasing of land acquisition from planning and preparation to implementation and handing over of the land acquisition results; iii) clear budget allocation for all phases of land acquisition stated in the regulations of the Ministry of Finance and Ministry of Home Affairs; iv) evaluation of compensation by an independent appraiser; and v) expanded eligibility for compensation. In particular, the Law recognizes that residents who manage and utilize land are entitled to compensation and that all kinds of losses (loss of land and non-land assets, and other losses that can be valued) are to be appraised by a professional appraiser. The remaining gaps include the principle of no

[1] Indigenous people have not been confirmed regarding Jakarta-Bandung area of the project.

depreciation for compensation of loss of structures, clear provisions on livelihood restoration programs for severely affected persons and vulnerable groups to ensure that their living standards do not deteriorate, assistance for relocation (transition allowance), and requirements for external monitoring.

However, the effectiveness and practicality of the new Law have yet to be tested since the previous law and regulation still apply for projects that started prior to promulgation of the Law. As of February 2015, the number of projects in which the current Law has been applied remain limited to small, locally-financed projects. Several donor-financed projects that use the new Law are in different stages of project preparation, but none of them has been completed.

As discussed above, the indicative alignment passes through areas designated as forest (kawasan hutan). Therefore, the project proponent will be required to obtain a forest land use permit (Izin pinjam pakai kawasan hutan). For using forest for commercial purposes including the HSR project, the project proponent must i) acquire land twice the size of the forest to be used and ii) transfer the land to the Ministry of Forestry and plant trees based on Ministry's instruction. For projects in Java Island, the compensation land will have to be acquired within Java Island, according to the Ministry. The exact location of such land will have to be studied during Phase II of the study. This rule applies for projects that use an area underground of the forest such as gold mining. According to the indicative alignment, the size of underground area beneath the forest is approximately 2.9 ha. The estimated cost of the project discussed below takes into account this requirement regardless of the depth of the tunnel underneath the forest, but the rationale and necessity of such compensation should be discussed further with the Ministry to determine the rate of compensation that is commensurate with the likely impacts.

Likewise, irrigated paddy fields will have to be compensated with three times as much land based on Ministry of Agriculture Act No. 41/ 2009 on the protection of sustainable food agricultural land. The Act stipulates that irrigated paddy fields must be compensated by irrigated paddy at least three times as large as the size of acquired area. If an irrigated paddy field will be compensated by a non-irrigated paddy, it has to be compensated with 9 times as much land.

The use of underground space for the tunnel section will be guided by Regulation of the Ministry of Public Works No. 02/ PRT/ M/ 2014 as well as the regulation of DKI Jakarta No. 167/ 2012. The regulation of DKI Jakarta provides provisions for using a shallow underground area (up to 10m from the ground[2]) for infrastructure projects such as the MRT project currently under construction. On the other hand, the regulation by the Ministry of Public Works divides the underground section into shallow (up to 30m from the surface) and deep (30m and below the surface), and provides the list of

[2] For underground areas at a depth of 10m or more, the approval from DKI Jakarta government will be required but not the landowners.

priority structures and usages for each segment. Technical recommendation from the competent authority will have to be obtained for the use of the underground space, but the regulation only provides generic guidance without detailed procedures and requirements. For the treatment of underground sections in the HSR project, it will be necessary to harmonize existing regulations and ones being prepared[3] so that consistent and fair rules can be applied. Japan enacted the "Act on Special Measures concerning Public Use of Deep Underground" in 2001, which allows the use of deep underground (40m or below) for projects in the public interest without payment of superficies. The Act has been applied for several projects including Chuo Shinkansen project and thus might offer useful insights for elaborating discussions on the use of underground space for HSR project in Indonesia.

(2) Rationale and Scale of Land Acquisition

Avoiding and minimizing disturbance to local livelihoods is one of the key criteria for selecting the indicative alignment. A more detailed study on the alignment proposed in Stage I has been carried out and resulted in several changes in the indicative alignment. For example, the tunnel section in Bekasi has been extended to avoid disturbance to existing infrastructure on the ground. Also, environmental and social issues have been key factors[4] in selecting the site for depot and workshop out of five candidate sites. The scale of land acquisition and the cost associated with it have been estimated based on the indicative alignment proposed in Chapter 4. The total area to be acquired for the project is estimated to be 271.7 ha, of which 265.1 ha will be in West Java Province. The areas for main track, side road for construction and maintenance, and depot and workshop will be 198.2 ha, 25.8 ha, and 47.7 ha respectively. The detailed estimate of land acquisition per administrative area and per land type is shown below.

[3] It has been reported that the National Land Agency is preparing a draft Law relating to construction activities below the ground.

[4] Of particular importance was food security in Indonesia (i.e. to avoid affecting paddy fields). Also, one candidate site has been dropped to avoid impact on a cemetery.

Table 11.3-2 Estimated Scale of Land Acquisition for HSR Main Track and Depot/Workshop

	Residential/ commercial (high density)	Residential/ commercial (low density)	Irrigated Paddy Field	Non-irrigated Paddy Field	Forest	Plantation and dryland	Total (ha)
Jakarta Pusat	0	0	0	0	0	0	0
Jakarta Selatan	0	0	0	0	0	0	0
Jakarta Timur	0	3.3	0	0	0	0	3.3
DKI Jakarta	**0**	**3.3**	**0**	**0**	**0**	**0**	**3.3**
Kota Bekasi	0.1	0.7	0	0	0	0	0.8
Kab. Bekasi	23	75.4	8.3	1.7	2	0	110.4
Kab. Karawang	18.8	0.5	5.9	6.9	32.2	0	64.3
Kab. Purwakarta	13.4	0	5.7	0	0.1	2.6	21.8
Kab. Bdg Barat	17.4	0	0	0	0	3.6	21
Kota Cimahi	0.5	2	0	0	0	0	2.5
Kota Bandung	0	7.1	0	0	0	0	7.1
West Java	**73.2**	**85.7**	**19.9**	**8.6**	**34.3**	**6.2**	**227.9**
Total	**73.2**	**89**	**19.9**	**8.6**	**34.3**	**6.2**	**231.2**

Note: Depot and workshop will be located in Karawan with the total area of 33.3ha.
Source: JICA Study Team

Table 11.3-3 Estimated Scale of Land Acquisition for Side Road

	Residential/ commercial (high density)	Residential/ commercial (low density)	Irrigated Paddy Field	Non-irrigated Paddy Field	Forest	Plantation and dryland	Total (ha)
Jakarta Pusat	0	0	0	0	0	0	0
Jakarta Selatan	0	0	0	0	0	0	0
Jakarta Timur	0	3.3	0	0	0	0	3.3
DKI Jakarta	**0**	**3.3**	**0**	**0**	**0**	**0**	**3.3**
Kota Bekasi	0	0.4	0	0	0	0	0.4
Kab. Bekasi	6.8	1.3	1.4	0.3	0	0.4	10.2
Kab. Karawang	0.4	0	0	0.5	0	0	0.9
Kab. Purwakarta	0.4	0	0	0	0	0.3	0.7
Kab. Bdg Barat	1.2	0	0	0	0	0	1.2
Kota Cimahi	1	1.1	0	0	0	0	2.1
Kota Bandung	0.2	7.2	0	0	0	0	7.4
West Java	**10**	**10**	**1.4**	**0.8**	**0**	**0.7**	22.9
Total	**10**	**13.3**	**1.4**	**0.8**	**0**	**0.7**	26.2

Source: JICA Study Team

In addition to the above, the proposed HSR use of underground areas is as follows.

Table 11.3-4 Use of Underground Space

	Area (ha.)		Area (ha.)
DKI Jakarta		**West Java**	
Jakarta Pusat	4.7 (1.4)	Kota Bekasi	8.2
Jakarta Selatan	3.5 (1.7)	Kab. Bekasi	0
Jakarta Timur	3.4 (1.8)	Kab. Karawang	4.3
Sub-Total	**11.6 (4.9)**	Kab. Purwakarta	22.8
		Kab. Bdg Barat	21.4
		Kota Cimahi	0.8
		Kota Bandung	0
		Sub-Total	**57.5**
Overall Total	**69.1 (62.4)**		

Note: Adjusted figures excluding public areas such (that do not require land acquisition) are shown in brackets. The adjustment is based on a review of satellite imagery and supplementary field survey.
Source: JICA Study Team

(3) Scale of Involuntary Resettlement

The scale of involuntary resettlement was assessed based on the estimated amount of housing and other structures to be affected. The review of satellite imagery and supplementary field survey have identified the numbers and types of structures along the main track and side road of the indicative alignment as shown in Tables 11.3-5 and 11.3-6.

Table 11.3-5 Estimated Number and Types of Structure for HSR Main Track

	Residence (high quality)	Residence (middle quality)	Residence (low quality)	Commercial	Government	Social	Total
Jakarta Pusat	0	0	0	0	0	0	0
Jakarta Selatan	0	0	0	0	0	0	0
Jakarta Timur	199	0	0	6	1	5	211
DKI Jakarta	**199**	**0**	**0**	**6**	**1**	**5**	**211**
Kota Bekasi	0	67	0	6	0	2	75
Kab. Bekasi	1	451	0	25	2	16	495
Kab. Karawang	0	153	0	0	0	0	153
Kab. Purwakarta	0	93	0	0	0	0	93
Kab. Bdg Barat	0	442	0	4	1	0	447
Kota Cimahi	0	430	0	7	4	1	442
Kota Bandung	0	767	1	111	23	1	903
West Java	**1**	**2403**	**1**	**153**	**30**	**20**	2608
Total	**200**	**2403**	**1**	**159**	**31**	**25**	2819

Source: JICA Study Team

Table 11.3-6 Estimated Number and Types of Structure for Side Road

	Residence (high quality)	Residence (middle quality)	Residence (low quality)	Commercial	Government	Social	Total
Jakarta Pusat	0	0	0	0	0	0	0
Jakarta Selatan	0	0	0	0	0	0	0
Jakarta Timur	1	68	0	4	0	3	76
DKI Jakarta	**1**	**68**	**0**	**4**	**0**	**3**	**76**
Kota Bekasi	0	16	0	2	0	2	20
Kab. Bekasi	0	96	0	13	0	11	120
Kab. Karawang	0	8	0	0	0	0	8
Kab. Purwakarta	0	0	0	0	0	0	0
Kab. Bdg Barat	0	66	6	2	3	0	77
Kota Cimahi	0	159	23	0	0	1	183
Kota Bandung	0	391	0	7	0	0	398
West Java	**0**	**736**	**29**	**24**	**3**	**14**	806
Total	**1**	**804**	**29**	**28**	**3**	**17**	882

Note: Several structures are standing on the border between main track and side road and thus counted twice. For cost estimation, the figure is adjusted to remove the overlap.
Source: JICA Study Team

Through a review of satellite imagery and supplementary field survey, a total of 2,604 housing structures have been identified on the main track (199 in DKI Jakarta and 2,405 in West Java). For side road, the figure is 834 (69 in DKI Jakarta and 765 in West Java). Since many houses are constructed on the border between the main track and side road, the adjusted figure of 584 is used for estimating the size of household for side road area. Assuming that one housing structure is owned and resided in by one household, and assuming the average household size of 4.3 (based on the livelihood survey carried out along the indicative alignment), it is estimated that the project will trigger involuntary resettlement of 3,188 households with the total affected population of about 13,700. The figure is larger than the estimate during the METI-FS in 2012, which estimated the scale of involuntary resettlement to be up to 1,800 households for Jakarta-Gedebage section, mainly due to rapid expansion of urban and industrial areas along the alignment in recent years.

(4) Implementation and Timeframe of Land Acquisition

According to the Law No. 2/ 2012, the process of land acquisition is divided into four phases, namely i) planning; ii) preparation; iii) implementation; and iv) handover. The tasks to be carried out in each phase and timeframe for specific tasks are specified in the Law as shown in Table 11.3-7.

Table 11.3-7 Key Tasks and Timeframe for Land Acquisition

Details of Tasks	Responsible Institution	Time*
Stage 1: Planning ● Preparation of LARAP document ● Submission of LARAP to Governors	Project Proponent	15 month (F/S Phase II)
Preparation ● Forming Preparation Team	Governors	10 days
● Notification to community ● Preliminary data collection ● Public consultation	Preparatory Team	20 days 30 days 60-90 days
● Periods for lodging complaints	Community	31-149 days
- Case brought to courts in case of complaints	Administrative and Supreme Court	
● Determination and announcement of project location**	Governors	
● Application for execution of land acquisition to the Head of National Land Agency (BPN)	Project Proponent	
Total duration of Preparation Phase		**141-289 days**
Implementation ● Inventory of loss ● Verification and correction	Land Acquisition Team formed by the head of BPN	44-72 days
● Selection of appraiser and valuation of assets	Independent Appraiser	60 days
● Negotiation on compensation and court decisions in case of disagreement	Community, Land Acquisition Team, Administrative and Supreme Court	30-118 days
● Payment of compensation and release of land title	Land Acquisition Team, Community	7 days
Total duration of Implementation Phase		**141-257 days**
Handover ● Delivery of land	Land Acquisition Team to Project Proponent	7 days
● Certification and registration of land	Project Proponent	30 days
Total duration of Handover Phase		**37 days**
Total duration of Land Acquisition		**319-583 days**

Note: * Days refer to working days.
** The location stipulation issued by the governor is valid for two years with possible extension of one year.
Source: Law No. 2/ 2012 and Presidential Regulation No. 71/2012

In addition to the above, a separate process will be required for obtaining forest use permit (Izin Pinjam Pakai Kawasan Hutan). The project proponent seeking to obtain the permit must first choose appropriate land for compensation in consultation with Dinas Kehutanan (Forestry Service Office) and Perum Perhutani (State-owned Forestry Enterprise) in relevant province. The proponent then acquires the land and transfers it to the Ministry of Environment and Forestry. Upon completion of the transfer, the proponent can apply for the permit and the Ministry will check the land condition and advise project proponent about forestation method.

(5) Estimated Cost of Land Acquisition and Involuntary Resettlement

Under the METI-FS, the land price was estimated based on the tax object (NJOP) in 2012. During Stage I of the study, the unit price was updated, taking into account the inflation rate and especially appreciation of NJOP price over the past two years. The 2014 NJOP price for each Kota and Kabutaen was obtained during Stage II. In addition, additional survey was carried out to estimate the market price of land for each Kota and Kabupaten, which should be the basis for compensation as per the Law No. 2/2012. The market price in local areas was estimated based on the sample survey targeting village officials and local residents in 92 villages along the indicative alignment. Specifically, the respondents were asked to give a high and a low price for land and structures in their neighborhood. The answers were then grouped for each Kota/Kabupaten to generate estimated high and low price for land and structure. The results were then verified by local real estate agencies who confirmed the figures are appropriate, and thus they are treated as the proxy for the market price in estimating the land acquisition cost in Phase I, Stage II[5]. The figures are shown in Table 11.3-8 below. The higher price is used for estimating the land acquisition cost for high density residential and commercial areas while the lower price is applied for other land use categories.

Table 11.3-8 Estimated Unit Price of Land in Each Kota and Kabupaten (thousand IDR per m^2)

	NJOP (2014)	Market Price (High)	Market Price (Low)
DKI Jakarta			
Jakarta Pusat	1,500	25,100	10,800
Jakarta Selatan	1,500	6,600	4,500
Jakarta Timur	1,500	5,600	3,400
West Java			
Kota Bekasi	464	2,300	900
Kab. Bekasi	36	1,100	600
Kab. Karawang	36	1,000	400
Kab. Purwakarta	82	400	80
Kab. Bdg Barat	464	900	500
Kota Cimahi	0.4	3,300	800
Kota Bandung	1,280	4,400	1,600

Source: NJOP and JICA Study Team

The price for affected structure was estimated in a similar manner, as shown in Table 11.3-9.

[5] During the implementation of the land acquisition, the market price for land and assets will be verified by independent appraisers to be procured by the Land Acquisition Team.

Table 11.3-9 Estimated Unit Price of Structure in Each Kota and Kabupaten (thousand IDR per m^2)

	NJOP (2014)	Market Price
DKI Jakarta		
Jakarta Pusat	2,500	3,300
Jakarta Selatan	2,500	2,300
Jakarta Timur	310	1,500
West Java		
Kota Bekasi	823	1,250
Kab. Bekasi	150	580
Kab. Karawang	595	616
Kab. Purwakarta	150	427
Kab. Bdg Barat	425	869
Kota Cimahi	429	783
Kota Bandung	191	650

Source: NJOP and JICA Study Team

Based on the land requirement, unit costs and the need for providing allowance and transitional support to affected households, the overall cost associated with land acquisition and involuntary resettlement is estimated to be IDR 3,746,600 million (JPY40,536 million) as shown in Table 11.3-10 below.

Table 11.3-10 Estimated Cost of Land Acquisition

	Item	Cost (million IDR)
A	Land[1]	2,361,000
B	Structure	177,000
C	Underground[2]	270,000
D	Allowance to affected households[3]	150,000
E	Total Direct Cost (A to D)	2,958,000
F	Indirect Cost (5% of direct cost)	148,000
G	Irrigation and plantation[4]	300,000
H	Total	3,406,000
I	Contingency (10% of H)	340,600
J	**Grand Total**	**3,746,600 (JPY40,536 million)[5]**

Note: 1. Include cost for additional land for forest (2x) and irrigated paddy field (3x) as per requirements of Ministry of Forestry Regulation No. P16 / Menhut-II/ 2014 and Ministry of Agriculture Act No. 41/ 2009; 2. Assumes the super superficies of 30% (i.e. paying land owner 30% of the land price for using underground space); 3. Includes *solatium*, which is a sort of emotional compensation for residents, as per SPI 306; 4. Based on expert judgment; 5. IDR1 = JPY0.01023.
Source: JICA Study Team

11.4 Estimated Mitigation Effect of Climate Change

(1) Conditions

By introduction of HSR for Jakarta-Bandung, the HSR demand of 44,000 passengers/day in 2020 and 148,000 passengers/day will be expected. This demand will be shared among car, bus and conventional railway in the without-HSR case. To estimate the mitigation effect by HSR, CDM methodology AM0101 (HSR system) and JICA Climate Finance Impact Tool (JICA Climate-FIT) “3. Railway (Passenger) / Modal Shift” are useful. In this Study, these methodologies were examined and it was decided to regard the difference of following CO_2 emission amounts as mitigation effect.

- CO_2 emission from the electricity consumption by HSR between Jakarta-Bandung
- CO_2 emission to transport 44,000 passengers/day without HSR between Jakarta-Bandung

Conditions of estimate are as follows.

Table 11.4-1 Modal Shift in 2020 to HSR

	Transportation mode	Passengers	%
1	Car	37,532	85.3%
2	Bus	4,620	10.5%
3	Conventional railway	1,848	4.2%
	Total	44,000	100.0%

Table 11.4-2 Unit Emission of CO_2

	Transportation mode	[g-CO2e/PKM]	Note
1	Car	174.1	This is the average for gasoline-fueled vehicle (average of small size car).
2	Bus	59.9	This is the average of city bus and highway bus.
3	Conventional railway	56.5	This is the average in British Rail (BR).

Department for Environment, Food and Rural Affairs (DEFRA) of UK, 2011/Energy and Carbon Conversion 2011 updated CARBON TRUST

Table 11.4-3 Energy Consumption by HSR

	Item	Qty	Unit	Note
1	Average energy consumption for JKT-BDG section	4,575	kwh/train	Jakarta to Bandung Express: 5,150kWh, Local: 6,450kWh Bandung to Jakarta Express: 2,700kWh, Local: 4,000kWh
2	Frequency	70	train/day	
	Energy consumption 1 x 2	320.3	MWh/day	

Source: JICA Study Team

(2) Mitigation Effect

Under the conditions above, total emission is 260.7tCO_2/day from 320.3MWh/day consumption by HSR and 0.814 tCO_2/MWh (emission factor of JaMaLi grid in 2012).

On the other hand, without HSR, 1,037.3 tCO_2/day will be generated (distance of Jakarta-Bandung is set to be 150km). Thus, the mitigation effect is estimated to be 776.6 tCO_2/day, or 283,500 tCO_2 per year in 2020.

Table 11.4-4 Mitigation Effect on Climate Change by HSR

	Transportation Mode	Passengers [person]	Unit emission [g-CO2e/PKM]	CO_2 emission [tCO2/day]
Without HSR case				
1	Car	37,532	174.1	980.1
2	Bus	4,620	59.9	41.5
3	Conventional Railway	1,848	56.5	15.7
	Total	44,000		1,037.3
With HSR case				
	HSR	44,000	42.3*	260.7
Mitigation effect				
				776.6

*: emission per PKM was calculated from total CO2 emission estimated from electricity consumption
Source: JICA Study Team

Chapter 12

Cost Estimation

Chapter 12 Cost Estimation

12.1 Cost Estimation

12.1.1 Basic Policy of Project Cost Estimation

(1) Civil Works

Calculation of the construction cost is performed by multiplying the section length of each type of structure by the unit price and totaling the construction costs. The unit price for each type of civil works, namely earthworks, viaducts, bridges, tunnels, etc., is based on the information obtained in Indonesia which is reviewed and assessed for its validity.

The unit price for double track shield tunneling works by the TBM method is determined based on the cost of the single track tunneling works in the Jakarta MRT project and multiplied by the cross-sectional dimensions.

(2) Tracks

The unit price of track is determined based on the unit price of construction in Japan, taking into consideration the local procurement of materials and the unit price of labor in Indonesia.

The turnouts will be brought in from Japan. The unit price for installation and construction is determined taking into consideration the conditions in Indonesia.

(3) Stations

The construction cost of stations is calculated by first evaluating the unit price for construction of the area of square meter in Indonesia and then by multiplying the area of each of the main stations and intermediate stations by the unit price. The unit price for the underground stations is determined based on the unit price of Jakarta MRT project.

(4) Depots and Workshops

The construction costs for depots, workshops, and other related structures are based on the construction cost of car depots in Japan. The quantities of works are compared according to the shapes and installation locations. After reviewing and evaluating the validity of the costs for application in Indonesia, the construction cost for the car depots is calculated.

(5) Electrical and Mechanical Facilities

The unit prices for the construction of electrical and mechanical (E&M) facilities are based on the unit prices in Japan. Their validity for Indonesia is reviewed and assessed and the construction cost is calculated.

(6) Division of Local and Foreign Currencies

The construction costs of all items from (1) to (5) above are estimated in both local and foreign currencies based on the methods of procurement for the equipment and materials, understanding of local labor costs, and the possibility of procurement in Indonesia.

(7) Rolling Stock

The unit price of each unit of rolling stock is set. The rolling stock cost is calculated based on the number of train sets estimated based on the demand forecast results.

(8) Land Acquisition Cost

The unit price per square meter of urban land around the existing stations and farmland in the suburban areas is surveyed. The land acquisition cost is then calculated by multiplying the unit prices by the areas to be acquired for the high-speed railway.

(9) Consulting Service Fee, Value Added Tax, Contingencies, etc.

In addition, a consulting service fee (preparation of tender documents, approval of the detailed design prepared by the contractor, construction management, etc.), value-added tax (VAT), administrative cost, land acquisition fee, and reserve fund shall also be added to the total project cost.

- The consulting service fee is calculated at 5% of the construction and procurement cost, excluded rolling stock, maintenance machine and preparation cost.
- The administrative cost is the cost incurred on the Indonesian client side. It is assumed to be 10% of the consulting service fee..
- Import duties are not included in the project cost.
- The contingencies are estimated to be 5% of the construction cost and procurement cost and consulting service fee , excluded rolling stock cost.
- The 10.0% tax rate in Indonesia will be applied to the total construction cost and consulting service fee as VAT.

12.1.2 Composition of Project Cost

The preliminary project cost is calculated as the sum of the following items:

- I. Construction and procurement cost
- II. Consulting service fee
- III. Land acquisition fee
- IV. Administrative cost
- V. Contingencies

VI. VAT

Figure 12.1-1 shows the composition of the project cost of the high-speed railway system.

In this case, the total project cost of the high-speed railway system includes not only the construction and procurement cost (civil works, track works, facility-related cost, E&M and rolling stock) but also the consulting service fee, land acquisition and housing compensation cost, general administrative cost, reserve fund and value-added tax.

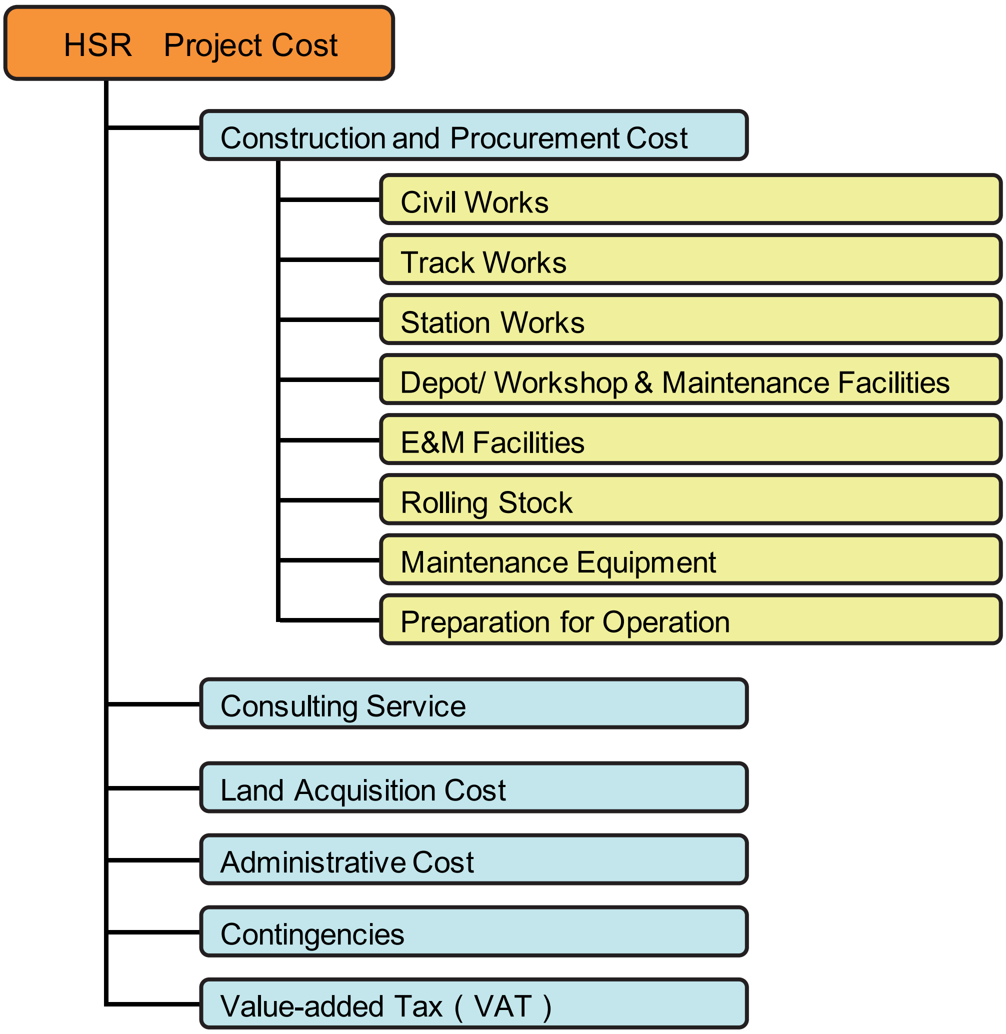


Figure 12.1-1 Breakdown of Project Cost of the High Speed Railway System

Table 12.1-1 shows the detailed breakdown of the project cost.

Table 12.1-1 Breakdown of Project Cost

I	Construction and Procurement Cost	
I-1	Civil Works	Cutting, embankments, viaducts, bridges, tunnels, noise barriers, tunnel entrance hoods, etc.
I-2	Track Works	Frame-shaped slab tracks, Balast Track
I-3	Station Works	
I-4	Depot and Workshop & Maintenance Facilities	Depots, workshops, and maintenance facilities
I-5	E&M Facility	
/01	Power Supply Facilities	Substation facilities, overhead line facilities, lights and power supply facilities, and dispatching facilities
/02	Signal and Telecommunication Facilities	Train protection facilities, telecommunication facilities, telecommunication routes, traffic control / signal / telecommunication-related dispatching facilities
I-6	Rolling Stock	
I-7	Maintenance Equipment	
I-8	Preparation for Operation	Education and training facilities, such as simulators, etc.
	Import Duties	Import duties are not included in the project cost
II	Consulting Service	The engineering service includes detailed design, bidding assistance, construction management, etc. It is calculated at 5% of the construction and procurement cost, excluded rolling stock, maintenance machine and preparation cost.
III	Land Acquisition Cost	The total cost for acquiring land, including land acquisition cost, relocation fee, and acquisition costs of tracks, stations, garages, inspection and repair facilities; and various costs for the relocation of residents
IV	Administrative Cost	It is including administrative cost of the special purpose entity and cost of environmental measures, etc., at 10% of the consulting service fee.
V	Contingencies	The project's reserved fund is calculated at 5% of the construction cost and procurement cost and consulting service fee , excluded rolling stock cost.
VI	VAT	VAT is calculated at 10.0% of sum of construction cost, procurement cost and consulting service fee.

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(1) The base month for the calculation is March 2014.

(2) Currency exchange rates (2014/3/1)

1 USD = 99.24 JPY

1 IDR＝0.01023 JPY

1 JPY = 97.75 IDR

12.2 Operation and Maintenance Cost

Operation and maintenance cost was calculated in each filed. These include cost of manpower labor, materials, consumable supplies and other required. Cost indicated in operation filed includes crew of trains, station staff, operation control center and car cleaning.

The cost which does not needed in each year but required for refurbishment of each facility is indicated as ‘Refurbishment cost’. The cycle of refurbishment is also indicated in same table.

Operation and maintenance cost is as shown in Table 12.2-1.

Table 12.2-1 Operation and Maintenance Cost

Item		Unit	2020	2030	2040	2050	Refurbishment Cycle	Refurbishment Cost
Operation	Manpower	per annum	1,133	1,328	1,522	1,716	-	-
	Electricity	per annum	2,537	3,833	5,128	6,424	-	-
Rolling Stock	Maintenance	per annum	1,170	1,530	2,340	2,460	12 years	5,400 Mil JPY/ train set
Track	Maintenance	per annum	1,500	1,500	1,500	1,500	15 years	13,000
Electricity	Maintenance	per annum	1,268	1,300	3,200	1,300	30 years	29,300
Signal & Tele-communications	Maintenance	per annum	1,200	1,200	1,200	1,200	20 years	17,400
			-	-	-	-	30 years	6,400
AFC	Maintenance	per annum	30	30	30	30	10 years	3,000
OCC	Refurbishment	ls	-	-	-	-	12 years	13,800

12.3 Calculation of Preliminary Project Cost

12.3.1 Unit Prices of Civil Works

Based on the policies for calculation of the project cost stated in section 8.1.1, the following unit prices of civil works and various facilities are adopted for calculation of the project cost.

(1) Unit Cost of Civil Works

Table 12.3-1 shows the unit cost of the civil works.

Table 12.3-1 Basic Cost of the Civil Works

HSR Unit Cost

1JPY=97.75IDR

		Unit	Unit cost		Total Equivalent JPY
			Foreign currency	Domestic currency	
			X 1,000JPY	X1,000IDR	X 1,000JPY
Civil Works					
Embankment					
Embankment-A H=1m	(including soil improvement)	m	0	26,429	270
Embankment-B (Reinforced Earth Retaining Wall) H=3m	(including soil improvement)	m	0	45,657	467
Embankment-C (Reinforced Earth Retaining Wall) H=6m	(including soil improvement)	m	0	66,008	675
Cutting					
Cutting-A D=6m		m	0	29,288	300
Cutting-B D=12m		m	0	54,269	555
Cutting-C D=9m		m	0	0	0
U type Retaining Wall		m	208	118,903	1,424
Viaduct					
Viaduct-A(Regular Bridge) H=8m	20mPC simply supported girder, pile ：6@20m	m	0	190,973	1,954
Viaduct-B(Regular Bridge) H=16m	20mPC simply supported girder、pile ：6@30m	m	0	249,538	2,553
Viaduct-C(Regular Bridge)	(Station 2P-4T)	m	669	590,055	6,705
Viaduct-C(Regular Bridge)	(Station 1P-2T)	m	365	334,143	3,783
Bridge					
Bridge-A Span:40m		m	94	229,279	2,440
Bridge-B Span:60m		m	127	300,172	3,198
Tunnel (Mountain Tunneling)					
Tunnel-A (Mountain Tunneling)	Entrance of tunnel （countermeasures against land slide、tunnel entrance buffering hood）	m	2,235	108,377	3,343
Tunnel-B (Mountain Tunneling)		m	1,015	71,472	1,747
Tunnel-C (Mountain Tunneling)	Fault fracture zone、etc	m	1,189	86,498	2,074
Shield Tunnel					
Shield Tunnel	Double-track tunnel	m	3,949	63,976	4,603
Shaft	20m(W)×20m(D)×35m(H)	nos.	63,249	19,324,286	260,940
Cut and Cover					
Cut and Cover-A	Jakarta underground station (triple-deck 5 span)	m	4,398	2,310,933	28,039
Cut and Cover-B	Karawang underground station (double-deck 5 span)	m	4,685	2,461,857	29,870
Cut and Cover-C	Tunnel (single-deck 1 span)	m	493	243,118	2,981
Transverse					
Box Culvert W=8m H=7m L=15m		nos.	0	3,513,211	35,941
Bridge		nos.	12,389	6,721,645	81,153
Service Road					
Service Road		m	0	4,860	50
Construction Road		m	0	3,240	33
Environmental program		ls	0	0	0
Sound Protection Wall （Embankment）		m	0	978	10
Sound Protection Wall （Viaduct）		m	0	3,441	36

(2) Unit Cost of E&M

The unit cost of E&M and rolling stock is as shown in Table 12.3-2

Table 12.3-2 Unit Cost of E&M

Initial Cost	Item	Detailed Item	Unit	Q'ty	Unit Price (Mil. JpY)		Cost (Mil. JpY)	
					Foreign	Local	Foreign	Local
I-3	Disaster Prevention Facility		ls	1	1,900	100	1,900	100
I-4	Track		km	140	92.8	140.6	12,985	19,682
I-5	Station	Construction					0	0
		Air conditioner, E&M (Ev etc)					0	0
		Sanitary Facility					0	0
		Electric Facility					0	0
		Sub- total	ls	1	9,100	7,440	9,100	7,440
I-6-1	Depot	Civil Works	ls	1	0	2,295	0	2,295
		Building	ls	1	0	4,329	0	4,329
		Depot Facility	ls	1	15,600	3,900	15,600	3,900
		Track	ls	1	373	1,077	373	1,077
		Substations	ls	1	4,700	700	4,700	700
		Distribution Facility	ls	1	300	100	300	100
		Contact Line	ls	1	500	100	500	100
		Signal Facility	ls	1	658	687	658	687
		Telecommunication Facility	ls	1	156	196	156	196
I-6-2	Workshop	Civil Works	ls	1	0	188	0	188
		Track	m	5034.8	0	0	50	252
		Turnout 9# (50N)	set	24	6	2	144	36
		Turnout for Mainline 12# (60kg)	set	3	28	10	84	30
		Building	ls	1	0	70	0	70
		Workshop Facility	ls	3	20	2	60	6
I-7	Electric Facility	Substations	ls	1	25,300	9,800	25,300	9,800
		Distribution Facility	ls	1	8,500	1,500	8,500	1,500
		Contact Line	ls	1	9,900	2,100	9,900	2,100
I-8	AFC		ls	1	3,470	0	3,470	0
I-9-1	Signal& Tele-communications	Signal Facility	ls	1	5,290	5,043	5,290	5,043
		Telecommunication Facility	ls	1	3,090	8,910	3,090	8,910
I-9-2	OCC		ls	1	13,830	0	13,830	0
I-10	Rolling Stock		cars	84	425	0	35,700	0
I-11	Maintenance Equipment	Track	ls	1	2,000	0	2,000	0
		Electric Facility	set	**3**	70	0	210	0
I-12	Preparation Cost		ls	1	1,000	1,000	1,000	1,000

1) Construction Cost of Disaster Prevention Facilities and Track Works

Table 12.3-3 shows the construction cost of disaster prevention facilities and track works.

Table 12.3-3 Construction Cost of Disaster Prevention Facilities and Track Works

Initial Cost	Item	Detailed Item	Unit	Q'ty	Unit Price (Mil. JpY)		Cost (Mil. JpY)	
					Foreign	Local	Foreign	Local
I-3	Disaster Prevention Facility		ls	1	1,900	100	1,900	100
I-4	Track		km	140	92.8	140.6	12,985	19,682

2) Station Construction Cost

Table 12.3-4 shows the station construction cost.

Table 12.3-4 Station Construction Cost

1 JPY=97.75IDR

Station Construction Cost 2020				Foreign Currency	Local Currency	Conversion to Foreign Currency	Conversion to Local Currency
Station Construction Cost				x1,000JPY	x1,000IDR	x1,000JPY	x1,000IDR
1	Civil Works	LS	1			-	-
2	Building Work	LS	1	5,598,000	447,695,000	10,178,000	994,899,500
3	Mechanical Equipment	LS	1	235,000	18,768,000	427,000	41,739,250
4	Sanitary Facilities	LS	1	759,000	60,703,000	1,380,003	134,895,250
5	Electric Facilities	LS	1	1,120,000	89,539,000	2,036,000	199,019,000
	Total			7,712,000	616,705,000	14,021,003	1,370,553,000

3) Construction Cost of Depot and Workshop

Table 12.3-5 shows the construction cost of depot and workshop.

Table 12.3-5 Construction Cost of Depot and Workshop

1 JPY=97.75IDR

Cikarang Depot				Foreign Currency	Local Currency	Conversion to Foreign Currency	Conversion to Local Currency
Construction Cost				x1,000JPY	x1,000IDR	x1,000JPY	x1,000IDR
1	Site Preparation	m2	476,851.0		258,680,900	2,646,352	258,680,900
2	Building Work	m2	120,246.0		423,145,674	4,328,856	423,145,674
3	Factory Equipment	LS	1.0	15,600,000	381,225,000	19,500,000	1,906,125,000
4	Track	LS	1.0	373,000	105,276,750	1,450,000	141,737,500
5	Substation Equipment	LS	1.0	4,700,000	68,425,000	5,400,000	527,850,000
6	Power Distribution Equipment	LS	1.0	300,000	9,775,000	400,000	39,100,000
7	Electric Train Line	LS	1.0	500,000	9,775,000	600,000	58,650,000
8	Signaling Facility Cost	LS	1.0	658,000	67,154,250	1,345,000	131,473,750
9	Communications Facility Cost	LS	1.0	156,000	19,159,000	352,000	34,408,000
	Total			22,287,000	1,342,616,574	36,022,208	3,521,170,824

Workshop Construction Cost 2020

1 JPY=97.75IDR

Workshop				Foreign Currency	Local Currency	Conversion to Foreign Currency	Conversion to Local Currency
Construction Cost				x1,000JPY	x1,000IDR	x1,000JPY	x1,000IDR
1	Site Preparation	m2	409,663.0		18,422,510	188,466	18,422,510
2	Building Work	m2	120,246		6,809,265	69,660	6,809,265
3	Factory Equipment	LS	1	60,000	557,175	65,700	6,422,175
4	Track	LS	1	50,348	24,607,585	302,088	29,529,102
5	Substation Equipment	LS	1	144,000	3,519,000	180,000	17,595,000
6	Power Distribution Equipment	LS	1	84,000	2,932,500	114,000	11,143,500
7	Electric Train Line	LS	1	0	0	0	0
8	Signaling Facility Cost	LS	1	0	0	0	0
9	Communications Facility Cost	LS	1	0	0	0	0
	Total			338,348	56,848,035	919,914	89,921,552

4) Cost of E&M Facilities

Table 12.3-6 shows the construction cost of E&M facilities.

Table 12.3-6 Construction Cost of E&M Facilities

Electric Facility Cost 2020 | 1 JPY=97.75IDR

				Foreign Currency	Local Currency	Conversion to Foreign Currency	Conversion to Local Currency	Remarks
Electric Facility Cost				x1,000JPY	x1,000IDR	x1,000JPY	x1,000IDR	
1	Site Preparation	LS	1		2,066,982	21,146	2,066,982	
/01	Substation	LS	1	0	1,519,840	15,548	1,519,840	4nos.x20,000m2
/02	Sectioning Point	LS	1	0	273,571	2,799	273,571	4nos.x3,600m2
/03	Sub-Sectioning Point	LS	1	0	273,571	2,799	273,571	4nos.x2,400m2
2	Substation Equipment	LS	1	25,300,000	957,950,000	35,100,000	3,431,025,000	
3	Power Distribution Equipment	LS	1	8,500,000	146,625,000	10,000,000	977,500,000	
4	Electric Train Line	LS	1	9,900,000	205,275,000	12,000,000	1,173,000,000	
	Total			43,700,000	1,311,916,982	57,121,146	5,583,591,982	

5) Cost of Signal and Telecommunications Facility

Table 12.3-7 shows the cost of signal and telecommunications facilities.

Table 12.3-7 Construction Cost of Signal and Telecommunications Facilities

Signal and Telecommunications Facility Cost | 1 JPY=97.75IDR

				Foreign Currency	Local Currency	Conversion to Foreign Currency	Conversion to Local Currency
Signal and Telecommunications Facility Cost				x1,000JPY	x1,000IDR	x1,000JPY	x1,000IDR
1	Signaling Facility Cost	LS	1	5,290,000	492,953,250	10,333,000	1,010,050,750
2	Telecommunications Facility Cost	LS	1	3,090,000	870,952,500	12,000,000	1,173,000,000
3	Operation Control Center	LS	1	13,830,000	0	13,830,000	1,351,882,500
	Total			22,210,000	1,363,905,750	36,163,000	3,534,933,250

6) Rolling Stock Cost

The unit price of one train car is calculated at 425 million yen. 35.7 Billion yen for 84 train cars will be necessary in the beginning year of operation.

12.3.2 Calculation of Preliminary Project Cost

Each of the required quantities is multiplied by the basic unit price shown in 12.3-1 to calculate the construction cost of each facility, which is then totaled to calculate the construction costs.

Table 12.3-8 shows Preliminary Project Cost

Table 12.3-9 shows Breakdown of Preliminary Project Cost

Table 12.3-8 Preliminary Project Cost

Project cost of Route: Jakarta-Bandung-Gedebage Unit: million JPY

Route Length: 140 km 1 JPY=97.75IDR

Item		Breakdown		Quantity	Unit Cost	Amount (JPY)
Construction / Procurement Cost	Civil Works	Embankment	Length :	34.6 km	625.16	21,630.4
		Cutting	Length :	22.4 km	349.82	7,836.0
		U type Retaining Wall	Length :	1.2 km	1,424.00	1,708.8
		Viaduct	Length :	37.6 km	2,225.19	83,667.1
		Bridge	Length :	1.6 km	2,676.76	4,282.8
		Tunnel (Mountain Tunneling)	Length :	28.1 km	1,917.19	53,873.0
		Shield Tunnel	Length :	14.0 km	4,678.04	65,492.6
		Cut and Cover	Length :	0.5 km	18,015.80	9,007.9
		Transverse		1.0 LS		4,322.1
		Service Road	Length :	88.6 km	41.30	3,659.3
		Environmental Program	Length :	72.2 km	23.34	1,684.8
		Sub-total		140.00 km		257,164.7
	Disaster Prevention Equipment			1.0 LS		2,000.0
	Track Construction Cost			140.0 km	233.34	32,667.0
	Station Construction Cost			1.0 LS		14,021.0
	Depot/ Workshop			1.0 LS		36,942.1
	Electric Facility Cost			1.0 LS		57,121.1
	System/Automatic Fare Collection			1.0 LS		3,470.0
	Signaling and Telecommunications Facility Cost			1.0 LS		36,163.0
	Rolling Stock			84.0 train	425.00	35,700.0
	Maintenance Equipment			1.0 LS		2,210.0
	Equipment Cost for Education and Training			1.0 LS		2,000.0
(1) Construction/Procurement Cost				140.0 km	3,424.71	479,459.0
(2) Consulting Service Cost		{(1)-(Rolling Stock+Maintenance Eq.+Preoperating cost)}x5%				21,977.5
(3) Land Acquisition Cost				271.7 ha		40,536.8
(4) Management Cost		｛（2）｝x 10%				2,197.7
(5) Contingency		｛(1)＋(2) - Rolling Stock Cost｝x 5%				23,286.8
(6) Value-added Taxes		｛（1）＋（2）｝x 10%				50,143.6
Project Cost				140.0 km	4,411.44	617,601.48

Construction cost = 439,549 million JPY (3,139.6 million JPY/km) (2020)

Table 12.3-9 Breakdown of Preliminary Project Cost

Calculation of project cost

Base Year Cost Estimation	2014/3				
Country	Republic of Indonesia				
Name of Currency	IDR	Indonesia Rupee			
Exchange Rate	1 JPY=	97.75 IDR			
Price Escalation	FC portion	1.30%	LC portion	4.9%	
Physical Contingency	Construction	5%	Consultant		5%
Rate of Tax	VAT(Value Added Tax)	10.0%			
Rate of Administration Cost	10%				
Consulting Service	5%				

Project cost of Route**: Jakarta-Bandung-Gedebage**

2020 Route Length: 140 km

（Unit: x1,000 ）

No.	Item	Specification	Unit	Quantity	Unit price		Amount		Total	Total
					Foreign	Local	Foreign	Local	Conversion to	Conversion to Local
					Yen	IDR	Yen	IDR	JPY	IDR
Ⅰ.	Construction/ Procurement Cost									
Ⅰ-1	Civil Works						90,889,148	16,253,437,477	257,164,723	25,137,851,655
/01	Embankment	(including soil improvement)	m	34,600.0				2,114,374,600.0	21,630,431	2,114,374,600
a	Embankment-A H=1m		m	3,100.0		26,429		81,929,900	838,158	81,929,900
b	Embankment-B (Reinforced Earth Retaining Wall) H=3m		m	2,300.0		45,657		105,011,100	1,074,282	105,011,100
c	Embankment-C (Reinforced Earth Retaining Wall) H=6m		m	29,200.0		66,008		1,927,433,600	19,717,991	1,927,433,600
/02	Cutting		m	22,400.0				765,967,600	7,835,986	765,967,600
a	Cutting-A D=6m		m	18,000.0		29,288		527,184,000	5,393,187	527,184,000
b	Cutting-B D=12m		m	4,400.0		54,269		238,783,600	2,442,799	238,783,600
/03	U type Retaining Wall		m	1,200.0	208	118,903	249,120	142,683,174	1,708,794	167,034,654
/04	Viaduct		m	37,600.0			948,800	8,085,710,700	83,667,068	8,178,455,900
a	Viaduct-A(Regular Bridge) H=8m	20mPC simply supported girder, pile ：6@20m	m	29,700.0		190,973		5,671,898,100	58,024,533	5,671,898,100
b	Viaduct-B(Regular Bridge) H=16m	20mPC simply supported girder、pile ：6@30m	m	6,300.0		249,538		1,572,089,400	16,082,756	1,572,089,400
c	Viaduct-C(Regular Bridge)		m	1,200.0	669	590,055	802,800	708,066,000	8,046,442	786,539,700
d	Viaduct-C(Regular Bridge)		m	400.0	365	334,143	146,000	133,657,200	1,513,337	147,928,700
/05	Bridge		m	1,600.0			167,280.0	402,292,900.0	4,282,808	418,644,520
a	Bridge-A Span:40m		m	1,100.0	94	229,279	103,730	252,206,900	2,683,852	262,346,508
b	Bridge-B Span:60m		m	500.0	127	300,172	63,550	150,086,000	1,598,957	156,298,013
/06	Tunnel (Mountain Tunneling)		m	28,100.0			32,155,360	2,122,900,700	53,873,014	5,266,087,140
a	Tunnel-A (Mountain Tunneling)	Entrance of tunnel（countermeasures against land slide、tunnel entrance	m	2,900.0	2,235	108,377	6,480,630	314,293,300	9,695,907	947,774,883
b	Tunnel-B (Mountain Tunneling)		m	24,700.0	1,015	71,472	25,080,380	1,765,358,400	43,140,312	4,216,965,545
c	Tunnel-C (Mountain Tunneling)	Fault fracture zone、etc	m	500.0	1,189	86,498	594,350	43,249,000	1,036,795	101,346,713
/07	Shield Tunnel		m	14,000.0			55,538,996.0	972,961,144.0	65,492,563	6,401,898,003
a	Shield Tunnel	Double-track tunnel	m	14,000.0	3,949	63,976	55,286,000	895,664,000	64,448,803	6,299,870,500
b	Shaft	20m(W)×20m(D)×35m(H)	nos.	4.0	63,249	19,324,286	252,996	77,297,144	1,043,760	102,027,503
/08	Cut and Cover		nos.	500.0			1,418,094	741,903,465	9,007,899	880,522,154
a	Cut and Cover-A	Jakarta underground station (triple-	m	300.0	4,398	2,310,933	1,319,400	693,279,900	8,411,777	822,251,250
c	Cut and Cover-C	Tunnel (single-deck 1 span)	m	200.0	493	243,118	98,694	48,623,565	596,122	58,270,904
/09	Transverse		LS	1.0			396,457.6	383,726,793.7	4,322,051	422,480,524
a	Box Culvert W=8m H=7m L=15m		nos.	48.0		3,513,211		168,634,142	1,725,157	168,634,142
b	Bridge		nos.	32.0	12,389	6,721,645	396,458	215,092,652	2,596,894	253,846,382
/10	Service Road		m	88,600.0				357,696,000.0	3,659,294	357,696,000
a	Service Road		m	43,600		4,860		211,896,000	2,167,734	211,896,000
b	Construction Road		m	45,000		3,240		145,800,000	1,491,560	145,800,000
/10	Environmental Program			72,200.0			15,040.0	163,220,400.0	1,684,814	164,690,560
a	Sound Protection Wall （Embankment）		m	34,600.0		978		33,838,800	346,177	33,838,800
b	Sound Protection Wall （Viaduct）		m	37,600.0	0	3,441	15,040	129,381,600	1,338,637	130,851,760
/02										
I-2	Disaster Prevention Equipment		LS	1	1,900,000	9,775,000	1,900,000	9,775,000	2,000,000	195,500,000
I-3	Track Construction Cost			140			12,985,000	1,923,915,500	32,667,000	3,193,199,250
/01	Framed-shaped Slab Track		km	140.0	92,750	13,742,254	12,985,000	1,923,915,500	32,667,000	3,193,199,250
I-4	Station Construction Cost		LS	1	7,712,000	616,705,000	7,712,000	616,705,000	14,021,003	1,370,553,000
I-5	Depot/ Workshop		LS	1			22,625,348	1,399,464,609	36,942,121	3,611,092,376
/01	Depot/ Workshop		LS	1	22,287,000	1,342,616,574	22,287,000	1,342,616,574	36,022,208	3,521,170,824
/02	Maintenance Depot		LS	1	338,348	56,848,035	338,348	56,848,035	919,914	89,921,552
I-6	Electric Facility Cost		LS	1			43,700,000	1,311,916,982	57,121,146	5,583,591,982
/01	Site Preparation			1		2,066,982		2,066,982	21,146	2,066,982
/02	Substation Equipment		LS	1	25,300,000	957,950,000	25,300,000	957,950,000	35,100,000	3,431,025,000
/03	Power Distribution Equipment		LS	1	8,500,000	146,625,000	8,500,000	146,625,000	10,000,000	977,500,000
/04	Contact Line		LS	1	9,900,000	205,275,000	9,900,000	205,275,000	12,000,000	1,173,000,000
I-7	System/Automatic Fare Collection		LS	1	3,470,000		3,470,000		3,470,000	339,192,500
I-8	Signaling and Telecommunications Facility Cost		LS	1			22,210,000	1,363,905,750	36,163,000	3,534,933,250
/01	Signaling Facility Cost		LS	1	5,290,000	492,953,250	5,290,000	492,953,250	10,333,000	1,010,050,750
/02	Telecommunications Facility Cost		LS	1	3,090,000	870,952,500	3,090,000	870,952,500	12,000,000	1,173,000,000
/03	Operation Control Center		LS	1	13,830,000		13,830,000		13,830,000	1,351,882,500
	sub-total Ⅰ'	total（I-1～I-8)					205,491,496	22,879,120,318	439,548,992	42,965,914,013
I-9	Rolling Stock		train	84	425,000		35,700,000		35,700,000	3,489,675,000
I-10	Maintenance Equipment		LS	1	2,210,000		2,210,000		2,210,000	216,027,500
I-11	Equipment Cost for Education and Training	Preoperating cost	LS	1	1,000,000	97,750,000	1,000,000	97,750,000	2,000,000	195,500,000
	total Ⅰ						244,401,496	22,976,870,318	479,458,992	46,867,116,513
Ⅱ.	Consulting Service	5% of Construction/procurement cost (excluding Rolling stock Cost, Maintenance Machine & Preoperating cost)	LS	1			10,274,575	1,143,956,016	21,977,450	2,148,295,701
	Sub-total （II)						10,274,575	1,143,956,016	21,977,450	2,148,295,701
	Sub-total （I+II)						254,676,070	24,120,826,334	501,436,442	49,015,412,214
Ⅲ.	Right of Way Cost	2,717,000m2	LS	1		3,962,475,000		3,962,475,000	40,536,829	3,962,475,000
								3,962,475,000	40,536,829	3,962,475,000
Ⅳ.	Management Cost	10% of Total(Ⅱ)	LS	1				214,829,570	2,197,745	214,829,570
							254,676,070	28,298,130,904	544,171,016	53,192,716,784
Ⅴ.	Contingency	5% of (I+II-Rolling stock)	LS	1			10,948,804	1,206,041,317	23,286,822	2,276,286,861
							265,624,874	29,504,172,221	567,457,838	55,469,003,644
Ⅵ.	Value-added Taxes	10% of Total(Ⅰ+Ⅱ)	LS	1				4,901,541,221	50,143,644	4,901,541,221
	Grand Total	Total（I+II+III+IV+V+VI)					265,624,874	34,405,713,442	617,601,482	60,370,544,866

12.4 Calculation of Preliminary Project Cost for Jakarta - Surabaya Section

(1) Calculation of Quantity of Works

The work quantity for Jakarta - Gedebage - Surabaya is calculated with reference to the previous studies listed below.

References:

1. Study on JAVA High-Speed Railway Construction Project in the Republic of Indonesia, Ministry of Economy, Trade and Industry (2008)
2. Feasibility Study for Promotion of International Infrastructure Projects in FY2011, Study on the High Speed Railway Project (Jakarta - Bandung Section), Republic of Indonesia, Ministry of Economy, Trade and Industry (2011)

The quantity of works is calculated as shown in Table 12.4-1.

Table 12.4-1 Quantity for Civil Works (Jakarta-Surabaya Section)

		Section		
Item	Unit	Jakarta - Gedebage	Gedebage - Surabaya	Jakarta - Gedebage - Surabaya
Embankment	m	34,600	314,284	348,884
Cutting	m	21,000	16,304	37,304
U-shaped Ret. Wall	m	1,200	0	1,200
Viaduct	m	37,600	188,630	226,230
Bridge	m	1,600	14,347	15,947
Mountain Tunneling	m	29,500	54,523	84,023
Shield Tunneling	m	14,000	0	14,000
Cut & Cover	m	500	6,170	6,670
Length	m	140,000	594,258	734,258

(2) Calculation of Preliminary Project Cost for Jakarta - Surabaya Section

The unit cost per kilometer for each work item adopted for calculation of the preliminary project cost for the Jakarta - Surabaya section is multiplied by the above quantities for the Gedebage - Surabaya section. The project cost for the Jakarta-Surabaya section is calculated as the sum of the project cost of the Jakarta - Gedebage section shown in Table 12.3-8 and the Gedebage - Surabaya section.

Table 12.4.2 shows the project cost of the Gedebage - Surabaya section, and Table 12.4.3 shows the project cost of the Jakarta - Surabaya section.

Table 12.4-2 Preliminary Project Cost (Gedebage- Surabaya Section)

Project Cost of Route: Gedebage - Surabaya — Unit: million JPY

Route Length: 594.3 km — 1 JPY=97.75IDR

Item		Breakdown			Unit Cost	Amount (JPY)
Construction/ Procurement Cost	Civil Works	Embankment	Length :	314.3 km	625.16	196,476.8
		Cutting	Length :	16.3 km	349.82	5,703.5
		U type Retaining Wall	Length :	0.0 km	1,424.00	0.0
		Viaduct (Regular Bridge)	Length :	188.6 km	2,225.19	419,737.2
		Bridge	Length :	14.3 km	2,676.76	38,403.4
		Tunnel (Mountain Tunneling)	Length :	54.5 km	1,917.19	104,530.9
		Shield Tunnel	Length :	0.0 km	4,678.04	0.0
		Cut and Cover	Length :	6.2 km	18,015.80	111,157.5
		Transverse	Length :	1.0 LS		18,345.8
		Service Road	Length :	0.0 km	41.30	0.0
		Environmental Program	Length :	502.9 km	23.34	11,735.7
		Sub-total		594.3 km	1,524.74	906,090.8
	Disaster Prevention Equipment			1.0 LS		8,489.4
	Track Construction Cost			594.3 km	233.34	138,661.6
	Station Construction Cost			1.0 LS		59,515.0
	Depot/ Workshop			1.0 LS		156,808.2
	Electric Facility Cost			1.0 LS		242,462.1
	System/Automatic Fare Collection			1.0 LS		14,729.1
	Signaling and Telecommunications Facility Cost			1.0 LS		153,501.1
	Rolling Stock			380.0 train	425.00	161,500.0
	Maintenance Equipment			1.0 LS		9,380.8
	Equipment Cost for Education and Training			1.0 LS		8,489.4
(1) Construction/ Procurement Cost					3,129.33	1,859,627.5
(2) Consulting Service Cost		{(1)-(Rolling Stock+Maintenance Eq.+Preoperating cost)}x5%				84,012.9
(3) Land Acquisition Cost						172,066.7
(4) Management Cost		｛（2）｝x 10%				8,401.3
(5) Contingency		{(1)＋(2) - Rolling Stock Cost}x 5%				89,107.0
(6) Value-added Taxes		｛（1）＋（2）｝x 10%				194,364.0
Project Cost					4,051.40	2,407,579.38

Project cost per km = 2,407.6 Billion JPY/ 594.3 km = 4.051 billion JPY/km (2020)

Table 12.4-3 Preliminary Project Cost (Jakarta- Surabaya Section)

Project Cost of Route: Jakarta- Gedebage- Surabaya						Unit: million JPY
Route Length:		734.3 km			1 JPY=97.75IDR	
Item		Breakdown			Unit Cost	Amount (JPY)
Construction/ Procurement Cost	Civil Works	Embankment	Length :	348.9 km	625.16	218,107.3
		Cutting	Length :	38.7 km	349.82	13,539.5
		U type Retaining Wall	Length :	1.2 km	1,424.00	1,708.8
		Viaduct (Regular Bridge)	Length :	226.2 km	2,225.19	503,404.3
		Bridge	Length :	15.9 km	2,676.76	42,686.2
		Tunnel (Mountain Tunneling)	Length :	82.6 km	1,917.19	158,403.9
		Shield Tunnel	Length :	14.0 km	4,678.04	65,492.6
		Cut and Cover	Length :	6.7 km	18,015.80	120,165.4
		Transverse	Length :	1.0 LS		22,667.9
		Service Road	Length :	88.6 km	41.30	3,659.3
		Environmental Program	Length :	575.1 km	23.34	13,420.5
		Sub-total		734.26 km	1,584.26	1,163,255.5
	Disaster Prevention Equipment			1.0 LS		10,489.4
	Track Construction Cost			734.3 km	233.34	171,328.6
	Station Construction Cost			1.0 LS		73,536.0
	Depot/ Workshop			1.0 LS		193,750.3
	Electric Facility Cost			1.0 LS		299,583.3
	System/Automatic Fare Collection			1.0 LS		18,199.1
	Signaling and Telecommunications Facility Cost			1.0 LS		189,664.1
	Rolling Stock			464.0 train	425.00	197,200.0
	Maintenance Equipment			1.0 LS		11,590.8
	Equipment Cost for Education and Training			1.0 LS		10,489.4
(1) Construction/ Procurement Cost					3,185.65	2,339,086.5
(2) Consulting Service Cost		{(1)-(Rolling Stock+Maintenance Eq.+Preoperating cost)}x5%				105,990.3
(3) Land Acquisition Cost						212,603.5
(4) Management Cost		{ (2) } x 10%				10,599.0
(5) Contingency		{(1)＋(2) - Rolling Stock Cost} x 5%				112,393.8
(6) Value-added Taxes		{ (1) ＋ (2) } x 10%				244,507.7
Project Cost					4,120.05	3,025,180.86

Project cost per km = 3,025.18 Billion JPY/ 734.3 km = 4.120 billion JPY/km (2020)

12.5 Reconfirmation of High Speed Railway Project Cost

In order to calculate the most suitable project cost, the decision of the most desirable railway alignments and type of structure to be used was based on new information such as geological and topographic data, etc.

Reconfirmed and decided construction items, specifications and quantities were based on this new information.
The Project cost was calculated based on these new items, specifications and quantities.

The following are the changes in the content:

Table 12.5-1 shows the Structure specification change.
Table 12.5-2 shows Change in Construction Items and Quantities.

Table12-5-1 Structure Specification Change

Item		Changed contents	
		Previous Stage	This Stage
Viaduct-A	structure-changing	H=6m pile6@15m	H=8m pile6@20m
Viaduct-B	structure-changing	H=12m pile6@20m	H=16m pile6@30m
Bridge-A Span 40m	structure-changing	pile20m	pile10m
Bridge-B Span 60m			New item
Service road		road width W=4m	road width W=6m
Depot		site area 40.97ha	site area 47.69ha
Section of Karawang St.	Construction method	Cut & Cover with Station Building	Cutting without Station Building

Table12.5-2 Change in Construction Item and Quantities

Change in Construction Item and Quanties

	Item	Specification	Unit	Stage- I Jakarta Gedebage		Stage-II Jakarta Gedebage
		Route length		140.4km	-0.4km	140km
	Item	Specification	Unit	①	②-①	②
Ⅰ-1	Civil Works					
/01	Embankment	**(including soil improvement)**	**m**	**31,700**	**2,900**	**34,600**
a	Embankment-A H=1m		m	3,400	-300	3,100
b	Embankment-B (Reinforced Earth Retaining Wall) H=3m		m	2,700	-400	2,300
c	Embankment-C (Reinforced Earth Retaining Wall) H=6m		m	25,600	3,600	29,200
/02	**Cutting**		**m**	**19,500**	**2,900**	**22,400**
a	Cutting-A D=6m		m	16,500	1,500	18,000
b	Cutting-B D=12m		m	3,000	1,400	4,400
/03	**U type Retaining Wall**		**m**	**1,200**		**1,200**
/04	**Viaduct**		**m**	**41,600**	**-4,000**	**37,600**
a	Viaduct-A(Regular Bridge)	20mPC simply supported girder, H=6m, pile :6@15m **→H=8m, pile :6@20m**	m	37,600	-7,900	29,700
b	Viaduct-B(Regular Bridge)	20mPC simply supported girder、H＝12m,pile :6@20m **→H＝16m,pile :6@30m**	m	2,400	3,900	6,300
c	Viaduct-C(Regular Bridge)	(Station 2P-4T)	m	1,200		1,200
d	Viaduct-C(Regular Bridge)	(Station 1P-2T)	m	400		400
/05	**Bridge**		**m**	**1,100**	**500**	**1,600**
a	Bridge-A Span:40m	Pile length 20m→10m	m	1,100		1,100
b	Bridge-B Span:60m	**New item**	m			500
/06	**Tunnel (Mountain Tunneling)**		**m**	**31,800**	**-3,700**	**28,100**
a	Tunnel-A (Mountain Tunneling)	Entrance of tunnel(countermeasures against land slide、tunnel entrance buffering hood)	m	3,000	-100	2,900
b	Tunnel-B (Mountain Tunneling)		m	27,900	-3,200	24,700
c	Tunnel-C (Mountain Tunneling)	Fault fracture zone、 etc	m	900	-400	500
/07	**Shield Tunnel**		**m**	**12,500**	**1,500**	**14,000**
a	Shield Tunnel	Double-track tunnel	m	12,500	1,500	14,000
b	Shaft	20m(W)×20m(D)×35m(H)	nos.	4		4
/08	**Cut and Cover**		**m**	**1,000**	**-500**	**500**
a	Cut and Cover-A	Jakarta underground station (triple-deck 5 span)	m	400	-100	300
b	Cut and Cover-B	Karawang underground station (double-deck 5 span)	m	400	-400	
c	Cut and Cover-C	Tunnel (single-deck 1 span)	m	200		200
/09	**Transverse**		**LS**			
a	Box Culvert	W=8m H=7m L=15m	nos.	48		48
b	Bridge		nos.	32		32
/10	**Service Road**		**m**	**88,200**	**400**	**88,600**
a	Service Road	B=4m→**B=6m**	m	43,200	400	43,600
b	Construction Road		m	45,000		45000
/11	**Environmental Program**		m	**73,300**	**-1,100**	**72,200**
a	Sound Protection Wall	(Embankment)	m	31,700	2,900	34,600
b	Sound Protection Wall	(Viaduct)	m	41,600	-4,000	37,600

Table12.5-3 shows a comparison of project cost between the previous stage and this stage.

Construction cost of each item is the increase or decrease in each item. However, the total project cost for this stage is a 14.937billion yen reduction from the previous stage.

Table12.5-3 The Comparison Project Cost between the Previous Stage and this Stage

Comparison Project cost — 1 JPY=97.75IDR — Unit: million JPY

Item		Breakdown		①This Stage Qty.		Unit Cost	Amount (JPY)	②Previous Stage Qty.		Unit Cost	Amount (JPY)	①-② Qty.		Amount (JPY)
				Route Length:		140	km	Route Length:		140.4	km	-0.4		km
Construction / Procurement Cost	Civil Works	Embankment	L :	34.6	km	625.16	21,630	31.7	km	614.11	19,467	2.9	km	2,163.0
		Cutting	L :	22.4	km	349.82	7,836	19.5	km	338.94	6,609	2.9	km	1,226.7
		U type Retaining Wall	L :	1.2	km	1424.00	1,709	1.2	km	1,424.00	1,709		km	
		Viaduct	L :	37.6	km	2225.19	83,667	41.6	km	1,947.75	81,026	-4.0	km	2,640.6
		Bridge	L :	1.6	km	2676.76	4,283	1.1	km	2,539.82	2,794	0.5	km	1,489.0
		Tunnel (Mountain Tun	L :	28.1	km	1917.19	53,873	31.8	km	1,906.47	60,626	-3.7	km	-6,752.8
		Shield Tunnel	L :	14.0	km	4678.04	65,493	12.5	km	4,686.99	58,587	1.5	km	6,905.2
		Cut and Cover	L :	0.5	km	18015.80	9,008	1.0	km	23,759.92	23,760	-0.5	km	-14,752.0
		Transverse		1.0	LS		4,322	1.0	LS		4,322			
		Service Road	L :	88.6	km	41.30	3,659	88.2	km	33.15	2,923	0.4	km	735.8
		Environmental Prograı	L :	72.2	km	23.34	1,685	73.3	km	21.96	1,609	-1.1	km	75.4
		Sub-total		140.0	km	18.37	257,165	140.4	km	1,876.31	263,434	-0.4	km	-6,269.0
	Disaster Prevention Equipment			1.0	LS		2,000	1.0	LS		2,000			
	Track Construction Cost			140.0	km	233.34	32,667	140.4	km	231.00	32,432	-0.4	km	234.6
	Station Construction Cost			1.0	LS		14,021	1.0	LS		16,543			-2,522.0
	Depot/ Workshop			1.0	LS		36,942	1.0	LS		36,591			350.9
	Electric Facility Cost			1.0	LS		57,121	1.0	LS		57,121			
	System/Automatic Fare Collection			1.0	LS		3,470	1.0	LS		3,470			
	Signaling and Telecommunications Facility Cost			1.0	LS		36,163	1.0	LS		36,163			
	Rolling Stock			84.0	train	425.00	35,700	84.0	train	425.00	35,700			
	Maintenance Equipment			1.0	LS		2,210	1.0	LS		2,210			
	Preparation for Operation			1.0	LS		2,000	1.0	LS		2,000			
(1) Construction/Procurement Cost				140.0	km	3,424.71	479,459	140.4	km	3,473.39	487,664	-0.4	km	-8,205.5
(2) Consulting Service Cost		{(1)-(Rolling Stock+Maintenance Eq.+Preoperating cost)} x 5%					21,977				22,388			-410.3
(3) Land Acquisition Cost							40,537				45,525			-4,988.6
(4) Management Cost		{(2)} x 10%					2,198				2,239			-41.0
(5) Contingency		{(1) +(2) - Rolling Stock Cost} x 5%					23,287				23,718			-430.8
(6) Value-added Taxes		{(1) + (2)} x 10%					50,144				51,005			-861.6
Project Cost				140.0	km	4,411.44	617,601	140.4	km	4,505.26	632,539	-0.4	km	-14,937.7

12.6 Comparison of Construction Cost

(1) Cost comparison of civil structure

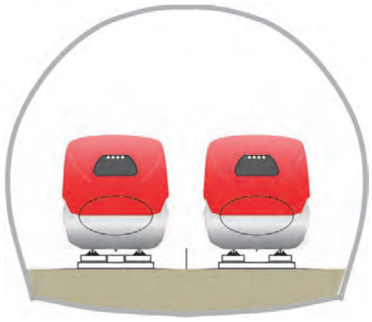
Small size civil structure is one of the crucial characteristic of Japanese High-speed Railway System. For example, tunnel cross-sectional are is 70 m^2 for the High-speed Railway System proposed by study team based on Japanese High-speed Railway System specification, and 100 m^2 for the case of other countries. The width of viaduct structure is 11.2m for the proposed system and 13.2m for the system of other countries.

These differences are caused by rolling stock structures. Structure of Japanese High-speed Railway, namely Shinkansen, vehicle has adequate strength against pressure difference. Beside this, the structure has smooth shapes which moderate effect of train draft.

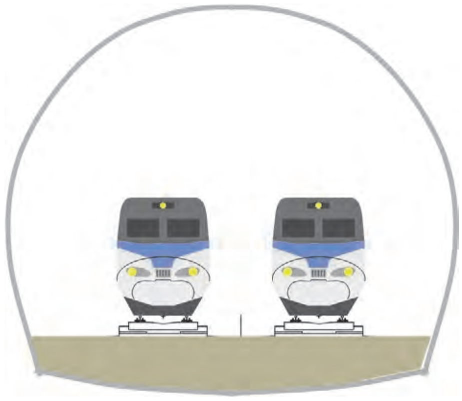
Because of above reasons, in case of using Other High-speed Railway standard, civil construction cost will increase by 20% in comparison with Study Team proposal, when applying same quality and same labor unit cost. For this project, the work cost will increase by 526 million USD. This cost estimation includes cost difference of Dukuh Atas station construction cost and land acquisition cost described in (2).

Table 12.6-1 Cost Comparison of Civil Works unit : USD in million

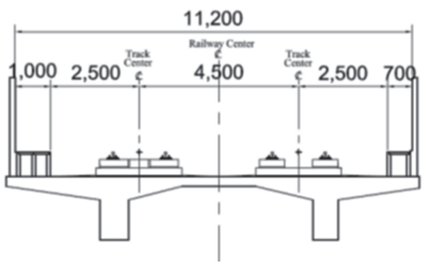
Item	Breakdown		Work Costs		Ratio
			Study Team Proposal (Based on Japanese Standard)	Other Standard	
Civil Works	Embankment	34.9km	218.0	226.7	1.04
	Cutting	22.4km	79.0	79.0	1.00
	U type Retaining Wall	1.2km	17.2	17.2	1.00
	Viaduct	37.6km	843.1	893.7	1.06
	Bridge	1.6km	43.2	45.7	1.06
	Mountain Tunneling	28.1km	542.9	667.7	1.23
	Shield Tunnel	14.0km	659.9	796.3	1.21
	Cut and Cover	0.5km	90.8	215.1	2.37
	Transverse	1.0LS	43.6	43.6	1.00
	Service Road	88.6km	36.9	36.9	1.00
	Environmental Program	72.2km	17.0	17.9	1.06
Land Acquisition	Our Proposal (Base on Japanese Standard)	271.7ha	408.5		1.19
	Other Style	320.6ha		486.1	
Total Construction Cost			2,999.8	3,525.8	1.18



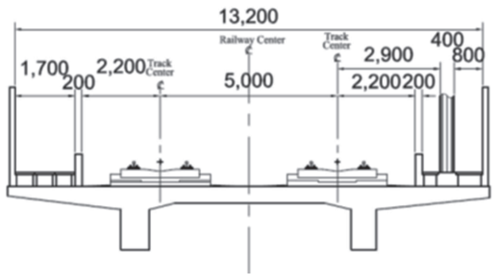
Study Team proposal based on Japanese Standard
70 m^2



Other High Speed Railway Standard
100 m^2



JST proposal based on Japanese Standard
11.2 m



Other High Speed Railway Standard
13.2m

Figure 12.6-1 Comparison of Civil Structure (Tunnel cross section, Viaduct formation width)

(2) Cost difference from viewpoint of utilization efficiency at the terminal station

The high-speed railway system of Japan has achieved operation with extremely high transport density, which can be proved also in terms of the station use efficiency. For example, the Tokaido Shinkansen system operates 426 trains per day, for which the terminal station, Tokyo Station, has three platforms and six tracks to handle these trains. However, at the Beijing South Station, for example, there are six platforms and 12 tracks to handle 156 trains a day. With this layout, Japan can offer the turn-back operation in minimum 12 minutes, but China requires about 40 minutes for the turn-back operation. Reduction of the turn-back operation period requires not only intangible knowhow, such as quick cleaning service, but also complete provision of station and vehicle facilities to support such intangible measures.

This study is based on the assumption that the station will be the facilities capable of carrying maximum 350,000 passengers per day between Jakarta and Bandung. If the system of other countries is employed, resulting in failure of reducing the turn-back operation period the terminal station must have the doubled number of tracks. Particularly for Jakarta Station where the right-of-way on the ground is difficult to acquire and the underground station is to be developed according to the cut-and-cover method, the difference in the size of station governs substantially the construction costs. The cost comparison is shown below.

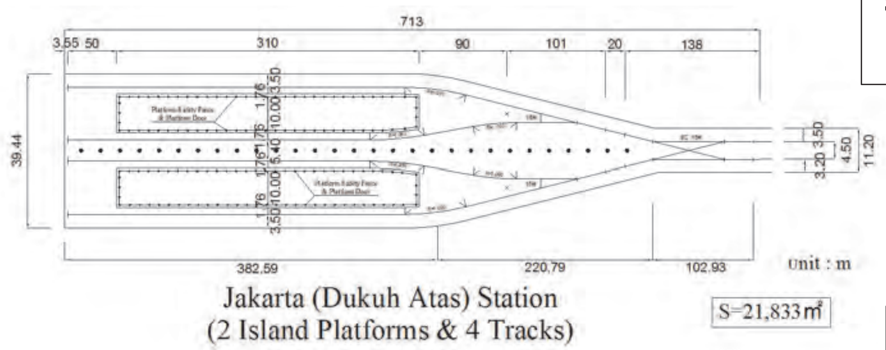
Table 12.6-2 Cost comparison of underground station (Dukuh Atas) Unit: Million USD

Item		Necessary Size	Construction Cost	Ratio
Underground Station by Cut-and-Cover	Study Team Proposal (Based on Japanese Standard)	21,833 m^2	90.8	2.37
	Other Style	51,652 m^2	215.1	

Source: Study Team

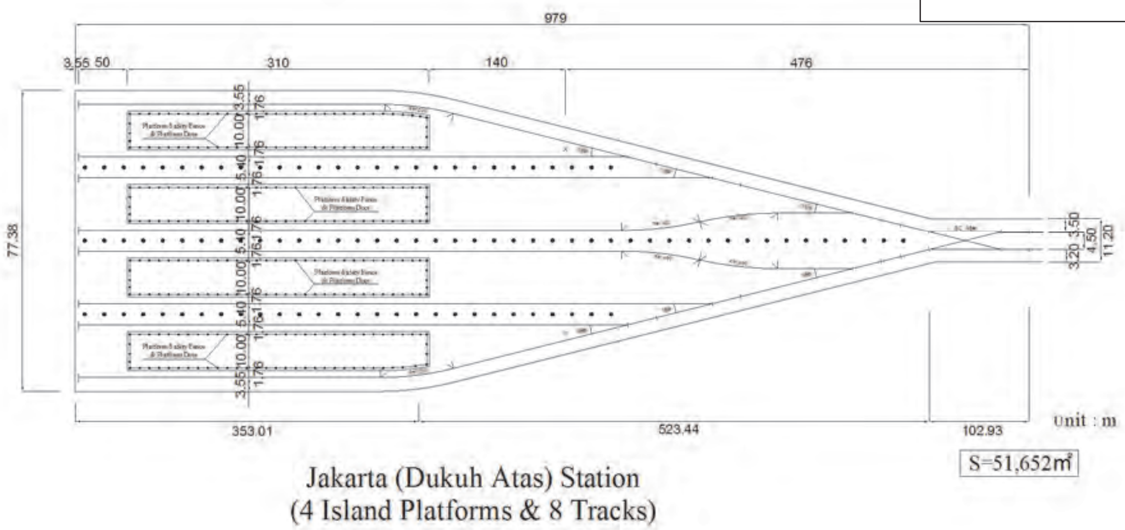
Study Team Proposal

(Based on Japanese



Other

Specification



Source: Study Team

Figure 12.6-2 Comparison of Scale of Stations with considering operation efficiency

As is evident from above description, the cost required for construction of Jakarta Station will increase by 2.4 when the overseas specifications are employed, namely, the cost increase of 124 million USD.

(3) Station located in city center is crucial point.

As one solution to cope with possible large amount of costs incurred during construction of the underground station in the center of Jakarta, construction of a terminal station in the suburb may be considered. In this Study, "Halim" could be one candidate of the suburb stations as already mentioned in Chapter 4. However, as described in that chapter, longer time required for arriving at the suburban station from the center of Jakarta is considered to result in reduction of the users from Jakarta to about 70%. In addition, the demand is also considered to decrease seriously from the level of this study. In consequence, the investment will be difficult to recover.

For Jakarta, the matured city, selection of tangible and intangible resources with compactly-designed station and efficient operation is essential elements for alleviation of congestion and TOD promotion.

Chapter 13

Project Modality

Chapter 13 Project Modality

13.1 Legal Framework

The legal framework related to railway projects can be looked at from four perspectives: railway sector regulations, PPP regulations, regional regulations and other sector regulations. Of these the railway sector and PPP regulations are very important to investigate the project modality for the HSR project.

13.1.1 Railway Sector Laws and Regulations

(1) Outline of the Laws and Regulations

The following are the railway sector laws and regulations in Indonesia:

- Law No. 23 / 2007 concerning Railways (hereinafter referred to as the "Railways Law")
- Government Regulation No. 56 / 2009 concerning Railway Development
- Government Regulation No. 72 / 2009 concerning Railway Traffic and Transportation
- Ministry of Transportation Regulation No. 83 / 2010 concerning Cooperation between Government and Business Entities in the Provision of Transportation Infrastructure

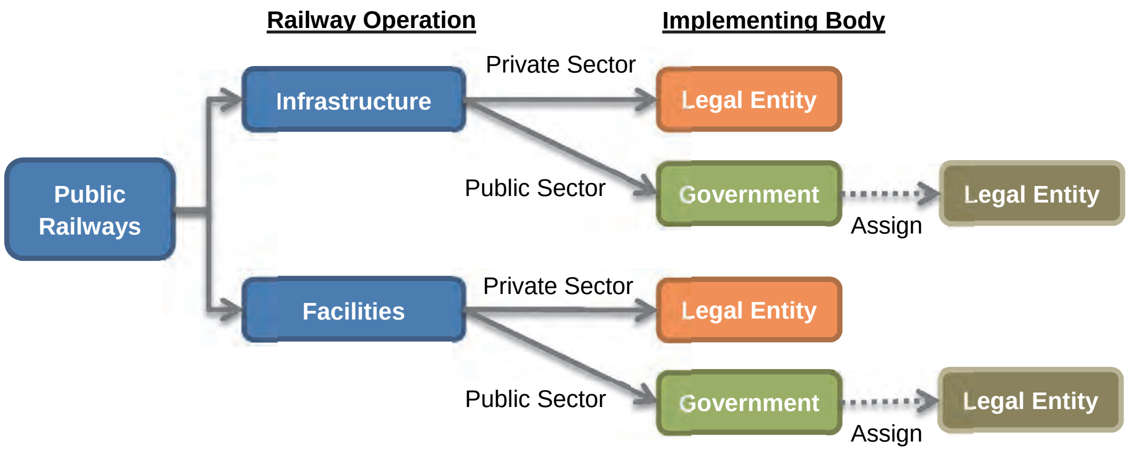
The Railways Law defines the railways, types of railways, railway operators, license required for railway operation, outlines of railway infrastructure, facilities, electric and mechanical features, rolling stock and traffic operation, and so on. Government Regulation No. 56 / 2009 and Government Regulation No. 72 / 2009 provide the details of railway implementation. Ministry of Transportation Regulation No. 83 / 2010 basically follows the Ministry of National Development Planning / National Planning Agency Regulation No. 4 / 2010 concerning General Guidelines for Implementation of Cooperation between the Government and Business Entities in the Provision of Infrastructure, which provides the guidelines for railway project implementation with PPP.

According to the Railways Law, the operation of public railways is stipulated as follows:

Operation of public railway infrastructure shall be carried out by a legal entity as the operator, individually or in partnership. In case of no legal entity that operates public railway infrastructure, the Government or Regional Government may operate the railway infrastructure (Article 23).

Operation of public railway facilities is carried out by a legal entity as the operator, whether individually or in partnership. In case of no legal entity that operates public railway facilities, the Government or Regional Government may operate the railway facilities (Article 31).

Figure 13.1-1 illustrates the structure of public railway operation in Indonesia.



Source: prepared by the JICA Study Team

Figure 13.1-1 Structure of Railway Operation in Indonesia

(2) Existing Operator of Public Railway

According to the prevailing Railways Law, the public railway business is open to the private sector. However, currently the public railways in Indonesia are predominantly operated by PT KAI, a state-owned limited liability company. PT KAI's main business scope is as follows (source: PT KAI, Annual Report 2011):

- Public railway infrastructure management, including construction, operation, maintenance, and exploitation of infrastructure
- Public railway facilities management including procurement, operation, maintenance, and development of rolling stock
- Railway transportation of passengers and/or freight
- Pre- and post-railway transport, intermodal transport, loading and unloading
- Leasing of railway rolling stock, infrastructure, and facilities
- Miscellaneous services for procurement of materials and services related to railway maintenance
- Railway expertise and transportation consulting services
- Railway training and education services
- Trading and property business covering hotels, offices, apartments, shops, restaurants, integrated terminals, integrated shopping areas, warehouses, and logistics
- Utilization of land, buildings, spaces, and facilities

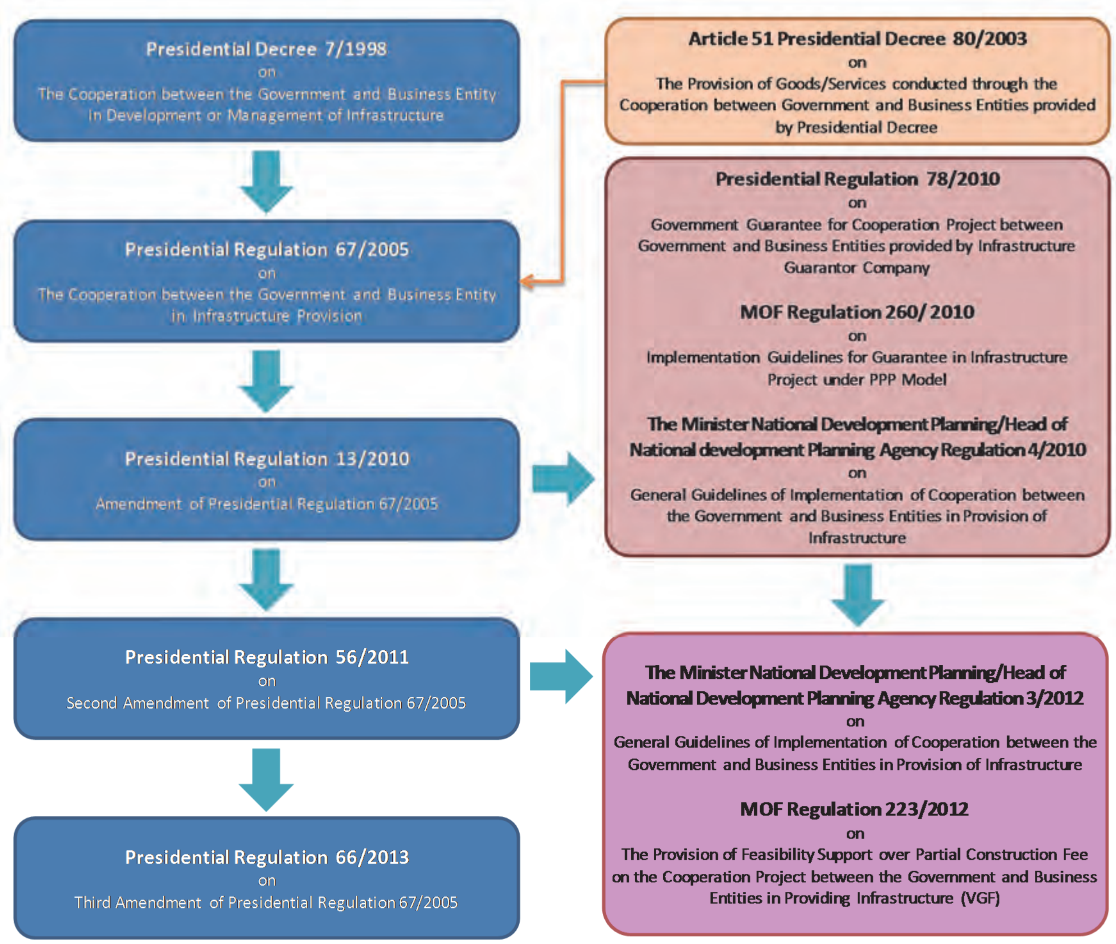
In order to increase the efficiency in providing railway transportation services, the Joint Declaration of the Ministry of Transportation, Ministry of Finance and Ministry of National Development Planning No. KM 19/1999, No. 83/KMK.03/1999 and No. KEP.024/K/03/1999 dated March 4, 1999 was issued.

The declaration states that the government is responsible for determining and financing selected public services for economy class train passengers as determined by the Government (PSO: Public Service Obligations) and the maintenance and operational costs of the train infrastructure (IMO: Infrastructure Maintenance and Operation), and the legal operating entity's obligation is to pay the cost of the railway infrastructure used (TAC: Track Access Charge). This means in effect PT KAI pays the TAC to the government and receives the PSO and IMO from the government.

13.1.2 PPP Regulations

(1) Outline of PPP Regulations

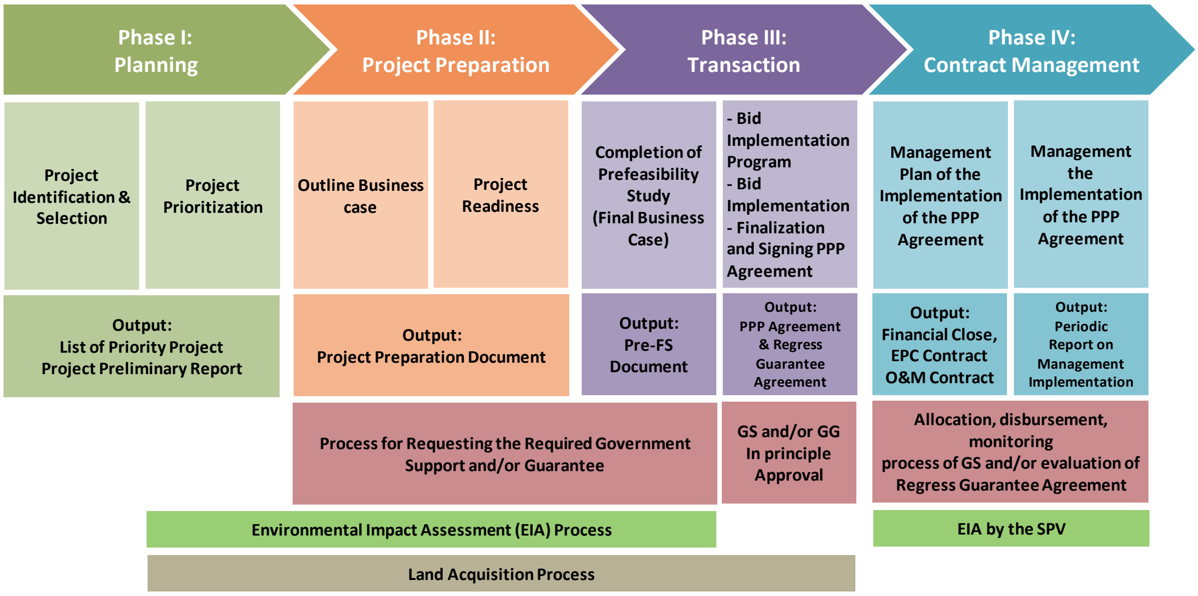
The main legislation concerning PPP projects in Indonesia is Presidential Regulation No. 67 / 2005 concerning cooperation between the government and the private sector in infrastructure provision as amended by Presidential Regulation No. 12 / 2010, No. 56 / 2011 and No. 66 / 2013. The regulation provides the cross-sector regulatory framework for implementing PPPs in the provision of infrastructure. Figure 13.1-2 shows the evolving process of the regulatory framework for PPP projects in Indonesia.



Source: Bappenas, "Public-Private Partnerships Infrastructure Project Plan in Indonesia 2013"

Figure 13.1-2 Legal Framework of PPP Projects and Amendment Process in Indonesia

The eligible types of infrastructure as PPP projects are 1) transport infrastructure (including railways), 2) road infrastructure, comprising toll roads and bridges, 3) irrigation infrastructure, 4) drinking water infrastructure, 5) wastewater infrastructure, 6) telecommunication and information infrastructure, 7) electricity infrastructure, and 8) oil and gas infrastructure. Infrastructure projects with PPP follow the implementation flow shown in Figure 13.1-3.

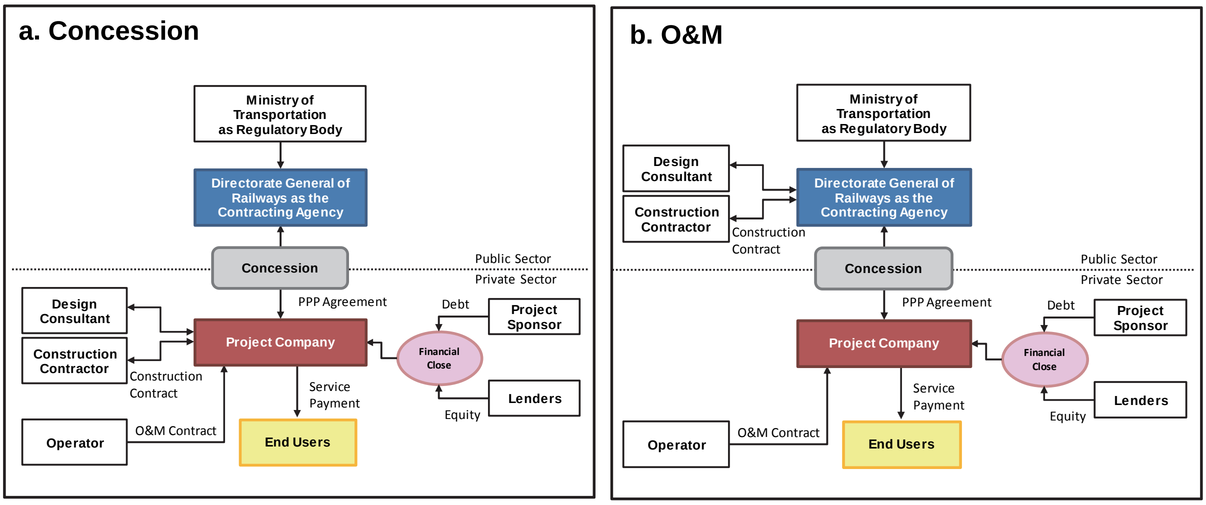


Source: Bappenas, "Public-Private Partnerships Infrastructure Project Plan in Indonesia 2013"

Figure 13.1-3 Implementation Flow of PPP Projects in Indonesia

(2) Railway Project with PPP

The Indonesian Infrastructure Guarantee Fund (IIGF), a state-owned company wholly-funded and established by the Ministry of Finance, issued the guidelines relevant to risk allocation of PPP projects. The guidelines exemplify two schemes, concession and O&M, as examples of PPP modalities for railway projects. The guidelines also note that in view of the huge investment costs and regulated tariffs, experiences in other countries show that the project will face difficulties in achieving the acceptable financial viability level if the scope includes the rolling stock, stations and tracks all at once (source: IIGF, Risk Allocation Guidelines). Figure 13.1-4 shows the project modalities exemplified in the guidelines. Under the concession type agreement, the private sector business entity (Project Company) will be responsible for the design, construction, financing, operation and maintenance of the whole railway infrastructure and facilities and fare collection from passengers. The O&M agreement requires the business entity (Project Company) to operate and maintain the railway infrastructure and facilities and collect fares from passengers.



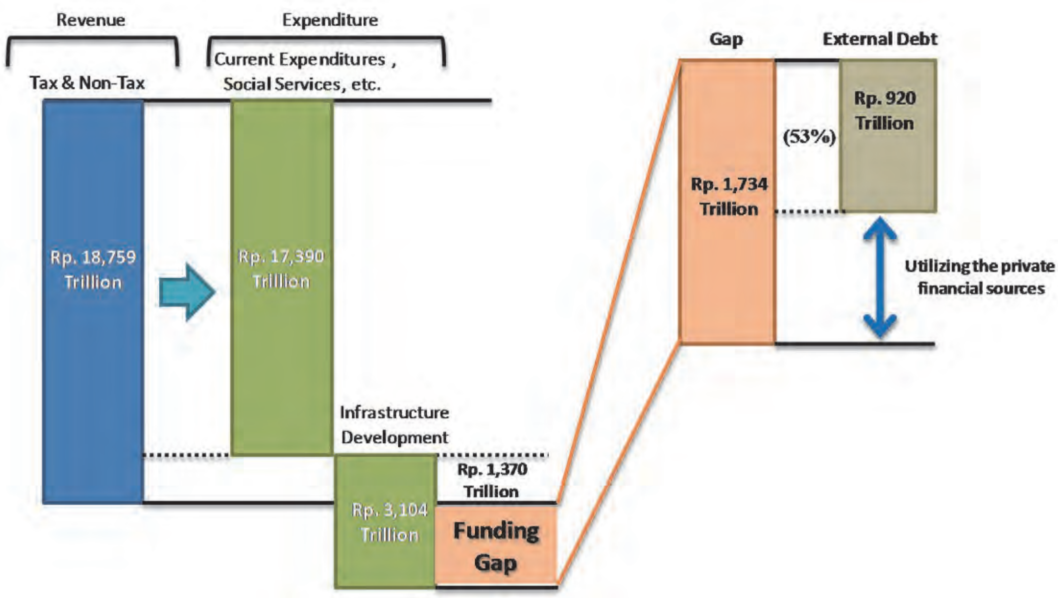
Source: IIGF, Risk Allocation Guideline

Figure 13.1-4 Examples of Project Modalities in the Railway Projects

13.2 Constraints to be Considered

13.2.1 Budgetary Constraint

According to the result of the “Background Study for RPJMN 2015-2019”, the expected total government revenue for the five years is Rp. 18,759 trillion, while the expected expenditure for current payments and social services amounts to Rp. 17,390 trillion (see Figure 13.2-1) .



Source: BAPPENAS, Medium Term Economic Infrastructure Strategy: Background Study for RPJMN 2015-2019

Figure 13.2-1 Funding Gap in the National Medium Term Development Plan 2015-2019

This means that the portion that can be spent on infrastructure development accounts for only seven (7) percent of the total revenue. The national expenditure pattern shows the same situation for the last decade. There is a gap between the demand for infrastructure development and the budget that can be allocated. Therefore, it is planned that half of the funding gap for infrastructure development will be made up by external debts and private financial sources will be utilized for the remainder.

Table 13.2-1 shows the allocation of government expenditure to infrastructure development in 2014 and 2015 for three ministries. Budget allocation to the Ministry of Transportation is around 40 trillion Rp. This amount is less than the HSR project cost.

Table 13.2-1 Allocation of Government Expenditure to Infrastructure Development

(Unit: Trillion Rp.)

Year	Ministry of Transportation	Ministry of Public Works and People's Housing	Ministry of Energy and Mineral Resources
2014	36.0	78.5	13.3
2015	44.9	85.9	10.0

Note: The figures for the Ministry of Public Works and Housing is total of the former Ministry of Public Works and the former Ministry of Housing

Source: MOF

The funding gap analysis of the background study and the budget allocation to the infrastructure development imply that the HSR development might not be realized by funding from only the government revenue, but would need other financial sources such as external debts, private funding and municipal bonds.

13.2.2 Institutional Constraint

The HSR development can be categorized as a mega project that may highly require a new institutional framework and special legal support from the state government for the project to be successfully executed both in the short or long term. However, technical standards of the HSR systems are not available in Indonesia yet. Therefore, the state government must establish an authoritative legal body to be responsible for the development of the HSR's technical regulations and standards and to control the technical aspect of the HSR development. In addition, it is necessary to improve the PPP regulations that are applicable to mega projects.

13.3 Case Studies of Railway Projects in Other Countries with PPP

Overviewing railway projects with PPP modalities in other countries is helpful in examining the implementation structure of HSR development in Indonesia. Table 13.3-1 shows examples of railway projects including HSR development. Japan's Shinkansen is an example of conventional public procurement, while the others are projects with project modalities.

Table 13.3-1 Railway Projects in Other Countries with PPP

	Shinkansen	Taiwan HSR	Seoul Metro 9	Gautrain	LGV-SEA	TAV
Country	Japan	Taiwan	South Korea	South Africa	France	Brazil
Train Type	HSR	HSR	Metro	Airport Link	HSR	HSR
Modality	Direct appointment	BOT	BTO	DBFO	Concession	Concession
Project Model	Vertically separated	Integrated (infrastructure & transport)	Integrated (infrastructure & transport)	Integrated (infrastructure & transport)	Infrastructure only	Vertically separated
Operation Years under Concession	Not limited	35 years	30 years	20 years	50 years	40 years
Government Support	- Construction cost	- Land acquisition and clearance - Loan guarantees - Substantial equity investment (operation)	- Construction cost (68%) - No track access charges - Minimum revenue guarantee	- Construction cost (89%) - Availability payment	- Construction cost (51%) - Loan guarantee	- Equity participation in the concession company (minority)
Operation of Rolling Stock	Japan Railway Company	Taiwan HSR	Consortium	Consortium	SNCF	Concessionaire for rolling stock operation
Ownership of Infrastructure	JRTT	Taiwan HSR (transfer to the government after the concession period)	Infrastructure: Seoul City Rolling stock: consortium	Provincial Government	Réseau Ferré de France (RFF)	Concessionaire for infrastructure
Current Situation	- In operation - New lines under construction	In operation	In operation	In operation	- Under construction	- Bidding process postponed
Remarks	-	Management taken over by the government after two years in operation	-	-	Track access charges to be paid by operators	No guarantee or fare rate ceiling

Notes:
LGV-SEA: Ligne à Grande Vitesse Sud Europe Atlantique, TAV: Trem de Alta Velocidade
BOT: Build, Operate and Transfer, BTO: Build, Transfer and Operate, DBFO: Design, Build, Finance and Operate
Source: JICA Study Team

Japan's Shinkansen projects have been implemented under a vertically separated model. According to the Nationwide Shinkansen Railway Development Act, the Japan Railway Construction, Transport and Technology Agency (JRTT) is appointed by the Ministry of Land, Infrastructure, Transport and Tourism as the implementing body for the construction of Shinkansen railways, owns the infrastructure, and leases it to the Japan Railway Company appointed as the implementing body for operation and maintenance.

Taiwan's HSR development started as a BOT project. However, its start was delayed and the actual number of passengers was about half of the demand forecast at the beginning of the service period. This resulted in reduced operation revenue. Repayment of the private loan also worsened the operating company's financial condition. The company started operation under government control two years from the inauguration.

In the case of Seoul Metro No. 9 in South Korea and Gautrain in the Republic of South Africa, the operating companies received government support for the construction cost and guarantee of the ridership risk and did not face any difficulties in staying in business. As the case of LGV-SEA in France is a PPP project only for construction and maintenance of the infrastructure, it cannot be simply compared to the other cases. However, the EU, the Government of France and local governments bore 51 percent of the construction cost. Track access charges which do not depend on passenger demand are paid to the concessionaire by the railway operators such as Société Nationale des Chemins de Fer Français (SNCF) during the concession period. This is good in that it enables the concessionaire to easily forecast income and expenditure. On the other hand, as in the case of TAV in the Federal Republic of Brazil, the government shares less risk (land acquisition and inflation risk) compared to the private sector. It was considered that conditions such as track access charges and setting of a fare rate ceiling might make the business unprofitable. Eventually, foreign consortiums put off participating in the tender process due to the unfavorable conditions and the government decided to postpone the tender process.

The following are the lessons learned from the above-mentioned examples and other railway projects regarding the implementation of railway projects with PPP.

- A feature of HSR development is the project risk.

  The amount of initial investment required is huge and the construction period tends to be prolonged. Overrun of the infrastructure construction cost is a project risk. The increase in operation revenue also tends to be slower than expected. In this case, operation may fall into difficulties as in the case of Taiwan HSR.

- Public portion accounts for a large part of the project cost.

  Even if a project starts under the BOT scheme, such as Taiwan HSR, the high interest rates of private financing and lower actual number of passengers than the demand forecast may worsen the financial condition after start of operation. As a result, the government needs to provide the operating company with support to continue services. In other cases, the public portion accounts for a large part of the project cost and other types of support such as no track access charges and minimum revenue guarantee are provided.

- The commercial risk of projects tends to be transferred from the private sector to the public sector.

  The introduction of HSR may expand the commutable area. It may also expand the area in which passengers can travel within one day and this may change passenger behavior. However, it will take time for the public to accept the fare system and new technology of the HSR and for the use of HSR to become established in daily life in Indonesia compared to other transportation modes. This will tend to cause fewer passengers initially than the demand forecast. If the commercial risk is borne by the private sector, it may affect the profitability of the business and make it impossible to carry on the operation of services. As railway projects are of a highly public nature, failure will have a high socioeconomic impact. This is why there is a tendency to transfer the commercial risk of projects from the private sector to the public sector; the government provides business entities with support such as availability payments or minimum revenue guarantees to secure the operation of services.

It is necessary to examine the implementation structure and project scheme of the HSR development in Indonesia, based on the lessons learned from the railway projects in other countries.

13.4 Examination of Implementation Structure and Project Modality

13.4.1 Implementation Structure

The HSR project needs the following key players to enable it to be planned, implemented and operated:

- Ministry responsible for the policy
- HSR Authority, a public agency functioning primarily as regulator and supervisor but also as coordinator for regional development and HSR industry development
- HSR construction and operating companies

The ministry responsible for the policy in Indonesia is the Directorate General of Railways. Establishment of the HSR Authority and companies is needed for the HSR development.

(1) Regulatory Authority

HSR technology is very new in Indonesia and its technical standards are different from the ones for the conventional lines. Currently, DGR does not have regulations and standards on HSR development and operation and also does not have any section that will be engaged in the formulation of the institutional framework for the HSR development. As stated in Subsection 13.2.2, it is necessary to establish a regulatory authority and delegate power to institutionalize the technical regulations and standards to the authority. Such institutional setup or preparation must have been completed before the commencement of HSR development. There are two options for the institutional setup: 1) creation of one department dedicated to the HSR in DGR, or 2) establishment of a new authority that falls under the Ministry of Transportation (MoT). Table 13.4-1 shows the comparison of the options. Considering that the HSR is a new technology in the country and the paradigm, standards and safety controls that are totally different from those of the business management in the conventional lines are required, the second option, establishment of a new authority that falls under the Ministry of Transportation, would be the better one for the country. Figure 13.4-1 shows a plan of organizational structure of the authority. The HSR Authority will function as a coordinator with regional and local governments and facilitator for HSR industry development as well as HSR Regulator and Supervisor.

Table 13.4-1 Comparison of Options for the Regulatory Authority

Option	Advantage	Disadvantage
Creation of one department dedicated to the HSR in DGR	Relatively faster process because of establishment of a new directorate in the existing directorate general	Possibility of less penetration of the HSR concept of standards and safety control within the authority because those are different from the conventional lines
Establishment of a new authority that falls under the MoT	Better penetration of the HSR concept of standards and safety control within the authority because the authority is dedicated to the HSR development	Possibility of longer process due to establishment of a new quasi-governmental organization

Source: prepared by the JICA Study Team

Note: Figures in brackets show the number of personnel.

Source: prepared by the JICA Study Team

Figure 13.4-1 Organizational Structure of the Authority

The overall planning, regulatory and supervisory role for HSR projects can continue to be trusted to the ministry responsible for railway transportation as long as it has adequate capacity in HSR operations. It is, however, strongly suggested that the HSR Authority is the most suited body to play those roles, due mainly to its highly advanced technological system particularly focusing on safety. Therefore, the HSR Authority shall have an advanced planning, managing, establishing, granting, monitoring, supervising and evaluating capacity on HSR standards and rules to be observed by the HSR operators. The HSR Authority also shall provide the key principles of regulations, rules, standards and certifications, most of which maybe common among the HSR network. It is strongly recommended that the public sector agency shall be able set up rules, regulations, standards or certifications on such areas as procurement, engineering, technical, safety, operational, driving and maintenance matters particularly applied for HSR operations. Table 13.4-2 shows some examples required during the operation and maintenance period.

Table 13.4-2 Examples of Regulations and Standards Required

Category	Contents
Technical and engineering areas	• Technical standards rules • Railway system and its oversight • Signal and train control rules • Maintenance rules • Engineer licensing • Environmental protection rules
HSR operation areas	• Train operation and traffic rules • Driving license rules • Safety and accident management rules
Institutional areas	• Procurement Rules • Accounting Rules • Reporting and Auditing & Inspection Rules

Source: prepared by the JICA Study Team

(2)State-Owned Enterprise

Currently, PT Kereta Api Indonesia (hereinafter referred to as “PT KAI”) operates and maintains the existing public railway networks as the railway operator. HSR technology has not been introduced into Indonesia and PT KAI does not have any experience in operation and maintenance of HSR. As discussed above, the Railways Law stipulates that if there is no legal entity to operate the public railway infrastructure and facilities, the Government or Regional Government is responsible for the operation of public railways. However, implementation can be assigned to a legal entity established for that purpose. As the existing tracks of conventional lines cannot be utilized for HSR development due to different concept and standards, new dedicated tracks must be constructed. In order to avoid impact on the HSR development from the business operation of the conventional lines, it is recommended that a state-owned company (hereinafter referred to as “SOE”) that will be engaged in HSR development be established.

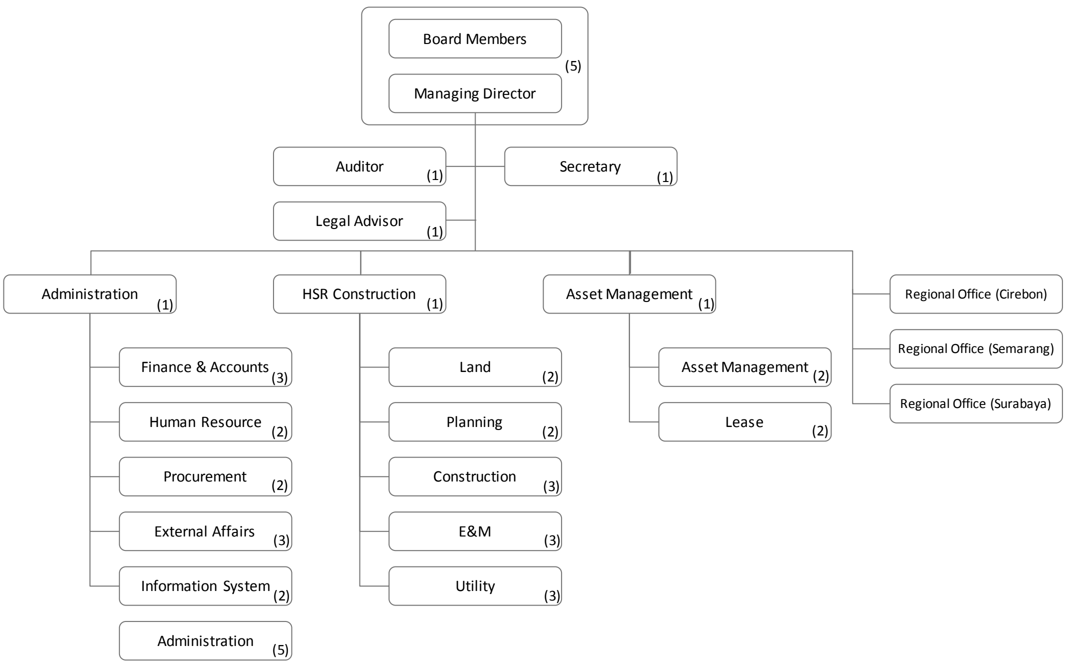
Law No. 19/2003 concerning State-owned Enterprises defines two types of SOE: Perusahaan Umum (PERUM) and Perusahaan Perseroan (PERSERO) as shown in Table 13.4-3. The concept of PERSERO lies on the idea of profit making instead of providing the public with high quality services at affordable prices. Assessing the situation involved in the HSR project, PERSERO is the suitable

SOE type for the HSR development in the country. Figure 13.4-2 shows a plan of SOE organizational structure. As the first development section is between Jakarta and Bandung, only the function of headquarters is needed at the beginning. Regional offices in Cirebon, Semarang and Surabaya may be established in response to the extension progress to Surabaya. Figure 13.4-3 shows the flow of establishing a state-owned enterprise.

Table 13.4-3 Comparison of SOE Types

	Perusahaan Perseroan (PERSERO)	Perusahaan Umum (PERUM)
Orientation	• Profit making • To provide high quality goods and/or services that are competitive	• For public interest, to provide high quality goods and/or services at affordable prices
State Financial Participation	All or at least 51% (fifty one percent) of shares are owned by the government	Entirely owned by the state (not divided into shares)

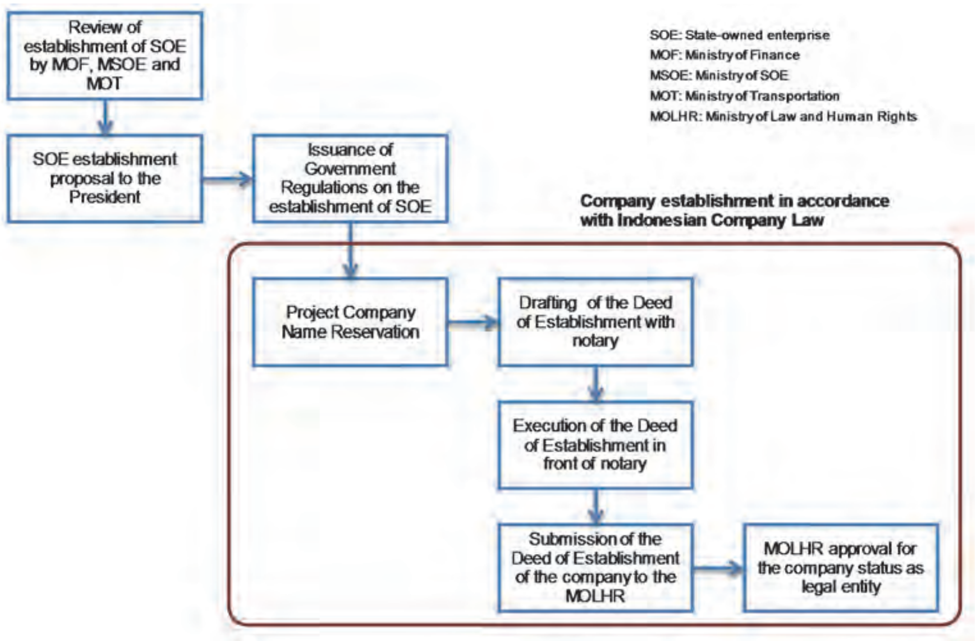
Source: Law No. 19/2003 concerning State-owned Enterprises



Note: Figures in brackets show the number of personnel.

Source: prepared by the JICA Study Team

Figure 13.4-2 Organizational Structure of the SOE for the HSR Development



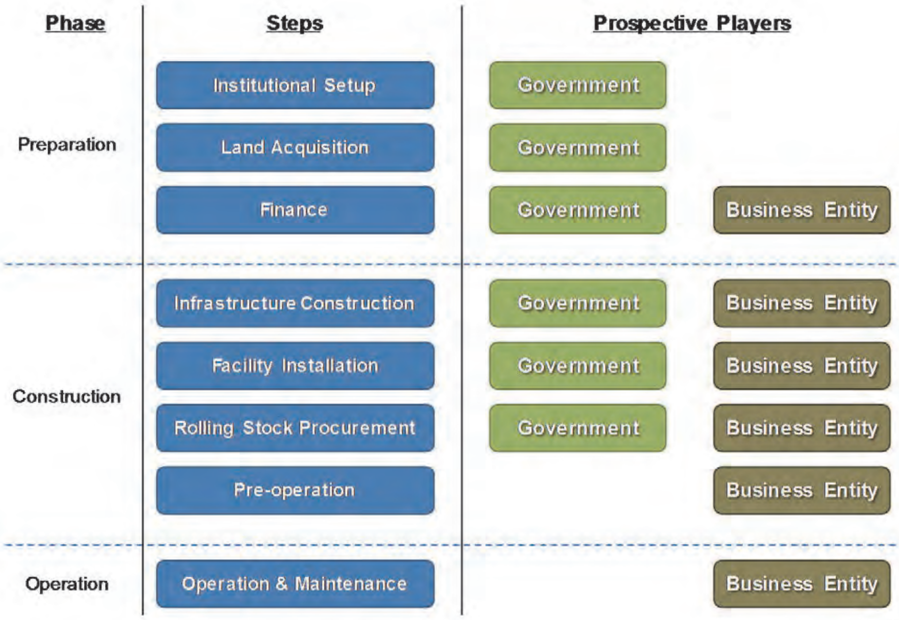
Source: prepared by the JICA Study Team

Figure 13.4-3 Procedure for Establishment of SOE

13.4.2 Project Modality

(1) Prospective Players at Each Project Phase

Figure 13.4-4 shows the prospective players in the HSR development and O&M. There are three major steps of the HSR project: 1) preparation, 2) construction and procurement, and 3) operation and maintenance. The government is made responsible for the land acquisition based on the prevailing legal framework. Business entities can take part in steps other than land acquisition. The business entity includes not only private companies but also state-owned/regional-owned enterprises because these are recognized as being in the private sector in Indonesia. The state-owned enterprises also can function as a body having sub-sovereign authority. Both the government and business entities can be the player at the construction stage. The government will be the proponent for the case of conventional public works procurement and the business entities will participate in the project as contractors. As for the case of project implementation with PPP, the business entities can participate in the project not only as contractors but also project investors. The government cannot be the player at the operation stage for both the cases, conventional public works and project implementation with PPP because of no operational function. Business entities will be the main player at the operation stage.



Source: prepared by the JICA Study Team

Figure 13.4-4 Project Phase and Prospective Players

(2) Other Organizations related to the Project Implementation

Table 13.4-4 shows organizations related to the project implementation. The central and regional government authorities are the bodies for project implementation under conventional public procurement. In addition, there are sections of the central government related to PPP projects, such as the Directorate of PPP Development, Bappenas and the Risk Management Unit, MOF, and state-owned companies such as IIGF that function as a single channel for government support to business entities promoting PPP projects and PT SMI.

Table 13.4-4 Organizations related to Project Implementation

Organization	Role
[Central Government]	
Ministry of National Development Planning/ National Development Planning Agency (BAPPENAS)	• Registration of the project in the National Development Plan • Registration of candidate projects in the PPP Book (by the Directorate of PPP Development)
Coordinating Ministry for Economic Affairs (CMEA)	• Coordination with relevant authorities for project execution
Coordinating Ministry for Maritime Affairs (CMMA)	• Coordination with relevant authorities for project execution
Directorate General of Railways, Ministry of Transportation (DGR)	• Enhancement and management of projects listed in the National Railway Master Plan
Ministry of Public Works and People's Housing	• Registration of the project in spatial planning at national level • Advice on utilization of underground space
Ministry of Environment and Forestry	• AMDAL assessment • Project approval • Approval and advice on protected areas
Ministry of Agriculture	• Approval and advice on diversion of agricultural land

Organization	Role
Ministry of Finance	• Coordination of project financing • Appraisal and approval of government support and guarantees for PPP projects (by the Risk Management Unit)
Ministry of State-owned Enterprises (BUMN)	• Approval of establishment of new SOEs • Supervision of performance of SOEs
National Land Agency	• Planning of land acquisition and resettlement • Enhancement of land acquisition
Indonesia Investment Coordinating Board	• Management of foreign investment
Committee for Acceleration and Expansion of Indonesia Economic Development (KP3EI)	• Management of implementation of MP3EI
[Provincial Government]	
DKI Jakarta West Java	• Registration of the project in regional spatial planning • Land acquisition • Development of area surrounding stations
[Other]	
Indonesia Infrastructure Guarantee Fund (IIGF)	• Point of contact for government guarantees and support for PPP projects
PT Sarana Multi Infrastruktur (PT. SMI)	• Provision of long-term loans in local currency

Source: JICA Study Team

(3) Project Modality

Based on the previous discussion, the following polices were set for the examination of project modality.

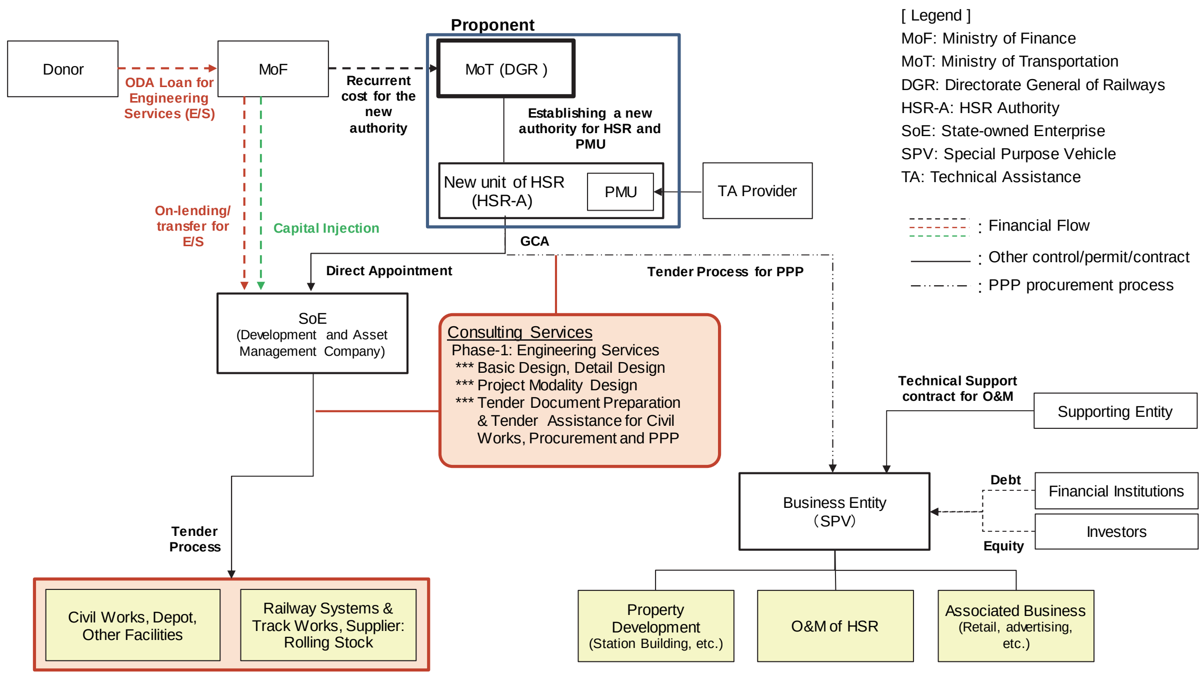
Polices	Measures
1) Considering the institutional setup that is suitable for introduction of the HSR technology	=> Assignment of reliable executing agency dedicated to the HSR development
2) Considering alternative financial source other than the national budget	=> Direct lending of external loan to sub-sovereign and private financing
3) Considering use of soft loan that is applicable for the mega project	=> Utilization of Japan’s ODA loan with STEP

Private financing, in particular, is highly expected by the Indonesian side because of the financial constraint of the government. Therefore, a PPP-based model is prioritized for the examination of project modality, while the SOE-based model is examined as the alternative. The project scheme of both the models is shown by project stage because the relationship between the stakeholders might be complicated. Figure 13.4-5 shows the structure for the PPP-based model.

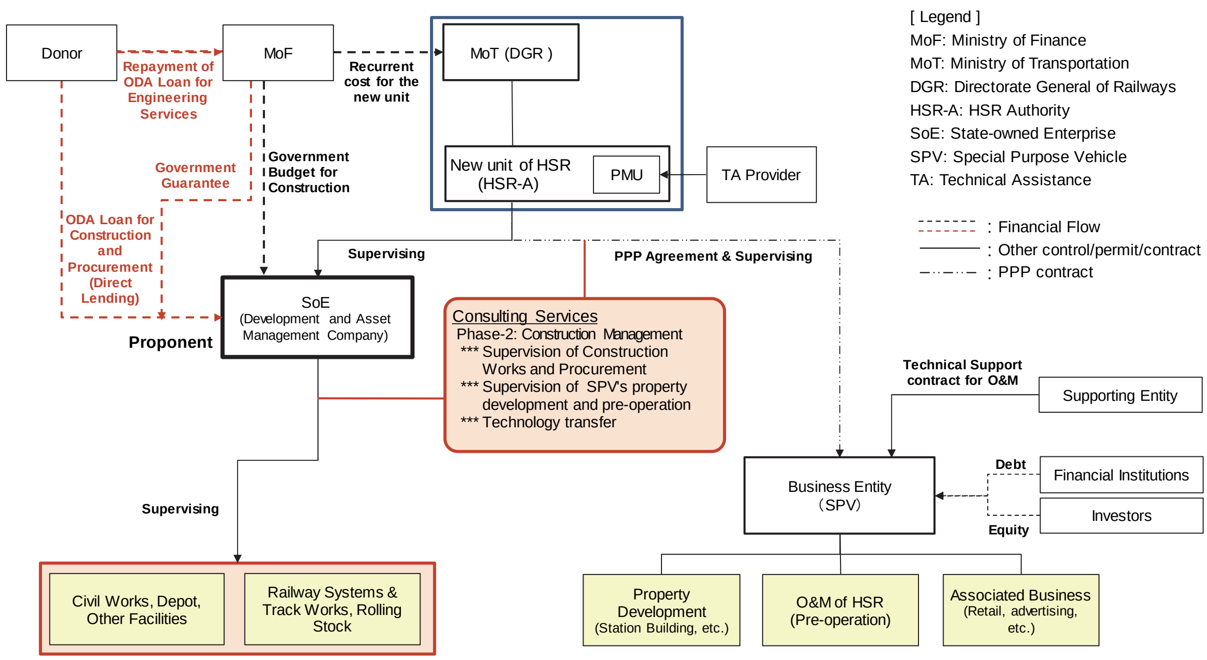
Under this model, DGR will be the proponent and prepare the request of assistance to the engineering services and promote the establishment of the HSR Authority and SOE at the preparation stage. The SOE will be the proponent of the construction stage, finance the construction cost, and promote the project implementation.

PPP-based Model

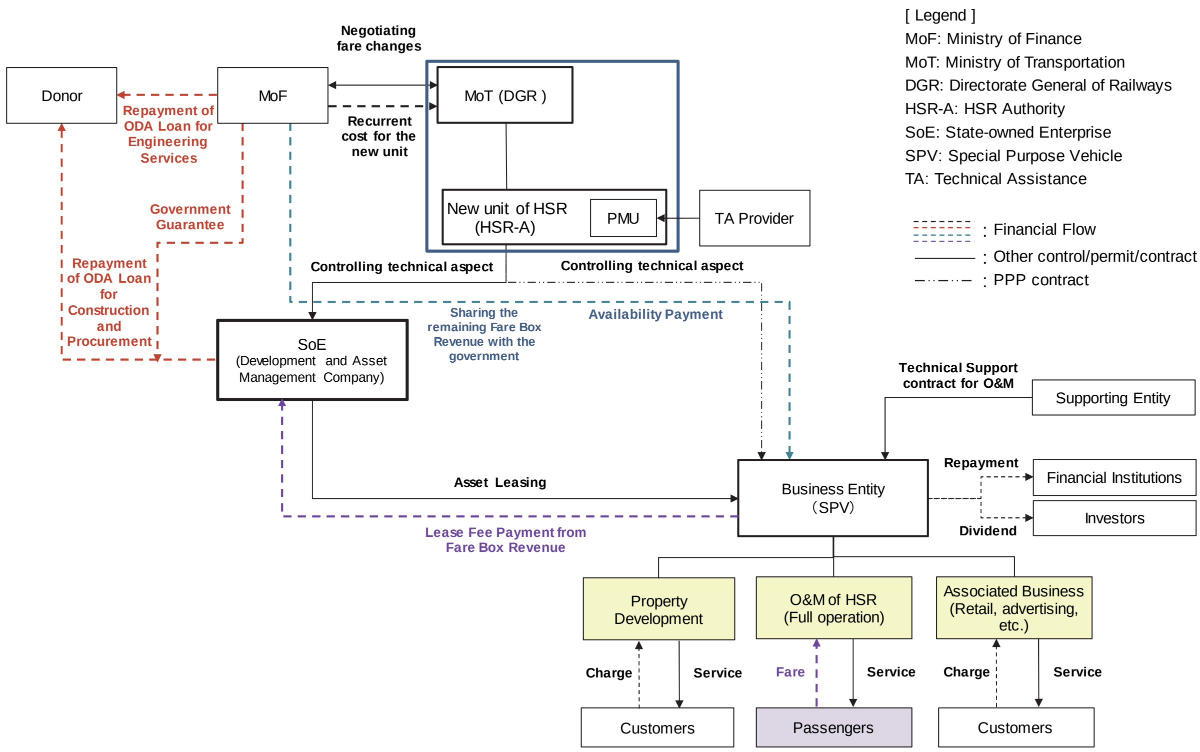
1) Preparation State (Design and Tender Documents Preparation)



2) Construction Stage (Supervision)



3) Operation Stage (Operation and Maintenance)



Source: JICA Study Team

Figure 13.4-5　Project Scheme of PPP-based Model (by Stage)

In parallel with the SOE's activities, the HSR Authority will procure the business entities for the project implementation with PPP. The HSR infrastructure and facilities will be leased from the SOE to the SPV at the operation stage. The SPV will pay the lease fee from the fare revenue to the SOE. The SOE will repay the loan for the construction cost to the donor. Table 13.4-5 shows the functions of key players in the PPP-based model. The project management unit (PMU) that will be established within the HSR Authority will be composed of some officials of the authority and made responsible for coordinating technical assistance activities with the TA provider and related organizations.

Table 13.4-5　Functions of Key Players for the PPP-based Model

Player	Function
DGR (MoT)	- Delegating rights related to HSR development to the authority - Approving technical regulations and standards formulated by the authority (Approval only, actual enforcement will be done by the authority)
HSR Authority	- Formulating HSR technical regulations and standards and certification systems - Issuing licenses for HSR development and operation - Enforcing HSR technical regulations and standards - Supervising HSR project - Supervising HSR operations
SOE (Development and Asset Management	- Financing HSR construction cost - Conducting the basic and detail design (with the engineering services) - Preparing tender documents (with the engineering services)

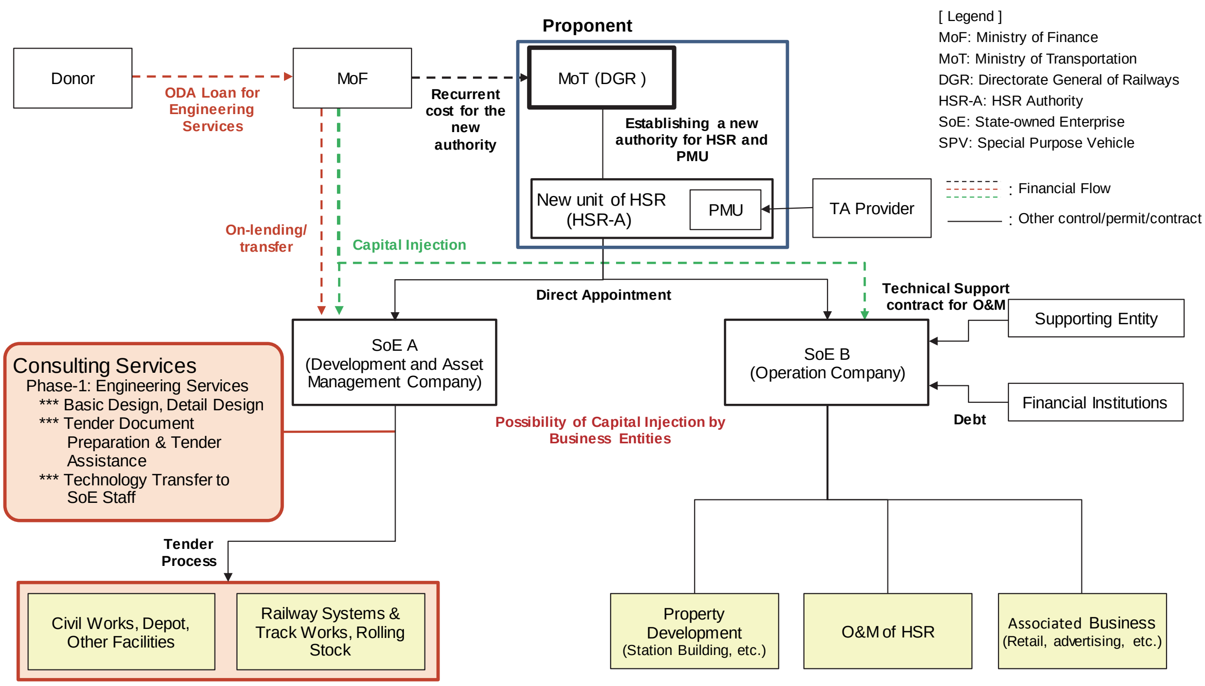
Player	Function
Company)	- Procuring contractors and business entities for PPP (with the engineering services) - Training staff (with the engineering services) - Supervising construction and procurement (with the engineering services) - Managing HSR assets after completion of the construction works - Receiving lease fee from the SPV - Repaying loan for the HSR construction cost to the donor
SPV	- Investing in the private portion of the project cost such as station building construction - Accepting technical support for the pre-operation and full operation from the supporting entity - Training operation and maintenance staff - Operating and maintaining HSR systems - Carrying out related businesses - Paying lease fee to the SOE

Source: JICA Study Team

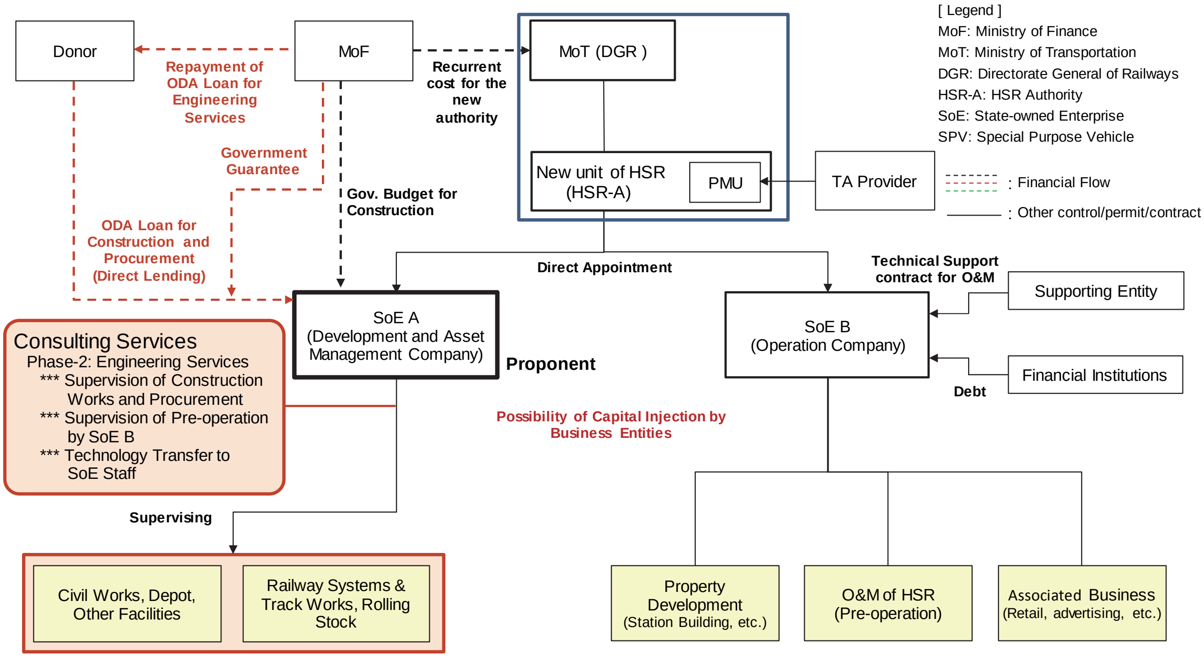
If no private entity participates in the investment in the PPP portion (therefore impossible to implement the project with PPP), the SOE-based model will be the alternative option (see Figure 13.4-6). Under the SOE-based model, a new SOE engaged in the operation and maintenance of the HSR systems will be established instead of the procurement of business entities. As for the operation and maintenance, similar to the PPP-based model, HSR infrastructure and facilities will be leased to the operating company (SOE B) and the lease fee will be paid from the operating company (SOE B) to the development and asset management company (SOE A).

SOE-based Model

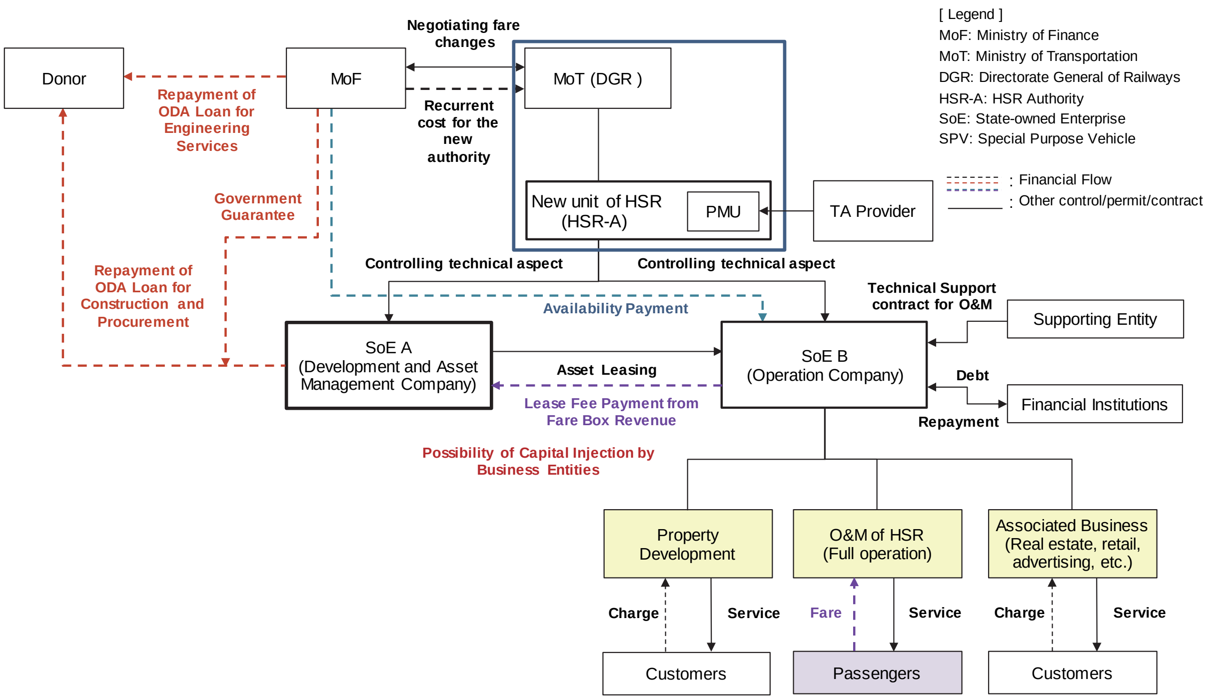
1) Preparation State (Design and Tender Documents Preparation)



2) Construction Stage (Supervision)



3) Operation Stage (Operation and Maintenance)



Source: JICA Study Team

Figure 13.4-6 Project Scheme of SOE-based Model (by Stage)

Table 13.4-6 shows the functions of key players under the SOE-based model.

Table 13.4-6 Functions of Key Players for the SOE-based Model

Player	Function
DGR (MoT)	- Delegating rights related to the HSR development to the authority - Approving technical regulations and standards formulated by the authority (Approval only, actual enforcement will be done by the authority)
HSR Authority	- Formulating HSR technical regulations and standards and certification systems - Issuing licenses for HSR development and operation - Enforcing HSR technical regulations and standards - Supervising HSR project - Supervising HSR operations
SOE A (Development and Asset Management Company)	- Financing HSR construction cost - Conducting basic and detail design (with the engineering services) - Preparing tender documents (with the engineering services) - Procuring contractors (with the engineering services) - Training staff (with the engineering services) - Supervising construction and procurement (with the engineering services) - Managing HSR assets after completion of the construction works - Receiving lease fee from SOE B (Operation Company) - Repaying loan for the HSR construction cost to the donor
SOE B (Operating Company)	- Accepting technical support for the pre-operation and full operation from the supporting entity - Training operation and maintenance staff - Operating and maintaining HSR systems - Carrying out related businesses - Paying lease fee to the SOE A (Development and Asset Management Company)

Source: JICA Study Team

(4) Risk Analysis

The IIGF's guidelines show the risk categories and its allocation for the two PPP modalities, concession and O&M shown in Figure 13.1-4. There are eleven risk categories expected in railway projects as shown in Table 13.4-7.

Table 13.4-7 Risk Categories and Events expected in the Railway Projects

Risk Category		Risk Event
1	Location Risks	Land acquisition delay, cost overrun, incomplete land acquisition, complex resettlement process, unforeseen difficulties of site conditions, damage of artifacts and antiquities on the site, failure to maintain site safety and contamination/pollution of the site environment
2	Design, Construction and Commissioning Risks	Incomplete design brief, design faults, delay in completing construction works, construction cost increase and commissioning risk (matching rolling stock with facilities, etc.)
3	Sponsor Risks	Poor performance of subcontractors, default by subcontractors, default

Risk Category		Risk Event
		by SPC and default by project sponsor
4	Financial Risks	Failure to achieve financial close, inefficiency of financial structure, fluctuation of foreign exchange rate, increase of inflation rate, fluctuation of loan interest rate and applicable coverage of insurance
5	Operating Risks	Availability of facilities, poor performance of services, industrial action, incorrect estimation of life cycle expenditure and traffic accidents
6	Revenue Risks	Changes in traffic demand projection, incorrect income generation model, failure of fare payment by passengers, failure of fare collection, failure of proposed fare changes, delay in tariff adjustment and miscalculation of tariff estimates
7	Network Connectivity Risks	Breach of authority's obligation to build and maintain required rail network and connecting facilities, and not to build competing tracks
8	Interface Risks	Disparity in quality of works implemented by the government and SPV, difficulty due to different standards/method of delivery or technology
9	Political Risks	Currency inconvertibility, currency non-transfer, expropriation, general changes in law, delay in achieving planning approval and delay in obtaining necessary consents
10	Force Majeure Risks	Natural disasters, extreme weather, political force majeure, etc.
11	Asset Ownership Risks	Asset loss event due to fire, explosion, etc., uncertainty regarding transfer from earlier railway operator and unanticipated condition of constructed railway facilities

Source: IIGF, Risk Allocation Guideline

The vertical separation model is one of the project implementing measures for railway projects. Project components will be separated into two parts under this model: 1) construction of infrastructure and facilities and 2) provision of operation services. Risks associated with each component will also be separated and will be taken by each executing body. The features of the vertical separation model are improvement of the profitability of the service provision component and enhancement of private participation in railway projects by means of detaching the responsibility for developing and owning the infrastructure and facilities from the project component for the private sector. This might promote private participation in the project in the future. Moreover the operator can pressure the developer to follow the construction schedule and can also contribute to improvement of the quality of infrastructure and facilities (checking defects) through the inspection for the lease.

Ridership risk is associated with the operational services. However, as discussed earlier, there is an international trend that governments provide the private executing body with financial support to reduce this ridership risk. Table 13.4-8 shows the tentative risk allocation between the players. The risk allocation needs to be reviewed when the project implementation structure with PPP and project scheme option is fixed. The risks on which the private sector may specially place significance are for the construction risks, delay in completing the construction works and construction cost increase; for the financial risks, fluctuations in the foreign exchange rate and changes in traffic demand projections; and for the revenue risks, incorrect income generation models.

Table 13.4-8 Risk Allocation among Players

Type of Risk and Risk Events		IIGF Guidelines		Risk Analysis by JICA Study	
		Concession	O&M	PPP-based Model	Vertical Separation Model
1. Location Risks	Land acquisition delay and costs overrun	Public	-	Gov	Gov
	Land acquisition can't be performed entirely	Public	-	Gov	Gov
	Costs over run and delay due to complex resettlement process	Public	-	Gov	Gov
	Unforeseen difficulties of site conditions	Private	-	SOE A	SOE A
	Damage of artifacts and antiquities on the site	Private	-	Private	SOE A
	Failure in maintaining site safety	Private	Private	Private	SOE A
	Contamination/pollution to the site environment	Private	Private	Private	SOE A
	Damage to the acquired land	Private	-	Private	SOE A
	Compensation due to unusual weather	Private	-	Gov	Gov
2. Design, Construction and Commissioning Risks	Time and cost overruns due to unclear/incomplete design brief	Private	-	Private	SOE A
	Design faults	Private	Public	Private	SOE A
	Delay in completing construction works	Private	Public	Private	SOE A
	- Due to fault by the PC	-	-	Private	-
	- Due to unforeseen site conditions	-	-	SOE A	-
	Construction cost increase	Private	Public	-	SOE A
	- Due to fault by the PC	-	-	Private	-
	- Due to unforeseen site conditions	-	-	SOE A	-
	Incorrect time/cost estimates of technical commissioning	Private	Public	Private	SOE A
	Additional design works requested by operator	Private	Public	Private	SOE B
3. Sponsor Risks	Poor performance of subcontractors	Private	-	Private	SOEs
	Default by subcontractors	Private	-	Private	SOEs
	Default by the PC	Private	Private	Private	-
	Default of project sponsor	Private	Private	Private	Gov
4. Financial Risks	Fail to achieve financial close	Private	-	Private	-
	Financial structure risk	Private	Private	Private	SOEs
	Foreign exchange rate risk	Private	Private	Gov	Gov
	Inflation rate risk	Private	Private	Gov	Gov
	Interest rate risk	Private	Private	Private	SOEs
	Insurance risk	Private	Private	Private	-
5. Operating Risks	Availability of facilities	Private	Private	Private	SOE B
	Poor performance of services	Private	Private	Private	SOE B
	Industrial action	Private	Private	Private	SOE B
	O&M cost overrun risk	Private	Private	Private	SOE B
	Estimation of life cycle expenditure is incorrect.	Private	Private	Private	SOE B
	Traffic accident or public safety concerns	Private	Private	Private	SOE B
6. Revenue Risks	Changes in the traffic demand projection	Private	Shared	Gov	Gov
	Incorrect estimation of revenue from income generation model	Not mentioned	Not mentioned	Gov	Gov
	End (retail) consumers fail to pay	Public	Public	Gov	Gov
	Fare collecting company fails to collect fares	Private	Private	Private	SOE B
	Failure of proposed fare changes	Private	Private	Gov	Gov
	Periodical tariff adjustment is delayed	Public	Public	Gov	Gov
	Level of the adjusted tariff is lower than initially projected	Public	Public	Gov	Gov
	Miscalculation of the tariff estimates	Private	Private	Private	SOE B
7. Network Connectivity Risks	Network risk (1) - build and maintain required rail network	Public	Public	Gov	Gov
	Network risk (2) - build connecting facilities	Public	Public	Gov	Gov
	Network risk (3) - not to build competing track	Public	Public	Gov	Gov
8. Interface Risks	Interface risk (1) - disparity of the quality of the works	Public/Private	Public/Private	SOE/Private	SOE A
	Interface risk (2) - different standard/ method of delivery or technology	Private	Private	SOE/Private	SOE A
9. Political Risks	Currency inconvertibility	Public	Public	Gov	Gov
	Currency non-transfer	Public	Public	Gov	Gov
	Expropriation risk	Private	Private	Gov	Gov
	General change in law (including tax)	Private	Private	Private	SOE B
	Discriminatory or project specific change in law (including tax)	Public	Public	Gov	Gov
	Delay in achieving planning approval	Public	Public	Gov	Gov
	Fail or delay in obtaining necessary consents (excl. Planning)	Public	Public	Gov	Gov
	Termination due to Authority default	Public	Public	Gov	Gov
10. Force Majeure Risks	Natural disasters	Shared	Shared	Shared	Shared
	Political force majeure	Shared	Shared	Shared	Shared
	Extreme weather	Shared	Shared	Shared	Shared
	Prolonged force majeure	Shared	Shared	Shared	Shared
11. Asset Ownership Risks	Asset loss event risk	Private	Private	Private	SOE B
	Transfer of existing railway business risk	-	Private	Private	SOE B
	Transfer of railway asset (including stations) risk	-	Private	Private	SOE B

Source: prepared by the JICA Study Team based on Risk Allocation Guideline of IIGF

13.5 Examination of Financial Options

In view of the huge demand for infrastructure projects, the financial community has been creating a number of innovative financial instruments though most of them are still under development. It is, however, worthwhile taking these into account and developing them together with both Indonesian and Japanese financial communities to better support implementation of infrastructure projects.

13.5.1 Possibility of Utilizing External Loans

Public financial sources are annual tax revenue and non-tax revenue. As mentioned in the discussion of the funding gap of the next Medium-Term National Development Plan in the previous section, infrastructure development cannot be realized by government revenue alone. Therefore, utilizing external loans is a realistic option to make up the funding gap. In particular, using soft loans with a lower interest rate may contribute to improving the profitability of the project, compared to using private financing with higher transaction costs. Table 13.5-1 shows the terms and conditions of some donors' loans. The financial cost of project implementation can be reduced by the special terms for economic partnership (STEP) of Japanese ODA loans, compared to other donors' loan conditions. The terms and conditions of Japanese ODA loans in the table are for middle income countries including Indonesia. STEP is extended to projects in which Japanese technologies and know-how are substantially utilized, based on the recipient country's request to utilize and transfer advanced Japanese technologies.

Table 13.5-1 Terms and Conditions of Japanese ODA Loans

a. Conditions of Major Donors' Loans

	World Bank Group	Asia Development Bank (ADB) Ordinary Capital Resources (OCR)
Maturity	24.5 years	Up to 32 years
Repayment Period	9 years	Up to 8 years
Grace Period	15.5 years	5 – 27 years
Interest Rate	LIBOR+1.0% (Fixed spread) LIBOR+0.48% (Variable spread)	LIBOR+0.4%

b. Japanese ODA Loans (for middle income countries including Indonesia)

Terms	Type of Interest Rate	Interest Rate	Repayment Period	Grace Period	Conditions for Procurement
General	Fixed	1.4%	25 years	7 years	Untied
Special terms for economic partnership (STEP)	Fixed	0.1%	40 years	10 years	Tied
Consulting Services	Interest rate: 0.01% The repayment, grace periods and conditions for procurement will be the same as those for the main components.				

Source: JICA, BAPPENAS

13.5.2 Possible Financing available from Japan

(1) Japan International Cooperation Agency (JICA)

JICA ODA Loans such as JICA STEP Loan and JICA Untied Loans are offered with good concessional fixed interest rates in Japanese Yen for an ultra long-term period. JICA also offers Private Sector Investment and Finance (PSIF) offering equity and lending options to support Japanese private sector company overseas investment. PSIF does not always require a Japanese company majority stake as its pre-condition.

JICA ODA STEP Yen Loan

The JICA ODA Loan “Special Terms for Economic Partnership” or STEP Yen Loan is specially designed when Japan’s partner country wishes to take advantage of Japanese advanced technology and import goods and equipment from Japan. On such occasions, STEP will be provided under further concessional terms. Advantages of the Japan’s ODA loan with STEP are as follows:

- Lower financial transaction cost (low interest rate) compared to other loans
  - ⇨ It may contribute to avoiding cash flow financing to cover the repayment and operation cost that may worsen the operator’s financial standing.
- Longer grace period and repayment period (maturity) compared to other loans
  - ⇨ It may contribute to setting less annual lease fee paid by the operator from its operational revenue.

JICA ODA Untied Yen Loan

This type of loan has been widely used to support development of countries by offering an ultra long-term Yen Loan with fixed interest rates. This loan is provided as a government-to-government loan. There is no country restriction to be applied when the borrowing government proceeds with procurement.

JICA PSIF (Private Sector Investment Finance) Loans

JICA PSIF is granted for Japanese investors for their overseas investment and export. Different from other ODA Loans above, this PSIF Loan is directly provided to Japanese companies investing in developing foreign countries. A joint venture company with some Japanese equity participation, minor or major, is eligible to apply for this PSIF Loan. This PSIF is also offered with a longer maturity and with a fixed interest rate in Japanese Yen.

(2) Japan Bank for International Cooperation (JBIC)

The Japan Bank for International Cooperation (JBIC) is wholly owned by the Japanese government, and its budget and operations are regulated by the JBIC law. It has a major role in promoting Japanese exports and imports, and the country's activities overseas, both in developed and developing countries. It tries to contribute to the stability of the international financial order and to the promotion of sustainable development. A policy of not competing with ordinary financial institutions followed. The bank is one of the key instruments of Japan's ODA.

JBIC Export Loans

JBIC Export loans are provided to overseas importers and financial institutions to support and finance exports of Japanese machinery, equipment and technology mainly to developing countries. In particular, products such as marine vessels, power generation facilities and other types of plant equipment incorporate a large amount of advanced technology, and their export contributes to enhancing the technological base of Japanese industries.

JBIC Overseas Investment Loans

JBIC Overseas investment loans support Japanese foreign direct investments. They are extended to Japanese companies (investors), overseas affiliates including joint ventures where Japanese companies have equity interests and governments or financial institutions that make equity participations in or extend loans to such overseas affiliates.

(3) Japan Overseas Infrastructure Investment Corporation for Transport & Urban Development (JOIN)

To further support private initiatives, the Japanese government set up an additional equity funding arm called the Japan Overseas Infrastructure Investment Corporation for Transport and Urban Development (JOIN) in the form of Infrastructure Development Fund at the Ministry of Land, Infrastructure, Land and Tourism (MLIT) in October 2014. The major objective of the corporation is to co-invest with private sector companies from Japan in relation to its overseas projects for transport projects and urban development projects. They may stay as a minority investor to support private sector companies that will take the majority.

(4) Loan from Japanese Banks through their Indonesian Subsidiaries and/or Branches

All the major Japanese banks are operating in Indonesia, albeit with limited competitiveness in Rupiah lending. As for the project based finance, only some working capital funding in relation to Japanese sponsor companies can be expected. Until now the mega Japanese banks have been active in project and infrastructure financing projects in Asia, however, their experience has been rather limited to the energy and electricity sector.

13.5.3 Possible Financing available from Indonesia

The Indonesian Government has been proactively promoting public financial support through PT SMI or IIGF mainly for PPP projects. New financing tools such as Viability Gap Funding (VGF) or municipal bonds are being developed. Further, Indonesian banks show interest in infrastructure finance, but so far they have focused on energy and electricity projects.

(1) Finance by PT Sarana Multi Infrastruktur

PT Sarana Multi Infrastruktur (PT SMI) was established in 2009 with the authorized capital of US$ 200 million as a 100% government owned financial institution for infrastructure development under Public-Private Partnership (PPP).

Its financing instruments are Senior Loan, Subordinated Loan, Mezzanine Finance, or Equity. It has two roles; on the one hand as facilitator to provide project appraisals and reviews as well as advisory activities, and on the other hand as catalyst to supplement financial institution loans for their development in infrastructure finance by participating with equity in infrastructure projects having strategic importance.

(2) Finance by PT Indonesia Infrastructure Finance

PT Indonesia Infrastructure Finance (PT IIF) was established in 2010 jointly by the Indonesian government and international development agencies as a non-bank financial institution. The paid-in capital was 1.6 billion Rupiah, among which the Indonesian government invested 600 million Rupiah via PT SMI, 400 million Rupiah each from IFC and ADB, DEG, the German Investment Development Agency, made 200 million Rupiah investment. In addition, Sumitomo-Mitsui Banking Corporation (SMBC) announced its equity participation with 14.9% share of the stake. PT IIF is expected to offer long-term loans in Rupiah. Though they have not reported any specific investment projects, due to the difficulties in seeking long-term financing sources, PT IIF could be expected as one of the useful financial sources.

(3) Indonesia Investment Guarantee Fund (IIGF) Guarantee

IIGF (PT Penjaminan Infrastruktur Indonesia (Persero)) was established in 2009 as a single channel in providing guarantees for infrastructure projects. Its initial paid-in capital was Rp. 3.5 trillion and later increased to Rp. 4.5 trillion in 2012. IIGF provides guarantees for government contracting agencies such as ministries, regional governments and SOEs. Its contractual obligations are under the cooperation agreement of PPP infrastructure projects. The following are the primary objectives of IIGF:

- Improve project creditworthiness for bankable PPP projects
- Provide guarantees for well-structured PPP projects
- Improve government transparency and consistency of guarantee provision processes
- Ring-fence the Indonesian government contingent liabilities and minimize sudden shock to the state budget

IIGF has set up its strategic sectors such as power, water, toll roads and railways. It has been preparing the procurement process, guarantee process, project and guarantee structure, and the key documents such as PPP Agreement, Guarantee Agreement and Recourse Agreement as well as PPP Risk Allocation Guideline for each sector. Furthermore, since 2012, the World Bank has been offering its technical assistance to IIGF to enhance its legal, technical, appraisal and implementation capacity.

(4) Loan from Indonesian Major Banks

The Indonesian major banks, Bank Mandiri, BNI and BRT, have been providing asset-based financing so far, but both Bank Mandiri and BNI, with exception of BRI which focuses on SMEs via their nation-wide network, have been proactively following and participating in infrastructure projects by setting up dedicated teams. Both banks informed of their general approaches mainly through the limited recourse project financing.

Long-term lending activities have, however, certain limitations due to their matching funding bases. Based on the direct interviews conducted by the Study team, the general terms are a maximum of 15 years after the loan agreement signing. The interest rate is floating and the recent rates have stayed around 10% p.a. Furthermore the banks showed their interest in participating in funding by considering high and good credit risks of Japanese private sector companies when they are the sponsors.

(5) Municipal Bond Issues

The bond market in Indonesia is still developing. Apart from Government bonds regularly issued in the market, with the benchmark bond having a 10-year maturity, other issuers are rather limited. Nevertheless, a PT SMI USD 100 million equivalent IDR bond was issued in 2013 with a 5-year maturity and received a BBB- rating from Fitch, the same rating as the sovereign bonds.

An active drive has been given to develop the bond market in Indonesia to respond to its strong needs for economic and social development, including public infrastructure building. In this regard, the bond market shall play an important role by developing a good regulatory framework, products and investors for sources of long-term financial instruments in addition to the lending markets.

The municipal bond issuance preparation which has been assisted by the World Bank should also be noted. There are some possibilities for using public sector bond issuance of the related provinces such as DKI and West Java Province as one of the options in the future for the HSR project.

13.5.4 Possible, New and Innovative Financing Sources

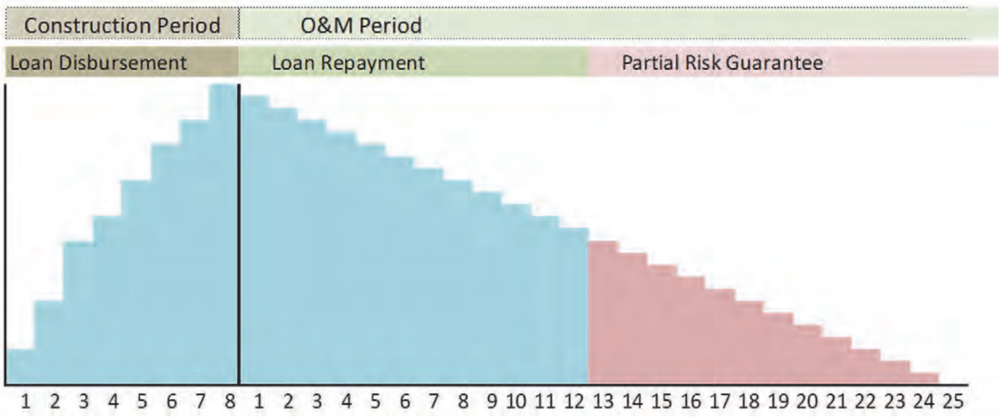
In order to support PPP Infrastructure projects, a number of initiatives have been taken in many countries. As of now, not all of these efforts have been fully realized or implemented but some of them can be expected to be institutionalized and implemented in years to come.

For realization, the Indonesian government needs to deepen its financial and capital markets not only in terms of products or instruments, but also in the fields such as providing a conducive legal framework as well as a variety and higher capacity of financial institutions and further development of institutional investors. The following are examples of the new and innovative financing sources:

(1) Innovative Financial Menu

- <u>Partial Risk Guarantee</u>
    - Private sector bank loan – rather short for infrastructure finance

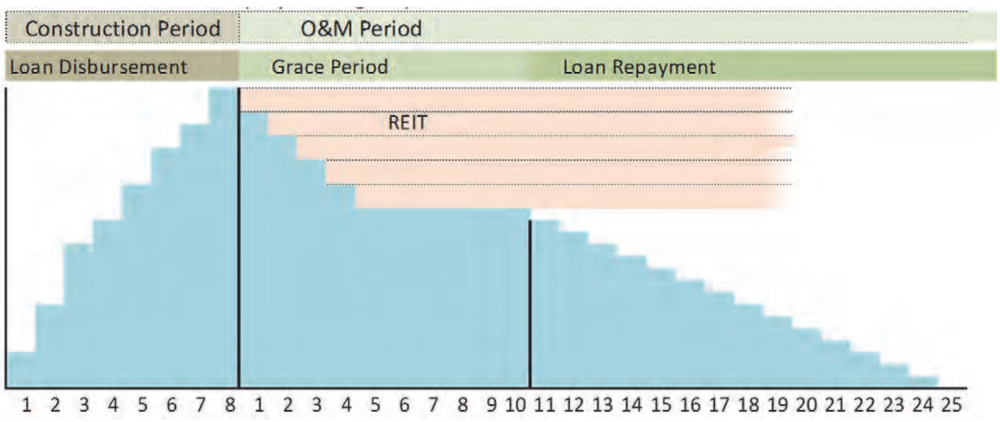
- World Bank and JBIC – offering the partial risk guarantee beyond the period of private sector bank can assume (see Figure 13.5-1)



Source: JICA Study Team

Figure 13.5-1 Concept of Partial Risk Guarantee

➢ <u>Real Estate Investment Trusts (REIT) and Infrastructure Investment Trusts (InvIT)</u>
- Listed to stock exchange, "a perpetual certificate" (see Figure 13.5-2)



Source: JICA Study Team

Figure 13.5-2 Concept of Real Estate Investment Trust

(2) Land Value Capturing Financing

By taking those possible new taxable levies, regional or local governments may consider plans and develop an urban master plan, create a development fund to pool some part of those new and incremental revenues as financial resources, and to contribute to the HSR project to aim at development goals not only for economic and social objectives but also fiscal and administrative outcomes.

- <u>Town Planning Schemes (TPS)</u>
  - No land acquisition necessary, but
  - Local municipalities, railway station owners and land owners are invited.

- <u>Station Development</u>
  - HSR/railway stations are not only entry/departing points of passengers.
  - Station facilities for passengers but also visitors to stations

13.6 Considerations towards the Realization

In order to realize the institutional framework and project modality examined above, the following maters need to be addressed at the next phase of the project.

- Establishment and capacity development of the high-speed railway authority and state-owned enterprise

  It is necessary to establish the high-speed railway authority and develop the capacity of the authority to fulfil its responsibility. In parallel with the establishment of the authority, the state-owned enterprise that will be engaged in the HSR development must be incorporated. The state government is required to proceed with such institutional arrangement without delay.

  After the introduction of the HSR regulations and standards, they need to be disseminated, understood, learned and practiced by relevant HSR management and personnel. This capacity building could be implemented by creating a HSR Training Center as a part of the HSR Authority. The training center could regularly offer capacity building seminars, training, workshops and license certifications to different target groups. Technical assistance from a donor might be required to develop the training programs because it requires advanced technological standards.

- Institutionalization of the direct lending to sub-sovereign entities

  It is necessary to clarify and establish the regulations on government guarantee for the direct lending from donors to sub-sovereign entities and its contingent liabilities, such as who should take responsibility on that.

- Improvement of PPP regulations

  Prevailing PPP regulations do not include instruments that may promote private participation in the infrastructure development, such as the concept of vertical separation on the operation of transportation infrastructure and an incentive that gives business entities a right on development of surrounding area. Risk allocation is also not attractive to the private sector because most of expected risks are planned to be transferred from the public sector to them. It is necessary for the state government to take the demand risk in transportation projects and provide support to the business entities such as availability payment, based on the recent world trends. Government support to exchange rate risk is also one of the major concerns for the private sector because of difficulty in getting local currency loans for the infrastructure development and difference of currencies between loans and revenues.

➢ Cost sharing between the key players

As mentioned in Subsection 13.1.2, there are only two models of project modality in the IIGF's guidelines: investment in all project costs by the business entity (concession model) or by the government (O&M model). However, it is necessary to consider the vertical separation model in the infrastructure project and examine the cost sharing between the key players. Table 13.6-1 shows some example patterns of the cost sharing between the key players for the PPP-based model. Considering the result of financial analysis, the cost sharing must be continuously examined.

Table 13.6-1 Examples of Cost Sharing between the Key Players for the PPP-based Model

Unit: billiion IDR			Pattern 1 (Base Case)			Pattern 2			Pattern 3			Pattern 4			Private Model		
Item		Breakdown	Gov	SOE	SPV	Gov	SOE	SPV	Gov	SOE	SPV	Gov	SOE	SPV	Gov	SOE	SPV
Construction/ Procurement Cost	Civil Works	Embankment		2,114			2,114			2,114			2,114				2,114
		Cutting		766			766			766			766				766
		U type Retaining Wall		167			167			167			167				167
		Viaduct (Regular Bridge)		8,178			8,178				8,178			8,178			8,178
		Bridge		419			419			419			419				419
		Tunnel (Mountain Tunneling)		5,266			5,266			5,266			5,266				5,266
		Shield Tunnel		6,402			6,402			6,402			6,402				6,402
		Cut and Cover		881			881			881			881				881
		Transverse		422			422			422			422				422
		Service Road		358			358			358			358				358
		Environmental Program		165			165			165			165				165
		Sub-Total	0	25,138	0	0	25,138	0	0	16,959	8,178	0	16,959	8,178	0	0	25,138
	Disaster Prevention Equipment			196				196		196				196			196
	Track Works			3,193				3,193		3,193			3,193				3,193
	Station Works				1,371			1,371			1,371			1,371			1,371
	Depot/ Workshop			3,611			1,269	2,342		3,611				3,611			3,611
	Electric Facility			5,584			5,584			5,584			5,584				5,584
	System/Automatic Fare Collection			339			339			339			339				339
	Signaling and Telecommunications Facility				3,535		3,535			3,535			3,535				3,535
	Rolling Stock			3,490			3,490			3,490			3,490				3,490
	Maintenance Equipment				216			216			216			216			216
	Preparation for Operation				196			196			196			196			196
(1) Construction/Procurement Cost			0	41,550	5,317	0	39,354	7,513	0	36,907	9,961	0	33,100	13,767	0	0	46,867
(2) Land Acquisition Cost			3,962			3,962			3,962			3,962			3,962		
(3) Consulting Service Cost			680	1,397	266	680	1,288	376	680	1,575	89	680	1,384	279			2,343
(4) Management Cost			68	139	27	68	129	38	68	157	9	68	138	28			234
(5) Contingency			34	2,147	279	34	2,032	394	34	1,924	502	34	1,724	702			2,461
(6) Value-added Taxes			4,921			4,921			4,921			4,921					4,921
Total Project Cost			**9,665**	**45,233**	**5,889**	**9,665**	**42,803**	**8,321**	**9,665**	**40,563**	**10,561**	**9,665**	**36,347**	**14,777**	**3,962**	**0**	**56,826**
Percentage to Total Project Cost			16%	74%	10%	16%	70%	14%	16%	67%	17%	16%	60%	24%	6%	0%	94%

Note: Private Model shows a case that the government takes responsibility for land acquisition only and the remaining portion is taken by the SPV.

Source: JICA Study Team

➢ Promotion of Regional Development

The HSR project, along with its alignment as well as via its stations, can contribute to and accelerate regional/urban development. By conducting further work on the Town Planning Scheme (TPS) based regional/urban development, the Land Value Capture (LVC) approaches, offering further higher benefits to both regional/urban development as well as HSR project feasibility, as a new financial source, are expected to continue further studies. As explained above, the LVC approach, which is a rather new concept having been developed in the USA, Germany, Japan and recently in India, is considered a strong tool to mobilize Land Value for financing options particularly suitable for Public-Private Partnership type infrastructure and urban development programs. HSR Stations are not only for passengers. Stations are expected to satisfy or respond to the needs of both passengers and users/visitors to the station. In-Station, Above-Station, Station-Front and Around-Station development are possible to be implemented. In-Station and Above-Station developments could be initiated by the HSR operator to be realized by business communities as well as local governments. Station-Front and Around-Station developments shall be developed in close collaboration with local authorities as well as business and civil communities.

In terms of the financial point of view, In-Station and Above-Station developments can generate additional Non-Fare Revenues in the form of Rent/Lease from the station building commercial developers as well as tenants. As we see in the Regional Development part of this report, Non-Fare business revenues mainly from stations are substantial in the case of Japan.

Chapter 14

Estimating Project Effects

Chapter 14 Estimating Project Effects

14.1 Operation and Effects Indices Calculation

The operation and effects indices of high speed railways suggested in this research have been summarized in the table below. Indices have been chosen that can be quantitatively evaluated, regarding operation projects and use of institutions and facilities. By utilizing these indices, it is possible to monitor the emergence of project implementing effects quantitatively

As operation indices, "passenger transportation volume", "the number of trains", "the time required", "fare revenue" and "maintenance and operation cost" were selected. Additionally, as effects indices, "passenger transportation volume", "travel time reduction", "traffic congestion rate", and "the amount of carbon dioxide reduction" were chosen. Based on the results of this research, desired values are set as the table below.

Table 14.1-1 Operation and Effects Indices

	Items	Indices	Monitoring Target	Desired Values (2030)
Operation Indices	Passenger Transportation Volume	Number of Passengers (people/day)	Jakarta-Bandung	68,000 people/day
	Number of Trains	Total Number of Trains	All Routes	106/day
	Time Required	Minutes	Jakarta-Bandung (fastest)	37 minutes
	Fare Revenue	Fare Revenue (IDR)	Fare Revenue of All Routes	3.5 trillion rupiah (Prices as of 2014)
	Maintenance and Operation Cost	Maintenance and Operation Cost	Maintenance and Operation Cost of All Routes	1.05 trillion rupiah (Prices as of 2014)
Effects Indices	Passenger Transportation Volume	Number of Passengers (people/day)	Jakarta-Bandung	68,000 people/day
	Travel Time Reduction	Amount of Transit Time Reduction compared with the time required by Automobiles (minutes)	Jakarta-Bandung	113 minutes
	Traffic Congestion Rate	Sharing Ratio of Automobiles and	Jakarta-Bandung	17%

		Buses (%)		
	Amount of Carbon Dioxide Reduction	Amount of Carbon Dioxide Reduction compared with the case without high speed railway services (tons/day)	Jakarta-Bandung	777 tons/day

14.2 Calculation of Qualitative Effects

Based on the results of the research above, of the positive and negative impacts expected on the society and economy of Java caused by this high speed railway project, we can identify the following points that are difficult to quantify. As the project is proceeding, it is important to keep monitoring these social and economic impacts.

(1) Qualitative Effects accompanied by Station Surroundings Development Plans and Urban/Rural Development (Refer to 5.1)
By utilizing the high speed railways plan, a modal shift in transportation will occur mainly on the railway line between Jakarta-Bandung. As a result, of this and also due to increasing traffic congestion many more people will use trains in Java. It is also expected that economy in Java will develop by stronger cooperation among communities.

(2) Qualitative Effects accompanied by Direct Connections between the Capital City and the Regional Main Cities (Refer to 5.1)
By connecting 3 urban areas in West Java Province with the capital city, Jakarta, it is expected that the tourism and service industry will be developed and a new business model will be established through stronger connections among cities.

(3) Qualitative Effects accompanied by the Establishment of Urban Areas with a focus on High Speed Railway Stations and Attractive Station Surroundings (Refer to 5.2)
Accompanying high speed railway stations, facilities such as commercial buildings and hotels will be also be constructed. As a result, it is assumed that the higher numbers of people will come and that attractive urban areas will be established.

(4) Qualitative Effects accompanied by Reorganization of Regional Transportation System as a Result of Introduction of High Speed Railway Stations (Refer to 5.2)
The introduction of high speed railway stations will also stimulate regional transportation to provide access to high speed railway stations. Primarily, transportation that is more beneficial to residents is expected to be created.

(5) Qualitative Effects accompanied by Expansion of Travel Opportunities for Ordinary Citizens (Refer to 6.6)

By setting a fare of 200,000 rupiah between Jakarta and Bandung, not only the wealthy but also ordinary citizens can use high speed railways. As a result, ordinary people in Java will be able to travel more widely and frequently stimulating both commuting and tourism.

(6) Qualitative Effects accompanied by Space Efficiency Increase (Refer to 6.6)

High speed railways, which are more spatially efficient than highways, enable mass transportation using much less land area. It is also possible to reduce the environmental burden caused by traffic infrastructure development.

(7) Qualitative Effects accompanied by Changes on Land Use (Refer to Chapter 11)

It is assumed that some resettlement and land allocation will be needed to construct high speed railways. As a result, it is possible that reorganization of local communities and conversion of the community industrial model will occur.

(8) Qualitative Effects accompanied by the Creation of the New Project Scheme (Refer to 13.5)

Following the implementation of railway projects using PPP scheme, there is the possibility that new fundraising schemes in Indonesia will be practiced in addition to revising and organizing each existing system. By developing these systems and finance, in not only railway projects but also other transportation projects and infrastructure projects, the expansion of such projects using the new project scheme and PPP scheme is expected.

14.3 Financial Analysis

In this section, the financial feasibility of the project execution plan as has been discussed will be confirmed. Specifically, financial feasibility of the project will be evaluated using estimated financial internal rate of return (FIRR) based on cash flows in real terms. Further, the funding availability of the project will be evaluated by estimating the equity internal rate of return (EIRR), project internal rate of return (PIRR), and debt service coverage ratio (DSCR) based on cash flows in nominal terms.

14.3.1 Preconditions

(1) Project period

The project period is set to 50 years, in consideration of factors such as facility lifetime.

(2) Exchange rate (respecified)

The exchange rates are set as below, in accordance with the tentative JICA Yen loan evaluation criteria for Indonesia in FY2013.

・USD/JPY 1 USD ＝ 99.24 JPY

・USD/IDR 1 USD ＝ 9,697.3 IDR

・IDR/JPY 1 IDR = 0.001023 JPY

(3) Cases under evaluation

In general the analysis is based on the business scheme studied in Chapter 13. In addition analyses were conducted on each case of project cost sharing schemes described in Table 13.6-1, necessitated by the need to evaluate different cost sharing schemes between related parties under the project structure, as written in section 13.6.

(4) Value-added tax rate

A value-added tax for the project is exempted as written in Chapter 13.

(5) Tariff

It is assumed that all portion financed in foreign currency is subject to tariff, for which tariff rate of 5% is applied in view of the laws of Indonesia.

(6) Corporation tax

A corporation tax of 25% is applied in view of the laws of Indonesia.

(7) Rate of lease

Among all infrastructures acquired and leased by the state-owned enterprise, for assets financed by Yen-loan scheme, the operating company is assumed to pay the lease amount to the state-owned enterprise under the condition of lease rate of 0.1% and lease period of 40 years. That is, for the Yen loan used for infrastructure development signed by the state-owned enterprise, the repayment for both interest and principal is to be made by the operating company paying equal amount each year.

(8) Fund-raising method

The state-owned enterprise acting as the main project development body is assumed to be able to use Yen loan (STEP) to procure full funding for items that are under the subject of Yen loan mechanism. For those items outside the coverage of Yen loan mechanism, and for the government-funded portion of construction cost, it is assumed that they would be funded by equity investment from the Indonesian government's budget. Also, the main project operating body which is the private entity is set to finance the initial cost through equity capital and commercial bank loans with debt equity ratio of 85%.

(9) Short-term loan

It is assumed that when the accumulated cash flow becomes negative, the whole cumulative deficit is to be covered by short-term loan.

(10) Loan conditions

1) Yen loan

STEP conditions are applied to Yen loan: annual interest rate of 0.1% and 40 year repayment period including a 10 year grace period. Annual interest rate during construction period is assumed to be 0.3% on both construction works and consultancy services[1].

2) Commercial bank loan

Based on the Indonesian 10 year government bond yield added with risk premium under Indonesian standard, the annual interest rate of a commercial bank loan is assumed to be 14% for a 10-year loan. The interest during construction is set to be 14% on both construction works and consultancy services.

3) Short-term loan

Likewise, considering the yield rate of a 10-year Indonesian government bond and risk premiums in Indonesia, annual interest rate for a 5-year loan is assumed to be 12%.

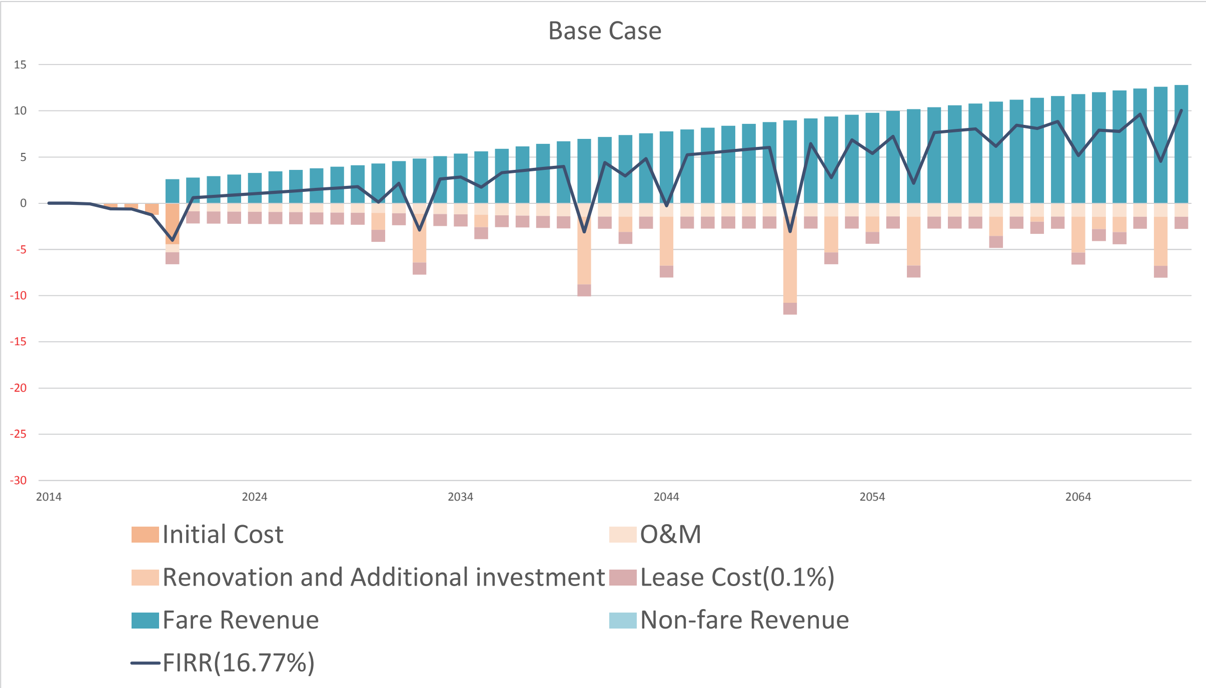
14.3.2 Estimation of FIRR

The estimation result for each case shows positive FIRR for both the State-owned enterprise and the private project operating body. The project is evaluated as financially feasible.

Table 14.3-1 Financial Analysis (FIRR)

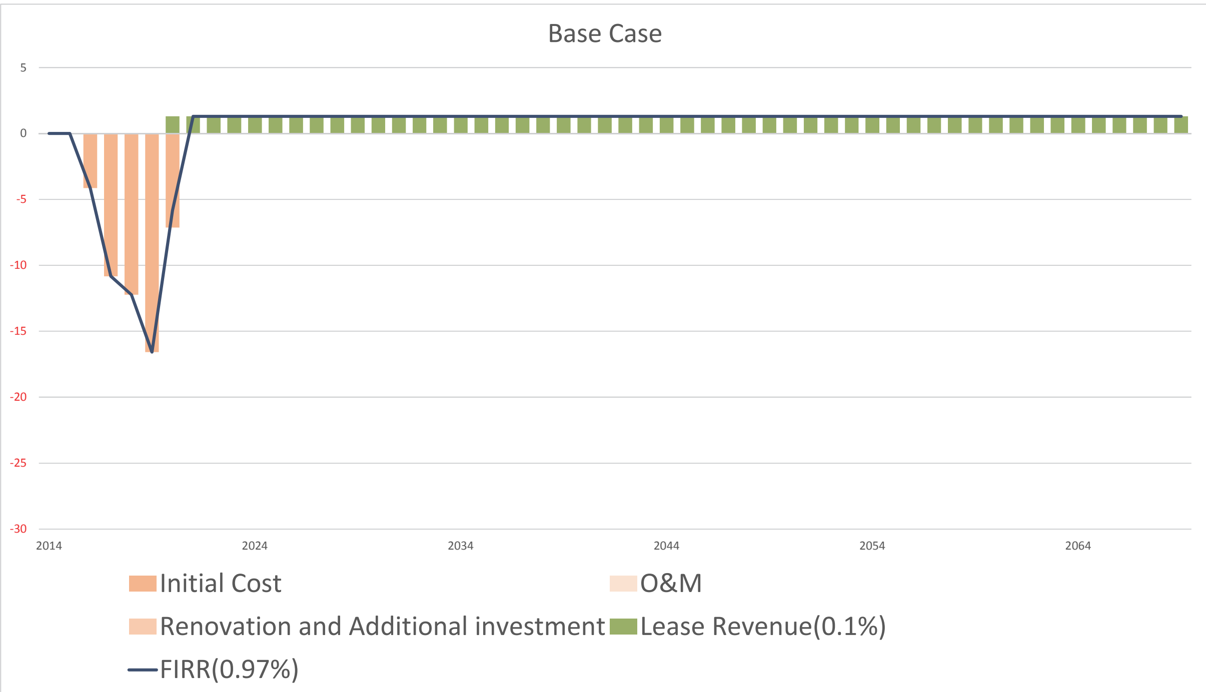
	FIRR (Private operator)	FIRR (State-owned enterprise)
Cost Sharing Case 1 (Base Case)	16.77%	0.97%
Cost Sharing Case 2	13.67%	0.97%
Cost Sharing Case 3	10.99%	0.98%
Cost Sharing Case 4	9.54%	0.97%
Reference: Private Project Case 1 (Land Acquisition Cost charged to Indonesian Government)	5.28%	0.90%
Reference: Private Project Case 1 (Land Acquisition Cost charged to SPV)	5.04%	-

1 Refer to JICA Yen loan evaluation criteria for other middle-income country in FY2013.



Source: JICA Study Team

Chart 14.3-1 Cash Flow of Project Operating Private Body (Case 1 (Base Case), FIRR, Real Term, Unit: trillion IDR)



Source: JICA Study Team

Chart 14.3-2 Cash Flow of Project Developing State-Owned Enterprise (Case 1 (Base Case), FIRR, Real Term, Unit: trillion IDR)

Table 14.3-2 Cash Flow of Project Operating Private Body (Case 1 (Base Case), FIRR, Real Term, Unit: trillion IDR)

Private Entity Lease Rate= 0.10%

(billion IDR)

Year	Initial Cost	O&M	Renovation and Additional investment	Lease Cost(0.1%)	Fare Revenue	Non-fare Revenue	FIRR(16.77%)
2014	0	0	0	0	0	0	0.0
2015	0	0	0	0	0	0	0.0
2016	-66	0	0	0	0	0	-66.3
2017	-605	0	0	0	0	0	-605.2
2018	-623	0	0	0	0	0	-623.1
2019	-1,266	0	0	0	0	0	-1,266.2
2020	-4,437	-864	0	-1,299	2,598	0	-4,002.6
2021	0	-882	0	-1,299	2,767	0	584.9
2022	0	-901	0	-1,299	2,935	0	735.3
2023	0	-919	0	-1,299	3,104	0	885.6
2024	0	-938	0	-1,299	3,273	0	1,036.0
2025	0	-956	0	-1,299	3,442	0	1,186.4
2026	0	-974	0	-1,299	3,610	0	1,336.8
2027	0	-993	0	-1,299	3,779	0	1,487.1
2028	0	-1,011	0	-1,299	3,948	0	1,637.5
2029	0	-1,030	0	-1,299	4,117	0	1,787.9
2030	0	-1,048	-1,831	-1,299	4,286	0	107.0
2031	0	-1,089	0	-1,299	4,553	0	2,165.0
2032	0	-1,130	-5,296	-1,299	4,821	0	-2,904.4
2033	0	-1,171	0	-1,299	5,089	0	2,618.5
2034	0	-1,212	0	-1,299	5,357	0	2,845.2
2035	0	-1,253	-1,334	-1,299	5,625	0	1,737.7
2036	0	-1,294	0	-1,299	5,892	0	3,298.7
2037	0	-1,335	0	-1,299	6,160	0	3,525.4
2038	0	-1,376	0	-1,299	6,428	0	3,752.2
2039	0	-1,417	0	-1,299	6,696	0	3,978.9
2040	0	-1,459	-7,317	-1,299	6,964	0	-3,111.5
2041	0	-1,456	0	-1,299	7,165	0	4,409.9
2042	0	-1,453	-1,663	-1,299	7,366	0	2,951.5
2043	0	-1,450	0	-1,299	7,568	0	4,818.5
2044	0	-1,447	-5,296	-1,299	7,769	0	-273.4
2045	0	-1,444	0	-1,299	7,971	0	5,227.1
2046	0	-1,441	0	-1,299	8,172	0	5,431.4
2047	0	-1,439	0	-1,299	8,374	0	5,635.7
2048	0	-1,436	0	-1,299	8,575	0	5,839.9
2049	0	-1,433	0	-1,299	8,777	0	6,044.2
2050	0	-1,430	-9,327	-1,299	8,978	0	-3,078.9
2051	0	-1,432	0	-1,299	9,179	0	6,448.0
2052	0	-1,434	-3,880	-1,299	9,381	0	2,767.8
2053	0	-1,436	0	-1,299	9,582	0	6,847.0
2054	0	-1,438	-1,663	-1,299	9,784	0	5,383.7
2055	0	-1,440	0	-1,299	9,985	0	7,245.9
2056	0	-1,442	-5,296	-1,299	10,187	0	2,149.2
2057	0	-1,444	0	-1,299	10,388	0	7,644.8
2058	0	-1,446	0	-1,299	10,590	0	7,844.1
2059	0	-1,448	0	-1,299	10,791	0	8,043.5
2060	0	-1,450	-2,094	-1,299	10,993	0	6,149.0
2061	0	-1,453	0	-1,299	11,194	0	8,442.1
2062	0	-1,455	-554	-1,299	11,395	0	8,087.1
2063	0	-1,457	0	-1,299	11,597	0	8,840.6
2064	0	-1,459	-3,880	-1,299	11,798	0	5,160.1
2065	0	-1,461	-1,334	-1,299	12,000	0	7,904.7
2066	0	-1,464	-1,663	-1,299	12,201	0	7,775.5
2067	0	-1,466	0	-1,299	12,403	0	9,637.4
2068	0	-1,468	-5,296	-1,299	12,604	0	4,540.3
2069	0	-1,471	0	-1,299	12,806	0	10,035.6
Total	-6,998	-65,246	-57,725	-64,967	385,016	0	190,079

IRR=	16.77%

Table 14.3-3 Cash Flow of Project Developing State-Owned Enterprise (Case 1 (Base Case), FIRR, Real Term, Unit: trillion IDR)

Public Entity Lease Rate= 0.10%

(billion IDR)

Year	Initial Cost	O&M	Renovation and Additional investment	Lease Revenue(0.1%)	FIRR(0.97%)
2014	0	0	0	0	0.0
2015	0	0	0	0	0.0
2016	-4,138	0	0	0	-4,137.8
2017	-10,833	0	0	0	-10,832.6
2018	-12,234	0	0	0	-12,233.7
2019	-16,577	0	0	0	-16,576.8
2020	-7,142	0	0	1,299	-5,842.9
2021	0	0	0	1,299	1,299.3
2022	0	0	0	1,299	1,299.3
2023	0	0	0	1,299	1,299.3
2024	0	0	0	1,299	1,299.3
2025	0	0	0	1,299	1,299.3
2026	0	0	0	1,299	1,299.3
2027	0	0	0	1,299	1,299.3
2028	0	0	0	1,299	1,299.3
2029	0	0	0	1,299	1,299.3
2030	0	0	0	1,299	1,299.3
2031	0	0	0	1,299	1,299.3
2032	0	0	0	1,299	1,299.3
2033	0	0	0	1,299	1,299.3
2034	0	0	0	1,299	1,299.3
2035	0	0	0	1,299	1,299.3
2036	0	0	0	1,299	1,299.3
2037	0	0	0	1,299	1,299.3
2038	0	0	0	1,299	1,299.3
2039	0	0	0	1,299	1,299.3
2040	0	0	0	1,299	1,299.3
2041	0	0	0	1,299	1,299.3
2042	0	0	0	1,299	1,299.3
2043	0	0	0	1,299	1,299.3
2044	0	0	0	1,299	1,299.3
2045	0	0	0	1,299	1,299.3
2046	0	0	0	1,299	1,299.3
2047	0	0	0	1,299	1,299.3
2048	0	0	0	1,299	1,299.3
2049	0	0	0	1,299	1,299.3
2050	0	0	0	1,299	1,299.3
2051	0	0	0	1,299	1,299.3
2052	0	0	0	1,299	1,299.3
2053	0	0	0	1,299	1,299.3
2054	0	0	0	1,299	1,299.3
2055	0	0	0	1,299	1,299.3
2056	0	0	0	1,299	1,299.3
2057	0	0	0	1,299	1,299.3
2058	0	0	0	1,299	1,299.3
2059	0	0	0	1,299	1,299.3
2060	0	0	0	1,299	1,299.3
2061	0	0	0	1,299	1,299.3
2062	0	0	0	1,299	1,299.3
2063	0	0	0	1,299	1,299.3
2064	0	0	0	1,299	1,299.3
2065	0	0	0	1,299	1,299.3
2066	0	0	0	1,299	1,299.3
2067	0	0	0	1,299	1,299.3
2068	0	0	0	1,299	1,299.3
2069	0	0	0	1,299	1,299.3
Total	-50,923	0	0	64,967	14,044
					0.97%

14.3.3 Cash Flow Analysis

For each case nominal cash flows are estimated and analyzed. The project is found to be financially sound and investable. Resultant Equity IRR in each case exceeds 14%, a value higher than standard investment criterion in Indonesia where WACC of private companies are assumed to be between 14 to 20% based on comment by one Indonesian PPP specialist. Note that even though the DSCR can in some period run below 1.0, since in all cost sharing plans the cumulative cash flows for all project period are positive, in terms of accounting the periodic cash shortage for years of higher debt service payment can be covered by reserve account.

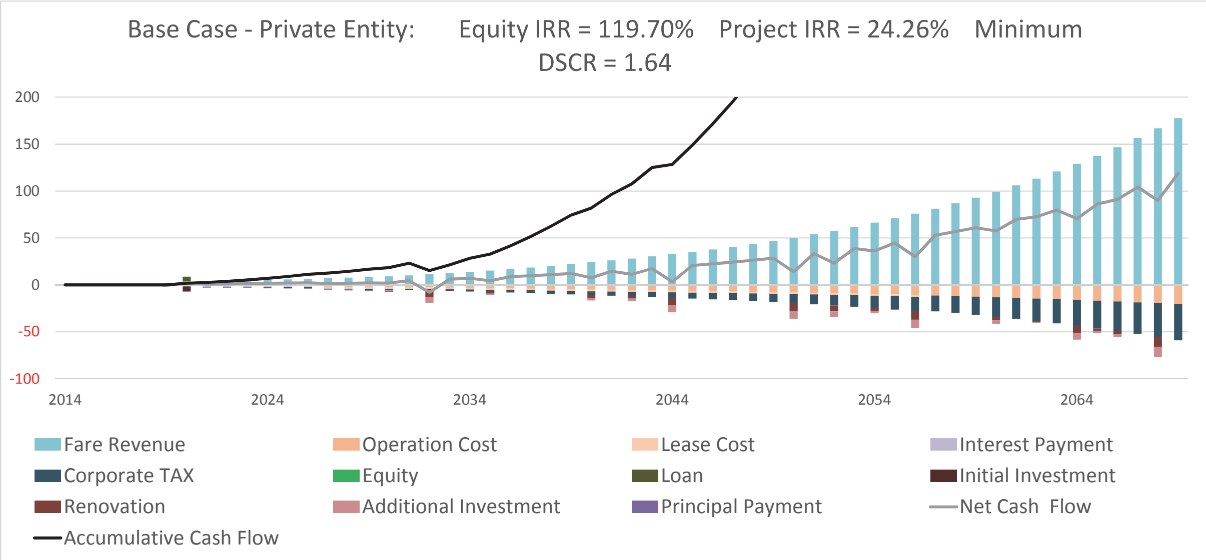
It is necessary to note, however, that the result of financial feasibility of the project in this analysis is based on following points.

- Normally investors and lenders tend to give more conservative figures to revenues and costs. In particular lenders are more risk-averse: they typically make loan decision based on the worst case scenario. Therefore some investors or lenders may not be satisfied by current equity IRR. For this project investors and lenders would be especially cautious compared with usual projects as it's project period spans to as long as 50 years with relatively massive investment amount.

- If project costs are borne solely by private operating body the body become insolvent.(Chart 14.3-11 and Chart 14.3-12) This is due to excessive burden of financial cost which would make the project reliant upon short-term borrowings. In other words, the project implementation would face significant difficulty without alleviation of financial burden through Yen loan. Therefore, Project IRR and other indicators are not calculated.

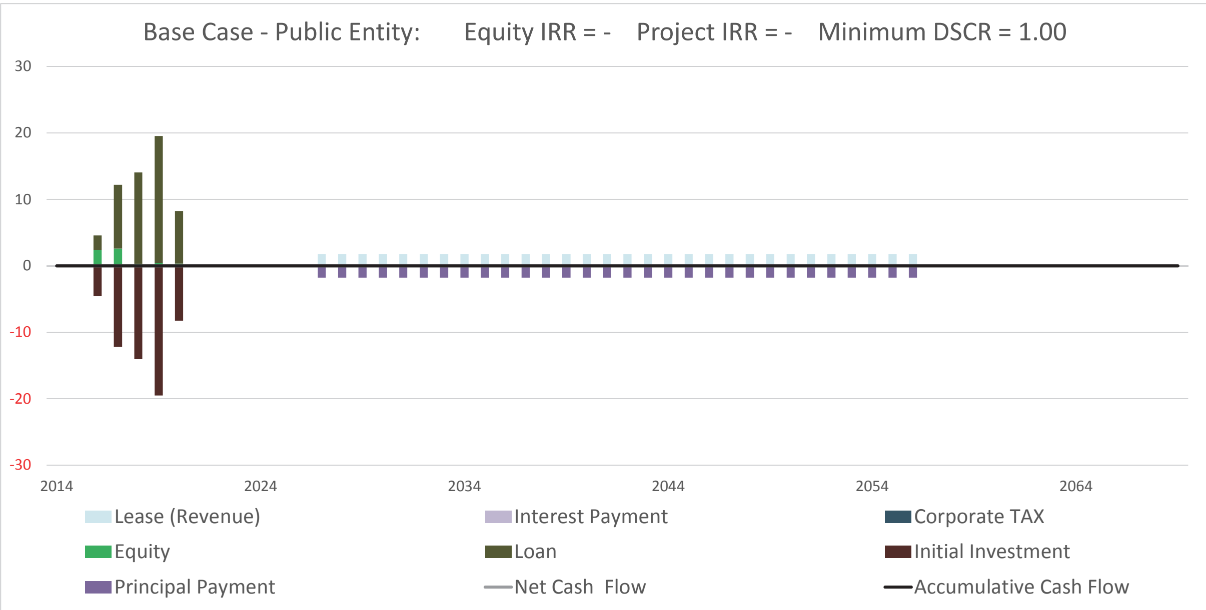
Table 14.3-4 Results of Cash Flow Analysis

	Results	Note:
Cost Sharing Case 1 (Base Case)	Equity IRR = 119.70% Project IRR=24.26% DSCR (minimum) = 1.64	Figures on the left are values for private operating body. For state-owned enterprise, the cash flows are always zero.
Cost Sharing Case 2	Equity IRR = 74.05% Project IRR=18.35% DSCR (minimum) = 1.20	
Cost Sharing Case 3	Equity IRR = 29.37% Project IRR=14.06% DSCR (minimum) = 0.86	
Cost Sharing Case 4	Equity IRR = 21.21% Project IRR=11.33% DSCR (minimum) = -3.36	



Source: JICA Study Team

Chart 14.3-3 Cash Flow of Project Operating Private Body (Case 1 (Base Case), Cash Flow Analysis, Nominal Term, Unit: trillion IDR)



Source: JICA Study Team

Chart 14.3-4 Cash Flow of Project Developing State-Owned Enterprise (Case 1 (Base Case), Cash Flow Analysis, Nominal Term, Unit: trillion IDR)

Table 14.3-5 Cash Flow of Project Operating Private Body (Case 1 (Base Case), Cash Flow Analysis, Nominal Term, Unit: trillion IDR)

(Unit: billion IDR)		Total	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
P&L Statement	Fare Revenue	2,605,115	0	0	0	0	0	0	3,462	3,867	4,304	4,774
	Operation Cost	378,328	0	0	0	0	0	0	1,151	1,233	1,321	1,414
	Lease Cost	53,269	0	0	0	0	0	0	0	0	0	0
	Net Income	2,173,518	0	0	0	0	0	0	2,310	2,634	2,983	3,361
	Depreciation	73,596	0	0	0	0	0	0	283	283	283	283
	Interest Payment(Yen-Loan)	0	0	0	0	0	0	0	0	0	0	0
	Interest Payment(Commercial Loan)	6,720	0	0	0	0	0	0	0	1,026	973	912
	Interest Payment(Short-term Loan)	0	0	0	0	0	0	0	0	0	0	0
	Net Profit before TAX	2,093,202	0	0	0	0	0	0	2,027	1,324	1,727	2,165
	Corporate TAX	523,300	0	0	0	0	0	0	506.7157219	331.1018204	431.7494271	541.2366744
	Net Profit after TAX	1,569,901	0	0	0	0	0	0	1,520	993	1,295	1,624
Cash Flow	Equity	1,050	0	0	10	91	93	190	666	0	0	0
	Yen-Loan	0	0	0	0	0	0	0	0	0	0	0
	Commercial-Loan	7,327	0	0	64	594	684	1,381	4,604	0	0	0
	Short-term Loan	0	0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX	1,569,901	0	0	0	0	0	0	1,520	993	1,295	1,624
	Depreciation	73,596	0	0	0	0	0	0	283	283	283	283
	Initial Investment	8,377	0	0	74	685	777	1,571	5,270	0	0	0
	Renovation	77,310	0	0	0	0	0	0	0	0	0	0
	Additional Investment	77,310	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Yen-Loan)	0	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Commercial Loan)	7,327	0	0	0	0	0	0	0	379	432	492
	Principal Payment(Short-term Loan)	0	0	0	0	0	0	0	0	0	0	0
	Net Cash Flow	1,481,549	0	0	0	0	0	0	1,804	898	1,147	1,415
	Accumulative Cash Flow	16,860,934	0	0	0	0	0	0	1,804	2,701	3,848	5,263
Service Payment		14,048	0	0	0	0	0	0	0	1,405	1,405	1,405
Equity IRR		119.70%	0	0	-10	-91	-93	-190	1,138	898	1,147	1,415
Project IRR		24.26%	0	0	-74	-685	-777	-1,571	-3,466	898	1,147	1,415
DSCR		1.64	-	-	-	-	-	-	-	1.64	1.82	2.01
(Unit: billion IDR)			2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
P&L Statement	Fare Revenue		5,281	5,825	6,410	7,039	7,713	8,437	9,213	10,269	11,405	12,629
	Operation Cost		1,513	1,618	1,730	1,849	1,976	2,110	2,253	2,456	2,673	2,906
	Lease Cost		0	0	0	1,776	1,776	1,776	1,776	1,776	1,776	1,776
	Net Income		3,768	4,207	4,680	3,414	3,962	4,551	5,185	6,037	6,956	7,947
	Depreciation		283	283	283	283	283	283	448	448	984	984
	Interest Payment(Yen-Loan)		0	0	0	0	0	0	0	0	0	0
	Interest Payment(Commercial Loan)		843	765	675	573	457	324	173	0	0	0
	Interest Payment(Short-term Loan)		0	0	0	0	0	0	0	0	0	0
	Net Profit before TAX		2,641	3,159	3,722	2,558	3,222	3,944	4,565	5,589	5,972	6,963
	Corporate TAX		660	790	930	639	806	986	1,141	1,397	1,493	1,741
	Net Profit after TAX		1,981	2,369	2,791	1,918	2,417	2,958	3,423	4,192	4,479	5,222
Cash Flow	Equity		0	0	0	0	0	0	0	0	0	0
	Yen-Loan		0	0	0	0	0	0	0	0	0	0
	Commercial-Loan		0	0	0	0	0	0	0	0	0	0
	Short-term Loan		0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX		1,981	2,369	2,791	1,918	2,417	2,958	3,423	4,192	4,479	5,222
	Depreciation		283	283	283	283	283	283	448	448	984	984
	Initial Investment		0	0	0	0	0	0	0	0	0	0
	Renovation		0	0	0	0	0	0	379	0	6,682	0
	Additional Investment		0	0	0	0	0	0	379	0	6,682	0
	Principal Payment(Yen-Loan)		0	0	0	0	0	0	0	0	0	0
	Principal Payment(Commercial Loan)		561	640	730	832	948	1,081	1,232	0	0	0
	Principal Payment(Short-term Loan)		0	0	0	0	0	0	0	0	0	0
	Net Cash Flow		1,703	2,013	2,345	1,370	1,752	2,161	1,882	4,640	-7,901	6,206
	Accumulative Cash Flow		6,966	8,978	11,323	12,693	14,445	16,605	18,487	23,127	15,225	21,432
Service Payment			1,405	1,405	1,405	1,405	1,405	1,405	1,405	0	0	0
Equity IRR			1,703	2,013	2,345	1,370	1,752	2,161	1,882	4,640	-7,901	6,206
Project IRR			1,703	2,013	2,345	1,370	1,752	2,161	1,882	4,640	-7,901	6,206
DSCR			2.21	2.43	2.67	1.98	2.25	2.54	2.34	-	-	-
(Unit: billion IDR)			2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
P&L Statement	Fare Revenue		13,945	15,359	16,879	18,511	20,262	22,140	24,154	26,071	28,117	30,301
	Operation Cost		3,156	3,422	3,708	4,013	4,339	4,687	5,059	5,297	5,545	5,806
	Lease Cost		1,776	1,776	1,776	1,776	1,776	1,776	1,776	1,776	1,776	1,776
	Net Income		9,014	10,161	11,396	12,723	14,148	15,678	17,319	18,998	20,796	22,720
	Depreciation		984	1,101	1,101	1,101	1,101	1,101	1,392	1,392	1,464	1,464
	Interest Payment(Yen-Loan)		0	0	0	0	0	0	0	0	0	0
	Interest Payment(Commercial Loan)		0	0	0	0	0	0	0	0	0	0
	Interest Payment(Short-term Loan)		0	0	0	0	0	0	0	0	0	0
	Net Profit before TAX		8,029	9,061	10,295	11,622	13,047	14,577	15,928	17,607	19,332	21,256
	Corporate TAX		2,007	2,265	2,574	2,905	3,262	3,644	3,982	4,402	4,833	5,314
	Net Profit after TAX		6,022	6,795	7,721	8,716	9,785	10,933	11,946	13,205	14,499	15,942
Cash Flow	Equity		0	0	0	0	0	0	0	0	0	0
	Yen-Loan		0	0	0	0	0	0	0	0	0	0
	Commercial-Loan		0	0	0	0	0	0	0	0	0	0
	Short-term Loan		0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX		6,022	6,795	7,721	8,716	9,785	10,933	11,946	13,205	14,499	15,942
	Depreciation		984	1,101	1,101	1,101	1,101	1,101	1,392	1,392	1,464	1,464
	Initial Investment		0	0	0	0	0	0	0	0	0	0
	Renovation		0	1,750	0	0	0	0	2,929	0	2,387	0
	Additional Investment		0	1,750	0	0	0	0	2,929	0	2,387	0
	Principal Payment(Yen-Loan)		0	0	0	0	0	0	0	0	0	0
	Principal Payment(Commercial Loan)		0	0	0	0	0	0	0	0	0	0
	Principal Payment(Short-term Loan)		0	0	0	0	0	0	0	0	0	0
	Net Cash Flow		7,006	4,396	8,822	9,817	10,886	12,033	7,479	14,597	11,189	17,406
	Accumulative Cash Flow		28,438	32,834	41,656	51,473	62,359	74,393	81,871	96,468	107,657	125,063
Service Payment			0	0	0	0	0	0	0	0	0	0
Equity IRR			7,006	4,396	8,822	9,817	10,886	12,033	7,479	14,597	11,189	17,406
Project IRR			7,006	4,396	8,822	9,817	10,886	12,033	7,479	14,597	11,189	17,406
DSCR			-	-	-	-	-	-	-	-	-	-

(Unit: billion IDR)		2044	2045	2046	2047	2048	2049	2050	2051	2052	2053
P&L Statement	Fare Revenue	32,632	35,119	37,771	40,598	43,612	46,824	50,246	53,890	57,771	61,904
	Operation Cost	6,078	6,364	6,662	6,975	7,302	7,645	8,004	8,407	8,831	9,277
	Lease Cost	1,776	1,776	1,776	1,776	1,776	1,776	1,776	1,776	1,776	1,776
	Net Income	24,778	26,980	29,333	31,847	34,534	37,403	40,466	43,707	47,165	50,851
	Depreciation	1,558	1,558	1,558	1,558	1,558	1,558	1,948	1,948	2,184	2,184
	Interest Payment(Yen-Loan)	0	0	0	0	0	0	0	0	0	0
	Interest Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0
	Interest Payment(Short-term Loan)	0	0	0	0	0	0	0	0	0	0
	Net Profit before TAX	23,221	25,422	27,775	30,290	32,976	35,845	38,518	41,759	44,981	48,667
	Corporate TAX	5,805	6,355	6,944	7,572	8,244	8,961	9,629	10,440	11,245	12,167
	Net Profit after TAX	17,415	19,066	20,831	22,717	24,732	26,884	28,888	31,319	33,736	36,501
Cash Flow	Equity	0	0	0	0	0	0	0	0	0	0
	Yen-Loan	0	0	0	0	0	0	0	0	0	0
	Commercial-Loan	0	0	0	0	0	0	0	0	0	0
	Short-term Loan	0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX	17,415	19,066	20,831	22,717	24,732	26,884	28,888	31,319	33,736	36,501
	Depreciation	1,558	1,558	1,558	1,558	1,558	1,558	1,948	1,948	2,184	2,184
	Initial Investment	0	0	0	0	0	0	0	0	0	0
	Renovation	7,803	0	0	0	0	0	8,448	0	6,338	0
	Additional Investment	7,803	0	0	0	0	0	8,448	0	6,338	0
	Principal Payment(Yen-Loan)	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Short-term Loan)	0	0	0	0	0	0	0	0	0	0
	Net Cash Flow	3,368	20,624	22,389	24,275	26,290	28,442	13,941	33,268	23,243	38,685
	Accumulative Cash Flow	128,431	149,055	171,444	195,719	222,009	250,450	264,391	297,659	320,902	359,587
Service Payment		0	0	0	0	0	0	0	0	0	0
Equity IRR		3,368	20,624	22,389	24,275	26,290	28,442	13,941	33,268	23,243	38,685
Project IRR		3,368	20,624	22,389	24,275	26,290	28,442	13,941	33,268	23,243	38,685
DSCR		-	-	-	-	-	-	-	-	-	-

(Unit: billion IDR)		2054	2055	2056	2057	2058	2059	2060	2061	2062	2063
P&L Statement	Fare Revenue	66,302	70,983	75,963	81,261	86,896	92,888	99,259	106,031	113,228	120,876
	Operation Cost	9,745	10,236	10,753	11,296	11,867	12,466	13,096	13,758	14,454	15,185
	Lease Cost	1,776	1,776	1,776	0	0	0	0	0	0	0
	Net Income	54,782	58,971	63,435	69,965	75,030	80,422	86,162	92,272	98,774	105,690
	Depreciation	2,217	2,217	2,326	2,326	2,326	2,326	2,291	2,291	2,334	2,334
	Interest Payment(Yen-Loan)	0	0	0	0	0	0	0	0	0	0
	Interest Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0
	Interest Payment(Short-term Loan)	0	0	0	0	0	0	0	0	0	0
	Net Profit before TAX	52,565	56,754	61,108	67,639	72,703	78,096	83,871	89,981	96,440	103,357
	Corporate TAX	13,141	14,188	15,277	16,910	18,176	19,524	20,968	22,495	24,110	25,839
	Net Profit after TAX	39,423	42,565	45,831	50,729	54,527	58,572	62,903	67,486	72,330	77,517
Cash Flow	Equity	0	0	0	0	0	0	0	0	0	0
	Yen-Loan	0	0	0	0	0	0	0	0	0	0
	Commercial-Loan	0	0	0	0	0	0	0	0	0	0
	Short-term Loan	0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX	39,423	42,565	45,831	50,729	54,527	58,572	62,903	67,486	72,330	77,517
	Depreciation	2,217	2,217	2,326	2,326	2,326	2,326	2,291	2,291	2,334	2,334
	Initial Investment	0	0	0	0	0	0	0	0	0	0
	Renovation	2,787	0	9,111	0	0	0	3,793	0	1,030	0
	Additional Investment	2,787	0	9,111	0	0	0	3,793	0	1,030	0
	Principal Payment(Yen-Loan)	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Short-term Loan)	0	0	0	0	0	0	0	0	0	0
	Net Cash Flow	36,066	44,783	29,936	53,056	56,854	60,898	57,609	69,777	72,603	79,851
	Accumulative Cash Flow	395,652	440,435	470,371	523,426	580,280	641,178	698,787	768,564	841,167	921,018
Service Payment		0	0	0	0	0	0	0	0	0	0
Equity IRR		36,066	44,783	29,936	53,056	56,854	60,898	57,609	69,777	72,603	79,851
Project IRR		36,066	44,783	29,936	53,056	56,854	60,898	57,609	69,777	72,603	79,851
DSCR		-	-	-	-	-	-	-	-	-	-

(Unit: billion IDR)		2064	2065	2066	2067	2068	2069
P&L Statement	Fare Revenue	129,001	137,633	146,801	156,536	166,874	177,848
	Operation Cost	15,954	16,761	17,610	18,502	19,439	20,425
	Lease Cost	0	0	0	0	0	0
	Net Income	113,047	120,871	129,191	138,034	147,434	157,424
	Depreciation	2,422	2,453	2,492	2,492	2,619	2,619
	Interest Payment(Yen-Loan)	0	0	0	0	0	0
	Interest Payment(Commercial Loan)	0	0	0	0	0	0
	Interest Payment(Short-term Loan)	0	0	0	0	0	0
	Net Profit before TAX	110,625	118,419	126,699	135,543	144,815	154,805
	Corporate TAX	27,656	29,605	31,675	33,886	36,204	38,701
	Net Profit after TAX	82,969	88,814	95,024	101,657	108,612	116,104
Cash Flow	Equity	0	0	0	0	0	0
	Yen-Loan	0	0	0	0	0	0
	Commercial-Loan	0	0	0	0	0	0
	Short-term Loan	0	0	0	0	0	0
	Net Profit after TAX	82,969	88,814	95,024	101,657	108,612	116,104
	Depreciation	2,422	2,453	2,492	2,492	2,619	2,619
	Initial Investment	0	0	0	0	0	0
	Renovation	7,401	2,578	3,255	0	10,638	0
	Additional Investment	7,401	2,578	3,255	0	10,638	0
	Principal Payment(Yen-Loan)	0	0	0	0	0	0
	Principal Payment(Commercial Loan)	0	0	0	0	0	0
	Principal Payment(Short-term Loan)	0	0	0	0	0	0
	Net Cash Flow	70,590	86,110	91,006	104,149	89,954	118,722
	Accumulative Cash Flow	991,608	1,077,718	1,168,724	1,272,873	1,362,827	1,481,549
Service Payment		0	0	0	0	0	0
Equity IRR		70,590	86,110	91,006	104,149	89,954	118,722
Project IRR		70,590	86,110	91,006	104,149	89,954	118,722
DSCR		-	-	-	-	-	-

Source: JICA Study Team

Table 14.3-6 Cash Flow of Project Developing State-owned Enterprise (Case 1 (Base Case), Cash Flow Analysis, Nominal Term, Unit: trillion IDR)

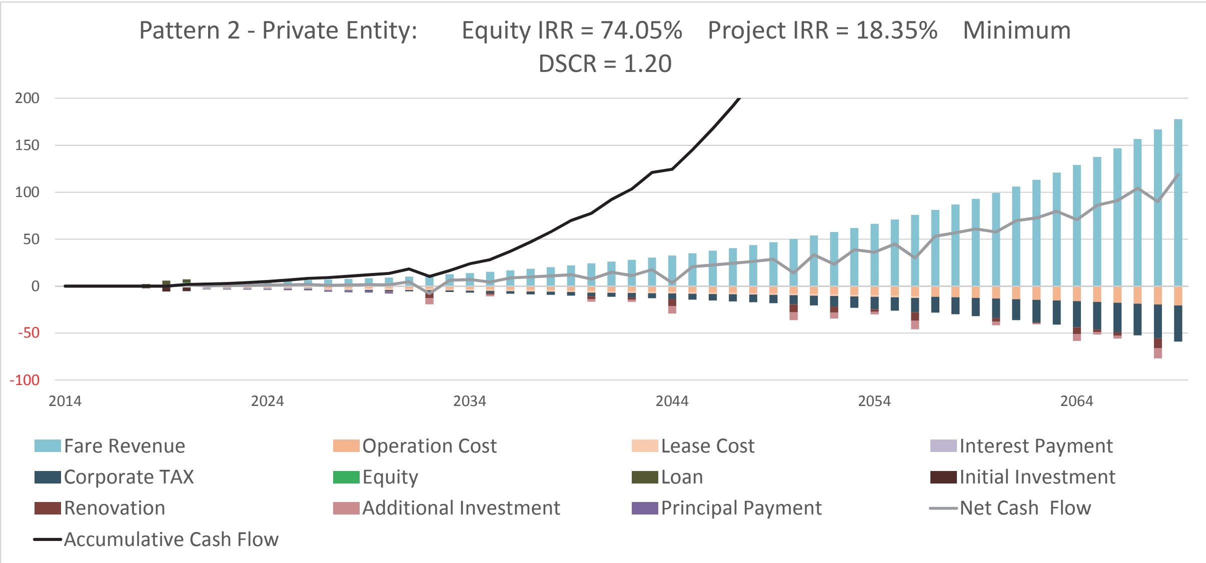
(Unit: billion IDR)		Total	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
	Lease (Revenue)	53,269	0	0	0	0	0	0	0	0	0	0
	Operation Cost	0	0	0	0	0	0	0	0	0	0	0
	Net Income	53,269	0	0	0	0	0	0	0	0	0	0
	Depreciation	124,638	0	0	0	0	0	0	1,710	1,710	1,710	1,710
	Interest Payment(Yen-Loan)	817	0	0	0	0	0	0	0	0	0	0
	Interest Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0	0
	Interest Payment(Short-term Loan)	0	0	0	0	0	0	0	0	0	0	0
	Net Profit before TAX	−72,186	0	0	0	0	0	0	−1,710	−1,710	−1,710	−1,710
	Corporate TAX	11	0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX	−72,196	0	0	0	0	0	0	−1,710	−1,710	−1,710	−1,710
Cash Flow	Equity	6,097	0	0	2,387	2,597	314	460	339	0	0	0
	Yen-Loan	52,452	0	0	2,189	9,582	13,721	19,063	7,897	0	0	0
	Commercial-Loan	0	0	0	0	0	0	0	0	0	0	0
	Short-term Loan	0	0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX	−72,196	0	0	0	0	0	0	−1,710	−1,710	−1,710	−1,710
	Depreciation	124,638	0	0	0	0	0	0	1,710	1,710	1,710	1,710
	Initial Investment	58,549	0	0	4,576	12,180	14,035	19,523	8,236	0	0	0
	Renovation	0	0	0	0	0	0	0	0	0	0	0
	Additional Investment	0	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Yen-Loan)	52,452	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Short-term Loan)	0	0	0	0	0	0	0	0	0	0	0
	Net Cash Flow	−11	0	0	0	0	0	0	0	0	0	0
	Accumulative Cash Flow	−454	0	0	0	0	0	0	0	0	0	0
Service Payment		53,269	0	0	0	0	0	0	0	0	0	0
Equirt IRR		−	0	0	−2,387	−2,597	−314	−460	−339	0	0	0
Project IRR		−	0	0	−4,576	−12,180	−14,035	−19,523	−8,236	0	0	0
DSCR		1.00	−	−	−	−	−	−	−	−	−	−
(Unit: billion IDR)			2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
	Lease (Revenue)		0	0	0	1,776	1,776	1,776	1,776	1,776	1,776	1,776
	Operation Cost		0	0	0	0	0	0	0	0	0	0
	Net Income		0	0	0	1,776	1,776	1,776	1,776	1,776	1,776	1,776
	Depreciation		1,710	1,710	1,710	1,710	1,710	1,710	1,836	1,836	2,064	2,064
	Interest Payment(Yen-Loan)		0	0	0	52	51	49	47	46	44	42
	Interest Payment(Commercial Loan)		0	0	0	0	0	0	0	0	0	0
	Interest Payment(Short-term Loan)		0	0	0	0	0	0	0	0	0	0
	Net Profit before TAX		−1,710	−1,710	−1,710	13	14	16	−108	−106	−332	−330
	Corporate TAX		0	0	0	3.180151357	3.610945518	4.042170473	0	0	0	0
	Net Profit after TAX		−1,710	−1,710	−1,710	10	11	12	−108	−106	−332	−330
Cash Flow	Equity		0	0	0	0	0	0	0	0	0	0
	Yen-Loan		0	0	0	0	0	0	0	0	0	0
	Commercial-Loan		0	0	0	0	0	0	0	0	0	0
	Short-term Loan		0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX		−1,710	−1,710	−1,710	10	11	12	−108	−106	−332	−330
	Depreciation		1,710	1,710	1,710	1,710	1,710	1,710	1,836	1,836	2,064	2,064
	Initial Investment		0	0	0	0	0	0	0	0	0	0
	Renovation		0	0	0	0	0	0	0	0	0	0
	Additional Investment		0	0	0	0	0	0	0	0	0	0
	Principal Payment(Yen-Loan)		0	0	0	1,723	1,725	1,727	1,728	1,730	1,732	1,734
	Principal Payment(Commercial Loan)		0	0	0	0	0	0	0	0	0	0
	Principal Payment(Short-term Loan)		0	0	0	0	0	0	0	0	0	0
	Net Cash Flow		0	0	0	−3	−4	−4	0	0	0	0
	Accumulative Cash Flow		0	0	0	−3	−7	−11	−11	−11	−11	−11
Service Payment			0	0	0	1,776	1,776	1,776	1,776	1,776	1,776	1,776
Equirt IRR			0	0	0	−3	−4	−4	0	0	0	0
Project IRR			0	0	0	−3	−4	−4	0	0	0	0
DSCR			−	−	−	1.00	1.00	1.00	1.00	1.00	1.00	1.00
(Unit: billion IDR)			2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
	Lease (Revenue)		1,776	1,776	1,776	1,776	1,776	1,776	1,776	1,776	1,776	1,776
	Operation Cost		0	0	0	0	0	0	0	0	0	0
	Net Income		1,776	1,776	1,776	1,776	1,776	1,776	1,776	1,776	1,776	1,776
	Depreciation		2,064	1,920	1,920	1,920	1,920	1,920	2,424	2,424	2,496	2,496
	Interest Payment(Yen-Loan)		40	39	37	35	33	32	30	28	26	25
	Interest Payment(Commercial Loan)		0	0	0	0	0	0	0	0	0	0
	Interest Payment(Short-term Loan)		0	0	0	0	0	0	0	0	0	0
	Net Profit before TAX		−329	−183	−181	−179	−178	−176	−678	−676	−747	−746
	Corporate TAX		0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX		−329	−183	−181	−179	−178	−176	−678	−676	−747	−746
Cash Flow	Equity		0	0	0	0	0	0	0	0	0	0
	Yen-Loan		0	0	0	0	0	0	0	0	0	0
	Commercial-Loan		0	0	0	0	0	0	0	0	0	0
	Short-term Loan		0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX		−329	−183	−181	−179	−178	−176	−678	−676	−747	−746
	Depreciation		2,064	1,920	1,920	1,920	1,920	1,920	2,424	2,424	2,496	2,496
	Initial Investment		0	0	0	0	0	0	0	0	0	0
	Renovation		0	0	0	0	0	0	0	0	0	0
	Additional Investment		0	0	0	0	0	0	0	0	0	0
	Principal Payment(Yen-Loan)		1,735	1,737	1,739	1,740	1,742	1,744	1,746	1,747	1,749	1,751
	Principal Payment(Commercial Loan)		0	0	0	0	0	0	0	0	0	0
	Principal Payment(Short-term Loan)		0	0	0	0	0	0	0	0	0	0
	Net Cash Flow		0	0	0	0	0	0	0	0	0	0
	Accumulative Cash Flow		−11	−11	−11	−11	−11	−11	−11	−11	−11	−11
Service Payment			1,776	1,776	1,776	1,776	1,776	1,776	1,776	1,776	1,776	1,776
Equirt IRR			0	0	0	0	0	0	0	0	0	0
Project IRR			0	0	0	0	0	0	0	0	0	0
DSCR			1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

(Unit: billion IDR)		2044	2045	2046	2047	2048	2049	2050	2051	2052	2053
	Lease (Revenue)	1,776	1,776	1,776	1,776	1,776	1,776	1,776	1,776	1,776	1,776
	Operation Cost	0	0	0	0	0	0	0	0	0	0
	Net Income	1,776	1,776	1,776	1,776	1,776	1,776	1,776	1,776	1,776	1,776
	Depreciation	2,590	2,590	2,590	2,590	2,590	2,590	2,765	2,765	3,001	3,001
	Interest Payment(Yen-Loan)	23	21	19	18	16	14	12	11	9	7
	Interest Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0
	Interest Payment(Short-term Loan)	0	0	0	0	0	0	0	0	0	0
	Net Profit before TAX	-837	-835	-834	-832	-830	-828	-1,002	-1,000	-1,234	-1,232
	Corporate TAX	0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX	-837	-835	-834	-832	-830	-828	-1,002	-1,000	-1,234	-1,232
Cash Flow	Equity	0	0	0	0	0	0	0	0	0	0
	Yen-Loan	0	0	0	0	0	0	0	0	0	0
	Commercial-Loan	0	0	0	0	0	0	0	0	0	0
	Short-term Loan	0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX	-837	-835	-834	-832	-830	-828	-1,002	-1,000	-1,234	-1,232
	Depreciation	2,590	2,590	2,590	2,590	2,590	2,590	2,765	2,765	3,001	3,001
	Initial Investment	0	0	0	0	0	0	0	0	0	0
	Renovation	0	0	0	0	0	0	0	0	0	0
	Additional Investment	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Yen-Loan)	1,753	1,754	1,756	1,758	1,760	1,761	1,763	1,765	1,767	1,769
	Principal Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Short-term Loan)	0	0	0	0	0	0	0	0	0	0
	Net Cash Flow	0	0	0	0	0	0	0	0	0	0
	Accumulative Cash Flow	-11	-11	-11	-11	-11	-11	-11	-11	-11	-11
Service Payment		1,776	1,776	1,776	1,776	1,776	1,776	1,776	1,776	1,776	1,776
Equirt IRR		0	0	0	0	0	0	0	0	0	0
Project IRR		0	0	0	0	0	0	0	0	0	0
DSCR		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

(Unit: billion IDR)		2054	2055	2056	2057	2058	2059	2060	2061	2062	2063
	Lease (Revenue)	1,776	1,776	1,776	0	0	0	0	0	0	0
	Operation Cost	0	0	0	0	0	0	0	0	0	0
	Net Income	1,776	1,776	1,776	0	0	0	0	0	0	0
	Depreciation	3,034	3,034	3,143	3,143	3,143	3,143	3,108	3,108	3,151	3,151
	Interest Payment(Yen-Loan)	5	4	2	0	0	0	0	0	0	0
	Interest Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0
	Interest Payment(Short-term Loan)	0	0	0	0	0	0	0	0	0	0
	Net Profit before TAX	-1,264	-1,262	-1,369	-3,143	-3,143	-3,143	-3,108	-3,108	-3,151	-3,151
	Corporate TAX	0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX	-1,264	-1,262	-1,369	-3,143	-3,143	-3,143	-3,108	-3,108	-3,151	-3,151
Cash Flow	Equity	0	0	0	0	0	0	0	0	0	0
	Yen-Loan	0	0	0	0	0	0	0	0	0	0
	Commercial-Loan	0	0	0	0	0	0	0	0	0	0
	Short-term Loan	0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX	-1,264	-1,262	-1,369	-3,143	-3,143	-3,143	-3,108	-3,108	-3,151	-3,151
	Depreciation	3,034	3,034	3,143	3,143	3,143	3,143	3,108	3,108	3,151	3,151
	Initial Investment	0	0	0	0	0	0	0	0	0	0
	Renovation	0	0	0	0	0	0	0	0	0	0
	Additional Investment	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Yen-Loan)	1,770	1,772	1,774	0	0	0	0	0	0	0
	Principal Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Short-term Loan)	0	0	0	0	0	0	0	0	0	0
	Net Cash Flow	0	0	0	0	0	0	0	0	0	0
	Accumulative Cash Flow	-11	-11	-11	-11	-11	-11	-11	-11	-11	-11
Service Payment		1,776	1,776	1,776	0	0	0	0	0	0	0
Equirt IRR		0	0	0	0	0	0	0	0	0	0
Project IRR		0	0	0	0	0	0	0	0	0	0
DSCR		1.00	1.00	1.00	-	-	-	-	-	-	-

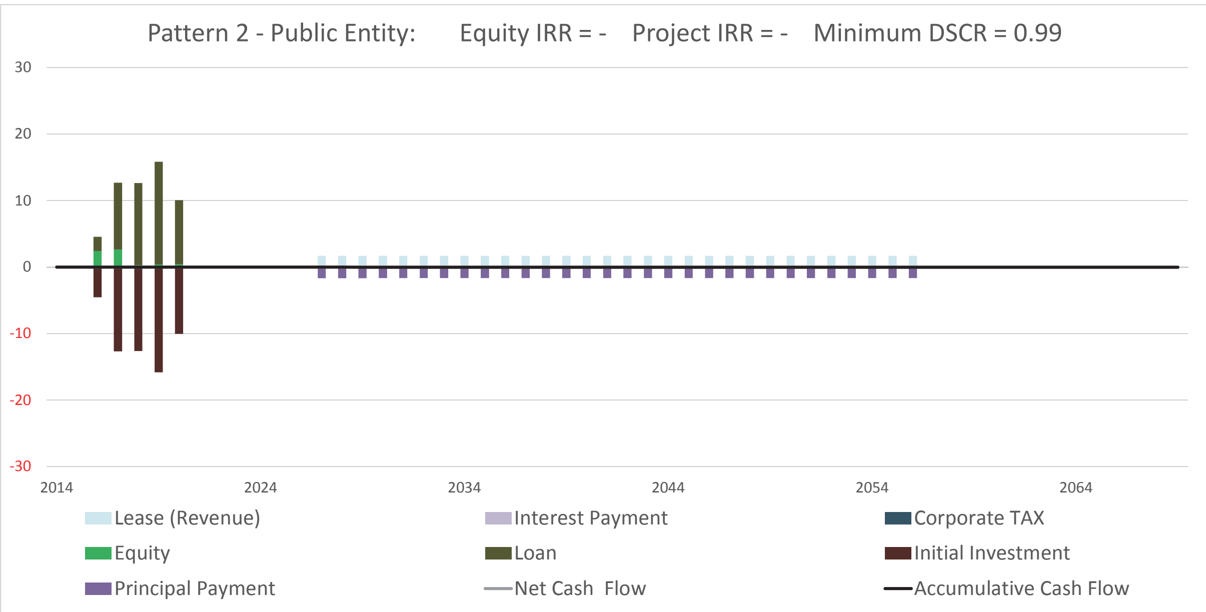
(Unit: billion IDR)		2064	2065	2066	2067	2068	2069
	Lease (Revenue)	0	0	0	0	0	0
	Operation Cost	0	0	0	0	0	0
	Net Income	0	0	0	0	0	0
	Depreciation	3,239	3,270	3,309	3,309	3,436	3,436
	Interest Payment(Yen-Loan)	0	0	0	0	0	0
	Interest Payment(Commercial Loan)	0	0	0	0	0	0
	Interest Payment(Short-term Loan)	0	0	0	0	0	0
	Net Profit before TAX	-3,239	-3,270	-3,309	-3,309	-3,436	-3,436
	Corporate TAX	0	0	0	0	0	0
	Net Profit after TAX	-3,239	-3,270	-3,309	-3,309	-3,436	-3,436
Cash Flow	Equity	0	0	0	0	0	0
	Yen-Loan	0	0	0	0	0	0
	Commercial-Loan	0	0	0	0	0	0
	Short-term Loan	0	0	0	0	0	0
	Net Profit after TAX	-3,239	-3,270	-3,309	-3,309	-3,436	-3,436
	Depreciation	3,239	3,270	3,309	3,309	3,436	3,436
	Initial Investment	0	0	0	0	0	0
	Renovation	0	0	0	0	0	0
	Additional Investment	0	0	0	0	0	0
	Principal Payment(Yen-Loan)	0	0	0	0	0	0
	Principal Payment(Commercial Loan)	0	0	0	0	0	0
	Principal Payment(Short-term Loan)	0	0	0	0	0	0
	Net Cash Flow	0	0	0	0	0	0
	Accumulative Cash Flow	-11	-11	-11	-11	-11	-11
Service Payment		0	0	0	0	0	0
Equirt IRR		0	0	0	0	0	0
Project IRR		0	0	0	0	0	0
DSCR		-	-	-	-	-	-

Source: JICA Study Team



Source: JICA Study Team

Chart 14.3-5 Cash Flow of Project Operating Private Body (Case 2, Cash Flow Analysis, Nominal Term, Unit: trillion IDR)



Source: JICA Study Team

Chart 14.3-6 Cash Flow of Project Developing State-owned Enterprise (Case 2, Cash Flow Analysis, Nominal Term, Unit: trillion IDR)

Table 14.3-7 Cash Flow of Project Operating Private Body (Case 2, Cash Flow Analysis, Nominal Term, Unit: trillion IDR)

(Unit: billion IDR)		Total	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
P&L Statement	Fare Revenue	2,605,115	0	0	0	0	0	0	3,462	3,867	4,304	4,774
	Operation Cost	378,328	0	0	0	0	0	0	1,151	1,233	1,321	1,414
	Lease Cost	50,481	0	0	0	0	0	0	0	0	0	0
	Net Income	2,176,306	0	0	0	0	0	0	2,310	2,634	2,983	3,361
	Depreciation	76,368	0	0	0	0	0	0	393	393	393	393
	Interest Payment(Yen-Loan)	0	0	0	0	0	0	0	0	0	0	0
	Interest Payment(Commercial Loan)	9,737	0	0	0	0	0	0	0	1,486	1,409	1,322
	Interest Payment(Short-term Loan)	0	0	0	0	0	0	0	0	0	0	0
	Net Profit before TAX	2,090,202	0	0	0	0	0	0	1,917	754	1,180	1,645
	Corporate TAX	522,550	0	0	0	0	0	0	479.2019937	188.4644264	295.0654855	411.3396685
	Net Profit after TAX	1,567,651	0	0	0	0	0	0	1,438	565	885	1,234
Cash Flow	Equity	1,465	0	0	14	14	305	742	391	0	0	0
	Yen-Loan	0	0	0	0	0	0	0	0	0	0	0
	Commercial-Loan	10,617	0	0	90	103	1,990	5,057	3,377	0	0	0
	Short-term Loan	0	0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX	1,567,651	0	0	0	0	0	0	1,438	565	885	1,234
	Depreciation	76,368	0	0	0	0	0	0	393	393	393	393
	Initial Investment	12,082	0	0	104	118	2,294	5,800	3,767	0	0	0
	Renovation	77,310	0	0	0	0	0	0	0	0	0	0
	Additional Investment	77,310	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Yen-Loan)	0	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Commercial Loan)	10,617	0	0	0	0	0	0	0	549	626	714
	Principal Payment(Short-term Loan)	0	0	0	0	0	0	0	0	0	0	0
	Net Cash Flow	1,478,782	0	0	0	0	0	0	1,831	410	653	914
	Accumulative Cash Flow	16,693,136	0	0	0	0	0	0	1,831	2,241	2,894	3,808
Service Payment		20,354	0	0	0	0	0	0	0	2,035	2,035	2,035
Equity IRR		74.05%	0	0	-14	-14	-305	-742	1,440	410	653	914
Project IRR		18.35%	0	0	-104	-118	-2,294	-5,800	-1,936	410	653	914
DSCR		1.20	-	-	-	-	-	-	-	1.20	1.32	1.45
(Unit: billion IDR)			2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
P&L Statement	Fare Revenue		5,281	5,825	6,410	7,039	7,713	8,437	9,213	10,269	11,405	12,629
	Operation Cost		1,513	1,618	1,730	1,849	1,976	2,110	2,253	2,456	2,673	2,906
	Lease Cost		0	0	0	1,683	1,683	1,683	1,683	1,683	1,683	1,683
	Net Income		3,768	4,207	4,680	3,507	4,055	4,644	5,278	6,130	7,049	8,040
	Depreciation		393	393	393	393	393	393	558	558	1,094	1,094
	Interest Payment(Yen-Loan)		0	0	0	0	0	0	0	0	0	0
	Interest Payment(Commercial Loan)		1,222	1,108	978	830	662	469	250	0	0	0
	Interest Payment(Short-term Loan)		0	0	0	0	0	0	0	0	0	0
	Net Profit before TAX		2,153	2,706	3,309	2,283	3,000	3,782	4,470	5,572	5,955	6,946
	Corporate TAX		538	676	827	571	750	945	1,117	1,393	1,489	1,736
	Net Profit after TAX		1,614	2,029	2,481	1,712	2,250	2,836	3,352	4,179	4,466	5,209
Cash Flow	Equity		0	0	0	0	0	0	0	0	0	0
	Yen-Loan		0	0	0	0	0	0	0	0	0	0
	Commercial-Loan		0	0	0	0	0	0	0	0	0	0
	Short-term Loan		0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX		1,614	2,029	2,481	1,712	2,250	2,836	3,352	4,179	4,466	5,209
	Depreciation		393	393	393	393	393	393	558	558	1,094	1,094
	Initial Investment		0	0	0	0	0	0	0	0	0	0
	Renovation		0	0	0	0	0	0	379	0	6,682	0
	Additional Investment		0	0	0	0	0	0	379	0	6,682	0
	Principal Payment(Yen-Loan)		0	0	0	0	0	0	0	0	0	0
	Principal Payment(Commercial Loan)		813	927	1,057	1,205	1,374	1,566	1,785	0	0	0
	Principal Payment(Short-term Loan)		0	0	0	0	0	0	0	0	0	0
	Net Cash Flow		1,194	1,495	1,818	901	1,270	1,664	1,368	4,737	-7,804	6,303
	Accumulative Cash Flow		5,002	6,497	8,315	9,216	10,486	12,149	13,517	18,254	10,450	16,753
Service Payment			2,035	2,035	2,035	2,035	2,035	2,035	2,035	0	0	0
Equity IRR			1,194	1,495	1,818	901	1,270	1,664	1,368	4,737	-7,804	6,303
Project IRR			1,194	1,495	1,818	901	1,270	1,664	1,368	4,737	-7,804	6,303
DSCR			1.59	1.73	1.89	1.44	1.62	1.82	1.67	-	-	-
(Unit: billion IDR)			2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
P&L Statement	Fare Revenue		13,945	15,359	16,879	18,511	20,262	22,140	24,154	26,071	28,117	30,301
	Operation Cost		3,156	3,422	3,708	4,013	4,339	4,687	5,059	5,297	5,545	5,806
	Lease Cost		1,683	1,683	1,683	1,683	1,683	1,683	1,683	1,683	1,683	1,683
	Net Income		9,107	10,254	11,489	12,816	14,241	15,771	17,412	19,091	20,889	22,813
	Depreciation		1,094	950	950	950	950	950	1,454	1,454	1,527	1,527
	Interest Payment(Yen-Loan)		0	0	0	0	0	0	0	0	0	0
	Interest Payment(Commercial Loan)		0	0	0	0	0	0	0	0	0	0
	Interest Payment(Short-term Loan)		0	0	0	0	0	0	0	0	0	0
	Net Profit before TAX		8,012	9,304	10,539	11,865	13,291	14,820	15,958	17,637	19,362	21,286
	Corporate TAX		2,003	2,326	2,635	2,966	3,323	3,705	3,990	4,409	4,841	5,322
	Net Profit after TAX		6,009	6,978	7,904	8,899	9,968	11,115	11,969	13,228	14,522	15,965
Cash Flow	Equity		0	0	0	0	0	0	0	0	0	0
	Yen-Loan		0	0	0	0	0	0	0	0	0	0
	Commercial-Loan		0	0	0	0	0	0	0	0	0	0
	Short-term Loan		0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX		6,009	6,978	7,904	8,899	9,968	11,115	11,969	13,228	14,522	15,965
	Depreciation		1,094	950	950	950	950	950	1,454	1,454	1,527	1,527
	Initial Investment		0	0	0	0	0	0	0	0	0	0
	Renovation		0	1,750	0	0	0	0	2,929	0	2,387	0
	Additional Investment		0	1,750	0	0	0	0	2,929	0	2,387	0
	Principal Payment(Yen-Loan)		0	0	0	0	0	0	0	0	0	0
	Principal Payment(Commercial Loan)		0	0	0	0	0	0	0	0	0	0
	Principal Payment(Short-term Loan)		0	0	0	0	0	0	0	0	0	0
	Net Cash Flow		7,103	4,428	8,854	9,849	10,918	12,066	7,564	14,682	11,274	17,491
	Accumulative Cash Flow		23,857	28,285	37,139	46,988	57,906	69,972	77,535	92,218	103,492	120,983
Service Payment			0	0	0	0	0	0	0	0	0	0
Equity IRR			7,103	4,428	8,854	9,849	10,918	12,066	7,564	14,682	11,274	17,491
Project IRR			7,103	4,428	8,854	9,849	10,918	12,066	7,564	14,682	11,274	17,491
DSCR			-	-	-	-	-	-	-	-	-	-

(Unit: billion IDR)		2044	2045	2046	2047	2048	2049	2050	2051	2052	2053
P&L Statement	Fare Revenue	32,632	35,119	37,771	40,598	43,612	46,824	50,246	53,890	57,771	61,904
	Operation Cost	6,078	6,364	6,662	6,975	7,302	7,645	8,004	8,407	8,831	9,277
	Lease Cost	1,683	1,683	1,683	1,683	1,683	1,683	1,683	1,683	1,683	1,683
	Net Income	24,871	27,072	29,426	31,940	34,627	37,496	40,559	43,800	47,258	50,944
	Depreciation	1,620	1,620	1,620	1,620	1,620	1,620	2,011	2,011	2,246	2,246
	Interest Payment(Yen-Loan)	0	0	0	0	0	0	0	0	0	0
	Interest Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0
	Interest Payment(Short-term Loan)	0	0	0	0	0	0	0	0	0	0
	Net Profit before TAX	23,251	25,452	27,805	30,320	33,007	35,876	38,548	41,789	45,011	48,698
	Corporate TAX	5,813	6,363	6,951	7,580	8,252	8,969	9,637	10,447	11,253	12,174
	Net Profit after TAX	17,438	19,089	20,854	22,740	24,755	26,907	28,911	31,342	33,758	36,523
Cash Flow	Equity	0	0	0	0	0	0	0	0	0	0
	Yen-Loan	0	0	0	0	0	0	0	0	0	0
	Commercial-Loan	0	0	0	0	0	0	0	0	0	0
	Short-term Loan	0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX	17,438	19,089	20,854	22,740	24,755	26,907	28,911	31,342	33,758	36,523
	Depreciation	1,620	1,620	1,620	1,620	1,620	1,620	2,011	2,011	2,246	2,246
	Initial Investment	0	0	0	0	0	0	0	0	0	0
	Renovation	7,803	0	0	0	0	0	8,448	0	6,338	0
	Additional Investment	7,803	0	0	0	0	0	8,448	0	6,338	0
	Principal Payment(Yen-Loan)	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Short-term Loan)	0	0	0	0	0	0	0	0	0	0
	Net Cash Flow	3,453	20,709	22,474	24,360	26,375	28,527	14,026	33,353	23,328	38,770
	Accumulative Cash Flow	124,436	145,145	167,620	191,980	218,355	246,882	260,909	294,262	317,590	356,360
Service Payment		0	0	0	0	0	0	0	0	0	0
Equity IRR		3,453	20,709	22,474	24,360	26,375	28,527	14,026	33,353	23,328	38,770
Project IRR		3,453	20,709	22,474	24,360	26,375	28,527	14,026	33,353	23,328	38,770
DSCR		–	–	–	–	–	–	–	–	–	–

(Unit: billion IDR)		2054	2055	2056	2057	2058	2059	2060	2061	2062	2063
P&L Statement	Fare Revenue	66,302	70,983	75,963	81,261	86,896	92,888	99,259	106,031	113,228	120,876
	Operation Cost	9,745	10,236	10,753	11,296	11,867	12,466	13,096	13,758	14,454	15,185
	Lease Cost	1,683	1,683	1,683	0	0	0	0	0	0	0
	Net Income	54,875	59,064	63,528	69,965	75,030	80,422	86,162	92,272	98,774	105,690
	Depreciation	2,280	2,280	2,389	2,389	2,389	2,389	2,354	2,354	2,396	2,396
	Interest Payment(Yen-Loan)	0	0	0	0	0	0	0	0	0	0
	Interest Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0
	Interest Payment(Short-term Loan)	0	0	0	0	0	0	0	0	0	0
	Net Profit before TAX	52,595	56,784	61,139	67,576	72,641	78,033	83,809	89,919	96,377	103,294
	Corporate TAX	13,149	14,196	15,285	16,894	18,160	19,508	20,952	22,480	24,094	25,824
	Net Profit after TAX	39,446	42,588	45,854	50,682	54,481	58,525	62,857	67,439	72,283	77,471
Cash Flow	Equity	0	0	0	0	0	0	0	0	0	0
	Yen-Loan	0	0	0	0	0	0	0	0	0	0
	Commercial-Loan	0	0	0	0	0	0	0	0	0	0
	Short-term Loan	0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX	39,446	42,588	45,854	50,682	54,481	58,525	62,857	67,439	72,283	77,471
	Depreciation	2,280	2,280	2,389	2,389	2,389	2,389	2,354	2,354	2,396	2,396
	Initial Investment	0	0	0	0	0	0	0	0	0	0
	Renovation	2,787	0	9,111	0	0	0	3,793	0	1,030	0
	Additional Investment	2,787	0	9,111	0	0	0	3,793	0	1,030	0
	Principal Payment(Yen-Loan)	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Short-term Loan)	0	0	0	0	0	0	0	0	0	0
	Net Cash Flow	36,151	44,868	30,021	53,071	56,869	60,914	57,624	69,793	72,619	79,867
	Accumulative Cash Flow	392,511	437,379	467,400	520,471	577,341	638,254	695,879	765,671	838,290	918,157
Service Payment		0	0	0	0	0	0	0	0	0	0
Equity IRR		36,151	44,868	30,021	53,071	56,869	60,914	57,624	69,793	72,619	79,867
Project IRR		36,151	44,868	30,021	53,071	56,869	60,914	57,624	69,793	72,619	79,867
DSCR		–	–	–	–	–	–	–	–	–	–

(Unit: billion IDR)		2064	2065	2066	2067	2068	2069
P&L Statement	Fare Revenue	129,001	137,633	146,801	156,536	166,874	177,848
	Operation Cost	15,954	16,761	17,610	18,502	19,439	20,425
	Lease Cost	0	0	0	0	0	0
	Net Income	113,047	120,871	129,191	138,034	147,434	157,424
	Depreciation	2,485	2,515	2,554	2,554	2,681	2,681
	Interest Payment(Yen-Loan)	0	0	0	0	0	0
	Interest Payment(Commercial Loan)	0	0	0	0	0	0
	Interest Payment(Short-term Loan)	0	0	0	0	0	0
	Net Profit before TAX	110,563	118,356	126,637	135,480	144,753	154,742
	Corporate TAX	27,641	29,589	31,659	33,870	36,188	38,686
	Net Profit after TAX	82,922	88,767	94,977	101,610	108,565	116,057
Cash Flow	Equity	0	0	0	0	0	0
	Yen-Loan	0	0	0	0	0	0
	Commercial-Loan	0	0	0	0	0	0
	Short-term Loan	0	0	0	0	0	0
	Net Profit after TAX	82,922	88,767	94,977	101,610	108,565	116,057
	Depreciation	2,485	2,515	2,554	2,554	2,681	2,681
	Initial Investment	0	0	0	0	0	0
	Renovation	7,401	2,578	3,255	0	10,638	0
	Additional Investment	7,401	2,578	3,255	0	10,638	0
	Principal Payment(Yen-Loan)	0	0	0	0	0	0
	Principal Payment(Commercial Loan)	0	0	0	0	0	0
	Principal Payment(Short-term Loan)	0	0	0	0	0	0
	Net Cash Flow	70,605	86,126	91,022	104,164	89,969	118,738
	Accumulative Cash Flow	988,762	1,074,888	1,165,910	1,270,074	1,360,043	1,478,782
Service Payment		0	0	0	0	0	0
Equity IRR		70,605	86,126	91,022	104,164	89,969	118,738
Project IRR		70,605	86,126	91,022	104,164	89,969	118,738
DSCR		–	–	–	–	–	–

Source: JICA Study Team

Table 14.3-8 Cash Flow of Project Developing State-owned Enterprise (Case 2, Cash Flow Analysis, Nominal Term, Unit: trillion IDR)

(Unit: billion IDR)		Total	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
	Lease (Revenue)	50,481	0	0	0	0	0	0	0	0	0	0
	Operation Cost	0	0	0	0	0	0	0	0	0	0	0
	Net Income	50,481	0	0	0	0	0	0	0	0	0	0
	Depreciation	121,866	0	0	0	0	0	0	1,600	1,600	1,600	1,600
	Interest Payment(Yen-Loan)	774	0	0	0	0	0	0	0	0	0	0
	Interest Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0	0
	Interest Payment(Short-term Loan)	0	0	0	0	0	0	0	0	0	0	0
	Net Profit before TAX	-72,159	0	0	0	0	0	0	-1,600	-1,600	-1,600	-1,600
	Corporate TAX	26	0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX	-72,185	0	0	0	0	0	0	-1,600	-1,600	-1,600	-1,600
Cash Flow	Equity	6,042	0	0	2,384	2,608	271	379	400	0	0	0
	Yen-Loan	49,706	0	0	2,160	10,083	12,354	15,450	9,660	0	0	0
	Commercial-Loan	0	0	0	0	0	0	0	0	0	0	0
	Short-term Loan	0	0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX	-72,185	0	0	0	0	0	0	-1,600	-1,600	-1,600	-1,600
	Depreciation	121,866	0	0	0	0	0	0	1,600	1,600	1,600	1,600
	Initial Investment	55,749	0	0	4,544	12,691	12,625	15,829	10,060	0	0	0
	Renovation	0	0	0	0	0	0	0	0	0	0	0
	Additional Investment	0	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Yen-Loan)	49,706	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Short-term Loan)	0	0	0	0	0	0	0	0	0	0	0
	Net Cash Flow	-26	0	0	0	0	0	0	0	0	0	0
	Accumulative Cash Flow	-1,077	0	0	0	0	0	0	0	0	0	0
Service Payment		50,481	0	0	0	0	0	0	0	0	0	0
Equirt IRR		-	0	0	-2,384	-2,608	-271	-379	-400	0	0	0
Project IRR		-	0	0	-4,544	-12,691	-12,625	-15,829	-10,060	0	0	0
DSCR		0.99	-	-	-	-	-	-	-	-	-	-

(Unit: billion IDR)			2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
	Lease (Revenue)		0	0	0	1,683	1,683	1,683	1,683	1,683	1,683	1,683
	Operation Cost		0	0	0	0	0	0	0	0	0	0
	Net Income		0	0	0	1,683	1,683	1,683	1,683	1,683	1,683	1,683
	Depreciation		1,600	1,600	1,600	1,600	1,600	1,600	1,726	1,726	1,954	1,954
	Interest Payment(Yen-Loan)		0	0	0	50	48	46	45	43	42	40
	Interest Payment(Commercial Loan)		0	0	0	0	0	0	0	0	0	0
	Interest Payment(Short-term Loan)		0	0	0	0	0	0	0	0	0	0
	Net Profit before TAX		-1,600	-1,600	-1,600	33	34	36	-88	-87	-313	-311
	Corporate TAX		0	0	0	8.145040125	8.553285446	8.961939013	0	0	0	0
	Net Profit after TAX		-1,600	-1,600	-1,600	24	26	27	-88	-87	-313	-311
Cash Flow	Equity		0	0	0	0	0	0	0	0	0	0
	Yen-Loan		0	0	0	0	0	0	0	0	0	0
	Commercial-Loan		0	0	0	0	0	0	0	0	0	0
	Short-term Loan		0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX		-1,600	-1,600	-1,600	24	26	27	-88	-87	-313	-311
	Depreciation		1,600	1,600	1,600	1,600	1,600	1,600	1,726	1,726	1,954	1,954
	Initial Investment		0	0	0	0	0	0	0	0	0	0
	Renovation		0	0	0	0	0	0	0	0	0	0
	Additional Investment		0	0	0	0	0	0	0	0	0	0
	Principal Payment(Yen-Loan)		0	0	0	1,633	1,635	1,636	1,638	1,640	1,641	1,643
	Principal Payment(Commercial Loan)		0	0	0	0	0	0	0	0	0	0
	Principal Payment(Short-term Loan)		0	0	0	0	0	0	0	0	0	0
	Net Cash Flow		0	0	0	-8	-9	-9	0	0	0	0
	Accumulative Cash Flow		0	0	0	-8	-17	-26	-26	-26	-26	-26
Service Payment			0	0	0	1,683	1,683	1,683	1,683	1,683	1,683	1,683
Equirt IRR			0	0	0	-8	-9	-9	0	0	0	0
Project IRR			0	0	0	-8	-9	-9	0	0	0	0
DSCR			-	-	-	1.00	0.99	0.99	1.00	1.00	1.00	1.00

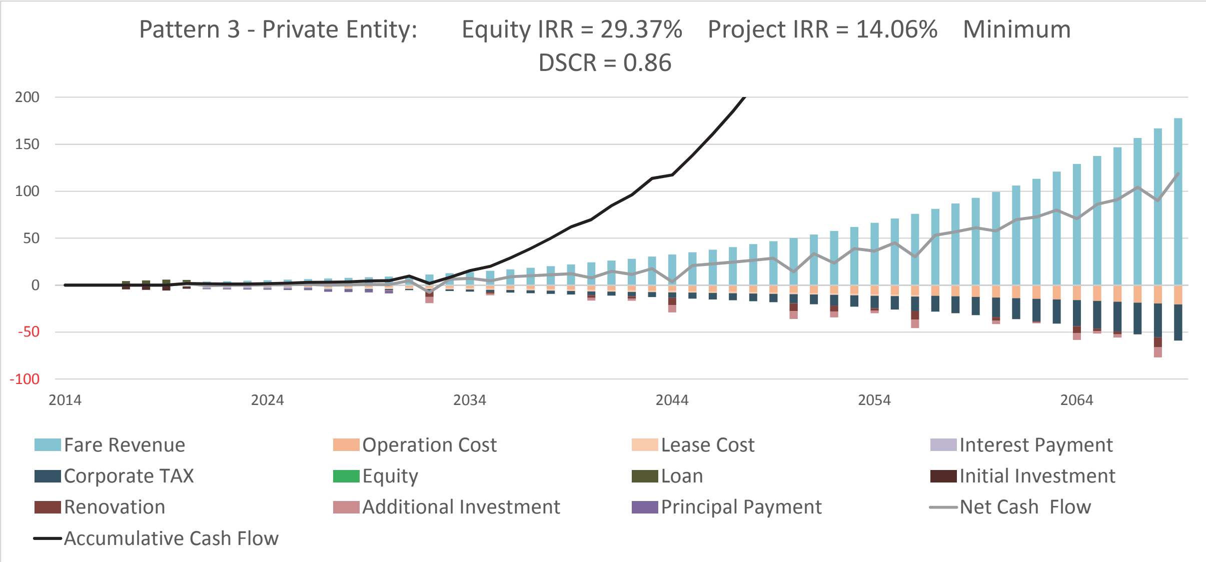
(Unit: billion IDR)			2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
	Lease (Revenue)		1,683	1,683	1,683	1,683	1,683	1,683	1,683	1,683	1,683	1,683
	Operation Cost		0	0	0	0	0	0	0	0	0	0
	Net Income		1,683	1,683	1,683	1,683	1,683	1,683	1,683	1,683	1,683	1,683
	Depreciation		1,954	2,070	2,070	2,070	2,070	2,070	2,361	2,361	2,434	2,434
	Interest Payment(Yen-Loan)		38	37	35	33	32	30	28	27	25	23
	Interest Payment(Commercial Loan)		0	0	0	0	0	0	0	0	0	0
	Interest Payment(Short-term Loan)		0	0	0	0	0	0	0	0	0	0
	Net Profit before TAX		-309	-424	-423	-421	-419	-418	-707	-705	-776	-775
	Corporate TAX		0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX		-309	-424	-423	-421	-419	-418	-707	-705	-776	-775
Cash Flow	Equity		0	0	0	0	0	0	0	0	0	0
	Yen-Loan		0	0	0	0	0	0	0	0	0	0
	Commercial-Loan		0	0	0	0	0	0	0	0	0	0
	Short-term Loan		0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX		-309	-424	-423	-421	-419	-418	-707	-705	-776	-775
	Depreciation		1,954	2,070	2,070	2,070	2,070	2,070	2,361	2,361	2,434	2,434
	Initial Investment		0	0	0	0	0	0	0	0	0	0
	Renovation		0	0	0	0	0	0	0	0	0	0
	Additional Investment		0	0	0	0	0	0	0	0	0	0
	Principal Payment(Yen-Loan)		1,644	1,646	1,648	1,649	1,651	1,653	1,654	1,656	1,658	1,659
	Principal Payment(Commercial Loan)		0	0	0	0	0	0	0	0	0	0
	Principal Payment(Short-term Loan)		0	0	0	0	0	0	0	0	0	0
	Net Cash Flow		0	0	0	0	0	0	0	0	0	0
	Accumulative Cash Flow		-26	-26	-26	-26	-26	-26	-26	-26	-26	-26
Service Payment			1,683	1,683	1,683	1,683	1,683	1,683	1,683	1,683	1,683	1,683
Equirt IRR			0	0	0	0	0	0	0	0	0	0
Project IRR			0	0	0	0	0	0	0	0	0	0
DSCR			1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

(Unit: billion IDR)		2044	2045	2046	2047	2048	2049	2050	2051	2052	2053
	Lease (Revenue)	1,683	1,683	1,683	1,683	1,683	1,683	1,683	1,683	1,683	1,683
	Operation Cost	0	0	0	0	0	0	0	0	0	0
	Net Income	1,683	1,683	1,683	1,683	1,683	1,683	1,683	1,683	1,683	1,683
	Depreciation	2,527	2,527	2,527	2,527	2,527	2,527	2,703	2,703	2,938	2,938
	Interest Payment(Yen-Loan)	22	20	18	17	15	13	12	10	8	7
	Interest Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0
	Interest Payment(Short-term Loan)	0	0	0	0	0	0	0	0	0	0
	Net Profit before TAX	-866	-865	-863	-861	-860	-858	-1,032	-1,030	-1,264	-1,262
	Corporate TAX	0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX	-866	-865	-863	-861	-860	-858	-1,032	-1,030	-1,264	-1,262
Cash Flow	Equity	0	0	0	0	0	0	0	0	0	0
	Yen-Loan	0	0	0	0	0	0	0	0	0	0
	Commercial-Loan	0	0	0	0	0	0	0	0	0	0
	Short-term Loan	0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX	-866	-865	-863	-861	-860	-858	-1,032	-1,030	-1,264	-1,262
	Depreciation	2,527	2,527	2,527	2,527	2,527	2,527	2,703	2,703	2,938	2,938
	Initial Investment	0	0	0	0	0	0	0	0	0	0
	Renovation	0	0	0	0	0	0	0	0	0	0
	Additional Investment	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Yen-Loan)	1,661	1,663	1,664	1,666	1,668	1,669	1,671	1,673	1,674	1,676
	Principal Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Short-term Loan)	0	0	0	0	0	0	0	0	0	0
	Net Cash Flow	0	0	0	0	0	0	0	0	0	0
	Accumulative Cash Flow	-26	-26	-26	-26	-26	-26	-26	-26	-26	-26
Service Payment		1,683	1,683	1,683	1,683	1,683	1,683	1,683	1,683	1,683	1,683
Equirt IRR		0	0	0	0	0	0	0	0	0	0
Project IRR		0	0	0	0	0	0	0	0	0	0
DSCR		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

(Unit: billion IDR)		2054	2055	2056	2057	2058	2059	2060	2061	2062	2063
	Lease (Revenue)	1,683	1,683	1,683	0	0	0	0	0	0	0
	Operation Cost	0	0	0	0	0	0	0	0	0	0
	Net Income	1,683	1,683	1,683	0	0	0	0	0	0	0
	Depreciation	2,972	2,972	3,081	3,081	3,081	3,081	3,046	3,046	3,088	3,088
	Interest Payment(Yen-Loan)	5	3	2	0	0	0	0	0	0	0
	Interest Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0
	Interest Payment(Short-term Loan)	0	0	0	0	0	0	0	0	0	0
	Net Profit before TAX	-1,294	-1,292	-1,400	-3,081	-3,081	-3,081	-3,046	-3,046	-3,088	-3,088
	Corporate TAX	0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX	-1,294	-1,292	-1,400	-3,081	-3,081	-3,081	-3,046	-3,046	-3,088	-3,088
Cash Flow	Equity	0	0	0	0	0	0	0	0	0	0
	Yen-Loan	0	0	0	0	0	0	0	0	0	0
	Commercial-Loan	0	0	0	0	0	0	0	0	0	0
	Short-term Loan	0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX	-1,294	-1,292	-1,400	-3,081	-3,081	-3,081	-3,046	-3,046	-3,088	-3,088
	Depreciation	2,972	2,972	3,081	3,081	3,081	3,081	3,046	3,046	3,088	3,088
	Initial Investment	0	0	0	0	0	0	0	0	0	0
	Renovation	0	0	0	0	0	0	0	0	0	0
	Additional Investment	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Yen-Loan)	1,678	1,679	1,681	0	0	0	0	0	0	0
	Principal Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Short-term Loan)	0	0	0	0	0	0	0	0	0	0
	Net Cash Flow	0	0	0	0	0	0	0	0	0	0
	Accumulative Cash Flow	-26	-26	-26	-26	-26	-26	-26	-26	-26	-26
Service Payment		1,683	1,683	1,683	0	0	0	0	0	0	0
Equirt IRR		0	0	0	0	0	0	0	0	0	0
Project IRR		0	0	0	0	0	0	0	0	0	0
DSCR		1.00	1.00	1.00	-	-	-	-	-	-	-

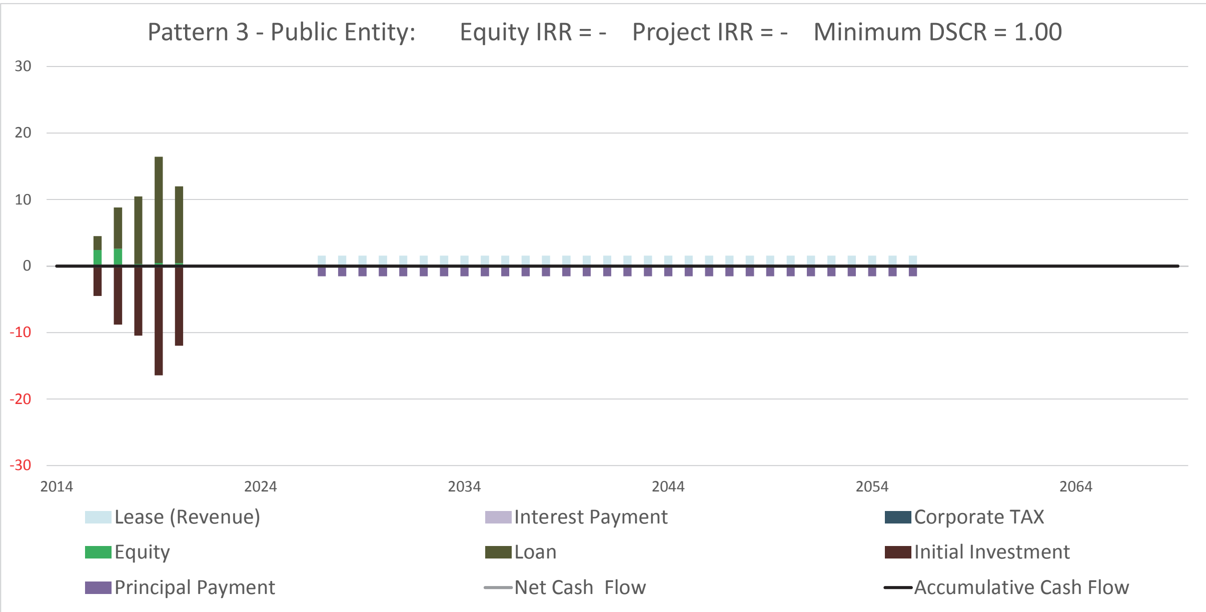
(Unit: billion IDR)		2064	2065	2066	2067	2068	2069
	Lease (Revenue)	0	0	0	0	0	0
	Operation Cost	0	0	0	0	0	0
	Net Income	0	0	0	0	0	0
	Depreciation	3,177	3,207	3,246	3,246	3,373	3,373
	Interest Payment(Yen-Loan)	0	0	0	0	0	0
	Interest Payment(Commercial Loan)	0	0	0	0	0	0
	Interest Payment(Short-term Loan)	0	0	0	0	0	0
	Net Profit before TAX	-3,177	-3,207	-3,246	-3,246	-3,373	-3,373
	Corporate TAX	0	0	0	0	0	0
	Net Profit after TAX	-3,177	-3,207	-3,246	-3,246	-3,373	-3,373
Cash Flow	Equity	0	0	0	0	0	0
	Yen-Loan	0	0	0	0	0	0
	Commercial-Loan	0	0	0	0	0	0
	Short-term Loan	0	0	0	0	0	0
	Net Profit after TAX	-3,177	-3,207	-3,246	-3,246	-3,373	-3,373
	Depreciation	3,177	3,207	3,246	3,246	3,373	3,373
	Initial Investment	0	0	0	0	0	0
	Renovation	0	0	0	0	0	0
	Additional Investment	0	0	0	0	0	0
	Principal Payment(Yen-Loan)	0	0	0	0	0	0
	Principal Payment(Commercial Loan)	0	0	0	0	0	0
	Principal Payment(Short-term Loan)	0	0	0	0	0	0
	Net Cash Flow	0	0	0	0	0	0
	Accumulative Cash Flow	-26	-26	-26	-26	-26	-26
Service Payment		0	0	0	0	0	0
Equirt IRR		0	0	0	0	0	0
Project IRR		0	0	0	0	0	0
DSCR		-	-	-	-	-	-

Source: JICA Study Team



Source: JICA Study Team

Chart 14.3-7 Cash Flow of Project Operating Private Body (Case 3, Cash Flow Analysis, Nominal Term, Unit: trillion IDR)



Source: JICA Study Team

Chart 14.3-8 Cash Flow of Project Developing State-owned Enterprise (Case 3, Cash Flow Analysis, Nominal Term, Unit: trillion IDR)

Table 14.3-9 Cash Flow of Project Operating Private Body (Case 3, Cash Flow Analysis, Nominal Term, Unit: trillion IDR)

(Unit: billion IDR)		Total	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
P&L Statement	Fare Revenue	2,605,115	0	0	0	0	0	0	3,462	3,867	4,304	4,774
	Operation Cost	378,328	0	0	0	0	0	0	1,151	1,233	1,321	1,414
	Lease Cost	46,726	0	0	0	0	0	0	0	0	0	0
	Net Income	2,180,061	0	0	0	0	0	0	2,310	2,634	2,983	3,361
	Depreciation	79,852	0	0	0	0	0	0	281	281	281	281
	Interest Payment(Yen-Loan)	0	0	0	0	0	0	0	0	0	0	0
	Interest Payment(Commercial Loan)	14,514	0	0	0	0	0	0	0	2,216	2,101	1,970
	Interest Payment(Short-term Loan)	0	0	0	0	0	0	0	0	0	0	0
	Net Profit before TAX	2,085,695	0	0	0	0	0	0	2,030	137	602	1,110
	Corporate TAX	521,424	0	0	0	0	0	0	507.4149202	34.35773615	150.3871882	277.4097392
	Net Profit after TAX	1,564,271	0	0	0	0	0	0	1,522	103	451	832
Cash Flow	Equity	1,988	0	0	19	596	623	652	99	0	0	0
	Yen-Loan	0	0	0	0	0	0	0	0	0	0	0
	Commercial-Loan	15,826	0	0	122	3,862	4,512	5,191	2,139	0	0	0
	Short-term Loan	0	0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX	1,564,271	0	0	0	0	0	0	1,522	103	451	832
	Depreciation	79,852	0	0	0	0	0	0	281	281	281	281
	Initial Investment	17,814	0	0	141	4,458	5,135	5,843	2,238	0	0	0
	Renovation	77,310	0	0	0	0	0	0	0	0	0	0
	Additional Investment	77,310	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Yen-Loan)	0	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Commercial Loan)	15,826	0	0	0	0	0	0	0	818	933	1,064
	Principal Payment(Short-term Loan)	0	0	0	0	0	0	0	0	0	0	0
	Net Cash Flow	1,473,677	0	0	0	0	0	0	1,803	-435	-201	49
	Accumulative Cash Flow	16,388,615	0	0	0	0	0	0	1,803	1,368	1,167	1,216
Service Payment		30,340	0	0	0	0	0	0	0	3,034	3,034	3,034
Equity IRR		29.37%	0	0	-19	-596	-623	-652	1,704	-435	-201	49
Project IRR		14.06%	0	0	-141	-4,458	-5,135	-5,843	-435	-435	-201	49
DSCR		0.86	-	-	-	-	-	-	-	0.86	0.93	1.02
(Unit: billion IDR)			2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
P&L Statement	Fare Revenue		5,281	5,825	6,410	7,039	7,713	8,437	9,213	10,269	11,405	12,629
	Operation Cost		1,513	1,618	1,730	1,849	1,976	2,110	2,253	2,456	2,673	2,906
	Lease Cost		0	0	0	1,558	1,558	1,558	1,558	1,558	1,558	1,558
	Net Income		3,768	4,207	4,680	3,632	4,180	4,770	5,403	6,255	7,175	8,165
	Depreciation		281	281	281	281	281	281	445	445	981	981
	Interest Payment(Yen-Loan)		0	0	0	0	0	0	0	0	0	0
	Interest Payment(Commercial Loan)		1,822	1,652	1,458	1,238	986	699	373	0	0	0
	Interest Payment(Short-term Loan)		0	0	0	0	0	0	0	0	0	0
	Net Profit before TAX		1,666	2,275	2,941	2,114	2,913	3,790	4,585	5,810	6,193	7,184
	Corporate TAX		416	569	735	528	728	947	1,146	1,453	1,548	1,796
	Net Profit after TAX		1,249	1,706	2,206	1,585	2,185	2,842	3,439	4,358	4,645	5,388
Cash Flow	Equity		0	0	0	0	0	0	0	0	0	0
	Yen-Loan		0	0	0	0	0	0	0	0	0	0
	Commercial-Loan		0	0	0	0	0	0	0	0	0	0
	Short-term Loan		0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX		1,249	1,706	2,206	1,585	2,185	2,842	3,439	4,358	4,645	5,388
	Depreciation		281	281	281	281	281	281	445	445	981	981
	Initial Investment		0	0	0	0	0	0	0	0	0	0
	Renovation		0	0	0	0	0	0	379	0	6,682	0
	Additional Investment		0	0	0	0	0	0	379	0	6,682	0
	Principal Payment(Yen-Loan)		0	0	0	0	0	0	0	0	0	0
	Principal Payment(Commercial Loan)		1,213	1,382	1,576	1,796	2,048	2,335	2,661	0	0	0
	Principal Payment(Short-term Loan)		0	0	0	0	0	0	0	0	0	0
	Net Cash Flow		317	604	911	70	418	788	465	4,803	-7,739	6,369
	Accumulative Cash Flow		1,534	2,138	3,049	3,118	3,536	4,324	4,790	9,592	1,854	8,223
Service Payment			3,034	3,034	3,034	3,034	3,034	3,034	3,034	0	0	0
Equity IRR			317	604	911	70	418	788	465	4,803	-7,739	6,369
Project IRR			317	604	911	70	418	788	465	4,803	-7,739	6,369
DSCR			1.10	1.20	1.30	1.02	1.14	1.26	1.15	-	-	-
(Unit: billion IDR)			2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
P&L Statement	Fare Revenue		13,945	15,359	16,879	18,511	20,262	22,140	24,154	26,071	28,117	30,301
	Operation Cost		3,156	3,422	3,708	4,013	4,339	4,687	5,059	5,297	5,545	5,806
	Lease Cost		1,558	1,558	1,558	1,558	1,558	1,558	1,558	1,558	1,558	1,558
	Net Income		9,232	10,380	11,614	12,941	14,366	15,896	17,538	19,216	21,014	22,938
	Depreciation		981	1,098	1,098	1,098	1,098	1,098	1,602	1,602	1,675	1,675
	Interest Payment(Yen-Loan)		0	0	0	0	0	0	0	0	0	0
	Interest Payment(Commercial Loan)		0	0	0	0	0	0	0	0	0	0
	Interest Payment(Short-term Loan)		0	0	0	0	0	0	0	0	0	0
	Net Profit before TAX		8,250	9,281	10,516	11,843	13,268	14,798	15,935	17,614	19,339	21,263
	Corporate TAX		2,063	2,320	2,629	2,961	3,317	3,699	3,984	4,404	4,835	5,316
	Net Profit after TAX		6,188	6,961	7,887	8,882	9,951	11,098	11,951	13,211	14,505	15,947
Cash Flow	Equity		0	0	0	0	0	0	0	0	0	0
	Yen-Loan		0	0	0	0	0	0	0	0	0	0
	Commercial-Loan		0	0	0	0	0	0	0	0	0	0
	Short-term Loan		0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX		6,188	6,961	7,887	8,882	9,951	11,098	11,951	13,211	14,505	15,947
	Depreciation		981	1,098	1,098	1,098	1,098	1,098	1,602	1,602	1,675	1,675
	Initial Investment		0	0	0	0	0	0	0	0	0	0
	Renovation		0	1,750	0	0	0	0	2,929	0	2,387	0
	Additional Investment		0	1,750	0	0	0	0	2,929	0	2,387	0
	Principal Payment(Yen-Loan)		0	0	0	0	0	0	0	0	0	0
	Principal Payment(Commercial Loan)		0	0	0	0	0	0	0	0	0	0
	Principal Payment(Short-term Loan)		0	0	0	0	0	0	0	0	0	0
	Net Cash Flow		7,169	4,559	8,985	9,980	11,049	12,196	7,695	14,813	11,405	17,622
	Accumulative Cash Flow		15,392	19,951	28,936	38,916	49,965	62,161	69,856	84,669	96,074	113,696
Service Payment			0	0	0	0	0	0	0	0	0	0
Equity IRR			7,169	4,559	8,985	9,980	11,049	12,196	7,695	14,813	11,405	17,622
Project IRR			7,169	4,559	8,985	9,980	11,049	12,196	7,695	14,813	11,405	17,622
DSCR			-	-	-	-	-	-	-	-	-	-

(Unit: billion IDR)		2044	2045	2046	2047	2048	2049	2050	2051	2052	2053
P&L Statement	Fare Revenue	32,632	35,119	37,771	40,598	43,612	46,824	50,246	53,890	57,771	61,904
	Operation Cost	6,078	6,364	6,662	6,975	7,302	7,645	8,004	8,407	8,831	9,277
	Lease Cost	1,558	1,558	1,558	1,558	1,558	1,558	1,558	1,558	1,558	1,558
	Net Income	24,996	27,198	29,551	32,066	34,752	37,621	40,684	43,925	47,383	51,070
	Depreciation	1,768	1,768	1,768	1,768	1,768	1,768	2,159	2,159	2,394	2,394
	Interest Payment(Yen-Loan)	0	0	0	0	0	0	0	0	0	0
	Interest Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0
	Interest Payment(Short-term Loan)	0	0	0	0	0	0	0	0	0	0
	Net Profit before TAX	23,228	25,429	27,783	30,297	32,984	35,853	38,525	41,767	44,988	48,675
	Corporate TAX	5,807	6,357	6,946	7,574	8,246	8,963	9,631	10,442	11,247	12,169
	Net Profit after TAX	17,421	19,072	20,837	22,723	24,738	26,890	28,894	31,325	33,741	36,506
Cash Flow	Equity	0	0	0	0	0	0	0	0	0	0
	Yen-Loan	0	0	0	0	0	0	0	0	0	0
	Commercial-Loan	0	0	0	0	0	0	0	0	0	0
	Short-term Loan	0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX	17,421	19,072	20,837	22,723	24,738	26,890	28,894	31,325	33,741	36,506
	Depreciation	1,768	1,768	1,768	1,768	1,768	1,768	2,159	2,159	2,394	2,394
	Initial Investment	0	0	0	0	0	0	0	0	0	0
	Renovation	7,803	0	0	0	0	0	8,448	0	6,338	0
	Additional Investment	7,803	0	0	0	0	0	8,448	0	6,338	0
	Principal Payment(Yen-Loan)	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Short-term Loan)	0	0	0	0	0	0	0	0	0	0
	Net Cash Flow	3,584	20,840	22,605	24,491	26,506	28,658	14,157	33,484	23,459	38,901
	Accumulative Cash Flow	117,280	138,120	160,726	185,217	211,723	240,381	254,538	288,022	311,481	350,382
Service Payment		0	0	0	0	0	0	0	0	0	0
Equity IRR		3,584	20,840	22,605	24,491	26,506	28,658	14,157	33,484	23,459	38,901
Project IRR		3,584	20,840	22,605	24,491	26,506	28,658	14,157	33,484	23,459	38,901
DSCR		-	-	-	-	-	-	-	-	-	-

(Unit: billion IDR)		2054	2055	2056	2057	2058	2059	2060	2061	2062	2063
P&L Statement	Fare Revenue	66,302	70,983	75,963	81,261	86,896	92,888	99,259	106,031	113,228	120,876
	Operation Cost	9,745	10,236	10,753	11,296	11,867	12,466	13,096	13,758	14,454	15,185
	Lease Cost	1,558	1,558	1,558	0	0	0	0	0	0	0
	Net Income	55,000	59,189	63,653	69,965	75,030	80,422	86,162	92,272	98,774	105,690
	Depreciation	2,428	2,428	2,537	2,537	2,537	2,537	2,502	2,502	2,544	2,544
	Interest Payment(Yen-Loan)	0	0	0	0	0	0	0	0	0	0
	Interest Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0
	Interest Payment(Short-term Loan)	0	0	0	0	0	0	0	0	0	0
	Net Profit before TAX	52,572	56,761	61,116	67,429	72,493	77,885	83,661	89,771	96,229	103,146
	Corporate TAX	13,143	14,190	15,279	16,857	18,123	19,471	20,915	22,443	24,057	25,787
	Net Profit after TAX	39,429	42,571	45,837	50,571	54,370	58,414	62,746	67,328	72,172	77,360
Cash Flow	Equity	0	0	0	0	0	0	0	0	0	0
	Yen-Loan	0	0	0	0	0	0	0	0	0	0
	Commercial-Loan	0	0	0	0	0	0	0	0	0	0
	Short-term Loan	0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX	39,429	42,571	45,837	50,571	54,370	58,414	62,746	67,328	72,172	77,360
	Depreciation	2,428	2,428	2,537	2,537	2,537	2,537	2,502	2,502	2,544	2,544
	Initial Investment	0	0	0	0	0	0	0	0	0	0
	Renovation	2,787	0	9,111	0	0	0	3,793	0	1,030	0
	Additional Investment	2,787	0	9,111	0	0	0	3,793	0	1,030	0
	Principal Payment(Yen-Loan)	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Short-term Loan)	0	0	0	0	0	0	0	0	0	0
	Net Cash Flow	36,282	44,999	30,152	53,108	56,906	60,951	57,661	69,830	72,656	79,904
	Accumulative Cash Flow	386,664	431,663	461,814	514,923	571,829	632,780	690,441	760,271	832,926	912,830
Service Payment		0	0	0	0	0	0	0	0	0	0
Equity IRR		36,282	44,999	30,152	53,108	56,906	60,951	57,661	69,830	72,656	79,904
Project IRR		36,282	44,999	30,152	53,108	56,906	60,951	57,661	69,830	72,656	79,904
DSCR		-	-	-	-	-	-	-	-	-	-

(Unit: billion IDR)		2064	2065	2066	2067	2068	2069
P&L Statement	Fare Revenue	129,001	137,633	146,801	156,536	166,874	177,848
	Operation Cost	15,954	16,761	17,610	18,502	19,439	20,425
	Lease Cost	0	0	0	0	0	0
	Net Income	113,047	120,871	129,191	138,034	147,434	157,424
	Depreciation	2,633	2,663	2,702	2,702	2,829	2,829
	Interest Payment(Yen-Loan)	0	0	0	0	0	0
	Interest Payment(Commercial Loan)	0	0	0	0	0	0
	Interest Payment(Short-term Loan)	0	0	0	0	0	0
	Net Profit before TAX	110,415	118,208	126,489	135,332	144,605	154,594
	Corporate TAX	27,604	29,552	31,622	33,833	36,151	38,649
	Net Profit after TAX	82,811	88,656	94,866	101,499	108,454	115,946
Cash Flow	Equity	0	0	0	0	0	0
	Yen-Loan	0	0	0	0	0	0
	Commercial-Loan	0	0	0	0	0	0
	Short-term Loan	0	0	0	0	0	0
	Net Profit after TAX	82,811	88,656	94,866	101,499	108,454	115,946
	Depreciation	2,633	2,663	2,702	2,702	2,829	2,829
	Initial Investment	0	0	0	0	0	0
	Renovation	7,401	2,578	3,255	0	10,638	0
	Additional Investment	7,401	2,578	3,255	0	10,638	0
	Principal Payment(Yen-Loan)	0	0	0	0	0	0
	Principal Payment(Commercial Loan)	0	0	0	0	0	0
	Principal Payment(Short-term Loan)	0	0	0	0	0	0
	Net Cash Flow	70,642	86,163	91,059	104,201	90,006	118,775
	Accumulative Cash Flow	983,472	1,069,635	1,160,694	1,264,895	1,354,902	1,473,677
Service Payment		0	0	0	0	0	0
Equity IRR		70,642	86,163	91,059	104,201	90,006	118,775
Project IRR		70,642	86,163	91,059	104,201	90,006	118,775
DSCR		-	-	-	-	-	-

Source: JICA Study Team

Table 14.3-10 Cash Flow of Project Developing State-owned Enterprise (Case 3, Cash Flow Analysis, Nominal Term, Unit: trillion IDR)

(Unit: billion IDR)		Total	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
	Lease (Revenue)	46,726	0	0	0	0	0	0	0	0	0	0
	Operation Cost	0	0	0	0	0	0	0	0	0	0	0
	Net Income	46,726	0	0	0	0	0	0	0	0	0	0
	Depreciation	118,381	0	0	0	0	0	0	1,713	1,713	1,713	1,713
	Interest Payment(Yen-Loan)	717	0	0	0	0	0	0	0	0	0	0
	Interest Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0	0
	Interest Payment(Short-term Loan)	0	0	0	0	0	0	0	0	0	0	0
	Net Profit before TAX	-72,372	0	0	0	0	0	0	-1,713	-1,713	-1,713	-1,713
	Corporate TAX	0	0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX	-72,372	0	0	0	0	0	0	-1,713	-1,713	-1,713	-1,713
Cash Flow	Equity	6,191	0	0	2,383	2,591	307	470	439	0	0	0
	Yen-Loan	46,009	0	0	2,121	6,213	10,176	15,945	11,554	0	0	0
	Commercial-Loan	0	0	0	0	0	0	0	0	0	0	0
	Short-term Loan	0	0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX	-72,372	0	0	0	0	0	0	-1,713	-1,713	-1,713	-1,713
	Depreciation	118,381	0	0	0	0	0	0	1,713	1,713	1,713	1,713
	Initial Investment	52,200	0	0	4,503	8,804	10,484	16,415	11,993	0	0	0
	Renovation	0	0	0	0	0	0	0	0	0	0	0
	Additional Investment	0	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Yen-Loan)	46,009	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Short-term Loan)	0	0	0	0	0	0	0	0	0	0	0
	Net Cash Flow	0	0	0	0	0	0	0	0	0	0	0
	Accumulative Cash Flow	0	0	0	0	0	0	0	0	0	0	0
Service Payment		46,726	0	0	0	0	0	0	0	0	0	0
Equirt IRR		-	0	0	-2,383	-2,591	-307	-470	-439	0	0	0
Project IRR		-	0	0	-4,503	-8,804	-10,484	-16,415	-11,993	0	0	0
DSCR		1.00	-	-	-	-	-	-	-	-	-	-

(Unit: billion IDR)			2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
	Lease (Revenue)		0	0	0	1,558	1,558	1,558	1,558	1,558	1,558	1,558
	Operation Cost		0	0	0	0	0	0	0	0	0	0
	Net Income		0	0	0	1,558	1,558	1,558	1,558	1,558	1,558	1,558
	Depreciation		1,713	1,713	1,713	1,713	1,713	1,713	1,839	1,839	2,067	2,067
	Interest Payment(Yen-Loan)		0	0	0	46	44	43	41	40	38	37
	Interest Payment(Commercial Loan)		0	0	0	0	0	0	0	0	0	0
	Interest Payment(Short-term Loan)		0	0	0	0	0	0	0	0	0	0
	Net Profit before TAX		-1,713	-1,713	-1,713	-202	-200	-199	-323	-322	-548	-546
	Corporate TAX		0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX		-1,713	-1,713	-1,713	-202	-200	-199	-323	-322	-548	-546
Cash Flow	Equity		0	0	0	0	0	0	0	0	0	0
	Yen-Loan		0	0	0	0	0	0	0	0	0	0
	Commercial-Loan		0	0	0	0	0	0	0	0	0	0
	Short-term Loan		0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX		-1,713	-1,713	-1,713	-202	-200	-199	-323	-322	-548	-546
	Depreciation		1,713	1,713	1,713	1,713	1,713	1,713	1,839	1,839	2,067	2,067
	Initial Investment		0	0	0	0	0	0	0	0	0	0
	Renovation		0	0	0	0	0	0	0	0	0	0
	Additional Investment		0	0	0	0	0	0	0	0	0	0
	Principal Payment(Yen-Loan)		0	0	0	1,512	1,513	1,515	1,516	1,518	1,519	1,521
	Principal Payment(Commercial Loan)		0	0	0	0	0	0	0	0	0	0
	Principal Payment(Short-term Loan)		0	0	0	0	0	0	0	0	0	0
	Net Cash Flow		0	0	0	0	0	0	0	0	0	0
	Accumulative Cash Flow		0	0	0	0	0	0	0	0	0	0
Service Payment			0	0	0	1,558	1,558	1,558	1,558	1,558	1,558	1,558
Equirt IRR			0	0	0	0	0	0	0	0	0	0
Project IRR			0	0	0	0	0	0	0	0	0	0
DSCR			-	-	-	1.00	1.00	1.00	1.00	1.00	1.00	1.00

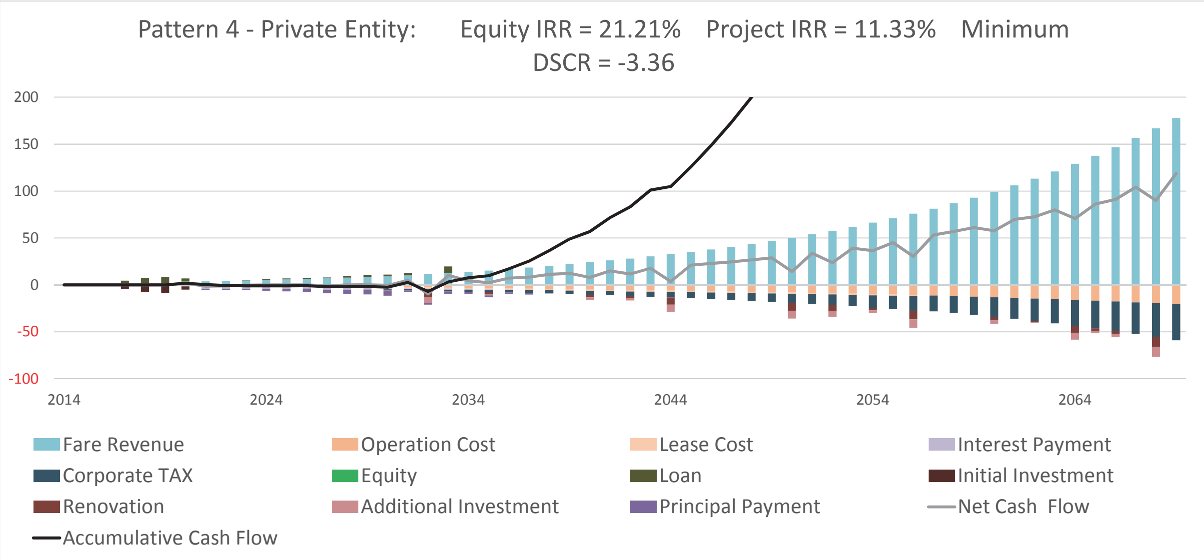
(Unit: billion IDR)			2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
	Lease (Revenue)		1,558	1,558	1,558	1,558	1,558	1,558	1,558	1,558	1,558	1,558
	Operation Cost		0	0	0	0	0	0	0	0	0	0
	Net Income		1,558	1,558	1,558	1,558	1,558	1,558	1,558	1,558	1,558	1,558
	Depreciation		2,067	1,923	1,923	1,923	1,923	1,923	2,213	2,213	2,286	2,286
	Interest Payment(Yen-Loan)		35	34	32	31	29	28	26	25	23	22
	Interest Payment(Commercial Loan)		0	0	0	0	0	0	0	0	0	0
	Interest Payment(Short-term Loan)		0	0	0	0	0	0	0	0	0	0
	Net Profit before TAX		-545	-399	-397	-396	-394	-393	-682	-681	-752	-750
	Corporate TAX		0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX		-545	-399	-397	-396	-394	-393	-682	-681	-752	-750
Cash Flow	Equity		0	0	0	0	0	0	0	0	0	0
	Yen-Loan		0	0	0	0	0	0	0	0	0	0
	Commercial-Loan		0	0	0	0	0	0	0	0	0	0
	Short-term Loan		0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX		-545	-399	-397	-396	-394	-393	-682	-681	-752	-750
	Depreciation		2,067	1,923	1,923	1,923	1,923	1,923	2,213	2,213	2,286	2,286
	Initial Investment		0	0	0	0	0	0	0	0	0	0
	Renovation		0	0	0	0	0	0	0	0	0	0
	Additional Investment		0	0	0	0	0	0	0	0	0	0
	Principal Payment(Yen-Loan)		1,522	1,524	1,525	1,527	1,528	1,530	1,531	1,533	1,534	1,536
	Principal Payment(Commercial Loan)		0	0	0	0	0	0	0	0	0	0
	Principal Payment(Short-term Loan)		0	0	0	0	0	0	0	0	0	0
	Net Cash Flow		0	0	0	0	0	0	0	0	0	0
	Accumulative Cash Flow		0	0	0	0	0	0	0	0	0	0
Service Payment			1,558	1,558	1,558	1,558	1,558	1,558	1,558	1,558	1,558	1,558
Equirt IRR			0	0	0	0	0	0	0	0	0	0
Project IRR			0	0	0	0	0	0	0	0	0	0
DSCR			1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

(Unit: billion IDR)		2044	2045	2046	2047	2048	2049	2050	2051	2052	2053
	Lease (Revenue)	1,558	1,558	1,558	1,558	1,558	1,558	1,558	1,558	1,558	1,558
	Operation Cost	0	0	0	0	0	0	0	0	0	0
	Net Income	1,558	1,558	1,558	1,558	1,558	1,558	1,558	1,558	1,558	1,558
	Depreciation	2,379	2,379	2,379	2,379	2,379	2,379	2,555	2,555	2,791	2,791
	Interest Payment(Yen-Loan)	20	19	17	15	14	12	11	9	8	6
	Interest Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0
	Interest Payment(Short-term Loan)	0	0	0	0	0	0	0	0	0	0
	Net Profit before TAX	-842	-840	-839	-837	-836	-834	-1,008	-1,007	-1,241	-1,239
	Corporate TAX	0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX	-842	-840	-839	-837	-836	-834	-1,008	-1,007	-1,241	-1,239
Cash Flow	Equity	0	0	0	0	0	0	0	0	0	0
	Yen-Loan	0	0	0	0	0	0	0	0	0	0
	Commercial-Loan	0	0	0	0	0	0	0	0	0	0
	Short-term Loan	0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX	-842	-840	-839	-837	-836	-834	-1,008	-1,007	-1,241	-1,239
	Depreciation	2,379	2,379	2,379	2,379	2,379	2,379	2,555	2,555	2,791	2,791
	Initial Investment	0	0	0	0	0	0	0	0	0	0
	Renovation	0	0	0	0	0	0	0	0	0	0
	Additional Investment	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Yen-Loan)	1,537	1,539	1,540	1,542	1,544	1,545	1,547	1,548	1,550	1,551
	Principal Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Short-term Loan)	0	0	0	0	0	0	0	0	0	0
	Net Cash Flow	0	0	0	0	0	0	0	0	0	0
	Accumulative Cash Flow	0	0	0	0	0	0	0	0	0	0
Service Payment		1,558	1,558	1,558	1,558	1,558	1,558	1,558	1,558	1,558	1,558
Equirt IRR		0	0	0	0	0	0	0	0	0	0
Project IRR		0	0	0	0	0	0	0	0	0	0
DSCR		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

(Unit: billion IDR)		2054	2055	2056	2057	2058	2059	2060	2061	2062	2063
	Lease (Revenue)	1,558	1,558	1,558	0	0	0	0	0	0	0
	Operation Cost	0	0	0	0	0	0	0	0	0	0
	Net Income	1,558	1,558	1,558	0	0	0	0	0	0	0
	Depreciation	2,824	2,824	2,933	2,933	2,933	2,933	2,898	2,898	2,940	2,940
	Interest Payment(Yen-Loan)	5	3	2	0	0	0	0	0	0	0
	Interest Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0
	Interest Payment(Short-term Loan)	0	0	0	0	0	0	0	0	0	0
	Net Profit before TAX	-1,271	-1,269	-1,377	-2,933	-2,933	-2,933	-2,898	-2,898	-2,940	-2,940
	Corporate TAX	0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX	-1,271	-1,269	-1,377	-2,933	-2,933	-2,933	-2,898	-2,898	-2,940	-2,940
Cash Flow	Equity	0	0	0	0	0	0	0	0	0	0
	Yen-Loan	0	0	0	0	0	0	0	0	0	0
	Commercial-Loan	0	0	0	0	0	0	0	0	0	0
	Short-term Loan	0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX	-1,271	-1,269	-1,377	-2,933	-2,933	-2,933	-2,898	-2,898	-2,940	-2,940
	Depreciation	2,824	2,824	2,933	2,933	2,933	2,933	2,898	2,898	2,940	2,940
	Initial Investment	0	0	0	0	0	0	0	0	0	0
	Renovation	0	0	0	0	0	0	0	0	0	0
	Additional Investment	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Yen-Loan)	1,553	1,554	1,556	0	0	0	0	0	0	0
	Principal Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Short-term Loan)	0	0	0	0	0	0	0	0	0	0
	Net Cash Flow	0	0	0	0	0	0	0	0	0	0
	Accumulative Cash Flow	0	0	0	0	0	0	0	0	0	0
Service Payment		1,558	1,558	1,558	0	0	0	0	0	0	0
Equirt IRR		0	0	0	0	0	0	0	0	0	0
Project IRR		0	0	0	0	0	0	0	0	0	0
DSCR		1.00	1.00	1.00	-	-	-	-	-	-	-

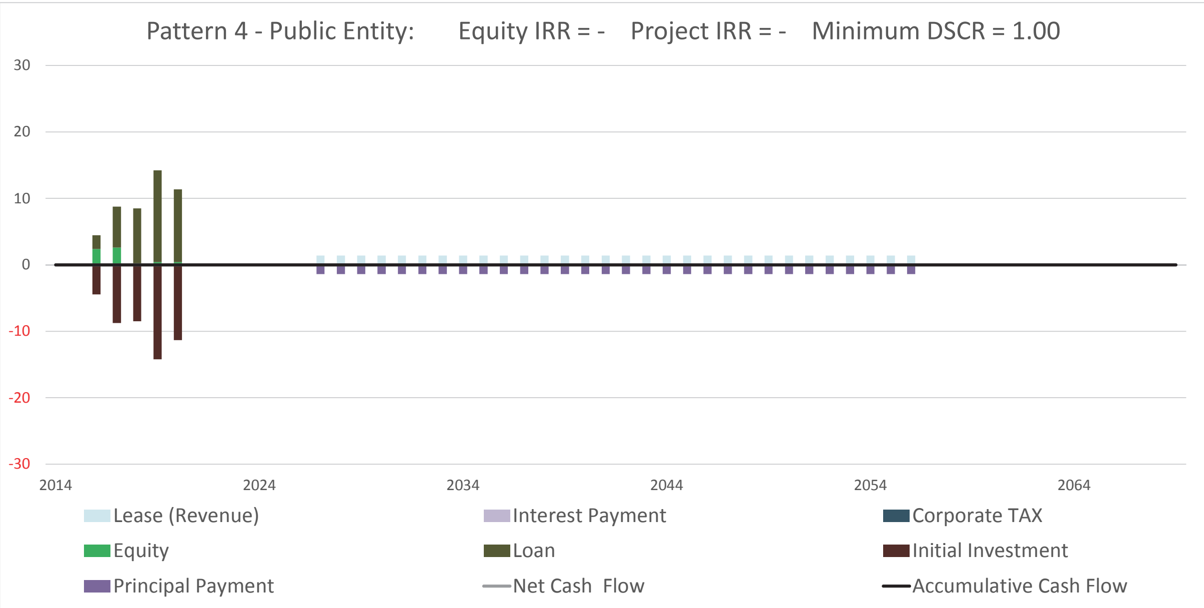
(Unit: billion IDR)		2064	2065	2066	2067	2068	2069
	Lease (Revenue)	0	0	0	0	0	0
	Operation Cost	0	0	0	0	0	0
	Net Income	0	0	0	0	0	0
	Depreciation	3,029	3,059	3,098	3,098	3,225	3,225
	Interest Payment(Yen-Loan)	0	0	0	0	0	0
	Interest Payment(Commercial Loan)	0	0	0	0	0	0
	Interest Payment(Short-term Loan)	0	0	0	0	0	0
	Net Profit before TAX	-3,029	-3,059	-3,098	-3,098	-3,225	-3,225
	Corporate TAX	0	0	0	0	0	0
	Net Profit after TAX	-3,029	-3,059	-3,098	-3,098	-3,225	-3,225
Cash Flow	Equity	0	0	0	0	0	0
	Yen-Loan	0	0	0	0	0	0
	Commercial-Loan	0	0	0	0	0	0
	Short-term Loan	0	0	0	0	0	0
	Net Profit after TAX	-3,029	-3,059	-3,098	-3,098	-3,225	-3,225
	Depreciation	3,029	3,059	3,098	3,098	3,225	3,225
	Initial Investment	0	0	0	0	0	0
	Renovation	0	0	0	0	0	0
	Additional Investment	0	0	0	0	0	0
	Principal Payment(Yen-Loan)	0	0	0	0	0	0
	Principal Payment(Commercial Loan)	0	0	0	0	0	0
	Principal Payment(Short-term Loan)	0	0	0	0	0	0
	Net Cash Flow	0	0	0	0	0	0
	Accumulative Cash Flow	0	0	0	0	0	0
Service Payment		0	0	0	0	0	0
Equirt IRR		0	0	0	0	0	0
Project IRR		0	0	0	0	0	0
DSCR		-	-	-	-	-	-

Source: JICA Study Team



Source: JICA Study Team

Chart 14.3-9 Cash Flow of Project Operating Private Body (Case 4, Cash Flow Analysis, Nominal Term, Unit: trillion IDR)



Source: JICA Study Team

Chart 14.3-10 Cash Flow of Project Developing State-owned Enterprise (Case 4, Cash Flow Analysis, Nominal Term, Unit: trillion IDR)

Table 14.3-11 Cash Flow of Project Operating Private Body (Case 4, Cash Flow Analysis, Nominal Term, Unit: trillion IDR)

(Unit: billion IDR)		Total	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
P&L Statement	Fare Revenue	2,605,115	0	0	0	0	0	0	3,462	3,867	4,304	4,774
	Operation Cost	378,328	0	0	0	0	0	0	1,151	1,233	1,321	1,414
	Lease Cost	41,859	0	0	0	0	0	0	0	0	0	0
	Net Income	2,184,928	0	0	0	0	0	0	2,310	2,634	2,983	3,361
	Depreciation	84,763	0	0	0	0	0	0	379	379	379	379
	Interest Payment(Yen-Loan)	0	0	0	0	0	0	0	0	0	0	0
	Interest Payment(Commercial Loan)	19,587	0	0	0	0	0	0	0	2,990	2,835	2,659
	Interest Payment(Short-term Loan)	7,609	0	0	0	0	0	0	0	0	0	89
	Net Profit before TAX	2,072,969	0	0	0	0	0	0	1,931	-735	-231	233
	Corporate TAX	518,484	0	0	0	0	0	0	482.861692	0	0	58.36601839
	Net Profit after TAX	1,554,485	0	0	0	0	0	0	1,449	-735	-231	175
Cash Flow	Equity	2,725	0	0	26	603	920	980	195	0	0	0
	Yen-Loan	0	0	0	0	0	0	0	0	0	0	0
	Commercial-Loan	21,357	0	0	168	3,915	6,444	7,562	3,268	0	0	0
	Short-term Loan	19,660	0	0	0	0	0	0	0	0	0	744
	Net Profit after TAX	1,554,485	0	0	0	0	0	0	1,449	-735	-231	175
	Depreciation	84,763	0	0	0	0	0	0	379	379	379	379
	Initial Investment	24,081	0	0	194	4,518	7,364	8,542	3,463	0	0	0
	Renovation	77,310	0	0	0	0	0	0	0	0	0	0
	Additional Investment	77,310	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Yen-Loan)	0	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Commercial Loan)	21,357	0	0	0	0	0	0	0	1,104	1,259	1,435
	Principal Payment(Short-term Loan)	19,660	0	0	0	0	0	0	0	0	0	117
	Net Cash Flow	1,463,270	0	0	0	0	0	0	1,827	-1,461	-1,111	-254
	Accumulative Cash Flow	15,920,223	0	0	0	0	0	0	1,827	367	-744	-999
Service Payment		68,212	0	0	0	0	0	0	0	4,094	4,094	4,301
Equity IRR		21.21%	0	0	-26	-603	-920	-980	1,632	-1,461	-1,111	-254
Project IRR		11.33%	0	0	-194	-4,518	-7,364	-8,542	-1,636	-1,461	-1,111	-999
DSCR		-3.36	-	-	-	-	-	-	-	0.64	0.73	0.94
(Unit: billion IDR)			2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
P&L Statement	Fare Revenue		5,281	5,825	6,410	7,039	7,713	8,437	9,213	10,269	11,405	12,629
	Operation Cost		1,513	1,618	1,730	1,849	1,976	2,110	2,253	2,456	2,673	2,906
	Lease Cost		0	0	0	1,395	1,395	1,395	1,395	1,395	1,395	1,395
	Net Income		3,768	4,207	4,680	3,794	4,342	4,932	5,565	6,417	7,337	8,327
	Depreciation		379	379	379	379	379	379	543	543	1,080	1,080
	Interest Payment(Yen-Loan)		0	0	0	0	0	0	0	0	0	0
	Interest Payment(Commercial Loan)		2,458	2,229	1,968	1,670	1,331	944	503	0	0	0
	Interest Payment(Short-term Loan)		195	280	339	370	491	585	645	753	546	1,187
	Net Profit before TAX		736	1,320	1,994	1,376	2,142	3,024	3,874	5,121	5,711	6,060
	Corporate TAX		184	330	499	344	535	756	969	1,280	1,428	1,515
	Net Profit after TAX		552	990	1,496	1,032	1,606	2,268	2,906	3,841	4,283	4,545
Cash Flow	Equity		0	0	0	0	0	0	0	0	0	0
	Yen-Loan		0	0	0	0	0	0	0	0	0	0
	Commercial-Loan		0	0	0	0	0	0	0	0	0	0
	Short-term Loan		999	994	976	943	1,936	1,909	1,793	2,352	0	7,013
	Net Profit after TAX		552	990	1,496	1,032	1,606	2,268	2,906	3,841	4,283	4,545
	Depreciation		379	379	379	379	379	379	543	543	1,080	1,080
	Initial Investment		0	0	0	0	0	0	0	0	0	0
	Renovation		0	0	0	0	0	0	379	0	6,682	0
	Additional Investment		0	0	0	0	0	0	379	0	6,682	0
	Principal Payment(Yen-Loan)		0	0	0	0	0	0	0	0	0	0
	Principal Payment(Commercial Loan)		1,636	1,865	2,126	2,424	2,764	3,150	3,592	0	0	0
	Principal Payment(Short-term Loan)		288	480	691	922	1,131	1,290	1,451	1,725	1,670	2,438
	Net Cash Flow		5	18	34	-993	26	116	-558	5,011	-9,672	10,200
	Accumulative Cash Flow		-994	-976	-943	-1,936	-1,909	-1,793	-2,352	2,659	-7,013	3,187
Service Payment			4,578	4,854	5,125	5,386	5,716	5,969	6,191	2,478	2,217	3,625
Equity IRR			5	18	34	-993	26	116	-558	5,011	-9,672	10,200
Project IRR			-994	-976	-943	-1,936	-1,909	-1,793	-2,352	2,659	-9,672	3,187
DSCR			1.00	1.00	1.01	0.82	1.00	1.02	0.91	3.02	-3.36	3.81
(Unit: billion IDR)			2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
P&L Statement	Fare Revenue		13,945	15,359	16,879	18,511	20,262	22,140	24,154	26,071	28,117	30,301
	Operation Cost		3,156	3,422	3,708	4,013	4,339	4,687	5,059	5,297	5,545	5,806
	Lease Cost		1,395	1,395	1,395	1,395	1,395	1,395	1,395	1,395	1,395	1,395
	Net Income		9,394	10,542	11,776	13,103	14,528	16,058	17,700	19,379	21,176	23,100
	Depreciation		1,080	1,196	1,196	1,196	1,196	1,196	1,700	1,700	1,773	1,773
	Interest Payment(Yen-Loan)		0	0	0	0	0	0	0	0	0	0
	Interest Payment(Commercial Loan)		0	0	0	0	0	0	0	0	0	0
	Interest Payment(Short-term Loan)		895	631	395	208	0	0	0	0	0	0
	Net Profit before TAX		7,420	8,715	10,185	11,698	13,332	14,862	15,999	17,678	19,403	21,327
	Corporate TAX		1,855	2,179	2,546	2,925	3,333	3,715	4,000	4,420	4,851	5,332
	Net Profit after TAX		5,565	6,536	7,639	8,774	9,999	11,146	11,999	13,259	14,553	15,995
Cash Flow	Equity		0	0	0	0	0	0	0	0	0	0
	Yen-Loan		0	0	0	0	0	0	0	0	0	0
	Commercial-Loan		0	0	0	0	0	0	0	0	0	0
	Short-term Loan		0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX		5,565	6,536	7,639	8,774	9,999	11,146	11,999	13,259	14,553	15,995
	Depreciation		1,080	1,196	1,196	1,196	1,196	1,196	1,700	1,700	1,773	1,773
	Initial Investment		0	0	0	0	0	0	0	0	0	0
	Renovation		0	1,750	0	0	0	0	2,929	0	2,387	0
	Additional Investment		0	1,750	0	0	0	0	2,929	0	2,387	0
	Principal Payment(Yen-Loan)		0	0	0	0	0	0	0	0	0	0
	Principal Payment(Commercial Loan)		0	0	0	0	0	0	0	0	0	0
	Principal Payment(Short-term Loan)		2,201	1,967	1,551	1,737	0	0	0	0	0	0
	Net Cash Flow		4,444	2,265	7,284	8,233	11,195	12,343	7,841	14,959	11,551	17,768
	Accumulative Cash Flow		7,631	9,896	17,180	25,413	36,608	48,950	56,791	71,750	83,302	101,070
Service Payment			3,095	2,598	1,946	1,946	0	0	0	0	0	0
Equity IRR			4,444	2,265	7,284	8,233	11,195	12,343	7,841	14,959	11,551	17,768
Project IRR			4,444	2,265	7,284	8,233	11,195	12,343	7,841	14,959	11,551	17,768
DSCR			2.44	1.87	4.74	5.23	-	-	-	-	-	-

(Unit: billion IDR)		2044	2045	2046	2047	2048	2049	2050	2051	2052	2053
P&L Statement	Fare Revenue	32,632	35,119	37,771	40,598	43,612	46,824	50,246	53,890	57,771	61,904
	Operation Cost	6,078	6,364	6,662	6,975	7,302	7,645	8,004	8,407	8,831	9,277
	Lease Cost	1,395	1,395	1,395	1,395	1,395	1,395	1,395	1,395	1,395	1,395
	Net Income	25,159	27,360	29,713	32,228	34,914	37,783	40,846	44,088	47,545	51,232
	Depreciation	1,866	1,866	1,866	1,866	1,866	1,866	2,257	2,257	2,493	2,493
	Interest Payment(Yen-Loan)	0	0	0	0	0	0	0	0	0	0
	Interest Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0
	Interest Payment(Short-term Loan)	0	0	0	0	0	0	0	0	0	0
	Net Profit before TAX	23,292	25,493	27,847	30,361	33,048	35,917	38,589	41,831	45,052	48,739
	Corporate TAX	5,823	6,373	6,962	7,590	8,262	8,979	9,647	10,458	11,263	12,185
	Net Profit after TAX	17,469	19,120	20,885	22,771	24,786	26,938	28,942	31,373	33,789	36,554
Cash Flow	Equity	0	0	0	0	0	0	0	0	0	0
	Yen-Loan	0	0	0	0	0	0	0	0	0	0
	Commercial-Loan	0	0	0	0	0	0	0	0	0	0
	Short-term Loan	0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX	17,469	19,120	20,885	22,771	24,786	26,938	28,942	31,373	33,789	36,554
	Depreciation	1,866	1,866	1,866	1,866	1,866	1,866	2,257	2,257	2,493	2,493
	Initial Investment	0	0	0	0	0	0	0	0	0	0
	Renovation	7,803	0	0	0	0	0	8,448	0	6,338	0
	Additional Investment	7,803	0	0	0	0	0	8,448	0	6,338	0
	Principal Payment(Yen-Loan)	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Short-term Loan)	0	0	0	0	0	0	0	0	0	0
	Net Cash Flow	3,730	20,986	22,751	24,637	26,652	28,804	14,303	33,630	23,605	39,047
	Accumulative Cash Flow	104,800	125,787	148,538	173,175	199,828	228,632	242,935	276,565	300,171	339,218
Service Payment		0	0	0	0	0	0	0	0	0	0
Equity IRR		3,730	20,986	22,751	24,637	26,652	28,804	14,303	33,630	23,605	39,047
Project IRR		3,730	20,986	22,751	24,637	26,652	28,804	14,303	33,630	23,605	39,047
DSCR		–	–	–	–	–	–	–	–	–	–

(Unit: billion IDR)		2054	2055	2056	2057	2058	2059	2060	2061	2062	2063
P&L Statement	Fare Revenue	66,302	70,983	75,963	81,261	86,896	92,888	99,259	106,031	113,228	120,876
	Operation Cost	9,745	10,236	10,753	11,296	11,867	12,466	13,096	13,758	14,454	15,185
	Lease Cost	1,395	1,395	1,395	0	0	0	0	0	0	0
	Net Income	55,162	59,351	63,815	69,965	75,030	80,422	86,162	92,272	98,774	105,690
	Depreciation	2,526	2,526	2,635	2,635	2,635	2,635	2,600	2,600	2,642	2,642
	Interest Payment(Yen-Loan)	0	0	0	0	0	0	0	0	0	0
	Interest Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0
	Interest Payment(Short-term Loan)	0	0	0	0	0	0	0	0	0	0
	Net Profit before TAX	52,636	56,825	61,180	67,330	72,395	77,787	83,563	89,672	96,131	103,048
	Corporate TAX	13,159	14,206	15,295	16,833	18,099	19,447	20,891	22,418	24,033	25,762
	Net Profit after TAX	39,477	42,619	45,885	50,498	54,296	58,340	62,672	67,254	72,098	77,286
Cash Flow	Equity	0	0	0	0	0	0	0	0	0	0
	Yen-Loan	0	0	0	0	0	0	0	0	0	0
	Commercial-Loan	0	0	0	0	0	0	0	0	0	0
	Short-term Loan	0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX	39,477	42,619	45,885	50,498	54,296	58,340	62,672	67,254	72,098	77,286
	Depreciation	2,526	2,526	2,635	2,635	2,635	2,635	2,600	2,600	2,642	2,642
	Initial Investment	0	0	0	0	0	0	0	0	0	0
	Renovation	2,787	0	9,111	0	0	0	3,793	0	1,030	0
	Additional Investment	2,787	0	9,111	0	0	0	3,793	0	1,030	0
	Principal Payment(Yen-Loan)	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Short-term Loan)	0	0	0	0	0	0	0	0	0	0
	Net Cash Flow	36,428	45,145	30,298	53,133	56,931	60,975	57,686	69,854	72,680	79,928
	Accumulative Cash Flow	375,646	420,791	451,089	504,222	561,153	622,128	679,814	749,668	822,348	902,276
Service Payment		0	0	0	0	0	0	0	0	0	0
Equity IRR		36,428	45,145	30,298	53,133	56,931	60,975	57,686	69,854	72,680	79,928
Project IRR		36,428	45,145	30,298	53,133	56,931	60,975	57,686	69,854	72,680	79,928
DSCR		–	–	–	–	–	–	–	–	–	–

(Unit: billion IDR)		2064	2065	2066	2067	2068	2069
P&L Statement	Fare Revenue	129,001	137,633	146,801	156,536	166,874	177,848
	Operation Cost	15,954	16,761	17,610	18,502	19,439	20,425
	Lease Cost	0	0	0	0	0	0
	Net Income	113,047	120,871	129,191	138,034	147,434	157,424
	Depreciation	2,731	2,761	2,800	2,800	2,927	2,927
	Interest Payment(Yen-Loan)	0	0	0	0	0	0
	Interest Payment(Commercial Loan)	0	0	0	0	0	0
	Interest Payment(Short-term Loan)	0	0	0	0	0	0
	Net Profit before TAX	110,316	118,110	126,390	135,234	144,507	154,496
	Corporate TAX	27,579	29,528	31,598	33,809	36,127	38,624
	Net Profit after TAX	82,737	88,583	94,793	101,426	108,380	115,872
Cash Flow	Equity	0	0	0	0	0	0
	Yen-Loan	0	0	0	0	0	0
	Commercial-Loan	0	0	0	0	0	0
	Short-term Loan	0	0	0	0	0	0
	Net Profit after TAX	82,737	88,583	94,793	101,426	108,380	115,872
	Depreciation	2,731	2,761	2,800	2,800	2,927	2,927
	Initial Investment	0	0	0	0	0	0
	Renovation	7,401	2,578	3,255	0	10,638	0
	Additional Investment	7,401	2,578	3,255	0	10,638	0
	Principal Payment(Yen-Loan)	0	0	0	0	0	0
	Principal Payment(Commercial Loan)	0	0	0	0	0	0
	Principal Payment(Short-term Loan)	0	0	0	0	0	0
	Net Cash Flow	70,667	86,187	91,083	104,226	90,031	118,800
	Accumulative Cash Flow	972,943	1,059,130	1,150,214	1,254,440	1,344,471	1,463,270
Service Payment		0	0	0	0	0	0
Equity IRR		70,667	86,187	91,083	104,226	90,031	118,800
Project IRR		70,667	86,187	91,083	104,226	90,031	118,800
DSCR		–	–	–	–	–	–

Source: JICA Study Team

Table 14.3-12 Cash Flow of Project Developing State-owned Enterprise (Case 4, Cash Flow Analysis, Nominal Term, Unit: trillion IDR)

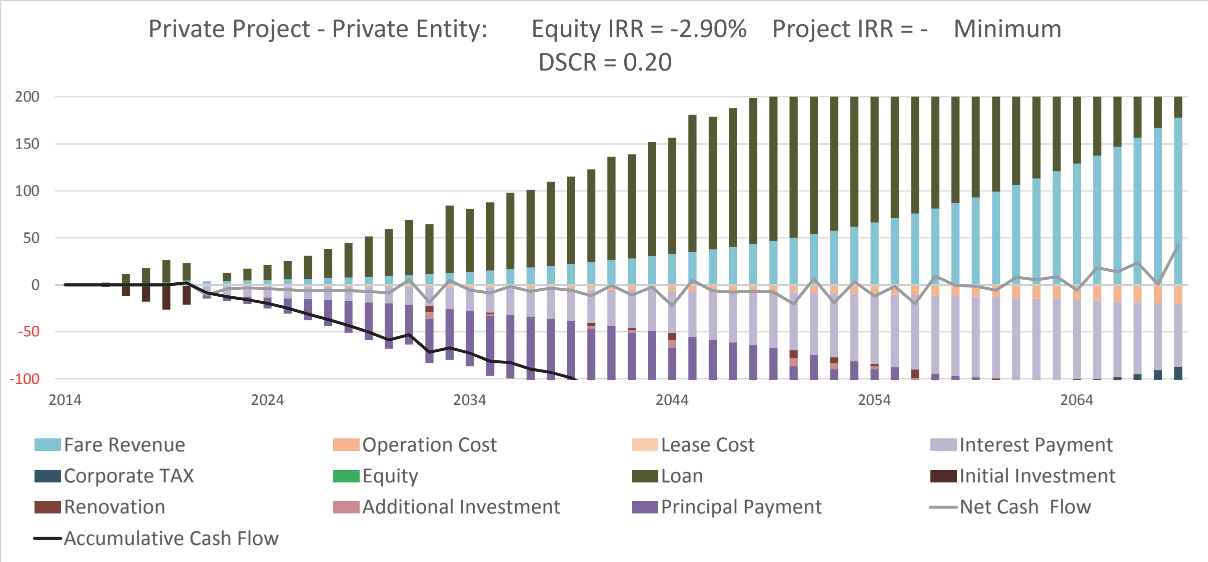
(Unit: billion IDR)		Total	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
	Lease (Revenue)	41,859	0	0	0	0	0	0	0	0	0	0
	Operation Cost	0	0	0	0	0	0	0	0	0	0	0
	Net Income	41,859	0	0	0	0	0	0	0	0	0	0
	Depreciation	113,471	0	0	0	0	0	0	1,615	1,615	1,615	1,615
	Interest Payment(Yen-Loan)	642	0	0	0	0	0	0	0	0	0	0
	Interest Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0	0
	Interest Payment(Short-term Loan)	0	0	0	0	0	0	0	0	0	0	0
	Net Profit before TAX	-72,253	0	0	0	0	0	0	-1,615	-1,615	-1,615	-1,615
	Corporate TAX	0	0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX	-72,253	0	0	0	0	0	0	-1,615	-1,615	-1,615	-1,615
Cash Flow	Equity	6,029	0	0	2,377	2,586	248	403	416	0	0	0
	Yen-Loan	41,217	0	0	2,069	6,169	8,248	13,809	10,922	0	0	0
	Commercial-Loan	0	0	0	0	0	0	0	0	0	0	0
	Short-term Loan	0	0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX	-72,253	0	0	0	0	0	0	-1,615	-1,615	-1,615	-1,615
	Depreciation	113,471	0	0	0	0	0	0	1,615	1,615	1,615	1,615
	Initial Investment	47,246	0	0	4,446	8,755	8,496	14,212	11,338	0	0	0
	Renovation	0	0	0	0	0	0	0	0	0	0	0
	Additional Investment	0	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Yen-Loan)	41,217	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Short-term Loan)	0	0	0	0	0	0	0	0	0	0	0
	Net Cash Flow	0	0	0	0	0	0	0	0	0	0	0
	Accumulative Cash Flow	0	0	0	0	0	0	0	0	0	0	0
Service Payment		41,859	0	0	0	0	0	0	0	0	0	0
Equirt IRR		-	0	0	-2,377	-2,586	-248	-403	-416	0	0	0
Project IRR		-	0	0	-4,446	-8,755	-8,496	-14,212	-11,338	0	0	0
DSCR		1.00	-	-	-	-	-	-	-	-	-	-
(Unit: billion IDR)			2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
	Lease (Revenue)		0	0	0	1,395	1,395	1,395	1,395	1,395	1,395	1,395
	Operation Cost		0	0	0	0	0	0	0	0	0	0
	Net Income		0	0	0	1,395	1,395	1,395	1,395	1,395	1,395	1,395
	Depreciation		1,615	1,615	1,615	1,615	1,615	1,615	1,741	1,741	1,968	1,968
	Interest Payment(Yen-Loan)		0	0	0	41	40	39	37	36	34	33
	Interest Payment(Commercial Loan)		0	0	0	0	0	0	0	0	0	0
	Interest Payment(Short-term Loan)		0	0	0	0	0	0	0	0	0	0
	Net Profit before TAX		-1,615	-1,615	-1,615	-261	-260	-258	-383	-381	-608	-606
	Corporate TAX		0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX		-1,615	-1,615	-1,615	-261	-260	-258	-383	-381	-608	-606
Cash Flow	Equity		0	0	0	0	0	0	0	0	0	0
	Yen-Loan		0	0	0	0	0	0	0	0	0	0
	Commercial-Loan		0	0	0	0	0	0	0	0	0	0
	Short-term Loan		0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX		-1,615	-1,615	-1,615	-261	-260	-258	-383	-381	-608	-606
	Depreciation		1,615	1,615	1,615	1,615	1,615	1,615	1,741	1,741	1,968	1,968
	Initial Investment		0	0	0	0	0	0	0	0	0	0
	Renovation		0	0	0	0	0	0	0	0	0	0
	Additional Investment		0	0	0	0	0	0	0	0	0	0
	Principal Payment(Yen-Loan)		0	0	0	1,354	1,355	1,357	1,358	1,360	1,361	1,362
	Principal Payment(Commercial Loan)		0	0	0	0	0	0	0	0	0	0
	Principal Payment(Short-term Loan)		0	0	0	0	0	0	0	0	0	0
	Net Cash Flow		0	0	0	0	0	0	0	0	0	0
	Accumulative Cash Flow		0	0	0	0	0	0	0	0	0	0
Service Payment			0	0	0	1,395	1,395	1,395	1,395	1,395	1,395	1,395
Equirt IRR			0	0	0	0	0	0	0	0	0	0
Project IRR			0	0	0	0	0	0	0	0	0	0
DSCR			-	-	-	1.00	1.00	1.00	1.00	1.00	1.00	1.00
(Unit: billion IDR)			2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
	Lease (Revenue)		1,395	1,395	1,395	1,395	1,395	1,395	1,395	1,395	1,395	1,395
	Operation Cost		0	0	0	0	0	0	0	0	0	0
	Net Income		1,395	1,395	1,395	1,395	1,395	1,395	1,395	1,395	1,395	1,395
	Depreciation		1,968	1,824	1,824	1,824	1,824	1,824	2,115	2,115	2,188	2,188
	Interest Payment(Yen-Loan)		32	30	29	28	26	25	24	22	21	19
	Interest Payment(Commercial Loan)		0	0	0	0	0	0	0	0	0	0
	Interest Payment(Short-term Loan)		0	0	0	0	0	0	0	0	0	0
	Net Profit before TAX		-605	-459	-458	-457	-455	-454	-743	-742	-813	-812
	Corporate TAX		0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX		-605	-459	-458	-457	-455	-454	-743	-742	-813	-812
Cash Flow	Equity		0	0	0	0	0	0	0	0	0	0
	Yen-Loan		0	0	0	0	0	0	0	0	0	0
	Commercial-Loan		0	0	0	0	0	0	0	0	0	0
	Short-term Loan		0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX		-605	-459	-458	-457	-455	-454	-743	-742	-813	-812
	Depreciation		1,968	1,824	1,824	1,824	1,824	1,824	2,115	2,115	2,188	2,188
	Initial Investment		0	0	0	0	0	0	0	0	0	0
	Renovation		0	0	0	0	0	0	0	0	0	0
	Additional Investment		0	0	0	0	0	0	0	0	0	0
	Principal Payment(Yen-Loan)		1,364	1,365	1,366	1,368	1,369	1,370	1,372	1,373	1,375	1,376
	Principal Payment(Commercial Loan)		0	0	0	0	0	0	0	0	0	0
	Principal Payment(Short-term Loan)		0	0	0	0	0	0	0	0	0	0
	Net Cash Flow		0	0	0	0	0	0	0	0	0	0
	Accumulative Cash Flow		0	0	0	0	0	0	0	0	0	0
Service Payment			1,395	1,395	1,395	1,395	1,395	1,395	1,395	1,395	1,395	1,395
Equirt IRR			0	0	0	0	0	0	0	0	0	0
Project IRR			0	0	0	0	0	0	0	0	0	0
DSCR			1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

(Unit: billion IDR)		2044	2045	2046	2047	2048	2049	2050	2051	2052	2053
	Lease (Revenue)	1,395	1,395	1,395	1,395	1,395	1,395	1,395	1,395	1,395	1,395
	Operation Cost	0	0	0	0	0	0	0	0	0	0
	Net Income	1,395	1,395	1,395	1,395	1,395	1,395	1,395	1,395	1,395	1,395
	Depreciation	2,281	2,281	2,281	2,281	2,281	2,281	2,457	2,457	2,692	2,692
	Interest Payment(Yen-Loan)	18	17	15	14	12	11	10	8	7	6
	Interest Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0
	Interest Payment(Short-term Loan)	0	0	0	0	0	0	0	0	0	0
	Net Profit before TAX	-904	-903	-901	-900	-898	-897	-1,071	-1,070	-1,304	-1,303
	Corporate TAX	0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX	-904	-903	-901	-900	-898	-897	-1,071	-1,070	-1,304	-1,303
Cash Flow	Equity	0	0	0	0	0	0	0	0	0	0
	Yen-Loan	0	0	0	0	0	0	0	0	0	0
	Commercial-Loan	0	0	0	0	0	0	0	0	0	0
	Short-term Loan	0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX	-904	-903	-901	-900	-898	-897	-1,071	-1,070	-1,304	-1,303
	Depreciation	2,281	2,281	2,281	2,281	2,281	2,281	2,457	2,457	2,692	2,692
	Initial Investment	0	0	0	0	0	0	0	0	0	0
	Renovation	0	0	0	0	0	0	0	0	0	0
	Additional Investment	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Yen-Loan)	1,377	1,379	1,380	1,381	1,383	1,384	1,386	1,387	1,388	1,390
	Principal Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Short-term Loan)	0	0	0	0	0	0	0	0	0	0
	Net Cash Flow	0	0	0	0	0	0	0	0	0	0
	Accumulative Cash Flow	0	0	0	0	0	0	0	0	0	0
Service Payment		1,395	1,395	1,395	1,395	1,395	1,395	1,395	1,395	1,395	1,395
Equirt IRR		0	0	0	0	0	0	0	0	0	0
Project IRR		0	0	0	0	0	0	0	0	0	0
DSCR		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

(Unit: billion IDR)		2054	2055	2056	2057	2058	2059	2060	2061	2062	2063
	Lease (Revenue)	1,395	1,395	1,395	0	0	0	0	0	0	0
	Operation Cost	0	0	0	0	0	0	0	0	0	0
	Net Income	1,395	1,395	1,395	0	0	0	0	0	0	0
	Depreciation	2,726	2,726	2,835	2,835	2,835	2,835	2,800	2,800	2,842	2,842
	Interest Payment(Yen-Loan)	4	3	1	0	0	0	0	0	0	0
	Interest Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0
	Interest Payment(Short-term Loan)	0	0	0	0	0	0	0	0	0	0
	Net Profit before TAX	-1,335	-1,333	-1,441	-2,835	-2,835	-2,835	-2,800	-2,800	-2,842	-2,842
	Corporate TAX	0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX	-1,335	-1,333	-1,441	-2,835	-2,835	-2,835	-2,800	-2,800	-2,842	-2,842
Cash Flow	Equity	0	0	0	0	0	0	0	0	0	0
	Yen-Loan	0	0	0	0	0	0	0	0	0	0
	Commercial-Loan	0	0	0	0	0	0	0	0	0	0
	Short-term Loan	0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX	-1,335	-1,333	-1,441	-2,835	-2,835	-2,835	-2,800	-2,800	-2,842	-2,842
	Depreciation	2,726	2,726	2,835	2,835	2,835	2,835	2,800	2,800	2,842	2,842
	Initial Investment	0	0	0	0	0	0	0	0	0	0
	Renovation	0	0	0	0	0	0	0	0	0	0
	Additional Investment	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Yen-Loan)	1,391	1,393	1,394	0	0	0	0	0	0	0
	Principal Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Short-term Loan)	0	0	0	0	0	0	0	0	0	0
	Net Cash Flow	0	0	0	0	0	0	0	0	0	0
	Accumulative Cash Flow	0	0	0	0	0	0	0	0	0	0
Service Payment		1,395	1,395	1,395	0	0	0	0	0	0	0
Equirt IRR		0	0	0	0	0	0	0	0	0	0
Project IRR		0	0	0	0	0	0	0	0	0	0
DSCR		1.00	1.00	1.00	-	-	-	-	-	-	-

(Unit: billion IDR)		2064	2065	2066	2067	2068	2069
	Lease (Revenue)	0	0	0	0	0	0
	Operation Cost	0	0	0	0	0	0
	Net Income	0	0	0	0	0	0
	Depreciation	2,931	2,961	3,000	3,000	3,127	3,127
	Interest Payment(Yen-Loan)	0	0	0	0	0	0
	Interest Payment(Commercial Loan)	0	0	0	0	0	0
	Interest Payment(Short-term Loan)	0	0	0	0	0	0
	Net Profit before TAX	-2,931	-2,961	-3,000	-3,000	-3,127	-3,127
	Corporate TAX	0	0	0	0	0	0
	Net Profit after TAX	-2,931	-2,961	-3,000	-3,000	-3,127	-3,127
Cash Flow	Equity	0	0	0	0	0	0
	Yen-Loan	0	0	0	0	0	0
	Commercial-Loan	0	0	0	0	0	0
	Short-term Loan	0	0	0	0	0	0
	Net Profit after TAX	-2,931	-2,961	-3,000	-3,000	-3,127	-3,127
	Depreciation	2,931	2,961	3,000	3,000	3,127	3,127
	Initial Investment	0	0	0	0	0	0
	Renovation	0	0	0	0	0	0
	Additional Investment	0	0	0	0	0	0
	Principal Payment(Yen-Loan)	0	0	0	0	0	0
	Principal Payment(Commercial Loan)	0	0	0	0	0	0
	Principal Payment(Short-term Loan)	0	0	0	0	0	0
	Net Cash Flow	0	0	0	0	0	0
	Accumulative Cash Flow	0	0	0	0	0	0
Service Payment		0	0	0	0	0	0
Equirt IRR		0	0	0	0	0	0
Project IRR		0	0	0	0	0	0
DSCR		-	-	-	-	-	-

Source: JICA Study Team



Source: JICA Study Team

Chart 14.3-11 Cash Flow of Project Operating Private Body (Private Project Case 1 (Land Acquisition Cost Charged to Indonesian Government), Cash Flow Analysis, Nominal Term, Unit: trillion IDR)

Table 14.3-13 Cash Flow of Project Operating Private Body (Private Project Case 1 (Land Acquisition Cost Charged to Indonesian Government), Cash Flow Analysis, Nominal Term, Unit: trillion IDR)

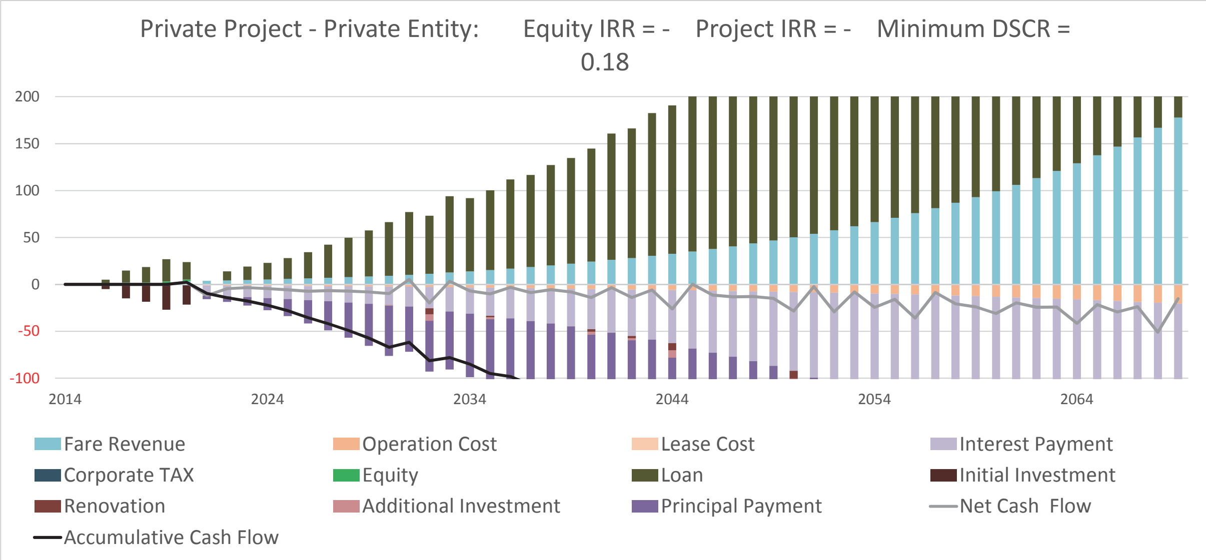
(Unit: billion IDR)		Total	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
P&L Statement	Fare Revenue	2,605,115	0	0	0	0	0	0	3,462	3,867	4,304	4,774
	Operation Cost	378,328	0	0	0	0	0	0	1,151	1,233	1,321	1,414
	Lease Cost	0	0	0	0	0	0	0	0	0	0	0
	Net Income	2,226,787	0	0	0	0	0	0	2,310	2,634	2,983	3,361
	Depreciation	126,945	0	0	0	0	0	0	1,900	1,900	1,900	1,900
	Interest Payment(Yen-Loan)	0	0	0	0	0	0	0	0	0	0	0
	Interest Payment(Commercial Loan)	63,435	0	0	0	0	0	0	0	9,683	9,183	8,612
	Interest Payment(Short-term Loan)	2,338,959	0	0	0	0	0	0	0	0	1,010	2,365
	Net Profit before TAX	-302,552	0	0	0	0	0	0	410	-8,950	-9,110	-9,516
	Corporate TAX	87,739	0	0	0	0	0	0	102.5541923	0	0	0
	Net Profit after TAX	-390,291	0	0	0	0	0	0	308	-8,950	-9,110	-9,516
Cash Flow	Equity	9,052	0	0	336	1,552	2,187	3,099	1,878	0	0	0
	Yen-Loan	0	0	0	0	0	0	0	0	0	0	0
	Commercial-Loan	69,167	0	0	2,173	10,295	15,628	23,250	17,821	0	0	0
	Short-term Loan	6,274,753	0	0	0	0	0	0	0	0	8,419	12,612
	Net Profit after TAX	-390,291	0	0	0	0	0	0	308	-8,950	-9,110	-9,516
	Depreciation	126,945	0	0	0	0	0	0	1,900	1,900	1,900	1,900
	Initial Investment	78,219	0	0	2,509	11,847	17,816	26,349	19,698	0	0	0
	Renovation	77,310	0	0	0	0	0	0	0	0	0	0
	Additional Investment	77,310	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Yen-Loan)	0	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Commercial Loan)	69,167	0	0	0	0	0	0	0	3,577	4,078	4,648
	Principal Payment(Short-term Loan)	5,903,331	0	0	0	0	0	0	0	0	1,325	3,470
	Net Cash Flow	-115,712	0	0	0	0	0	0	2,208	-10,627	-4,194	-3,121
	Accumulative Cash Flow	-6,388,257	0	0	0	0	0	0	2,208	-8,419	-12,612	-15,734
Service Payment		8,374,892	0	0	0	0	0	0	0	13,260	15,596	19,095
Equity IRR		-2.90%	0	0	-336	-1,552	-2,187	-3,099	330	-10,627	-4,194	-3,121
Project IRR		-	0	0	-2,509	-11,847	-17,816	-26,349	-17,491	-10,627	-12,612	-15,734
DSCR		0.20	-	-	-	-	-	-	-	0.20	0.73	0.84
(Unit: billion IDR)			2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
P&L Statement	Fare Revenue		5,281	5,825	6,410	7,039	7,713	8,437	9,213	10,269	11,405	12,629
	Operation Cost		1,513	1,618	1,730	1,849	1,976	2,110	2,253	2,456	2,673	2,906
	Lease Cost		0	0	0	0	0	0	0	0	0	0
	Net Income		3,768	4,207	4,680	5,190	5,738	6,327	6,960	7,813	8,732	9,723
	Depreciation		1,900	1,900	1,900	1,900	1,900	1,900	2,026	2,026	2,233	2,233
	Interest Payment(Yen-Loan)		0	0	0	0	0	0	0	0	0	0
	Interest Payment(Commercial Loan)		7,961	7,219	6,373	5,409	4,310	3,057	1,628	0	0	0
	Interest Payment(Short-term Loan)		3,836	5,436	7,175	9,065	11,121	13,359	15,794	18,536	19,823	22,757
	Net Profit before TAX		-9,929	-10,348	-10,768	-11,185	-11,594	-11,989	-12,488	-12,749	-13,323	-15,268
	Corporate TAX		0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX		-9,929	-10,348	-10,768	-11,185	-11,594	-11,989	-12,488	-12,749	-13,323	-15,268
Cash Flow	Equity		0	0	0	0	0	0	0	0	0	0
	Yen-Loan		0	0	0	0	0	0	0	0	0	0
	Commercial-Loan		0	0	0	0	0	0	0	0	0	0
	Short-term Loan		15,734	19,691	24,715	31,098	36,880	43,063	50,055	58,603	53,134	71,692
	Net Profit after TAX		-9,929	-10,348	-10,768	-11,185	-11,594	-11,989	-12,488	-12,749	-13,323	-15,268
	Depreciation		1,900	1,900	1,900	1,900	1,900	1,900	2,026	2,026	2,233	2,233
	Initial Investment		0	0	0	0	0	0	0	0	0	0
	Renovation		0	0	0	0	0	0	379	0	6,682	0
	Additional Investment		0	0	0	0	0	0	379	0	6,682	0
	Principal Payment(Yen-Loan)		0	0	0	0	0	0	0	0	0	0
	Principal Payment(Commercial Loan)		5,299	6,041	6,887	7,851	8,950	10,203	11,632	0	0	0
	Principal Payment(Short-term Loan)		6,363	10,226	15,343	19,744	24,419	29,764	35,752	42,411	47,237	53,960
	Net Cash Flow		-3,957	-5,023	-6,383	-5,782	-6,184	-6,992	-8,547	5,469	-18,559	4,698
	Accumulative Cash Flow		-19,691	-24,715	-31,098	-36,880	-43,063	-50,055	-58,603	-53,134	-71,692	-66,994
Service Payment			23,459	28,922	35,778	42,069	48,801	56,383	64,806	60,947	67,060	76,717
Equity IRR			-3,957	-5,023	-6,383	-5,782	-6,184	-6,992	-8,547	5,469	-18,559	4,698
Project IRR			-19,691	-24,715	-31,098	-36,880	-43,063	-50,055	-58,603	-53,134	-71,692	-66,994
DSCR			0.83	0.83	0.82	0.86	0.87	0.88	0.87	1.09	0.72	1.06
(Unit: billion IDR)			2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
P&L Statement	Fare Revenue		13,945	15,359	16,879	18,511	20,262	22,140	24,154	26,071	28,117	30,301
	Operation Cost		3,156	3,422	3,708	4,013	4,339	4,687	5,059	5,297	5,545	5,806
	Lease Cost		0	0	0	0	0	0	0	0	0	0
	Net Income		10,789	11,937	13,171	14,498	15,923	17,453	19,095	20,774	22,572	24,496
	Depreciation		2,233	2,089	2,089	2,089	2,089	2,089	2,380	2,380	2,452	2,452
	Interest Payment(Yen-Loan)		0	0	0	0	0	0	0	0	0	0
	Interest Payment(Commercial Loan)		0	0	0	0	0	0	0	0	0	0
	Interest Payment(Short-term Loan)		24,321	25,945	28,046	29,831	31,671	33,561	35,494	38,165	40,251	42,946
	Net Profit before TAX		-15,765	-16,097	-16,964	-17,422	-17,837	-18,196	-18,778	-19,770	-20,132	-20,903
	Corporate TAX		0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX		-15,765	-16,097	-16,964	-17,422	-17,837	-18,196	-18,778	-19,770	-20,132	-20,903
Cash Flow	Equity		0	0	0	0	0	0	0	0	0	0
	Yen-Loan		0	0	0	0	0	0	0	0	0	0
	Commercial-Loan		0	0	0	0	0	0	0	0	0	0
	Short-term Loan		66,994	72,566	81,164	82,688	89,559	93,091	98,800	110,295	110,838	121,624
	Net Profit after TAX		-15,765	-16,097	-16,964	-17,422	-17,837	-18,196	-18,778	-19,770	-20,132	-20,903
	Depreciation		2,233	2,089	2,089	2,089	2,089	2,089	2,380	2,380	2,452	2,452
	Initial Investment		0	0	0	0	0	0	0	0	0	0
	Renovation		0	1,750	0	0	0	0	2,929	0	2,387	0
	Additional Investment		0	1,750	0	0	0	0	2,929	0	2,387	0
	Principal Payment(Yen-Loan)		0	0	0	0	0	0	0	0	0	0
	Principal Payment(Commercial Loan)		0	0	0	0	0	0	0	0	0	0
	Principal Payment(Short-term Loan)		59,034	63,655	67,813	74,227	77,343	82,693	88,037	93,448	99,170	105,371
	Net Cash Flow		-5,572	-8,597	-1,524	-6,872	-3,531	-5,709	-11,495	-543	-10,786	-2,197
	Accumulative Cash Flow		-72,566	-81,164	-82,688	-89,559	-93,091	-98,800	-110,295	-110,838	-121,624	-123,821
Service Payment			83,356	89,600	95,859	104,058	109,014	116,254	123,531	131,612	139,422	148,317
Equity IRR			-5,572	-8,597	-1,524	-6,872	-3,531	-5,709	-11,495	-543	-10,786	-2,197
Project IRR			-72,566	-81,164	-82,688	-89,559	-93,091	-98,800	-110,295	-110,838	-121,624	-123,821
DSCR			0.93	0.90	0.98	0.93	0.97	0.95	0.91	1.00	0.92	0.99

(Unit: billion IDR)		2044	2045	2046	2047	2048	2049	2050	2051	2052	2053
P&L Statement	Fare Revenue	32,632	35,119	37,771	40,598	43,612	46,824	50,246	53,890	57,771	61,904
	Operation Cost	6,078	6,364	6,662	6,975	7,302	7,645	8,004	8,407	8,831	9,277
	Lease Cost	0	0	0	0	0	0	0	0	0	0
	Net Income	26,554	28,755	31,108	33,623	36,310	39,179	42,242	45,483	48,940	52,627
	Depreciation	2,546	2,546	2,546	2,546	2,546	2,546	2,721	2,721	2,957	2,957
	Interest Payment(Yen-Loan)	0	0	0	0	0	0	0	0	0	0
	Interest Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0
	Interest Payment(Short-term Loan)	45,160	49,265	51,727	54,201	56,670	59,113	61,505	65,845	68,288	72,131
	Net Profit before TAX	−21,152	−23,056	−23,164	−23,123	−22,906	−22,480	−21,985	−23,083	−22,305	−22,461
	Corporate TAX	0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX	−21,152	−23,056	−23,164	−23,123	−22,906	−22,480	−21,985	−23,083	−22,305	−22,461
Cash Flow	Equity	0	0	0	0	0	0	0	0	0	0
	Yen-Loan	0	0	0	0	0	0	0	0	0	0
	Commercial-Loan	0	0	0	0	0	0	0	0	0	0
	Short-term Loan	123,821	145,893	141,150	147,357	154,973	161,537	169,131	189,410	182,661	201,674
	Net Profit after TAX	−21,152	−23,056	−23,164	−23,123	−22,906	−22,480	−21,985	−23,083	−22,305	−22,461
	Depreciation	2,546	2,546	2,546	2,546	2,546	2,546	2,721	2,721	2,957	2,957
	Initial Investment	0	0	0	0	0	0	0	0	0	0
	Renovation	7,803	0	0	0	0	0	8,448	0	6,338	0
	Additional Investment	7,803	0	0	0	0	0	8,448	0	6,338	0
	Principal Payment(Yen-Loan)	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Short-term Loan)	111,682	120,640	126,739	134,395	141,177	149,197	153,251	162,300	169,650	178,762
	Net Cash Flow	−22,072	4,743	−6,206	−7,616	−6,565	−7,594	−20,279	6,749	−19,013	3,408
	Accumulative Cash Flow	−145,893	−141,150	−147,357	−154,973	−161,537	−169,131	−189,410	−182,661	−201,674	−198,266
Service Payment		156,842	169,906	178,465	188,596	197,847	208,310	214,756	228,144	237,938	250,893
Equity IRR		−22,072	4,743	−6,206	−7,616	−6,565	−7,594	−20,279	6,749	−19,013	3,408
Project IRR		−145,893	−141,150	−147,357	−154,973	−161,537	−169,131	−189,410	−182,661	−201,674	−198,266
DSCR		0.86	1.03	0.97	0.96	0.97	0.96	0.91	1.03	0.92	1.01

(Unit: billion IDR)		2054	2055	2056	2057	2058	2059	2060	2061	2062	2063
P&L Statement	Fare Revenue	66,302	70,983	75,963	81,261	86,896	92,888	99,259	106,031	113,228	120,876
	Operation Cost	9,745	10,236	10,753	11,296	11,867	12,466	13,096	13,758	14,454	15,185
	Lease Cost	0	0	0	0	0	0	0	0	0	0
	Net Income	56,557	60,747	65,210	69,965	75,030	80,422	86,162	92,272	98,774	105,690
	Depreciation	2,990	2,990	3,099	3,099	3,099	3,099	3,064	3,064	3,107	3,107
	Interest Payment(Yen-Loan)	0	0	0	0	0	0	0	0	0	0
	Interest Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0
	Interest Payment(Short-term Loan)	74,471	77,290	79,275	83,150	84,732	85,896	86,553	87,510	86,990	86,083
	Net Profit before TAX	−20,904	−19,534	−17,164	−16,284	−12,801	−8,573	−3,455	1,698	8,677	16,501
	Corporate TAX	0	0	0	0	0	0	0	425	2,169	4,125
	Net Profit after TAX	−20,904	−19,534	−17,164	−16,284	−12,801	−8,573	−3,455	1,274	6,508	12,375
Cash Flow	Equity	0	0	0	0	0	0	0	0	0	0
	Yen-Loan	0	0	0	0	0	0	0	0	0	0
	Commercial-Loan	0	0	0	0	0	0	0	0	0	0
	Short-term Loan	198,266	210,100	211,701	231,642	222,253	222,898	224,339	230,134	221,977	216,599
	Net Profit after TAX	−20,904	−19,534	−17,164	−16,284	−12,801	−8,573	−3,455	1,274	6,508	12,375
	Depreciation	2,990	2,990	3,099	3,099	3,099	3,099	3,064	3,064	3,107	3,107
	Initial Investment	0	0	0	0	0	0	0	0	0	0
	Renovation	2,787	0	9,111	0	0	0	3,793	0	1,030	0
	Additional Investment	2,787	0	9,111	0	0	0	3,793	0	1,030	0
	Principal Payment(Yen-Loan)	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Short-term Loan)	186,611	195,157	199,356	209,069	213,196	218,865	222,158	226,314	224,154	223,492
	Net Cash Flow	−11,833	−1,601	−19,942	9,389	−645	−1,441	−5,795	8,158	5,377	8,590
	Accumulative Cash Flow	−210,100	−211,701	−231,642	−222,253	−222,898	−224,339	−230,134	−221,977	−216,599	−208,009
Service Payment		261,082	272,447	278,631	292,219	297,928	304,761	308,711	313,824	311,143	309,575
Equity IRR		−11,833	−1,601	−19,942	9,389	−645	−1,441	−5,795	8,158	5,377	8,590
Project IRR		−210,100	−211,701	−231,642	−222,253	−222,898	−224,339	−230,134	−221,977	−216,599	−208,009
DSCR		0.95	0.99	0.93	1.03	1.00	1.00	0.98	1.03	1.02	1.03

(Unit: billion IDR)		2064	2065	2066	2067	2068	2069
P&L Statement	Fare Revenue	129,001	137,633	146,801	156,536	166,874	177,848
	Operation Cost	15,954	16,761	17,610	18,502	19,439	20,425
	Lease Cost	0	0	0	0	0	0
	Net Income	113,047	120,871	129,191	138,034	147,434	157,424
	Depreciation	3,195	3,226	3,265	3,265	3,392	3,392
	Interest Payment(Yen-Loan)	0	0	0	0	0	0
	Interest Payment(Commercial Loan)	0	0	0	0	0	0
	Interest Payment(Short-term Loan)	84,225	83,311	80,453	76,750	71,136	66,721
	Net Profit before TAX	25,627	34,334	45,473	58,020	72,906	87,311
	Corporate TAX	6,407	8,584	11,368	14,505	18,227	21,828
	Net Profit after TAX	19,220	25,751	34,105	43,515	54,680	65,483
Cash Flow	Equity	0	0	0	0	0	0
	Yen-Loan	0	0	0	0	0	0
	Commercial-Loan	0	0	0	0	0	0
	Short-term Loan	208,009	213,605	195,336	181,500	158,055	157,413
	Net Profit after TAX	19,220	25,751	34,105	43,515	54,680	65,483
	Depreciation	3,195	3,226	3,265	3,265	3,392	3,392
	Initial Investment	0	0	0	0	0	0
	Renovation	7,401	2,578	3,255	0	10,638	0
	Additional Investment	7,401	2,578	3,255	0	10,638	0
	Principal Payment(Yen-Loan)	0	0	0	0	0	0
	Principal Payment(Commercial Loan)	0	0	0	0	0	0
	Principal Payment(Short-term Loan)	221,219	219,155	212,360	204,835	194,208	184,587
	Net Cash Flow	−5,596	18,270	13,835	23,445	642	41,701
	Accumulative Cash Flow	−213,605	−195,336	−181,500	−158,055	−157,413	−115,712
Service Payment		305,444	302,467	292,813	281,585	265,344	251,308
Equity IRR		−5,596	18,270	13,835	23,445	642	41,701
Project IRR		−213,605	−195,336	−181,500	−158,055	−157,413	−115,712
DSCR		0.98	1.06	1.05	1.08	1.00	1.17

Source: JICA Study Team



Source: JICA Study Team

Chart 14.3-12 Cash Flow of Project Operating Private Body (Private Project Case 2 (Land Acquisition Cost Charged to SPV), Cash Flow Analysis, Nominal Term, Unit: trillion IDR)

Table 14.3-14 Cash Flow of Project Operating Private Body (Private Project Case (Land Acquisition Cost Charged to SPV), Cash Flow Analysis, Nominal Term, Unit: trillion IDR)

(Unit: billion IDR)		Total	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
P&L Statement	Fare Revenue	2,605,115	0	0	0	0	0	0	3,462	3,867	4,304	4,774
	Operation Cost	378,328	0	0	0	0	0	0	1,151	1,233	1,321	1,414
	Lease Cost	0	0	0	0	0	0	0	0	0	0	0
	Net Income	2,226,787	0	0	0	0	0	0	2,310	2,634	2,983	3,361
	Depreciation	131,635	0	0	0	0	0	0	1,994	1,994	1,994	1,994
	Interest Payment(Yen-Loan)	0	0	0	0	0	0	0	0	0	0	0
	Interest Payment(Commercial Loan)	69,389	0	0	0	0	0	0	0	10,592	10,044	9,420
	Interest Payment(Short-term Loan)	4,108,174	0	0	0	0	0	0	0	0	1,157	2,678
	Net Profit before TAX	-2,082,411	0	0	0	0	0	0	316	-9,952	-10,212	-10,731
	Corporate TAX	79	0	0	0	0	0	0	79.10171209	0	0	0
	Net Profit after TAX	-2,082,491	0	0	0	0	0	0	237	-9,952	-10,212	-10,731
Cash Flow	Equity	9,756	0	0	680	1,912	2,187	3,099	1,878	0	0	0
	Yen-Loan	0	0	0	0	0	0	0	0	0	0	0
	Commercial-Loan	75,659	0	0	4,391	12,894	16,186	23,808	18,379	0	0	0
	Short-term Loan	11,561,303	0	0	0	0	0	0	0	0	9,640	14,196
	Net Profit after TAX	-2,082,491	0	0	0	0	0	0	237	-9,952	-10,212	-10,731
	Depreciation	131,635	0	0	0	0	0	0	1,994	1,994	1,994	1,994
	Initial Investment	85,414	0	0	5,071	14,807	18,374	26,907	20,257	0	0	0
	Renovation	77,310	0	0	0	0	0	0	0	0	0	0
	Additional Investment	77,310	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Yen-Loan)	0	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Commercial Loan)	75,659	0	0	0	0	0	0	0	3,913	4,460	5,085
	Principal Payment(Short-term Loan)	10,096,267	0	0	0	0	0	0	0	0	1,517	3,934
	Net Cash Flow	-716,099	0	0	0	0	0	0	2,231	-11,871	-4,556	-3,561
	Accumulative Cash Flow	-12,275,170	0	0	0	0	0	0	2,231	-9,640	-14,196	-17,756
Service Payment		14,349,489	0	0	0	0	0	0	0	14,505	17,179	21,117
Equity IRR		-	0	0	-680	-1,912	-2,187	-3,099	354	-11,871	-4,556	-3,561
Project IRR		-	0	0	-5,071	-14,807	-18,374	-26,907	-18,025	-11,871	-14,196	-17,756
DSCR		0.18	-	-	-	-	-	-	-	0.18	0.73	0.83
(Unit: billion IDR)			2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
P&L Statement	Fare Revenue		5,281	5,825	6,410	7,039	7,713	8,437	9,213	10,269	11,405	12,629
	Operation Cost		1,513	1,618	1,730	1,849	1,976	2,110	2,253	2,456	2,673	2,906
	Lease Cost		0	0	0	0	0	0	0	0	0	0
	Net Income		3,768	4,207	4,680	5,190	5,738	6,327	6,960	7,813	8,732	9,723
	Depreciation		1,994	1,994	1,994	1,994	1,994	1,994	2,120	2,120	2,327	2,327
	Interest Payment(Yen-Loan)		0	0	0	0	0	0	0	0	0	0
	Interest Payment(Commercial Loan)		8,708	7,897	6,971	5,917	4,714	3,344	1,781	0	0	0
	Interest Payment(Short-term Loan)		4,337	6,146	8,119	10,272	12,623	15,189	17,993	21,149	22,749	26,035
	Net Profit before TAX		-11,271	-11,829	-12,404	-12,993	-13,593	-14,200	-14,934	-15,456	-16,344	-18,639
	Corporate TAX		0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX		-11,271	-11,829	-12,404	-12,993	-13,593	-14,200	-14,934	-15,456	-16,344	-18,639
Cash Flow	Equity		0	0	0	0	0	0	0	0	0	0
	Yen-Loan		0	0	0	0	0	0	0	0	0	0
	Commercial-Loan		0	0	0	0	0	0	0	0	0	0
	Short-term Loan		17,756	22,275	28,015	35,314	41,926	49,071	57,169	66,972	61,665	81,421
	Net Profit after TAX		-11,271	-11,829	-12,404	-12,993	-13,593	-14,200	-14,934	-15,456	-16,344	-18,639
	Depreciation		1,994	1,994	1,994	1,994	1,994	1,994	2,120	2,120	2,327	2,327
	Initial Investment		0	0	0	0	0	0	0	0	0	0
	Renovation		0	0	0	0	0	0	379	0	6,682	0
	Additional Investment		0	0	0	0	0	0	379	0	6,682	0
	Principal Payment(Yen-Loan)		0	0	0	0	0	0	0	0	0	0
	Principal Payment(Commercial Loan)		5,797	6,608	7,533	8,588	9,790	11,161	12,724	0	0	0
	Principal Payment(Short-term Loan)		7,201	11,572	17,370	22,339	27,681	33,801	40,677	48,329	54,039	61,709
	Net Cash Flow		-4,519	-5,740	-7,299	-6,613	-7,145	-8,098	-9,804	5,307	-19,756	3,399
	Accumulative Cash Flow		-22,275	-28,015	-35,314	-41,926	-49,071	-57,169	-66,972	-61,665	-81,421	-78,021
Service Payment			26,043	32,222	39,994	47,116	54,809	63,496	73,175	69,478	76,788	87,744
Equity IRR			-4,519	-5,740	-7,299	-6,613	-7,145	-8,098	-9,804	5,307	-19,756	3,399
Project IRR			-22,275	-28,015	-35,314	-41,926	-49,071	-57,169	-66,972	-61,665	-81,421	-78,021
DSCR			0.83	0.82	0.82	0.86	0.87	0.87	0.87	1.08	0.74	1.04
(Unit: billion IDR)			2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
P&L Statement	Fare Revenue		13,945	15,359	16,879	18,511	20,262	22,140	24,154	26,071	28,117	30,301
	Operation Cost		3,156	3,422	3,708	4,013	4,339	4,687	5,059	5,297	5,545	5,806
	Lease Cost		0	0	0	0	0	0	0	0	0	0
	Net Income		10,789	11,937	13,171	14,498	15,923	17,453	19,095	20,774	22,572	24,496
	Depreciation		2,327	2,183	2,183	2,183	2,183	2,183	2,474	2,474	2,546	2,546
	Interest Payment(Yen-Loan)		0	0	0	0	0	0	0	0	0	0
	Interest Payment(Commercial Loan)		0	0	0	0	0	0	0	0	0	0
	Interest Payment(Short-term Loan)		27,993	30,057	32,651	34,989	37,448	40,031	42,740	46,281	49,341	53,127
	Net Profit before TAX		-19,530	-20,303	-21,663	-22,673	-23,707	-24,760	-26,119	-27,980	-29,316	-31,177
	Corporate TAX		0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX		-19,530	-20,303	-21,663	-22,673	-23,707	-24,760	-26,119	-27,980	-29,316	-31,177
Cash Flow	Equity		0	0	0	0	0	0	0	0	0	0
	Yen-Loan		0	0	0	0	0	0	0	0	0	0
	Commercial-Loan		0	0	0	0	0	0	0	0	0	0
	Short-term Loan		78,021	84,986	95,055	98,111	106,895	112,536	120,581	134,673	138,125	152,202
	Net Profit after TAX		-19,530	-20,303	-21,663	-22,673	-23,707	-24,760	-26,119	-27,980	-29,316	-31,177
	Depreciation		2,327	2,183	2,183	2,183	2,183	2,183	2,474	2,474	2,546	2,546
	Initial Investment		0	0	0	0	0	0	0	0	0	0
	Renovation		0	1,750	0	0	0	0	2,929	0	2,387	0
	Additional Investment		0	1,750	0	0	0	0	2,929	0	2,387	0
	Principal Payment(Yen-Loan)		0	0	0	0	0	0	0	0	0	0
	Principal Payment(Commercial Loan)		0	0	0	0	0	0	0	0	0	0
	Principal Payment(Short-term Loan)		67,783	73,435	78,631	86,404	91,012	98,003	105,169	112,618	120,658	129,441
	Net Cash Flow		-6,964	-10,069	-3,056	-8,784	-5,642	-8,045	-14,092	-3,452	-14,077	-5,870
	Accumulative Cash Flow		-84,986	-95,055	-98,111	-106,895	-112,536	-120,581	-134,673	-138,125	-152,202	-158,072
Service Payment			95,775	103,492	111,282	121,393	128,459	138,034	147,909	158,899	169,999	182,568
Equity IRR			-6,964	-10,069	-3,056	-8,784	-5,642	-8,045	-14,092	-3,452	-14,077	-5,870
Project IRR			-84,986	-95,055	-98,111	-106,895	-112,536	-120,581	-134,673	-138,125	-152,202	-158,072
DSCR			0.93	0.90	0.97	0.93	0.96	0.94	0.90	0.98	0.92	0.97

(Unit: billion IDR)		2044	2045	2046	2047	2048	2049	2050	2051	2052	2053
P&L Statement	Fare Revenue	32,632	35,119	37,771	40,598	43,612	46,824	50,246	53,890	57,771	61,904
	Operation Cost	6,078	6,364	6,662	6,975	7,302	7,645	8,004	8,407	8,831	9,277
	Lease Cost	0	0	0	0	0	0	0	0	0	0
	Net Income	26,554	28,755	31,108	33,623	36,310	39,179	42,242	45,483	48,940	52,627
	Depreciation	2,640	2,640	2,640	2,640	2,640	2,640	2,815	2,815	3,051	3,051
	Interest Payment(Yen-Loan)	0	0	0	0	0	0	0	0	0	0
	Interest Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0
	Interest Payment(Short-term Loan)	56,562	62,036	66,030	70,220	74,612	79,208	84,012	91,052	96,520	103,751
	Net Profit before TAX	-32,648	-35,921	-37,561	-39,237	-40,942	-42,669	-44,585	-48,384	-50,631	-54,174
	Corporate TAX	0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX	-32,648	-35,921	-37,561	-39,237	-40,942	-42,669	-44,585	-48,384	-50,631	-54,174
Cash Flow	Equity	0	0	0	0	0	0	0	0	0	0
	Yen-Loan	0	0	0	0	0	0	0	0	0	0
	Commercial-Loan	0	0	0	0	0	0	0	0	0	0
	Short-term Loan	158,072	184,252	184,108	195,468	208,861	221,893	236,728	265,118	267,454	296,643
	Net Profit after TAX	-32,648	-35,921	-37,561	-39,237	-40,942	-42,669	-44,585	-48,384	-50,631	-54,174
	Depreciation	2,640	2,640	2,640	2,640	2,640	2,640	2,815	2,815	3,051	3,051
	Initial Investment	0	0	0	0	0	0	0	0	0	0
	Renovation	7,803	0	0	0	0	0	8,448	0	6,338	0
	Additional Investment	7,803	0	0	0	0	0	8,448	0	6,338	0
	Principal Payment(Yen-Loan)	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Short-term Loan)	138,638	150,827	160,547	172,264	183,590	196,698	206,452	221,885	236,387	253,507
	Net Cash Flow	-26,179	144	-11,361	-13,393	-13,031	-14,835	-28,390	-2,336	-29,189	-7,988
	Accumulative Cash Flow	-184,252	-184,108	-195,468	-208,861	-221,893	-236,728	-265,118	-267,454	-296,643	-304,631
Service Payment		195,200	212,863	226,577	242,484	258,202	275,907	290,464	312,937	332,907	357,258
Equity IRR		-26,179	144	-11,361	-13,393	-13,031	-14,835	-28,390	-2,336	-29,189	-7,988
Project IRR		-184,252	-184,108	-195,468	-208,861	-221,893	-236,728	-265,118	-267,454	-296,643	-304,631
DSCR		0.87	1.00	0.95	0.94	0.95	0.95	0.90	0.99	0.91	0.98

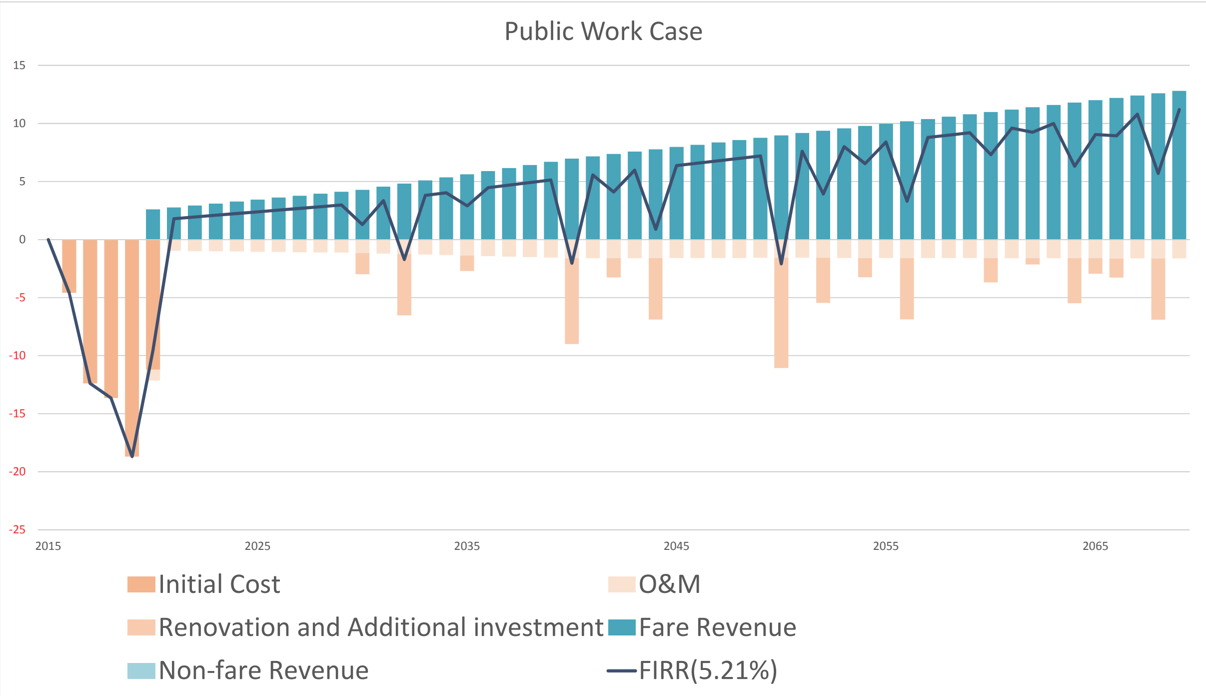
(Unit: billion IDR)		2054	2055	2056	2057	2058	2059	2060	2061	2062	2063
P&L Statement	Fare Revenue	66,302	70,983	75,963	81,261	86,896	92,888	99,259	106,031	113,228	120,876
	Operation Cost	9,745	10,236	10,753	11,296	11,867	12,466	13,096	13,758	14,454	15,185
	Lease Cost	0	0	0	0	0	0	0	0	0	0
	Net Income	56,557	60,747	65,210	69,965	75,030	80,422	86,162	92,272	98,774	105,690
	Depreciation	3,084	3,084	3,193	3,193	3,193	3,193	3,158	3,158	3,201	3,201
	Interest Payment(Yen-Loan)	0	0	0	0	0	0	0	0	0	0
	Interest Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0
	Interest Payment(Short-term Loan)	109,886	116,954	123,699	132,904	140,457	148,308	156,454	165,800	174,623	183,972
	Net Profit before TAX	-56,412	-59,292	-61,682	-66,132	-68,620	-71,079	-73,450	-76,685	-79,050	-81,482
	Corporate TAX	0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX	-56,412	-59,292	-61,682	-66,132	-68,620	-71,079	-73,450	-76,685	-79,050	-81,482
Cash Flow	Equity	0	0	0	0	0	0	0	0	0	0
	Yen-Loan	0	0	0	0	0	0	0	0	0	0
	Commercial-Loan	0	0	0	0	0	0	0	0	0	0
	Short-term Loan	304,631	329,228	345,124	381,077	389,620	410,349	434,284	465,273	484,907	509,270
	Net Profit after TAX	-56,412	-59,292	-61,682	-66,132	-68,620	-71,079	-73,450	-76,685	-79,050	-81,482
	Depreciation	3,084	3,084	3,193	3,193	3,193	3,193	3,158	3,158	3,201	3,201
	Initial Investment	0	0	0	0	0	0	0	0	0	0
	Renovation	2,787	0	9,111	0	0	0	3,793	0	1,030	0
	Additional Investment	2,787	0	9,111	0	0	0	3,793	0	1,030	0
	Principal Payment(Yen-Loan)	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Short-term Loan)	270,325	288,917	304,367	326,682	344,922	366,398	387,395	411,380	431,360	455,203
	Net Cash Flow	-24,597	-15,896	-35,953	-8,543	-20,729	-23,935	-30,989	-19,635	-24,363	-24,215
	Accumulative Cash Flow	-329,228	-345,124	-381,077	-389,620	-410,349	-434,284	-465,273	-484,907	-509,270	-533,485
Service Payment		380,211	405,871	428,066	459,586	485,379	514,706	543,849	577,180	605,983	639,175
Equity IRR		-24,597	-15,896	-35,953	-8,543	-20,729	-23,935	-30,989	-19,635	-24,363	-24,215
Project IRR		-329,228	-345,124	-381,077	-389,620	-410,349	-434,284	-465,273	-484,907	-509,270	-533,485
DSCR		0.94	0.96	0.92	0.98	0.96	0.95	0.94	0.97	0.96	0.96

(Unit: billion IDR)		2064	2065	2066	2067	2068	2069
P&L Statement	Fare Revenue	129,001	137,633	146,801	156,536	166,874	177,848
	Operation Cost	15,954	16,761	17,610	18,502	19,439	20,425
	Lease Cost	0	0	0	0	0	0
	Net Income	113,047	120,871	129,191	138,034	147,434	157,424
	Depreciation	3,289	3,319	3,358	3,358	3,486	3,486
	Interest Payment(Yen-Loan)	0	0	0	0	0	0
	Interest Payment(Commercial Loan)	0	0	0	0	0	0
	Interest Payment(Short-term Loan)	193,366	204,780	215,468	226,603	237,231	250,560
	Net Profit before TAX	-83,608	-87,228	-89,636	-91,927	-93,282	-96,622
	Corporate TAX	0	0	0	0	0	0
	Net Profit after TAX	-83,608	-87,228	-89,636	-91,927	-93,282	-96,622
Cash Flow	Equity	0	0	0	0	0	0
	Yen-Loan	0	0	0	0	0	0
	Commercial-Loan	0	0	0	0	0	0
	Short-term Loan	533,485	575,088	596,680	626,167	650,001	700,917
	Net Profit after TAX	-83,608	-87,228	-89,636	-91,927	-93,282	-96,622
	Depreciation	3,289	3,319	3,358	3,358	3,486	3,486
	Initial Investment	0	0	0	0	0	0
	Renovation	7,401	2,578	3,255	0	10,638	0
	Additional Investment	7,401	2,578	3,255	0	10,638	0
	Principal Payment(Yen-Loan)	0	0	0	0	0	0
	Principal Payment(Commercial Loan)	0	0	0	0	0	0
	Principal Payment(Short-term Loan)	479,968	507,614	533,380	561,432	589,844	622,963
	Net Cash Flow	-41,603	-21,592	-29,487	-23,833	-50,917	-15,181
	Accumulative Cash Flow	-575,088	-596,680	-626,167	-650,001	-700,917	-716,099
Service Payment		673,334	712,395	748,848	788,035	827,075	873,522
Equity IRR		-41,603	-21,592	-29,487	-23,833	-50,917	-15,181
Project IRR		-575,088	-596,680	-626,167	-650,001	-700,917	-716,099
DSCR		0.94	0.97	0.96	0.97	0.94	0.98

Source: JICA Study Team

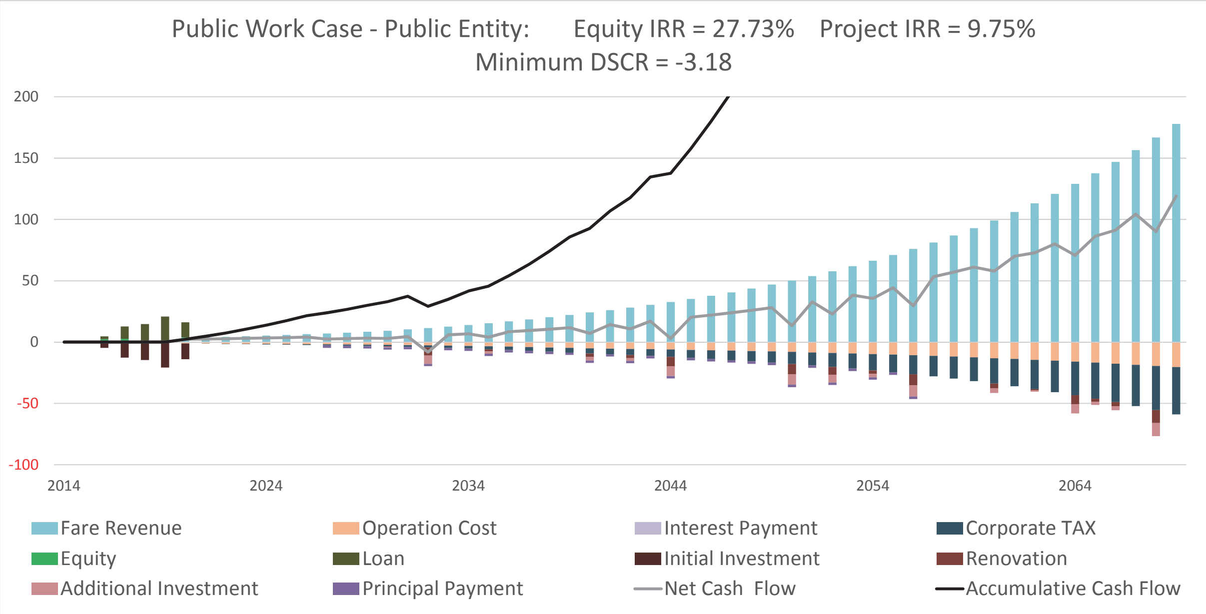
14.3.4 Reference – Public Work Case

Shown below is the financial analysis of the "public works type" case in which the public sector conducts the whole part of the project through Yen loan without separating operation from infrastructure. The positive value of FIRR 5.21% suggests the project is evaluated to be financially viable. The Equity IRR of 27.73% also supports financial feasibility in terms of financing. Note that the DSCR may go below 1.0 in years in which large-scale renovation need arises, in which case in terms of accounting the cash shortage for higher debt service can be covered by reserve fund thanks to positive cumulative cash flow throughout the project period.



Source: JICA Study Team

Chart 14.3-13 FIRR of Reference Case (Public Works Case, FIRR, Real Term, Unit: trillion IDR)



Source: JICA Study Team

Chart 14.3-14 Cash Flow of Reference Case (Public Works Case, Cash Flow Analysis, Nominal Term, Unit: trillion IDR)

Table 14.3-14 Cash Flow of Project Developing State-owned Enterprise (Public Work Case, Cash Flow Analysis, Nominal Term, Unit: trillion IDR)

(Unit: billion IDR)		Total	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
P&L Statement	Fare Revenue	2,605,115	0	0	0	0	0	0	3,462	3,867	4,304	4,774
	Operation Cost	378,328	0	0	0	0	0	0	1,151	1,233	1,321	1,414
	Net Income	2,226,787	0	0	0	0	0	0	2,310	2,634	2,983	3,361
	Depreciation	131,635	0	0	0	0	0	0	1,994	1,994	1,994	1,994
	Interest Payment(Yen-Loan)	923	0	0	0	0	0	0	0	0	0	0
	Interest Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0	0
	Interest Payment(Short-term Loan)	0	0	0	0	0	0	0	0	0	0	0
	Net Profit before TAX	2,094,228	0	0	0	0	0	0	316	640	989	1,367
	Corporate TAX	523,557	0	0	0	0	0	0	79	160	247	342
	Net Profit after TAX	1,570,671	0	0	0	0	0	0	237	480	742	1,025
Cash Flow	Equity	6,318	0	0	2,394	2,619	336	499	471	0	0	0
	Yen-Loan	59,276	0	0	2,261	10,168	14,326	20,298	12,223	0	0	0
	Commercial Loan	0	0	0	0	0	0	0	0	0	0	0
	Short-term Loan	0	0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX	1,570,671	0	0	0	0	0	0	237	480	742	1,025
	Depreciation	131,635	0	0	0	0	0	0	1,994	1,994	1,994	1,994
	Initial Investment	65,594	0	0	4,656	12,787	14,662	20,797	12,693	0	0	0
	Renovation	77,310	0	0	0	0	0	0	0	0	0	0
	Additional Investment	77,310	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Yen-Loan)	59,276	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Short-term Loan)	0	0	0	0	0	0	0	0	0	0	0
	Net Cash Flow	1,488,410	0	0	0	0	0	0	2,231	2,474	2,736	3,019
	Accumulative Cash Flow	17,263,951	0	0	0	0	0	0	2,231	4,705	7,441	10,460
Service Payment		59,276	0	0	0	0	0	0	0	0	0	0
Equirt IRR		27.73%	0	0	-2,394	-2,619	-336	-499	1,761	2,474	2,736	3,019
Project IRR		9.75%	0	0	-4,656	-12,787	-14,662	-20,797	-10,462	2,474	2,736	3,019
DSCR		-3.18	-	-	-	-	-	-	-	-	-	-
(Unit: billion IDR)			2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
P&L Statement	Fare Revenue		5,281	5,825	6,410	7,039	7,713	8,437	9,213	10,269	11,405	12,629
	Operation Cost		1,513	1,618	1,730	1,849	1,976	2,110	2,253	2,456	2,673	2,906
	Net Income		3,768	4,207	4,680	5,190	5,738	6,327	6,960	7,813	8,732	9,723
	Depreciation		1,994	1,994	1,994	1,994	1,994	1,994	2,120	2,120	2,327	2,327
	Interest Payment(Yen-Loan)		0	0	0	59	57	55	53	51	50	48
	Interest Payment(Commercial Loan)		0	0	0	0	0	0	0	0	0	0
	Interest Payment(Short-term Loan)		0	0	0	0	0	0	0	0	0	0
	Net Profit before TAX		1,774	2,213	2,686	3,137	3,687	4,278	4,787	5,642	6,356	7,348
	Corporate TAX		444	553	672	784	922	1,069	1,197	1,410	1,589	1,837
	Net Profit after TAX		1,331	1,660	2,015	2,352	2,765	3,208	3,590	4,231	4,767	5,511
Cash Flow	Equity		0	0	0	0	0	0	0	0	0	0
	Yen-Loan		0	0	0	0	0	0	0	0	0	0
	Commercial Loan		0	0	0	0	0	0	0	0	0	0
	Short-term Loan		0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX		1,331	1,660	2,015	2,352	2,765	3,208	3,590	4,231	4,767	5,511
	Depreciation		1,994	1,994	1,994	1,994	1,994	1,994	2,120	2,120	2,327	2,327
	Initial Investment		0	0	0	0	0	0	0	0	0	0
	Renovation		0	0	0	0	0	0	379	0	6,682	0
	Additional Investment		0	0	0	0	0	0	379	0	6,682	0
	Principal Payment(Yen-Loan)		0	0	0	1,947	1,949	1,951	1,953	1,955	1,957	1,959
	Principal Payment(Commercial Loan)		0	0	0	0	0	0	0	0	0	0
	Principal Payment(Short-term Loan)		0	0	0	0	0	0	0	0	0	0
	Net Cash Flow		3,324	3,654	4,009	2,399	2,809	3,251	3,000	4,396	-8,228	5,879
	Accumulative Cash Flow		13,784	17,438	21,447	23,845	26,655	29,906	32,906	37,301	29,073	34,952
Service Payment			0	0	0	1,947	1,949	1,951	1,953	1,955	1,957	1,959
Equirt IRR			3,324	3,654	4,009	2,399	2,809	3,251	3,000	4,396	-8,228	5,879
Project IRR			3,324	3,654	4,009	2,399	2,809	3,251	3,000	4,396	-8,228	5,879
DSCR			-	-	-	2	2	3	3	3	-3	4
(Unit: billion IDR)			2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
P&L Statement	Fare Revenue		13,945	15,359	16,879	18,511	20,262	22,140	24,154	26,071	28,117	30,301
	Operation Cost		3,156	3,422	3,708	4,013	4,339	4,687	5,059	5,297	5,545	5,806
	Net Income		10,789	11,937	13,171	14,498	15,923	17,453	19,095	20,774	22,572	24,496
	Depreciation		2,327	2,183	2,183	2,183	2,183	2,183	2,474	2,474	2,546	2,546
	Interest Payment(Yen-Loan)		46	44	42	40	38	36	34	32	30	28
	Interest Payment(Commercial Loan)		0	0	0	0	0	0	0	0	0	0
	Interest Payment(Short-term Loan)		0	0	0	0	0	0	0	0	0	0
	Net Profit before TAX		8,417	9,711	10,947	12,276	13,703	15,235	16,588	18,269	19,996	21,921
	Corporate TAX		2,104	2,428	2,737	3,069	3,426	3,809	4,147	4,567	4,999	5,480
	Net Profit after TAX		6,313	7,283	8,210	9,207	10,277	11,426	12,441	13,701	14,997	16,441
Cash Flow	Equity		0	0	0	0	0	0	0	0	0	0
	Yen-Loan		0	0	0	0	0	0	0	0	0	0
	Commercial Loan		0	0	0	0	0	0	0	0	0	0
	Short-term Loan		0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX		6,313	7,283	8,210	9,207	10,277	11,426	12,441	13,701	14,997	16,441
	Depreciation		2,327	2,183	2,183	2,183	2,183	2,183	2,474	2,474	2,546	2,546
	Initial Investment		0	0	0	0	0	0	0	0	0	0
	Renovation		0	1,750	0	0	0	0	2,929	0	2,387	0
	Additional Investment		0	1,750	0	0	0	0	2,929	0	2,387	0
	Principal Payment(Yen-Loan)		1,961	1,963	1,965	1,967	1,969	1,971	1,973	1,975	1,977	1,979
	Principal Payment(Commercial Loan)		0	0	0	0	0	0	0	0	0	0
	Principal Payment(Short-term Loan)		0	0	0	0	0	0	0	0	0	0
	Net Cash Flow		6,678	4,003	8,428	9,423	10,491	11,638	7,083	14,200	10,792	17,009
	Accumulative Cash Flow		41,630	45,633	54,061	63,484	73,975	85,613	92,695	106,895	117,687	134,696
Service Payment			1,961	1,963	1,965	1,967	1,969	1,971	1,973	1,975	1,977	1,979
Equirt IRR			6,678	4,003	8,428	9,423	10,491	11,638	7,083	14,200	10,792	17,009
Project IRR			6,678	4,003	8,428	9,423	10,491	11,638	7,083	14,200	10,792	17,009
DSCR			4.43	3.06	5.31	5.81	6.35	6.92	4.61	8.21	6.47	9.61

(Unit: billion IDR)		2044	2045	2046	2047	2048	2049	2050	2051	2052	2053
P&L Statement	Fare Revenue	32,632	35,119	37,771	40,598	43,612	46,824	50,246	53,890	57,771	61,904
	Operation Cost	6,078	6,364	6,662	6,975	7,302	7,645	8,004	8,407	8,831	9,277
	Net Income	26,554	28,755	31,108	33,623	36,310	39,179	42,242	45,483	48,940	52,627
	Depreciation	2,640	2,640	2,640	2,640	2,640	2,640	2,815	2,815	3,051	3,051
	Interest Payment(Yen-Loan)	26	24	22	20	18	16	14	12	10	8
	Interest Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0
	Interest Payment(Short-term Loan)	0	0	0	0	0	0	0	0	0	0
	Net Profit before TAX	23,888	26,092	28,447	30,964	33,652	36,523	39,413	42,656	45,880	49,568
	Corporate TAX	5,972	6,523	7,112	7,741	8,413	9,131	9,853	10,664	11,470	12,392
	Net Profit after TAX	17,916	19,569	21,335	23,223	25,239	27,392	29,559	31,992	34,410	37,176
Cash Flow	Equity	0	0	0	0	0	0	0	0	0	0
	Yen-Loan	0	0	0	0	0	0	0	0	0	0
	Commercial Loan	0	0	0	0	0	0	0	0	0	0
	Short-term Loan	0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX	17,916	19,569	21,335	23,223	25,239	27,392	29,559	31,992	34,410	37,176
	Depreciation	2,640	2,640	2,640	2,640	2,640	2,640	2,815	2,815	3,051	3,051
	Initial Investment	0	0	0	0	0	0	0	0	0	0
	Renovation	7,803	0	0	0	0	0	8,448	0	6,338	0
	Additional Investment	7,803	0	0	0	0	0	8,448	0	6,338	0
	Principal Payment(Yen-Loan)	1,981	1,983	1,985	1,987	1,989	1,991	1,993	1,995	1,997	1,999
	Principal Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Short-term Loan)	0	0	0	0	0	0	0	0	0	0
	Net Cash Flow	2,970	20,226	21,990	23,876	25,890	28,041	13,486	32,812	22,787	38,228
	Accumulative Cash Flow	137,665	157,891	179,881	203,757	229,647	257,688	271,174	303,987	326,774	365,002
Service Payment		1,981	1,983	1,985	1,987	1,989	1,991	1,993	1,995	1,997	1,999
Equirt IRR		2,970	20,226	21,990	23,876	25,890	28,041	13,486	32,812	22,787	38,228
Project IRR		2,970	20,226	21,990	23,876	25,890	28,041	13,486	32,812	22,787	38,228
DSCR		2.51	11.21	12.09	13.03	14.03	15.09	7.78	17.46	12.42	20.13

(Unit: billion IDR)		2054	2055	2056	2057	2058	2059	2060	2061	2062	2063
P&L Statement	Fare Revenue	66,302	70,983	75,963	81,261	86,896	92,888	99,259	106,031	113,228	120,876
	Operation Cost	9,745	10,236	10,753	11,296	11,867	12,466	13,096	13,758	14,454	15,185
	Net Income	56,557	60,747	65,210	69,965	75,030	80,422	86,162	92,272	98,774	105,690
	Depreciation	3,084	3,084	3,193	3,193	3,193	3,193	3,158	3,158	3,201	3,201
	Interest Payment(Yen-Loan)	6	4	2	0	0	0	0	0	0	0
	Interest Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0
	Interest Payment(Short-term Loan)	0	0	0	0	0	0	0	0	0	0
	Net Profit before TAX	53,467	57,658	62,015	66,772	71,836	77,229	83,005	89,114	95,573	102,490
	Corporate TAX	13,367	14,415	15,504	16,693	17,959	19,307	20,751	22,279	23,893	25,622
	Net Profit after TAX	40,101	43,244	46,511	50,079	53,877	57,922	62,253	66,836	71,680	76,867
Cash Flow	Equity	0	0	0	0	0	0	0	0	0	0
	Yen-Loan	0	0	0	0	0	0	0	0	0	0
	Commercial Loan	0	0	0	0	0	0	0	0	0	0
	Short-term Loan	0	0	0	0	0	0	0	0	0	0
	Net Profit after TAX	40,101	43,244	46,511	50,079	53,877	57,922	62,253	66,836	71,680	76,867
	Depreciation	3,084	3,084	3,193	3,193	3,193	3,193	3,158	3,158	3,201	3,201
	Initial Investment	0	0	0	0	0	0	0	0	0	0
	Renovation	2,787	0	9,111	0	0	0	3,793	0	1,030	0
	Additional Investment	2,787	0	9,111	0	0	0	3,793	0	1,030	0
	Principal Payment(Yen-Loan)	2,001	2,003	2,005	0	0	0	0	0	0	0
	Principal Payment(Commercial Loan)	0	0	0	0	0	0	0	0	0	0
	Principal Payment(Short-term Loan)	0	0	0	0	0	0	0	0	0	0
	Net Cash Flow	35,609	44,325	29,478	53,272	57,070	61,115	57,825	69,994	72,820	80,068
	Accumulative Cash Flow	400,611	444,937	474,415	527,687	584,757	645,872	703,698	773,691	846,511	926,579
Service Payment		2,001	2,003	2,005	0	0	0	0	0	0	0
Equirt IRR		35,609	44,325	29,478	53,272	57,070	61,115	57,825	69,994	72,820	80,068
Project IRR		35,609	44,325	29,478	53,272	57,070	61,115	57,825	69,994	72,820	80,068
DSCR		18.80	23.14	15.71	-	-	-	-	-	-	-

(Unit: billion IDR)		2064	2065	2066	2067	2068	2069
P&L Statement	Fare Revenue	129,001	137,633	146,801	156,536	166,874	177,848
	Operation Cost	15,954	16,761	17,610	18,502	19,439	20,425
	Net Income	113,047	120,871	129,191	138,034	147,434	157,424
	Depreciation	3,289	3,319	3,358	3,358	3,486	3,486
	Interest Payment(Yen-Loan)	0	0	0	0	0	0
	Interest Payment(Commercial Loan)	0	0	0	0	0	0
	Interest Payment(Short-term Loan)	0	0	0	0	0	0
	Net Profit before TAX	109,758	117,552	125,832	134,676	143,949	153,938
	Corporate TAX	27,440	29,388	31,458	33,669	35,987	38,485
	Net Profit after TAX	82,319	88,164	94,374	101,007	107,962	115,454
Cash Flow	Equity	0	0	0	0	0	0
	Yen-Loan	0	0	0	0	0	0
	Commercial Loan	0	0	0	0	0	0
	Short-term Loan	0	0	0	0	0	0
	Net Profit after TAX	82,319	88,164	94,374	101,007	107,962	115,454
	Depreciation	3,289	3,319	3,358	3,358	3,486	3,486
	Initial Investment	0	0	0	0	0	0
	Renovation	7,401	2,578	3,255	0	10,638	0
	Additional Investment	7,401	2,578	3,255	0	10,638	0
	Principal Payment(Yen-Loan)	0	0	0	0	0	0
	Principal Payment(Commercial Loan)	0	0	0	0	0	0
	Principal Payment(Short-term Loan)	0	0	0	0	0	0
	Net Cash Flow	70,806	86,327	91,223	104,365	90,171	118,939
	Accumulative Cash Flow	997,385	1,083,712	1,174,935	1,279,300	1,369,471	1,488,410
Service Payment		0	0	0	0	0	0
Equirt IRR		70,806	86,327	91,223	104,365	90,171	118,939
Project IRR		70,806	86,327	91,223	104,365	90,171	118,939
DSCR		-	-	-	-	-	-

Source: JICA Study Team

14.4 Economic Analysis

14.4.1 Preconditions

In this section, feasibility of the project execution plan as has been shown shall be confirmed from the economic perspective. Specifically, economic feasibility of the project will be evaluated using estimation results of economical internal rate of return (FIRR), benefit cost ratio (B/C), and net present value (NPV).

(1) Project period

The project period is set to 50 years, in consideration of factors such as facility lifetime.

(2) Exchange rate (respecified)

The exchange rates are set as below, in accordance with the tentative JICA Yen loan evaluation criteria for Indonesia in FY2013.

・USD/JPY 1 USD ＝ 99.24 JPY
・USD/IDR 1 USD ＝ 9,697.3 IDR
・IDR/JPY 1 IDR = 0.001023 JPY

(3) Without HSR Case

For the “Without HSR Case” which is to be utilized as a base case for comparison, the case without the HSR project whence only the current transportation system continues to be available is used in conducting the economic analysis.

(4) Social Discount Rate

Based on other similar projects and economic analysis given by ADB, the social discount rate is set to be 12%.

(5) Cost

As the cost of project we will use the economic price to which neither VAT nor internal tariff are applied.

(6) Benefit

Factors considered to be the benefits attributable to the project are: 1) supplier’s benefit of fare revenue and 2) passenger’s benefit of reduced travel time and reduced cost of travel for those switching transport modes. Below are the specific values set.

1) Supplier’s Benefit (Fare Revenue)

Based on the results of demand forecast given above the fare revenue is defined to be the sum of the number of HSR users multiplied by the fare amount for each path between zones. As the forecast is conducted only on 2020, 2030, 2040 and 2050 for the interval times between these times the fare revenue values are linearly supplemented. For substitutes in the period after 2050, the 2040 to 2050 growth rate is applied.

2) Benefit of Reduced Travel Time

The benefit is defined to be the difference between the travel time for HSR users and that for users in "Without HSR Case" multiplied by the value of time. The value of time is 77,001/hour (FY2014 standard) which is based upon the METI report of last year.

3) Benefit of Reduced Cost of Car Travel

For users who switch from automobiles to HSR the benefit of reduced car use cost is taken into account. As the basic unit for the calculation we used the preceding JICA report last year, in which a passenger car (carrying 3 persons) costs 3,356 IDR/vehicle-km, a small bus (carrying 5 persons) costs 1,670 IDR/vehicle-km and a large bus (carrying 15 persons) costs 2,684 IDR/vehicle-km.

14.4.2 Result of the Analysis

The economic analysis yielded evaluation results in support of economic feasibility. The EIRR was computed as 12.50% which is larger than social discount rate of 12%.

・EIRR=12.50%

・NPV=2.08 trillion IDR (approximately 21.3 billion JPY)

・B/C=1.05

Table 14.4-1 Results of Economic Analysis

Discount Rate= 12.00%

(billion IDR)

Year	Initial Cost	O&M	Renovation and Additional investment	Fare Revenue	Non-fare Revenue	Benefit(Travel Time Reduction)	Benefit(Car-operation Cost Reduction)	Discouted Cash Flow	Present Value(2014) Cost	Present Value(2014) Benefit
2014	0	0	0	0	0	0	0	0	0	0
2015	0	0	0	0	0	0	0	0	0	0
2016	-4,143	0	0	0	0	0	0	-4,143	-3,303	0
2017	-11,225	0	0	0	0	0	0	-11,225	-7,990	0
2018	-12,518	0	0	0	0	0	0	-12,518	-7,955	0
2019	-17,259	0	0	0	0	0	0	-17,259	-9,793	0
2020	-10,546	-864	0	2,362	0	1,733	1,667	-5,649	-5,781	2,919
2021	0	-882	0	2,515	0	1,846	1,764	5,244	-399	2,771
2022	0	-901	0	2,669	0	1,960	1,862	5,590	-364	2,622
2023	0	-919	0	2,822	0	2,074	1,960	5,936	-331	2,472
2024	0	-938	0	2,975	0	2,187	2,058	6,283	-302	2,325
2025	0	-956	0	3,129	0	2,301	2,155	6,629	-275	2,181
2026	0	-974	0	3,282	0	2,415	2,253	6,976	-250	2,041
2027	0	-993	0	3,436	0	2,528	2,351	7,322	-228	1,906
2028	0	-1,011	0	3,589	0	2,642	2,449	7,669	-207	1,776
2029	0	-1,030	0	3,743	0	2,756	2,546	8,015	-188	1,652
2030	0	-1,048	-1,817	3,896	0	2,869	2,644	6,545	-467	1,535
2031	0	-1,089	0	4,139	0	3,037	2,820	8,907	-159	1,456
2032	0	-1,130	-5,044	4,383	0	3,205	2,995	4,409	-803	1,376
2033	0	-1,171	0	4,626	0	3,373	3,171	9,999	-136	1,297
2034	0	-1,212	0	4,870	0	3,541	3,346	10,545	-126	1,219
2035	0	-1,253	-1,271	5,113	0	3,709	3,522	9,820	-234	1,143
2036	0	-1,294	0	5,357	0	3,877	3,697	11,637	-107	1,069
2037	0	-1,335	0	5,600	0	4,045	3,873	12,183	-99	997
2038	0	-1,376	0	5,844	0	4,213	4,048	12,728	-91	929
2039	0	-1,417	0	6,087	0	4,381	4,224	13,274	-83	864
2040	0	-1,459	-7,217	6,330	0	4,549	4,399	6,603	-456	802
2041	0	-1,456	0	6,514	0	4,680	4,528	14,266	-68	737
2042	0	-1,453	-1,584	6,697	0	4,810	4,658	13,128	-127	677
2043	0	-1,450	0	6,880	0	4,941	4,787	15,158	-54	621
2044	0	-1,447	-5,044	7,063	0	5,072	4,916	10,560	-217	569
2045	0	-1,444	0	7,246	0	5,203	5,045	16,050	-43	521
2046	0	-1,441	0	7,429	0	5,333	5,175	16,496	-38	477
2047	0	-1,439	0	7,612	0	5,464	5,304	16,942	-34	437
2048	0	-1,436	0	7,796	0	5,595	5,433	17,388	-30	399
2049	0	-1,433	0	7,979	0	5,725	5,563	17,834	-27	365
2050	0	-1,430	-9,075	8,162	0	5,856	5,692	9,205	-178	333
2051	0	-1,432	0	8,345	0	5,990	5,824	18,727	-22	304
2052	0	-1,434	-3,695	8,528	0	6,126	5,960	15,485	-69	278
2053	0	-1,436	0	8,711	0	6,266	6,098	19,640	-17	254
2054	0	-1,438	-1,584	8,894	0	6,409	6,240	18,522	-32	232
2055	0	-1,440	0	9,078	0	6,556	6,385	20,578	-14	211
2056	0	-1,442	-5,044	9,261	0	6,705	6,533	16,013	-56	193
2057	0	-1,444	0	9,444	0	6,858	6,685	21,543	-11	176
2058	0	-1,446	0	9,627	0	7,015	6,840	22,036	-10	160
2059	0	-1,448	0	9,810	0	7,175	6,999	22,536	-9	146
2060	0	-1,450	-1,994	9,993	0	7,339	7,162	21,050	-19	133
2061	0	-1,453	0	10,176	0	7,506	7,328	23,559	-7	122
2062	0	-1,455	-528	10,359	0	7,678	7,499	23,553	-9	111
2063	0	-1,457	0	10,543	0	7,853	7,673	24,612	-6	101
2064	0	-1,459	-3,695	10,726	0	8,032	7,851	21,455	-18	92
2065	0	-1,461	-1,271	10,909	0	8,216	8,034	24,426	-8	84
2066	0	-1,464	-1,584	11,092	0	8,403	8,221	24,668	-8	76
2067	0	-1,466	0	11,275	0	8,595	8,412	26,816	-4	70
2068	0	-1,468	-5,044	11,458	0	8,791	8,607	22,344	-14	63
2069	0	-1,471	0	11,641	0	8,992	8,807	27,970	-3	58
Total	-55,691	-65,246	-55,489	350,014	0	256,430	248,062	678,079	-41,277	43,352

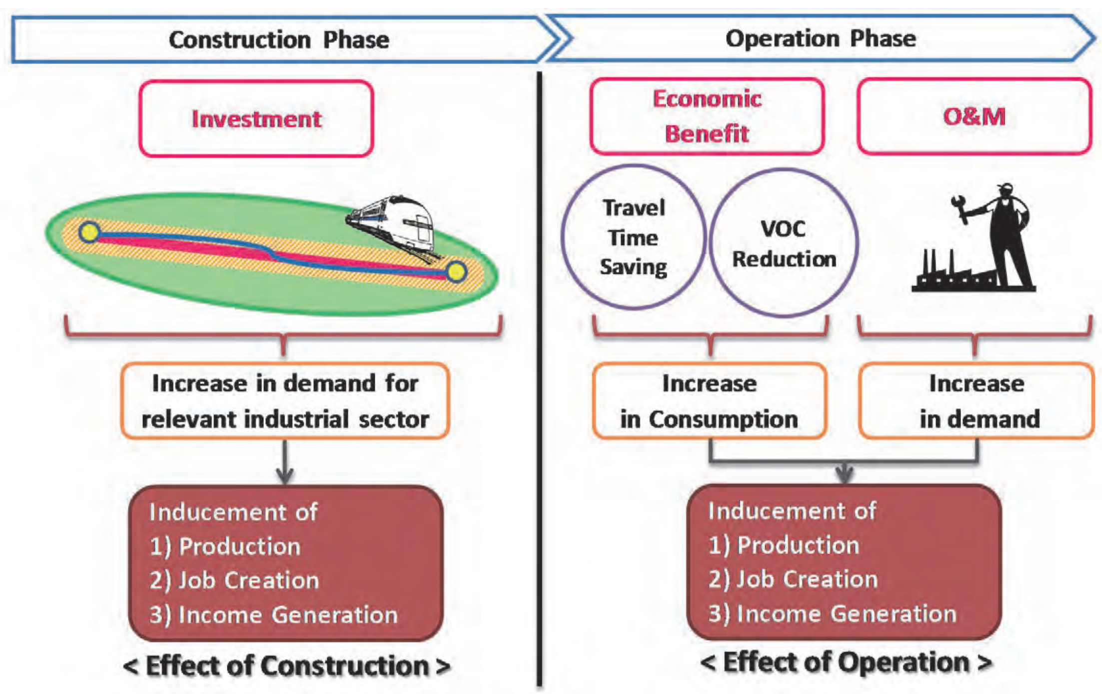
IRR=	12.50%
NPV=	2,075
B/C=	1.05

Source: JICA Study Team

14.5 Economic Multiplier Effect Analysis

14.5.1 Concept of Economic Multiplier Effect Analysis

The development of the HSR will create the direct economic benefit discussed above, such as travel time saving and reduction of vehicle operation cost for those who change over from the conventional transportation modes to the HSR. In addition, the investment in the construction of the HSR will also have an economic impact on companies and employees over the whole of Indonesia through the inter-industrial relationship and contribute to the stimulation of economic activities in Indonesia. The economic multiplier effect can be classified into two types: effect of construction and effect of operation. The effect of construction means the economic impact on the domestic economy brought by the increase in demand for the local currency portion of the construction cost during the construction phase. The effect of operation means the economic impact on the domestic economy brought by the rise in demand for the operation and maintenance of the HSR and increase in household consumption expenditure at the operational stage. For example, when a company employee uses the HSR between Jakarta and Bandung, a company can benefit from a reduced transportation cost. The cost saving may be diverted to new investment and increase in wages. Household consumption may increase because of the rise of household income and reduction of transportation expenditure. The effects will create new demand and may lead to the growth of production in the relevant industries. This will increase employment and bring a further increase in demand to the economy. Figure 14.5-1 shows the concept of economic multiplier effect from the development of the HSR.

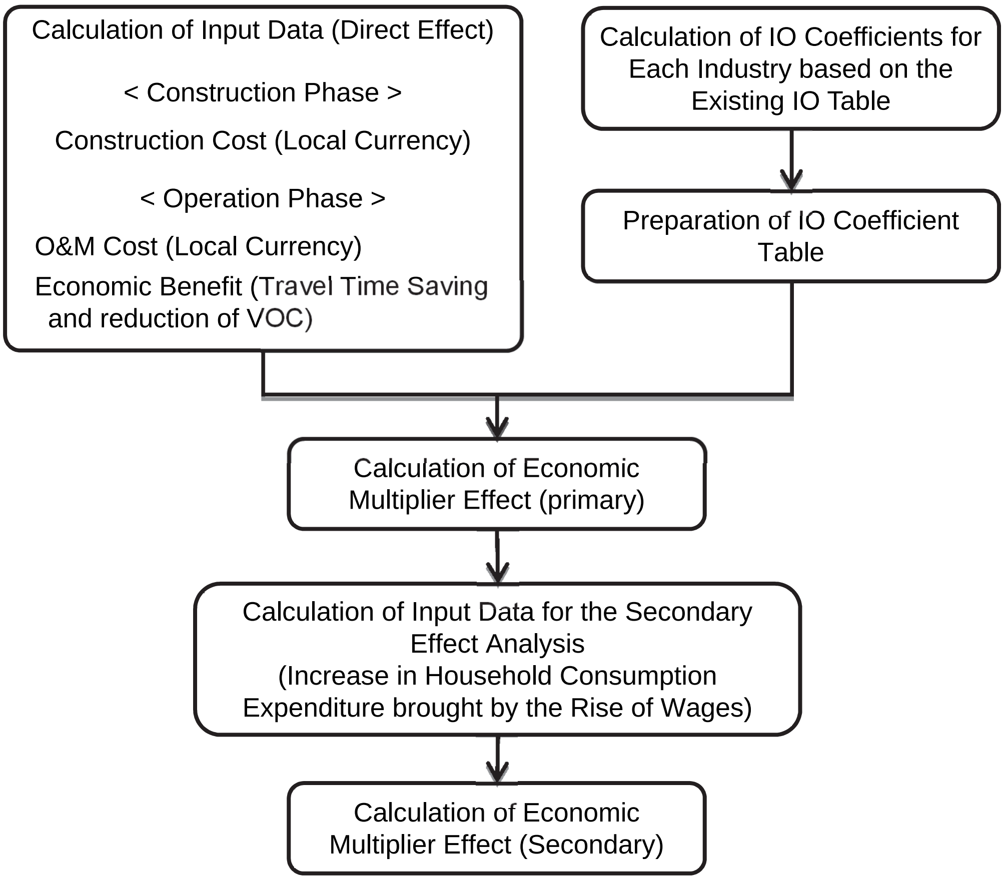


Source: JICA Study Team

Figure 14.5-1 Concept of Economic Multiplier Effect from the Development of the HSR

14.5.2 Calculation of Economic Multiplier Effect

An input-output table method, a simple and common way to calculate the economic multiplier effect, is applied in this study. Change of industry production, wages and employment can be analyzed by means of the input-output table method. The input-output table of Indonesia, prepared and published by the OECD, is utilized for the calculation. Figure 14.5-2 shows the calculation flow.



Source: JICA Study Team

Figure 14.5-2 Calculation Flow of the Economic Multiplier Effect

As for the input data of the input-output table analysis, the investment cost and operation and maintenance cost are the figures that can be definitively set based on the cost estimate. On the other hand, the increase in the demand for travel time saving and reduction of vehicle operation cost (VOC) can be estimated as the input data based on the following assumptions:

- Decrease in transportation cost of private entities leads to increase in capital investment and employee wages and creation of further demand.
  Increase in demand = reduction in transportation cost (travel time saving and reduction of VOC) for cars in business use

- Reduction in household transportation expenses leads to further household consumption (increase in demand).
  Increase in demand = reduction in transportation cost (reduction of VOC) for cars in private use

Table 14.5-1 shows the result of the input-output table analysis on the economic multiplier effect brought by the development of the HSR, based on the calculation flow shown in Figure 14.5-2. Employment induction is equivalent to the person-months that income induction is divided by the monthly minimum wage Rp. 2,700,000 in DKI Jakarta 2015 in the table.

Table 14.5-1 Economic Multiplier Effect of the HSR Development in Indonesia

		Direct, Primary and Secondary Effect				Induction of Income and Employment	
		Direct Effect	Primary Effect	Secondary Effect	Total	Income Induction	Employment Induction
Construction		Rp. 23.0 trillion (JPY 235 billion)	Rp. 18.6 trillion (JPY 190 billion)	Rp. 3.2 trillion (JPY 33 billion)	Rp. 44.8 trillion (JPY 459 billion)	Rp. 5.7 trillion (JPY 57.7 billion)	2,089,701 person-months
Operation	2020	Rp. 0.5 trillion (JPY 4.9 billion)	Rp. 1.7 trillion (JPY 17.4 billion)	Rp. 0.2 trillion (JPY 1.9 billion)	Rp. 2.4 trillion (JPY 24.2 billion)	Rp. 0.3 trillion (JPY 3.4 billion)	122,359 person-months
	2030	Rp. 1.2 trillion (JPY 11.8 billion)	Rp. 3.0 trillion (JPY 30.6 billion)	Rp. 0.4 trillion (JPY 3.7 billion)	Rp. 4.6 trillion (JPY 46.1 billion)	Rp. 0.6 trillion (JPY 6.5 billion)	236,473 person-months
	2040	Rp. 1.6 trillion (JPY 16.4 billion)	Rp. 4.7 trillion (JPY 48.5 billion)	Rp. 0.6 trillion (JPY 5.7 billion)	Rp. 6.9 trillion (JPY 70.6 billion)	Rp. 1.0 trillion (JPY 9.9 billion)	359,902 person-months
	2050	Rp. 1.6 trillion (JPY 16.1 billion)	Rp. 5.8 trillion (JPY 59.0 billion)	Rp. 0.6 trillion (JPY 6.5 billion)	Rp. 8.0 trillion (JPY 81.6 billion)	Rp. 1.1 trillion (JPY 11.4 billion)	412,477 person-months

Note: The figures of operation show the multiplier effect induced by the O&M cost and economic benefit at each year.
Employment induction is equivalent to the person-months that income induction is divided by the monthly minimum wage Rp. 2,700,000 in DKI Jakarta 2015.

Source: JICA Study Team

Chapter 15

Laws and Technical Criteria in Indonesia

Chapter 15 Laws and Technical Criteria in Indonesia

15.1 Legal Framework

15.1.1 Regulations of Railways Sector

(1) Sector Regulations

The following are the railway sector regulations in Indonesia:

- Law No. 23 / 2007 concerning Railways (hereinafter referred to as the "Railways Law")
- Government Regulation No. 56 / 2009 concerning Railway Development
- Government Regulation No. 72 / 2009 concerning Railway Traffic and Transportation
- Minister of Transportation Regulation No. 83 / 2010 concerning Cooperation between Government and Business Entities in the Provision of Transportation Infrastructure

The Railways Law defines the railways, types of railways, railway operators, license required for railway operation, outlines of railway infrastructure, facilities, electric and mechanical features, rolling stock and traffic operation, and so on. Government Regulation No. 56 / 2009 and Government Regulation No. 72 / 2009 provide the details of railway implementation. Minister of Transportation Regulation No. 83 / 2010 basically follows the Minister of National Development Planning / Head of National Planning Agency Regulation No. 4 / 2010 concerning General Guidelines for Implementation of Cooperation between the Government and Business Entities in the Provision of Infrastructure, which provides the guidelines for railway project implementation with PPP modality.

(2) Implementing Body of Railway System Development and Operation

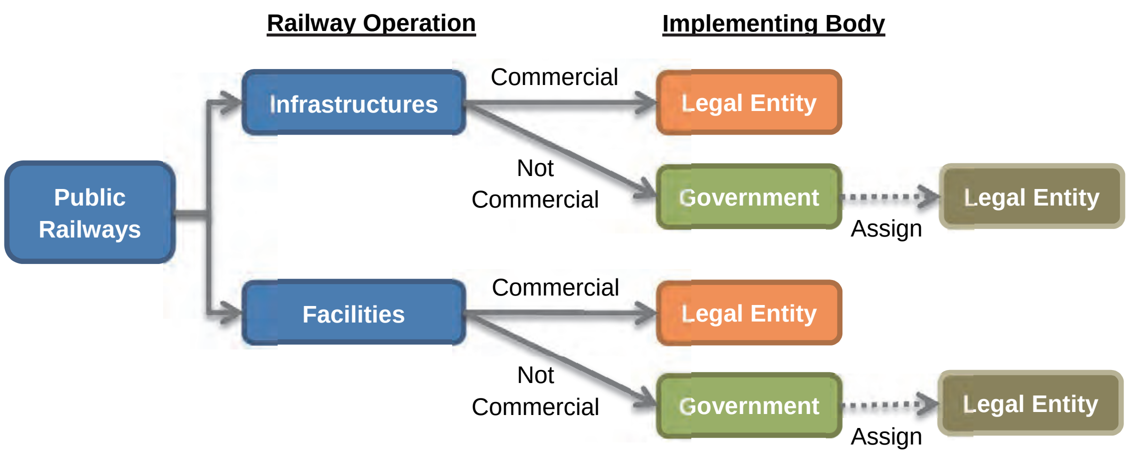
According to the Railways Law, the operation of public railways is stipulated as follows:

Operation of public railway infrastructure shall be carried out by a legal entity as the operator, individually or in partnership. In case of no legal entity that operates public railway infrastructure, the Government or Regional Government may operate the railway infrastructure (Article 23).

Operation of public railway facilities is carried out by a legal entity as the operator, whether individually or in partnership. In case of no legal entity that operates public railway facilities, the Government or Regional Government may operate the railway facilities (Article 31).

Railway operation is classified into two types: railway infrastructure and facilities under the Railways Law. The railway infrastructure includes the railway lines, train stations and train operation facilities, while the railway facilities are the locomotives, trains, cars and vehicles for special purposes such as inspection cars (lorries), support cars, cranes, measuring cars and cars for rail maintenance. The law defines "Operation" as construction, operation, maintenance and management of the railway infrastructure, and procurement, operation, maintenance and management of the railway facilities.

According to the provisions, legal entities, including State-owned Enterprises (SOE) and Regional-owned Enterprises (ROE), can be the operator of the railway infrastructure and facilities. If there is no such legal entity, the state government or regional government may operate the railway infrastructure and facilities. This means that the state government or regional government is given a mandate to operate the railway infrastructure and facilities. However, implementation can be assigned to a legal entity established for that purpose. In addition, when commercial operation has been achieved, operation of the railway infrastructure and/or facilities can be transferred to a legal entity that has a license for operating railway infrastructure and/or facilities. Figure 15.1-1 summarizes the implementing structure of railway operation in Indonesia.

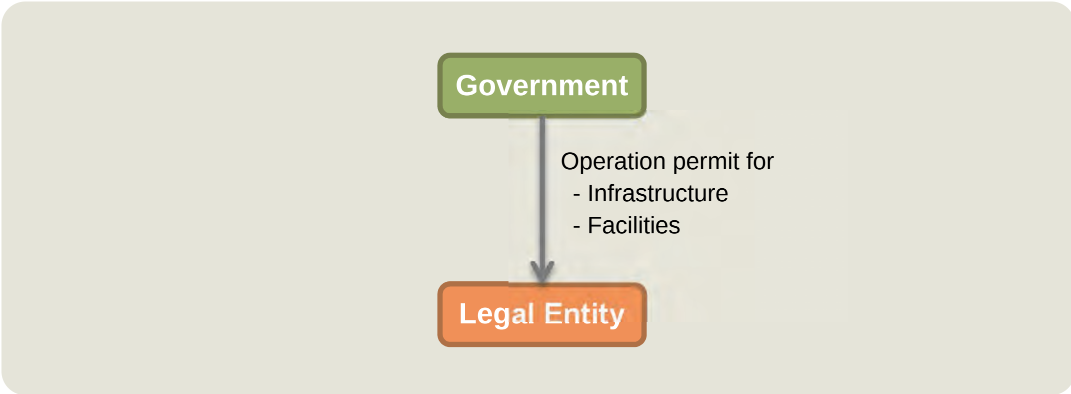


Source: JICA Study Team

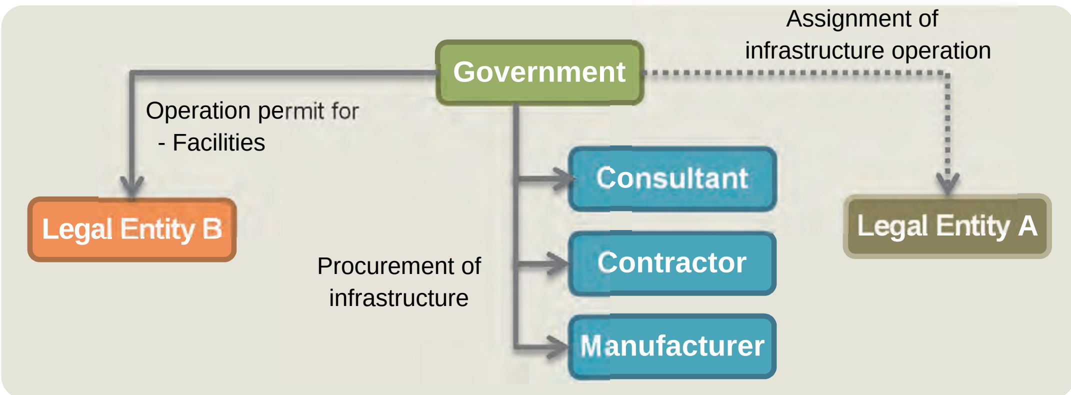
Figure 15.1-1 Implementing Bodies of Railway Operation

According to the Railways Law, three cases can be considered as the implementing structure of railway projects. Figure 15.1-2 shows the possible cases for railway implementation.

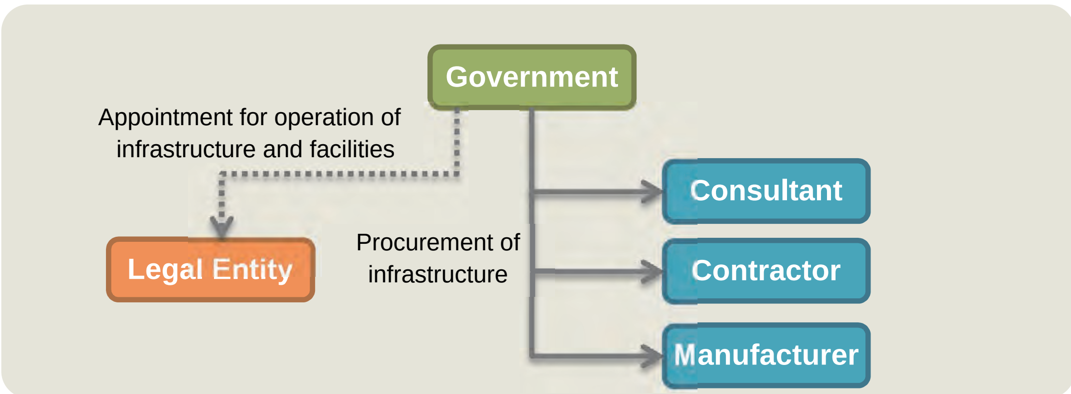
A: Commercial Case



B: Commercial Case (Facilities Only)



C: Non-Commercial Case



Source: JICA Study Team

Figure 15.1-2 Typical Patterns of Railway Operation

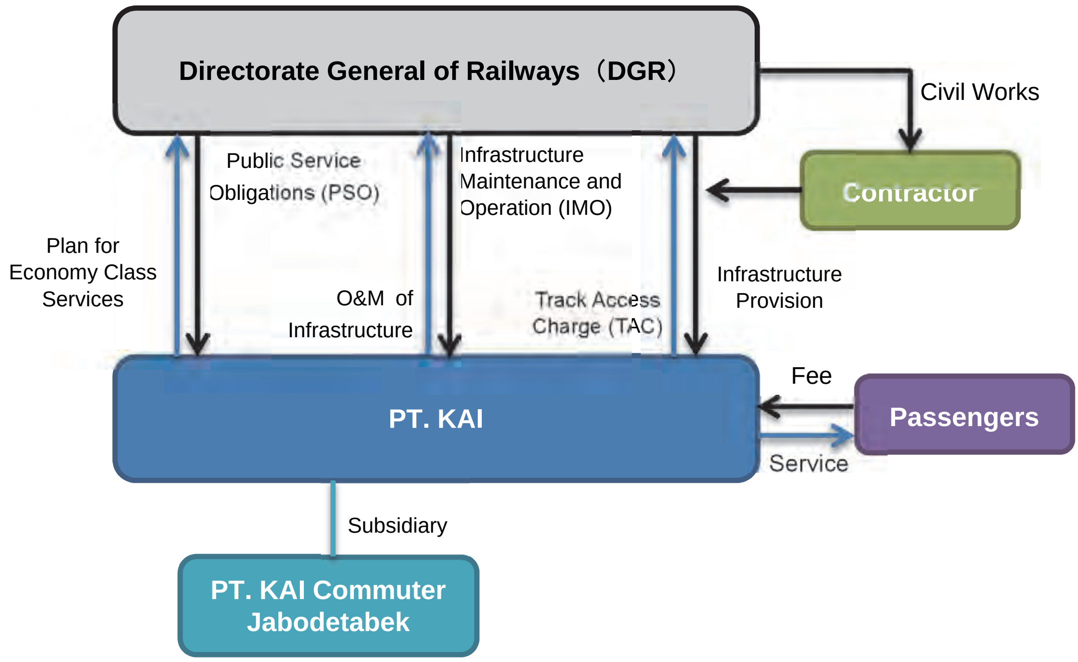
In the first case a license is granted for the whole project (infrastructure and facilities). In the second case, there is a legal entity that can operate part of the project and commercial operation can be realized (such as the facilities only). In this case, the government implements infrastructure development, while the legal entity obtains a license for the railway facilities, and procures and operates the facilities. The current implementation structure of the public railways is the second case and the legal entity, PT Kereta Api Indonesia (PT KAI), has a contract with the government for infrastructure maintenance and operation. In the third case, there is no legal entity that can operate the railways infrastructure and facilities, and commercial operation cannot be achieved. The government is given a mandate to implement the project, while implementation will be assigned to a legal entity established for that purpose and granted an operation license. The legal entity will be a State-owned Enterprise (SOE) for the project whose network covers more than two provinces, while the Regional-owned Enterprise (ROE) for the project will be an enterprise whose network covers one province.

(3) Existing Railway Operator

As discussed in the previous section, the railway business is open to business entities. However, currently, the railways in Indonesia are dominantly operated by PT KAI, a state-owned limited liability company. PT KAI's main business scope is as follows (source: PT KAI, Annual Report 2011):

- Public railway infrastructure management, including construction, operation, maintenance, and exploitation of infrastructure
- Public railway infrastructure management including procurement, operation, maintenance, and exploitation of rolling stock
- Railway transportation of passengers and/or freight
- Pre- and post-railway transport, intermodal transport, loading and unloading
- Leasing of railway rolling stock, infrastructure, and facilities
- Miscellaneous services for procurement of materials and services related to railway maintenance
- Railway expertise and transportation consulting services
- Railway training and education services
- Trading and property business covering hotels, offices, apartments, shops, restaurants, integrated terminals, integrated shopping areas, warehouses, and logistics
- Utilization of land, buildings, spaces, and facilities

In order to increase the efficiency in providing railway transportation services, the Joint Decision Letter of the Ministry of Transportation, Ministry of Finance and Ministry of National Development Planning No. KM 19/1999, No. 83/KMK.03 / 1999 and No. KEP.024/K/03/1999 dated March 4, 1999 was issued. The decision letter states that the government is responsible for financing public services for economy class train passengers determined by the Government (PSO: Public Service Obligations) and the maintenance and operational costs of the train infrastructure (IMO: Infrastructure Maintenance and Operation), and the legal entity's obligation is to pay the cost of the railway infrastructure used (TAC: Track Access Charge). Figure 5.1-4 shows the current structure of public railway operation in Indonesia. As for the commuter lines in the area of JABODETABEK, PT KAI Commuter Jabodetabek, one of the subsidiaries of PT KAI, operates the trains.



Source: JICA Study Team

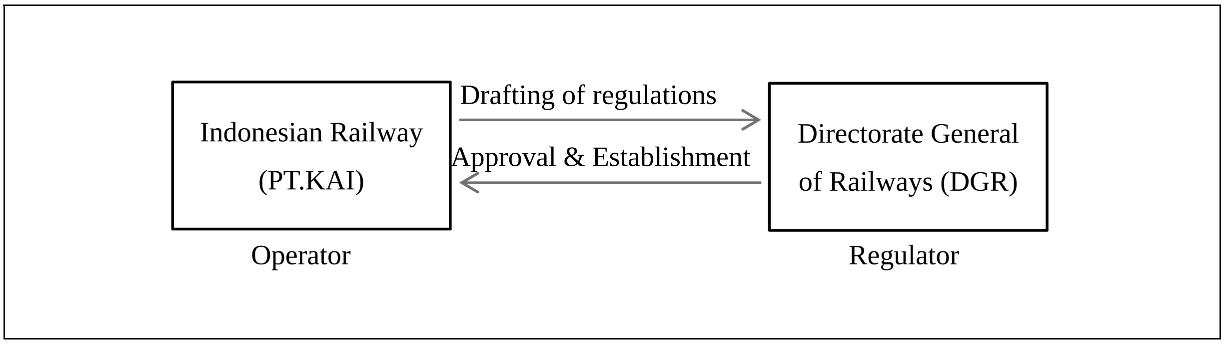
Figure 15.1-4 Current Implementation Structure of Public Railways in Indonesia

15.1.2 Technical Standards for Conventional Railways

The Railway Bureau Corporation (PJKA, Perusahaan Jawatan Kereta Api) that was the operating organization before privatization of the railways established the technical standards for the railways. The technical standards basically followed the rules that had been used from the time of Dutch occupation. At that time, establishment, approval and enforcement of the regulations were undertaken by the PJKA.

In 1991, the PJKA was changed to the Public Railway Corporation (Perum Kereta Api) and in 1999, the Public Railway Corporation was changed to the Indonesian Railway (PT.KAI, PT. Kereta Api) whose entire stock is held by the Indonesian government. On this occasion, the role of approving the regulations was undertaken by DGR (Directorate General of Railways, Ministry of Transportation), and the role of enforcing the regulations was undertaken by PT.KAI. In addition, PT.KAI is responsible for drafting regulations.

The effective laws today are: Railways (PERKERETAAPIAN) established in 2007, Regulations for Train Transportation and Traffic (LALU LINTAS DAN ANGKUTAN KERETA API) established in 2009 and Railway Provision (PENYELENGGARAAN PERKERETAAPIAN) established in 2009, which correspond to the Railway Business Act and Railway Operation Act in Japan.



Source: JICA Study Team

Figure. 5.1-5 Flow of Establishment of Regulations in Indonesia

(1) Technical Standards for Rolling Stock

As for the technical standards for rolling stock in Indonesia, technical specifications and standards for locomotives (KM40/2010), technical specifications and standards for cars hauled by locomotives (KM41/2010), technical specifications and standards for self-motorized trains (KM42/2010) and technical specifications and standards for goods trains (KM43/2010) have been published. These standards which correspond to Japan's Technical Regulatory Standards on Japanese Railways specify the terms/definitions, outline of functions, environment, etc. Moreover, regarding rolling stock maintenance, each railway company specifies the maintenance method in its own manuals. Meanwhile, there are no standards for high-speed railways.

In addition, with regard to rolling stock depots/workshops, Law No. 1/1970 concerning work safety specifies the working environment standards in Indonesia. The standards correspond to the Labor Standards Act and Occupational Health and Safety Law. Furthermore, the limits for factory disposal are decided by each state according to government guidelines. For example, the BOD and COD/pH for factory disposal are specified in the Decree of East Java Governor No. 45/2002 which was obtained in this investigation and corresponds to Japan's Water Pollution Prevention Act and Sewerage Law.

(2) Technical Standards for Electrical Equipment

In Indonesia, there was a law regarding electrical power, the Electricity Business Act (Act No. 15/1985). The law regulated the power business, licensing and approval system, rights of users and penalties.

It became difficult for PLN to supply power as the demand for power increased. As a countermeasure, IPPs (Independent Power Producers) were approved and restrictions on the electricity business were

relaxed with the establishment of the Electricity Business Act (Act No. 30/2009). The law is known as the New Electricity Business Act.
The law is much the same as Japan's Electricity Act. In addition, there is the Power Supply and Use Act (Act No. 10/1989). The law specifies the operational regulations concerning the power supply.
The Energy Resource Act (Act No. 30/2007) concerns the exploitation of natural resources. The law regulates the management, planning and policies of natural resources.
The Java-Bali Electricity Act (Act No. 3/ 2007) concerns the distribution system. The law regulates the frequency, voltage control and protection of the distribution system. The law applies to system connections between IPPs and the transmission lines of the PLN. Primary neutral grounding is necessary when a 150kV transformer is installed at substations. In Japan this is not necessary. The frequency and standard voltage are shown below.

- Frequency 49.5Hz～50.5Hz (normal)
  47.5Hz～52.0Hz (emergency)
- Standard voltage -10%～+5% (20kV, 70kV, 150kV)
  -5%～+5% (500kV)
- Grounding system
  Neutral Grounding System (more than 150kV)

The Distribution Act (Act No. 4/2009) concerns the distribution lines. The law provides for power quality and power measuring. The law regulates the voltage which must be within the range of -10% to +5%.
Each company establishes its operating regulations based on the above laws. PLN established its operating regulations in the SPLN (PLN Standards). The regulations clearly provide for design and work standards for electrical equipment. PT.KAI similarly established PEDOMAN PERAWATAN SINTELIS. The regulations are much the same as Japanese railway company safety regulations and criteria for electrical equipment. They provide for inspection of the electrical equipment, inspection items, inspection cycle, number of inspection team members and constitution of the inspection team.
In Indonesia there is no AC traction power supply and no standards for an AC traction power supply.

(3) Technical Criteria for Signaling and Telecommunication
Regarding the signal communication facilities, there are ministerial regulations (No. PM.10/2011) concerning railway signaling equipment technical requirements based on government regulations (56/2009) concerning signaling equipment, and ministerial regulations (No. PM.10/2011) concerning railway telecommunication equipment technical requirements based on government regulations (56/2009) concerning telecommunication equipment, and on this basis PT.KAI stipulated the signaling, telecommunication and electricity maintenance manual and various facility standards. This corresponds to the Japanese ministerial decree defining technical requirements of railways and also the

regulations on implementation of electrical equipment, regulations on implemenation of train protection equipment and facility standards specified by Japanese train operators.

Ministerial regulations concerning the technical requirements of railway signaling equipment

Concerning the signaling equipment required for train operation (interlocking devices, blocking devices, color signals, switches, track circuits, etc.), signs, markers and support equipment, the regulations stipulate the name, type, function overview and technical requirements (for installation, operation, electrical performance, environment, etc.).

1) Ministerial Regulations Concerning the Technical Requirements of Railway Telecommunication Equipment

Concerning the telecommunication equipment required for train operation such as telephones (train radios, inter-station telephones, etc.), sound recorders, transmitters, power supply protection systems (grounding, protection from over voltage) and support equipment, the regulations stipulate the name, type, function overview and technical requirements (for installation, operation, electrical performance, environment, etc.).

2) Signaling, Telecommunication and Electricity Maintenance Manual

Concerning the signaling, telecommunication and electric (power) equipment required for train operation, the manual stipulates the inspection items, maintenance period, maintenance procedures and number of workers.

3) Various Facility Standards

Concerning the functions, technical items and operation procedures of the signaling and telecommunication equipment, the manual describes the details of each equipment respectively.

15.2 Examination of Technical Standards for High-Speed Railways

(1) Rolling Stock

As for rolling stock, there are no standards for rolling stock for high-speed railways. Therefore, discussion of the standards (for example, environment, loading gauge, noise, etc.) among the various related parties, taking into consideration the existing standards for rolling stock for conventional trains, is required at the design stage. Moreover, with regard to rolling stock maintenance, maintenance standards and manuals should be established. However, the construction of rolling stock depots / workshops in compliance with Indonesian government ordinances and acts presents no problem, thus no new standards will be required.

(2) Power Supply

The Java-Bali Electricity Act (Act No. 3/2007) applies to transmission lines and substations. In accordance with the law, technical items such as frequency, control voltage and protection of the system need to be considered.

The Distribution Act (Act No. 4/2009) applies to distribution lines. In accordance with the law, technical items such as power quality and power measuring need to be considered.

It is necessary to observe the PLN standards for the sake of protection coordination when installing transmission lines, substations and distribution lines. Therefore, this equipment should be considered in accordance with SPLN. It will be necessary to conduct a meeting with PLN to consider the equipment standards.

There are no standards for an AC catenary system, as there is no AC traction power supply in Indonesia. When designing the AC catenary system, it will be necessary to hold a meeting with the counterparts to consider equipment standards such as the gap between live wires and buildings, nominal voltage and typical assembly.

(3) Signaling and Telecommunication

Regarding the signaling and telecommunication equipment, there are no technical standards concerning Automatic Train Control (ATC) of Shinkansen, etc. because there are no HSR lines in Indonesia. When designing the system, it will be necessary to examine HSR equipment standards (signaling and blocking methods, radio system, etc.) with the relevant section.

1) Examination of Maintenance and Operation of the System and Equipment

It is necessary to specify facility standards and to provide training in facility maintenance and operation of the new signaling devices (e.g. ATC, station PRC, electronic interlocking devices) and telecommunication devices (e.g. train radios and fiber-optic communication equipment), but various electronic devices are already being introduced on the existing lines in Indonesia, and there are deemed to be no major technical problems.

About the transport operation system, introduction of the system is in progress on existing lines, but route control for train operation and maintenance work are operated by the station dispatcher. To realize safe and punctual train operation, it is necessary to examine the ability of computer-aided direct train control from the OCC which is the same type as in Japan, from the perspective of the operator, with the relevant section..

About maintenance work, to maintain the necessary functions and performance of the equipment, it is important to take countermeasures from the perspective of operator morals to ensure the maintenance period and service condition of the equipment.

In addition, to prevent theft and destruction of the equipment, it is necessary to examine countermeasures such as guards and monitoring of the equipment and establishment of rules concerning security.

2) Examination of Design, Manufacturing and Installation

The new signal control systems are advanced systems using software logic to assure safety and they are different from the previous systems, so professional manufacturers and consultants with expertise in their use should be secured, because high technical skills are required for system design and manufacturing.

For installation of the equipment, a local sub-contractor should be used and execution supervision and inspection are important for ensuring the design value and execution standards.

After the system comes into service, the role of the manufacturer will be far more important than in previous system operation and maintenance, and it will be necessary to prepare a task structure (e.g. ensuring spare parts and components, staff training, etc.).

Chapter 16

Schedule towards HSR Inauguration

Chapter16 Schedule towards HSR Inauguration

16.1 Construction schedule

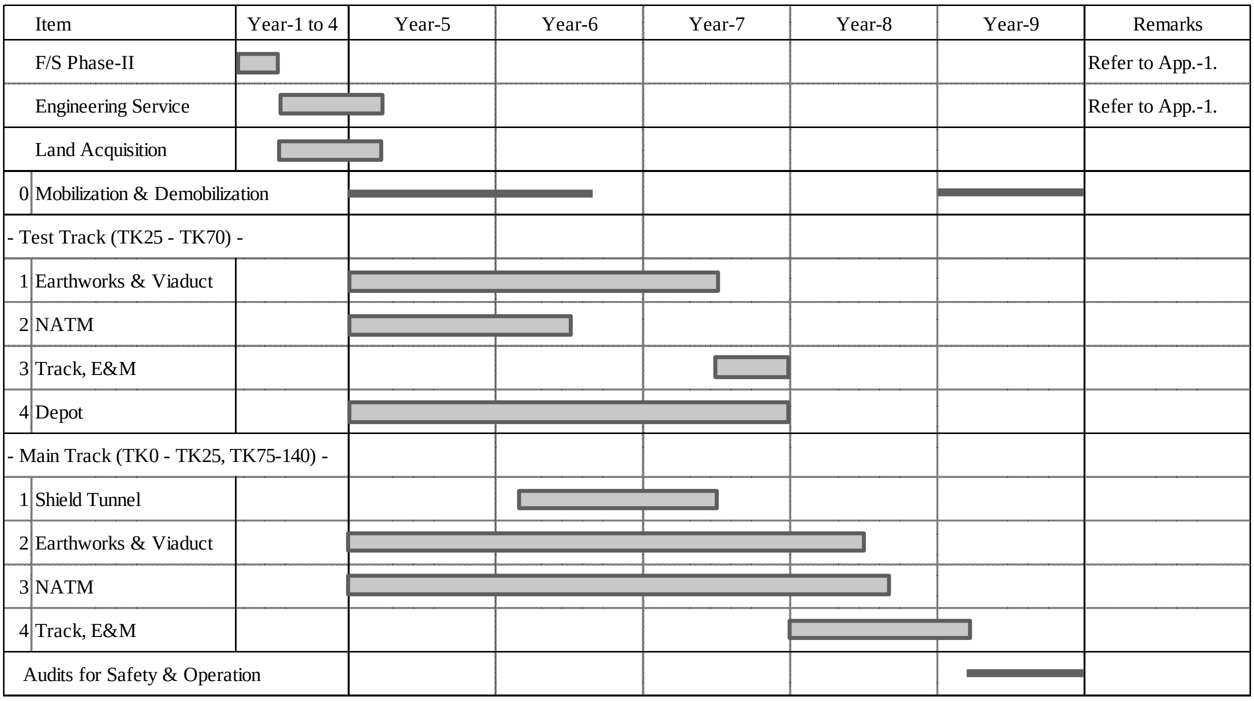
High-speed rail construction schedule tends to be prolonged by the land acquisition and budget considerations, but based on the construction capacity, operation can begin in five years from the start of construction.

The critical path of the construction schedule is a mountain tunnel of 5.6km in length that is planned between Karawang and Walini. This tunnel will be drilled from both ends in order to shorten the construction schedule.

Table 16.1-1 Production Capacity

Item		Efficiency	Source
Civil	Embankment/Cut /Viaduct	2.5-3.5 years/site	Kyushu-Shinkansen, Japan
	NATM tunnel	1.0 year/km	MLIT Standard, Japan (80m/month)
	Shield tunnel	0.3 years/km	Metropolitan Expressway Company, Japan (300m/month, MAX 500m/month)
Track	Track work	0.1 years/km	Kyushu-Shinkansen, Japan
Test	Electric work	0.3 years	Kyushu-Shinkansen, Japan
	Test, Inspection, Training	0.7 years	Kyushu-Shinkansen, Japan

Table 16.1-2 Construction Schedule



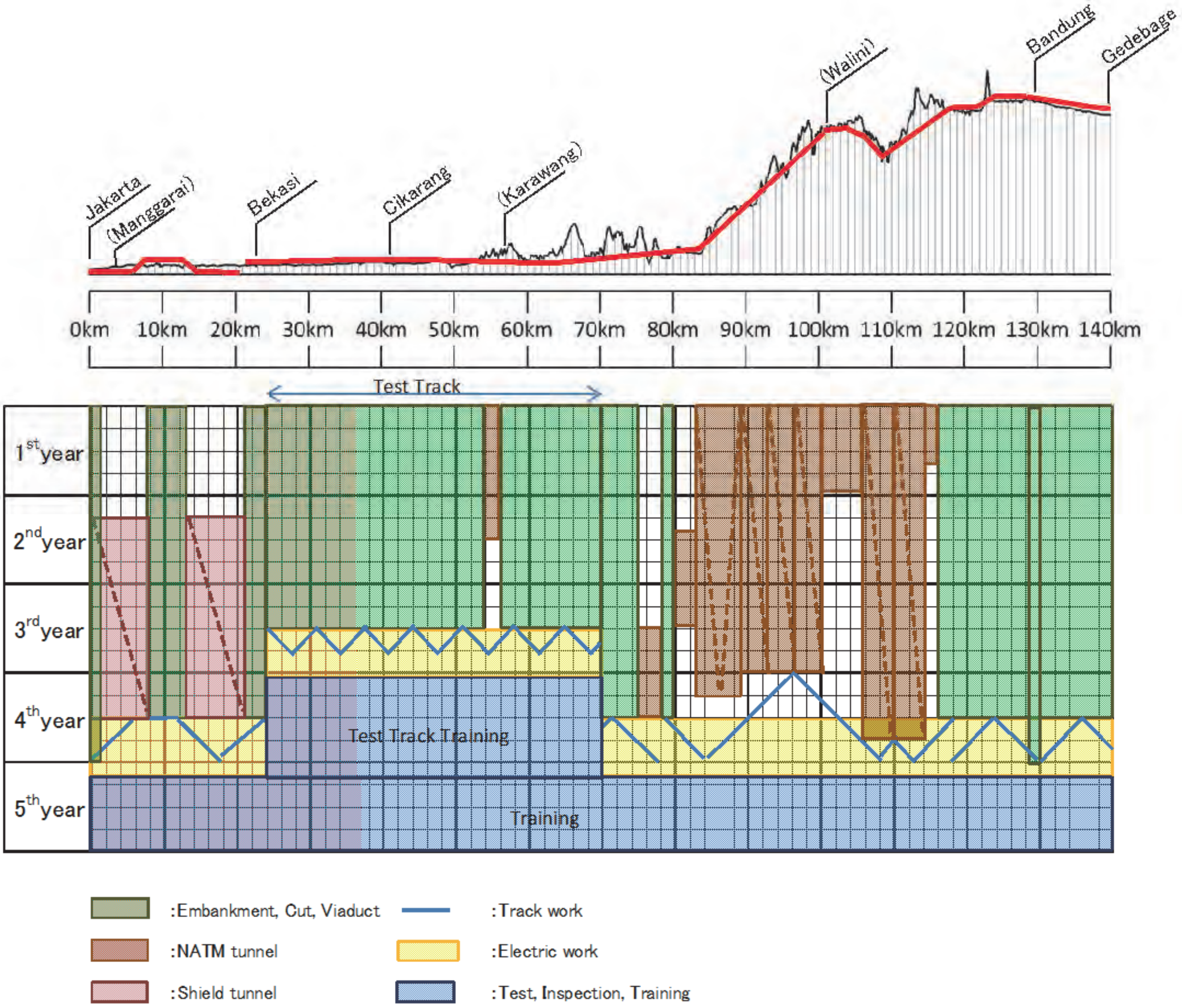


Figure 16.1-1 Construction Schedule by Section

16.2 Schedule for Land Acquisition and Involuntary Resettlement

According to the Law No.2/ 2012, the process of land acquisition is divided into four stages, namely i) planning; ii) preparation; iii) implementation; and iv) handover. The tasks to be carried out in each phase and timeframe for specific tasks are specified in the Law as shown in Table 16.2-1. The first stage (planning) is expected to be completed during F/S Phase II (15 months) and the three subsequent stages will take a minimum of 319 working days and a maximum of 583 days, depending on the time needed for grievance redress.

Table 16.2-1 Tasks and Timeframe for Land Acquisition

Details of Tasks	Responsible Institution	Time*
Stage 1: Planning ● Preparation of LARAP document ● Submission of LARAP to Governors	Project Proponent	15 months (F/S Phase II)
Stage 2: Preparation ● Forming Preparation Team	Governors	10 days
● Notification to community ● Preliminary data collection ● Public consultation	Preparatory Team	20 days 30 days 60-90 days
● Periods for lodging complaints	Community	31-149 days
- Case brought to courts in case of complaints	Administrative and Supreme Court	
● Determination and announcement of project location**	Governors	
● Application for execution of land acquisition to the Head of National Land Agency (BPN)	Project Proponent	
Total duration of Preparation Phase		**141-289 days**
Stage 3: Implementation ● Inventory of loss ● Verification and correction	Land Acquisition Team formed by the Head of BPN	44-72 days
● Selection of appraiser and valuation of assets	Independent Appraiser	60 days
● Negotiation on compensation and court decisions in case of disagreement	Community, Land Acquisition Team, Administrative and Supreme Court	30-118 days
● Payment of compensation and release of land title	Land Acquisition Team, Community	7 days
Total duration of Implementation Phase		**141-257 days**
Stage 4: Handover ● Delivery of land	Land Acquisition Team to Project Proponent	7 days
● Certification and registration of land	Project Proponent	30 days
Total duration of Handover Phase		**37 days**
Total duration of Land Acquisition		**319-583 days**

Note: * Days refer to working days; ** The location stipulation issued by the governor is valid for two years with possible extension of one year.

Source: Law No.2/ 2012 and Presidential Regulation No.71/2012

16.3 Schedule for Institutional Setup

Table 16.3-1 shows the schedule to establish the organizational structure for the project implementation. First, preparing establishment of the HSR Authority needs to be started. After the establishment, the authority will formulate HSR regulations and standards. In parallel with that, preparing incorporation of a SOE (HSR development company) needs to be started. After the incorporation, the SOE will commence with the detail design of HSR and preparation of tender documents. When the project is implemented with PPP, the project modality will be finalized at this stage, followed by the preparation of tender documents and bidding process. A bid-winner (SPV) will prepare pre-operation in collaboration with the SOE based on the PPP agreement, and will operate and maintain the HSR systems after completion of the construction works.

Table 16.3-1 Schedule for Institutional Setup

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13
[Engineering Services (ES)] Refer to Appendix-1.				ES - I		ES - II							
[Institutional Setup]													
Amendment of law for direct lending to SOE and improvement of PPP regulations for availability payment													
Capacity development of government officials on HSR development													
Preparing for establishment of the High-speed Railways Authority													
Establishment of the High-speed Railways Authority													
Formulation of regulations and standards related to HSR													
Preparing for establishment of the State-owned Company (Development Company)													
Establishment of the State-owned Company (Development Company)													
Detail Design towards Project Implementation with PPP													
Tendering Process of SPV Selection													
Selection of SPV and grant of concession agreement													
Pre-operation and preparation of related business by SPV													
Inauguration													

16.4 Schedule towards HSR Inauguration

The Schedule towards HSR inauguration is shown in Fig. 16.4-1. (Refer to Appendix-1 showing Engineering Service.)

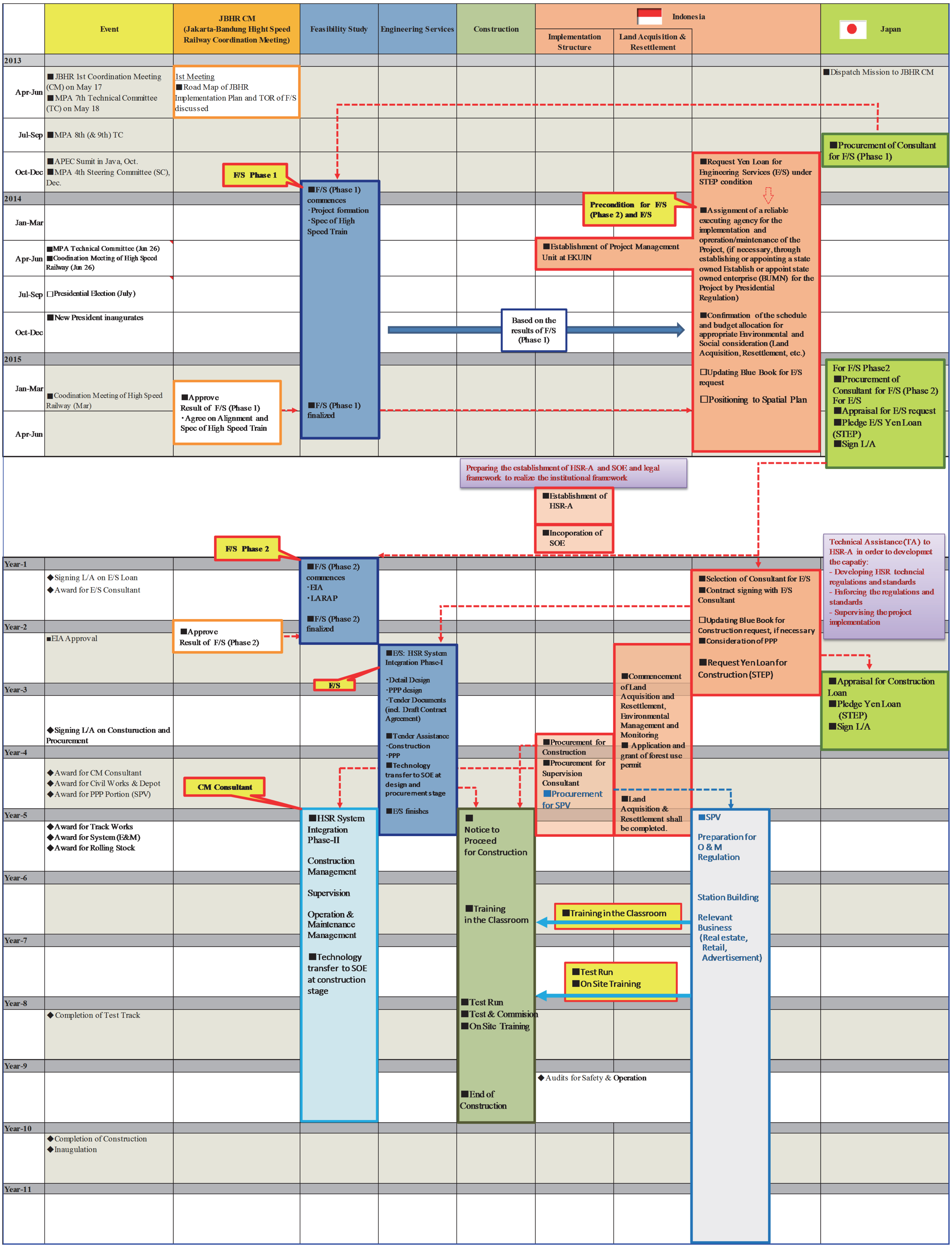


Fig. 16.4-1 Schedule towards HSR Inauguration

Chapter 17

Conclusion and Recommendations

Chapter 17 Conclusion and Recommendations

17.1 History of the Studies

17.1.1 Background

Railways are currently only operated on the islands of Java and Sumatra in Indonesia. The total length of railways operated on Java is 3,425 km, and the number of passengers transported by long-distance trains per year steadily grew from 2006 to 2010 at an average annual rate of 9%, but the percentage of passengers transported by railways is still low at approximately 6%. On the other hand, approximately 85% of all passengers are transported by the highways and roads, resulting in increasingly severe traffic jams on the urban roads and intercity highways. Accordingly, the government of Indonesia is proceeding with plans for electrification and expansion of tracks (double or quadruple tracks) in order to boost the transport capacity of the railway network in Java. In order to enable railways to play an important role in the passenger transport and to make them competitive with air and road transport services, in addition to improvement of the existing railway lines, further strengthening of the transportation network based on the development of a high speed railway to link cities has been positioned as an issue for urgent review.
Java High Speed Railway Development has been positioned in the main upper-level plans concerning railways as outlined below.

(1) Masterplan of Acceleration and Expansion of Indonesia Economic Development (*Masterplan Percepatan dan Perluasan Pembangunan Ekonomi Indonesia* - MP3EI): The development of a high speed railway route in the economic corridors between Jakarta - Bandung and Jakarta - Surabaya should be conducted as an integral part of the railway plan for this corridor.

(2) National Railway Master Plan (NRMP): This plan also discusses the introduction of a high speed railway connecting Jakarta and Surabaya.

(3) Metropolitan Priority Area (MPA) Concept: The Jakarta - Bandung High Speed Railway is one of the priority projects.

Development of a high speed railway between Jakarta - Surabaya (approximately 733 km) was considered based on the above plans. In 2009 the JETRO-F/S on Java HSR (High -Speed Rail) Construction Project was done for the above stated section. In 2011 the MLIT-F/S Preliminary Study was conducted and examined the Jakarta – Bandung section for the priority phase section where many passengers would be expected, from the standpoint of the scale of investment and economic viability. Three alternative routes were examined in the section, and the route along the current highway connecting Jakarta – Purwakarta - Bandung was preferred. The METI- Pre F/S on Jakarta -Bandung HSR was undertaken in 2012. Comparing the route via Bandung to that via the northern plain between Jakarta and Cirebon, the Jakarta-Bandung section was preferred as primary priority of a part of Jakarta – Surabaya HSR project authorized in the National Railway Master Plan, in spite of some constraints such as long distance and steep gradient. In

October 2013, the government of Indonesia requested the government of Japan to conduct a feasibility study concerning the achievability of HSR.

17.1.2 The Study (Phase I, Stage I)

The MOU of TOR signed between JICA and the Indonesian Government in October 2013, divided the "Feasibility Study for Jakarta - Bandung High Speed Railway Project" into 2 phases. The objective of Phase I was to analyze the necessity, relevance & basic feasibility, while that of Phase II was to examine the technical, financial, environmental and institutional feasibility. Two preconditions that should be achieved in the period between the 2 phases were set: (1) Request of Yen Loan for E/S after the project is listed in Blue Book, (2) Assigning reliable executing agencies, etc. Phase I was further divided into 2 stages, with a precondition of "Consensus-building of necessity, relevance and specification (decision of introducing Japanese "Shinkansen" technology if possible)" between the two stages. The objective of Stage I was to get basic agreement regarding HSR system, demand forecast, route alignment and stations location, etc., while that of Stage II was to study structure plan, environment and social considerations, project modality, etc. and to consider the spatial plans of the central and the local governments.

The JICA Study Team (JST) of the titled project explained the Inception Report at the Coordination Meeting in January, 2014, at the beginning of the study and got the agreement of Indonesian Government. At the meeting in April 2014, where the interim progress was reported, the Indonesian Government requested JST to closely communicate with local governments preparing spatial plans and to support MOT (Ministry of Transportation) in preparing the Blue Book. In the final Coordination Meeting of the Stage I held in June, 2014, it was approved to proceed to Stage II study based on Shinkansen Technology.

17.1.3 The Study (Phase I, Stage II)

In the Stage II, the geological survey and the topographic study (preparation of topographic maps of 1/10,000 scale) were conducted, followed by review of the environment and social consideration, estimation of scale and cost of the land acquisition as well as improvement of accuracy of route alignment and structure plan. The project scheme was examined in cooperation with the Gadjah Mada University, resulting in the reasonable execution agencies and profitable business scheme.

17.2 Summary

17.2.1 HSR System and Japanese Shinkansen Priority

Indonesia and Japan have very similar natural conditions – experiencing earthquakes, strong rains, volcanos, etc. The topographic challenges are also similar; the HSR faces 33km slopes with 25~30‰ gradient up to the 700m high Bandung Basin. Furthermore, Java Island and Honshu Island in Japan have equivalent social conditions such as population distribution. There are some large cities on the planned alignment such as Bekasi, Bandung and Semarang that have populations of more than one million as well as Jakarta and Surabaya. And these cities form the same urban structure as that of the Tokaido and Sanyo Shinkansen area.

In addition, being environment-friendly is an important issue. Considering the factors above, the Japanese system has the priority, and this was agreed upon the Coordination Meeting held on June 26. Japanese system's advantages are summarized as follows:

- Safety: No fatalities or injuries for more the 50 years
- Punctuality: Within 1 minute of the average delay time per trip (Record from 2001 to 2008)
- Sophisticated earthquake countermeasures: The quickest earthquake detection sysytem
- Power cut off after only 16 seconds (50 sec. shorter than TGV)
- Superior energy consumption: 23% lower than that of Chinese, 41 - 44% lower than others
- Gradability: Continuous steep section with 30‰
- Compact structure design: Tunnels with small cross section and track width, resulting in low cost
- Environment: Rolling stock design for noise control

The design speed will be 350km/h, and the trains will be able to run at 320km/h, utilizing Series E5 rolling stock capability. However in the years after inauguration, the speed will be limited to 300km/h, with a 37 minute travel time between Jakarta and Bandung, waiting for (1) Company staff to achieve the highest skill, (2) Inhabitants to become accustomed to the environmental impact from the HSR running.

17.2.2 Location of the Stations and Alignment

JST selected 8 candidate places in Jakarta for the main station. Among the alternatives, Dukuh Atas underground station is qualified because it is located within the CBD (Central Business District), and it allows easy transfer to MRT-J (under construction), Pt. KCJ and BRT. In Bandung, it was proposed to construct the HSR station parallel with the existing Bandung station. Regarding the terminal of Bandung, Gedebage was selected based on the request of West Java Province, where the area development is proceeding, and an extending it to Surabaya will be considered in the future. Bekasi and Cikarang stations were planned between Jakarta and Bandung. These stations are located adjacent to the downtown, and many industrial parks are planned and under construction. As a result, there will be five stations within the 140km alignment between Jakarta and Bandung (Gedebage) at the opening stage. After the inauguration 3 other stations are planned to be added; those are Manggarai (Development Plan), Karawang (Airport) and Walini (new province capital function).

As to the route alignment, it was designed so that number of resettlement and the impacts on paddy fields and forests will be minimized. To minimize resettlement in Jakarta, mainly tunnels, and elevated track over Banjir Kanal partially are selected. In Bekasi City and Bekasi Regency, ROW of the toll road are utilized. In the mountainous area where the train goes up 700m high, NATM tunnel is adopted. In Bandung area, HSR alignment is selected in the area of the convention line, that has ROW with 20m to 25m wide and an elevated track is planned.

The location of station and route alignment in Jakarta were approved in the meeting chaired by the vice governor, and the JST sent the meeting record to the governor. The station locations in the West Java Province were basically approved in June at West Java with related municipal governments in attendance.

The HSR route and the detailed station locations were agreed upon in the meeting with the West Java Province, followed by explanation to the each government along the route and advice regarding the development policy around the HSR station.

17.2.3 Traffic Demand

After inauguration supposed in 2020, 44,000 daily passengers are predicted to use the service, with 88% of the passengers coming from car users. In 2050 the volume of passengers is estimated to reach 148,000 passengers.

HSR can connect Jakarta to Bandung with only 37 minutes, and the transport capacity per HSR track is 5 times as much as that of per highway lane. The maximum revenue can be achieved when the fare between Jakarta and Bandung is set at 200 thousand rupiah. Some argue that the route length is too short for HSR; however, at present it takes 3 hours to travel between the two city centers by highway. When there is a traffic jam, it may take 4 or 5 hours. Accordingly, HSR has enough competitiveness due to its high operation speed even in the short distance. The share of HSR at the inauguration is forecast at 18%. However, when no additional investment for the highway is adopted, the share increases. For example, the demand will increase by 20% if the travel speed on the highway decreases by 15%.

17.2.4 Environment and Social Consideration

The route alignment is designed to minimize and mitigate the environmental impact, with natural and social matters being discussed with related ministries and municipal offices.

The total land acquisition is about 270 ha, with relocating 3,188 households. The land is acquired in accordance with the Compulsory Land Acquisition Law, but it is assumed to take time for the negotiation. And it is necessary to start discussion with developers of the industrial parks, especially in Karawang area, immediately because some of them already has the permission for development. An area of about 14km is used for the underground section. But there is only a general guideline for the underground space regulation, and detail procedures or compensation cost has not been stipulated yet.

17.2.5 Cost Estimation

Total project cost is estimated at US$6,223 million, including US$4,831 million for the construction/procurement cost and US$913 million for land acquisition cost & value-added tax. The local portions account for 57%. The exchange rates are 99.2JPY per USD and 97.7IDR per JPY.

17.2.6 Business Scheme and Financial Analysis

(1) Organizational Structure

A new authority (High Speed Railway Authority) must be established under the MOT because of necessity of the authority that will be responsible for technical control of HSR development and operation. A new state-owned enterprise (SOE) must be established to implement the construction works of the HSR development as an entity that can be a borrower of external loan from donors. In order to realize the effective development and operation, the function of development and operation must be separated. The new SOE will function as developer and the operation will be implemented by other entity. PPP can be applied to the function of HSR operation, considering the financial constraints of the Government of Indonesia and the funding policy of infrastructure development. To develop the technical foundation of the new authority and SOE, technical cooperation to those organizations is strongly requested.

(2) Financing

In order to reduce the financial transaction cost, soft loan with low interest rate and ultra-long term maturity must be utilized. Direct lending from donor to the new SOE is also one of the measures that can contribute to reduction of the financial cost and making the project bankability better. If the Japan's ODA loan with STEP is applied to the HSR development, conditions are as follows:

- Concessional interest rate: 0.1 percent, and
- Ultra-long term maturity: 10 years grace period and 30 years repayment period

If the project is implemented with PPP, a business entity (SPV) will lease out the HSR infrastructure from the new SOE and pay the lease fee. The SOE will repay the loan directly to donors using the lease fee paid by the SPV.

(3) Financial Analysis for PPP-based Model

Financial Internal rate of Return (FIRR) for 4 patterns of cost sharing was computed as follows;

- FIRR of SPV: 14.93% to 8.69% (SPV cost sharing: 10% to 24%)
- FIRR of SOE: 0.97% to 0.98% (SOE cost sharing: 60% to 74%)

Those 4 patterns results show the project feasibility in terms of FIRR. However, one of the major risks of project implementation with PPP is fare revenue or ridership. The accuracy of the expected ridership is not so high because no major-shared operator exists between Jakarta and Bandung. Therefore, the state government must provide the SPV with support to ridership risk such as availability payment in order to attract business entities to participate in the project. Amendment of the regulations on PPP to provide the availability payment to SPVs is under preparation by the Ministry of Finance.

As for a comparison with the PPP-based model, if a private company bears 94% of the project cost or all the project cost excluding land acquisition, accumulated loss in 2035 will reach to IDR 90 trillion and continue to increase. Besides, it is impossible to calculate some indices to evaluate the project feasibility, such as equity IRR and project IRR. This means the project implementation with only private financing is not feasible.

17.2.7 Economic Effect

The EIRR was computed as 12.5% which is larger than social discount rate of 12%, and this means the project is feasible from the viewpoint of the Indonesian economy.

Job creation in construction stage is approx. 35,000 workers for 5 years, considering only 1st effect. Effect of construction for relevant industrial sector in construction stage is IDR 44,800 billion, which is almost double of initial cost. Effect of operation including demand increase in the relevant industrial sector and household consumption ranges IDR 2,400 billion to IDR 8,000 billion per year.

17.3 Conclusions

17.3.1 HSR of Jakarta-Surabaya is necessary from the following viewpoints:

- Resolve the over-concentration in Jakarta and induce well-balanced development of the country
- Correspond the increasing traffic demand in the future and ensure the smooth economic activities and citizen life
- Promote industries related to HSR project and create job opportunities
- Introduce relatively energy- and environment-friendly transport modes
- Formulate efficient transportation system with HSR

17.3.2 Jakarta-Bandung is recommended as the first priority section

The first priority construction section of Java HSR is recommended between Jakarta and Bandung. After that the section Bandung and Surabaya will be realized. The reasons for this stepped development are outlined below:

- To reduce the risks - funding , managing railway and ridership
- To gradually built the operation know-how and HSR technology
- To take advantage of the marketability of Jakarta – Bandung section

17.3.3 Introducing Japanese HSR is relevant

Japanese Shinkansen technology has the priority as stated in 11.2.1. Considering the similarity of natural and social conditions, the rich countermeasures based on the advanced technology, the fact that no passenger fatality has been recorded since inauguration (over 50 years) will be useful. Series E5 is to be introduced, because of its stable operation speed of 320km/h. In Java HSR at first stage E5 will run at 300km/h until the operation know-how is acquired. Besides, the light, sharp and air-tight body of E5 makes cost saving for civil structures-- tunnel, bridges and soil structures, as well as energy-saving and environmental-friendly.

In addition to above, the experience and knowledge that has been gained from JR privatization since 1987 will be utilized. Study and examination of detailed regulations in Japan for the land acquisition and land utilization will also assist in developing the Indonesian HSR.

17.4 Recommendations

17.4.1 HSR project should be started now

Long time is required to make legislation, regulation, institutional set-up etc. for HSR. HSR technology and safety regulations are important. Those are inauguration process, driver’s license, official safety investigation committee, basic specification etc. And overtime rapid urbanization will make the land acquisition for suitable route difficult.

Furthermore, the Indonesian economy has reached a level suitable to construct HSR for the following reasons:

(1) GDP per capita in Indonesia is now US$3,400 (IMF in 2014)

This figure is much greater than that of the Tokaido Shinkansen inaugural year of 1964. Since then the Shinkansen has significantly contributed to increasing Japanese economic growth and balancing development nationwide.

(2) The HSR project cost ratio to national budget is comparatively smaller

In Japan of 1964, the ratio of the HSR project cost of 380 billion yen to the budget of 3,600 billion yen represented over 10%. On the other hand now in Indonesia HSR 60.4 trillion rupiah project cost compared to 2,020 trillion rupiah in the national budget makes a ratio of just 3%.

17.4.2 The HSR route must be registered in Spatial Plans

Along the proposed HSR route, many projects are under way — (1) public transportation such as LRT (AGT, APM), monorail, BRT, etc., (2) industrial parks and new roads, etc. To avoid future excessive cost and excessive negotiation time, the approval of HSR should be acted earlier and HSR should be considered in the Spatial Plan of each municipal government.

To develop better functions for the new stations, transfer facilities to buses, taxis, should be planned and be regulated under the urban design. In addition, to make the HSR right of way, land value capture policy and regulations are important including town planning schemes and relaxation of floor to space ratio rules.

17.4.3 Legislation for Project Scheme

HSR Project is a large scale linear route plan; therefore, related laws should be enacted.

(1) Legislation for PPP project Scheme

The project should be opened to access to the market by private companies. Following assistance by government will be expected.

- ➢ Improvement of PPP regulations on government support to ridership risk; to provide availability payment and fare change approval rules
- ➢ Institutionalization of the direct lending from the donors to SOE

(2) Institutional building for HSR

1) HSR-A

HSR-A will be the key-entity for this project and it should be establish as soon as possible. This authority makes basic regulations and standards of HSR - technology and safety and regulate th SOE's development works in preparation and construction stages. And in pre-operation stage, this authority issues certification of inauguration training completion and drivers' license and found official safety investigation committee.

2) SOE

SOE also should be established as a next entity of HSR-A without missing the opportunity. Major roles of this entity are as follows.

- ➢ To develop HSR structure and facilities

- To manage the HSR assets (leasing to the SPV)
- To streamline the financial management (receiving lease fee, repayment to donor, etc.)

(3) Possible new and innovative financing tools

Following financing tool is enacted in Japan and institutionalization in quick manner is expected.

- Partial risk guarantee
- REIT (Real Estate Investment Trust)
- LVC (Land Value Capture): Town Planning Scheme and Station Area Development

17.5 For the Next Step

JST had 8 Indonesian engineers and staff jointly working with Japanese experts, as well as JST contracted Indonesian universities and consultants. Through the Study, the Indonesians have steady acquired the Japanese technology of HSR, Shinkansen. JST expresses sincere gratitude for the cooperation of Indonesian Central/local governments as well as Japanese embassy and JICA. The spirit of Japanese cooperation on HSR is to be of the Indonesian people, by the Indonesian people and for the people. Japanese people are looking forward that by introduction of HSR system, Indonesian economy will greatly develop as Japan has passed..

JICA study team expresses sincere gratitude for the cooperation with Indonesian central/municipal governments and related organizations, as same as for JICA and Japanese governments. JST expects that HSR project will be realized and devote to develop Indonesian economy in the near future.